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ROYAL AUSTRALASIAN COLLEGE
OF DENTAL SURGEONS

Proceedings of the Twenty-first Convocation of the
Royal Australasian College of Dental Surgeons
31 March to 4 April, 2012

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Alwyn James Arnott
H Roy Cash

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3. First Council, elected 5 November, 1966

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CONVOCATIONS

No. 1. 31 August-1 September 1967: Canberra, Australia
No. 2. 13-16 August 1969: Sydney, Australia
No. 3. 11-13 August 1971: Sydney, Australia
No. 4. 3-6 March 1974: Adelaide, Australia
No. 5. 20-23 February 1977: Melbourne, Australia
No. 6. 13-16 May 1979: Christchurch, New Zealand
No. 7. 1-9 November 1981: Sydney, Australia
No. 8. 2-5 April 1984: Brisbane, Australia
No. 9. 30 October-3 November 1986: Melbourne, Australia
No. 10. 25 February-2 March 1989: Hong Kong
No. 11. 21-24 September 1991: Rotorua, New Zealand
No. 12. 16-19 April 1994: Canberra, Australia
No. 13. 26-30 April 1996: Sydney, Australia
No. 15. 20-24 October 2000: Auckland, New Zealand
No. 16. 17-20 October 2002: Melbourne, Australia
No. 17. 14-17 October 2004: Darwin, Northern Territory
No. 18. 31 August-3 September 2006 Sydney, Australia
No. 19. 30 May-2 June 2008 Hong Kong, SAR China
No. 20. 11 - 14 March 2010 Perth, Western Australia
No. 21. 31 March-4 April 2012 Queenstown, New Zealand

The Twenty-first Convocation in Queenstown, New Zealand lived up to all expectations. The Millennium Hotel provided excellent accommodation and a meeting venue that placed the lecture rooms and trade displays side by side on the one level. The lecture presentations were of the usual high standard with some controversial ideas up for discussion. What more could the organizers asked for – an idyllic setting overlooking Lake Wakatipu and surrounded by majestic mountain scenery and wonderful warm sunny weather. Where else in the world would Fellows and their guest travel by gondola to a height of 790 metres to attend the Opening Ceremony in the Skyline Function Centre?

The Convocation started with an informal get-together lake cruise and cocktail party on the 100+year-old TSS Earnshaw and this set the scene for what proved to be a relaxing and yet stimulating two and a half days. The lecture programme put together by the organizing committee lived up to the theme of the conference and drew on the perceptions of where dentistry is going as an integrated part of health care systems and an ageing population many of whom are remaining dentate for the whole of their lives.

Regrettably, only two presentations were given in the Young Lecturer Program – probably a sign of tight funding in these modern times preventing many would-be participants from attending the Convocation.

We will continue the practice of providing the Annals largely in an electronic format with a limited number of printed copies being prepared and made available on request.

Thank you to all those authors who sent their contributions in on time or almost so – modern communication techniques have made the editor’s task much easier in preparing page proofs and having them approved by the presenters. However, some presenters were unable to or unwilling to provide full manuscripts, so only abstracts of the presentations are published at the end of the Annals.

Thank you to all concerned in the organization of the Convocation and preparation of the Annals – the College Office staff, the Convocation organizing committee and the Convention Managers. I am retiring from the position of Honorary Editor with the publication of this Edition of the annals. It has been a great privilege to have been able to serve the College in this way for the past several years, but the time comes when this task needs to be undertaken by a younger Fellow.

John K. Harcourt, OAM, DDSc, FRACDS, FDSRCSEd(Hon)
Honorary Editor, Annals RACDS
Address by the President of the Royal Australasian College of Dental Surgeons
Werner H Bischof, BDSc, MDsc, FRACDS, MRACDS (Perio), FPFA, FICD
at the Opening Ceremony*

As President, it is a great honour to welcome, on behalf of the Council and the Organizing Committee, our Distinguished guests, College Fellows and Members and their Partners, Guests and Families to the Opening Ceremony of the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons. As we gather this evening, overlooking the natural beauty of The Remarkables and Lake Wakatipu, it is the fourth occasion that the College Convocation has been held on New Zealand soil. The College acknowledges the importance of Maori in the bicultural society in New Zealand and the development of oral health care by Maori health providers. Therefore, I also extend a formal Maori welcome Tena Koutou.

I would like to formally welcome and introduce our Distinguished guests this evening:

Ms Carole Heatly - Chief Executive Officer of the Southern District Health Board, Professor Tim Naish - The Robert Harris Orator, Dr Avijit Banerjee and Professor Panos Papapanou our international keynote speakers, Professor Gregory Seymour – Dean of the Faculty Of Dentistry, University Of Otago, Dry Shane Fryer - The President of The Australian Dental Association, Associate Professor Edmond Pow representing the President of the College of Dental Surgeons of Hong Kong, Professor John O'Donnell - The New Zealand President-Elect of the Royal Australasian College Of Physicians, Professor Stephen Best – The Vice President of the Royal Australian and New Zealand College Of Ophthalmologists, Dr Norman Firth - Faculty Member of The Royal College of Pathologists of Australasia, Mr Leslie Snape – President of the Australian and New Zealand Association of Oral and Maxillofacial Surgeons, and Dr Chris Waalkens - President of the Australian And New Zealand Academy of Periodontists.

This evening we also have with us a number of past and present College Councillors. In particular I would like to acknowledge our past presidents: Dr Richard King, Associate Professor John Harcourt, Dr Ross Bastiaan, Associate Professor Neil Peppitt and Professor Bernadette Drummond.

Convocation is recognized as the premier occasion of the College, comprising of this Opening ceremony and the accompanying Scientific Program. The Opening ceremony provides an opportunity for the College to formally admit Fellows and Members in both the general and special field streams as well as to recognize members of the profession through the presentation of College Awards.

With the theme that we have for this Convocation it prompts one to consider the Generational Challenges we

* Presented at the opening ceremony, Twenty-first Convocation, Royal Australasian College of Dental Surgeons, Skyline Gondola, Queenstown New Zealand, on Sunday 1 April 2012
face in dentistry. The clinical implications of this theme will be explored in detail throughout the next two and a half days of presentations. In this opening address I wish to reflect upon the Generational Challenge of Professional Standards, in both the global context and in clinical practice as they relate to the College and Dentistry in the Australasian region. In doing so I acknowledge the past Presidents and Councils of the College for their vision, direction and contribution to the advancement of the profession.

Dentistry, having been derived from one of the classical learned professions – medicine, has a definite identity as a modern profession. However, it continues to display a parallel linkage to medicine, through the recognition of the oral health-general health interrelationship, research into basic and applied sciences, the philosophy of disease prevention and the application of medical and surgical principles. Dentistry fulfills the criteria of a profession; as a disciplined group, accepted as possessing specific knowledge and skills, adhering to high ethical standards, with learning derived from education and training at a high level. We now recognize the professional need and community expectation for ongoing and advanced professional development throughout our career. In our duty of care to the individual, community and population the profession of dentistry exercise this knowledge and these skills, through consultation and advocacy, in the interest of others.

The definition and maintenance of professional standards occurs through the collaboration of organizations within the profession as well as timely review and self-assessment.

Almost fifty years ago the Federal Council of the Australian Dental Association resolved to appoint an advisory committee to establish the Australian College of Dental Surgeons. This was a collaborative process with membership of this committee including representatives with links to the Dental Association and the University as well as Dental Research and Public Dentistry Institutions. Historical records of this period show that there was also collaboration with members of the profession in New Zealand. The cornerstone of the College’s initial foundation was the establishment of post-graduate standard examinations, with supportive educational programs, for dentists to improve their scientific knowledge, clinical skills and professional standing.

Although there remains the autonomy of jurisdictional authorities for registration or licensure, we are moving to the era of the international recognition of competencies in knowledge, skills and standards. Such competencies are recognized by Universities, embedded within the curriculum, by Dental Councils or Boards, in the registration of new graduates, and by Dental Associations, in supporting the clinician’s professional career. There is also the recognition that a continuum exists as one commences a university program as a novice, enters the profession as a competent clinician to then develop proficiency in independent practice.

The College is well placed to contribute to both the regional and global recognition of standards. Its membership of almost 2000, has an international footprint and broad geographical representation. Members are predominantly in Australia, Hong Kong, New Zealand and Singapore, but are also present in 23 other countries. The College conducts examinations in either general dental practice or special field streams in five countries and in conjoint arrangements with two international Colleges and four Australian Universities. The College collaborates with the University of Otago for education and training in the field of Oral and Maxillofacial Surgery.

The College now provides a suite of examinations in both general dental practice and the specialties. The standards set for the Membership examinations in both General Dental Practice and the Special Field Streams are a benchmark to assess the competent clinician. The standard set for the Fellowship examinations, assess a greater depth and breadth of knowledge, of evidence-based and best practice dentistry and is the recognition of highest level of achievement within the College. These standards are not set in isolation but are developed and reviewed through a collaborative process engaging the profession, specialist academies, universities and other Colleges.

In a step that will allow for a strengthening of international benchmarks in clinical knowledge, skills and standards in General Dental Practice, I am extremely pleased to announce that at the Reception this evening we will formally sign a memorandum of understanding between our College and the College of Dental Surgeons of Hong Kong for the commencement of a conjoint examination, leading to the award of MRACDS and MGD, later this year.

The ability of the College to display well established expertise, standards and processes in training, education and assessment has been called upon by State Dental Boards in Australia for registration of overseas trained specialists. Of significance is that the College training pathway in Oral and Maxillofacial Surgery has accreditation with the Dental Council and Medical Council in both Australia and New Zealand. Most recently the Dental Council of New Zealand has recognized the Fellowship in Oral and Maxillofacial Surgery as a prescribed qualification in New Zealand for the purpose of registration in that specialty.

Sir John Walsh, the then Dean of the Faculty of Dentistry at the University of Otago, in his address at the first College Convocation in 1967, highlighted the interrelationship that exists between the dental education that occurs in the training of a dentist, the advanced dental training of a specialist, and continuing professional development. The international Dental Federation (FDI) recognizes that professional development is undertaken to maintain, improve and broaden knowledge and skills in order to keep professional expertise up-to-date and in line with current developments. Most importantly this knowledge and skill is aimed to enhance the quality of care for our patients. Mandatory continuing professional development is a requirement for registration in Australia, New Zealand and Singapore. Although in Hong Kong registration relies on a voluntary program for professional development, there is a mandatory requirement for those holding a Fellowship of the Hong Kong Academy of Medicine. Unique in our region, is the requirement here in New Zealand for Peer Contact Activities. This includes activities such as study group discussion, peer review, clinical audits and mentoring.
It has been recognized that an active involvement in self-assessment and self-directed learning are integral to ongoing professional development. The maintenance of competence involves reflection, self-monitoring and self-assessment with mentor interaction and external assessment being strong elements in developing ongoing self-directed learning.

One of the most dynamic initiatives in the recent history of the College is the Membership program in General Dental Practice. This program provides a framework to direct and structure a candidate’s Professional Development portfolio while providing mentor support and incorporating external assessment. The educational modules associated with this program are scientifically and clinically sound and relevant being delivered by organizations such as Dental Associations, Universities and Colleges.

To ensure that the College maintains strong candidate support there has been a staged expansion of the Membership program. The Board of Studies in General Dental Practice, with the support of Council, wish to take the opportunity at Convocation to announce the expansion of the Membership program to New Zealand in 2013.

Therefore, in the period of two generations the College, in collaboration with the profession, Dental Associations, Universities and Colleges has contributed significantly to defining and reviewing Professional Standards as they relate to academic and clinical achievement in dentistry. However, it must be acknowledged that to remain relevant in the current environment of professional development, while maintaining internationally recognized assessment standards, the College relies on the expertise of its Registrars, Boards of Studies and Examiners.

For the College, as a professional organization, to achieve these outcomes there is also a highly skilled and dedicated team that provides the support and infra-structure within the College office.

I would like to address my concluding comments to those Fellows and Members being formally admitted into the College this evening. I would like to congratulate you all on your dedication and individual achievement. I welcome you into the College, and encourage you to contribute to the maintenance of professional standards through your involvement in the Profession and the College.

I now have very great pleasure in inviting our Guest of Honour, Ms Carole Heatly, Chief Executive Officer of the Southern District Health Board, to officially open the proceedings of this 21st Convocation of the Royal Australasian College of Dental Surgeons.
OPENING ADDRESS BY CAROLE HEATLY,*
CHIEF EXECUTIVE OFFICER, SOUTHERN DISTRICT HEALTH BOARD

TWENTY FIRST CONVOCATION
ROYAL AUSTRALASIAN COLLEGE OF DENTAL SURGEONS
QUEENSTOWN, NEW ZEALAND, APRIL 2012

President Werner Bischof and President Elect, Braham Pearlman, Inductees, Honoured Guests, Ladies and Gentlemen.

It is my pleasure and honour to open this, the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, and to welcome you all to the beautiful south island of New Zealand and in particular, to Queenstown where we are surrounded by breathtaking scenery of lakes and mountains.

Queenstown as well as Invercargill on the southern tip of the South Island and the city of Dunedin are all part of the Southern District Health Board, where I have been the Chief Executive for all of four weeks.

My District Health Board is very fortunate indeed to have the prestigious dental school in Dunedin on our doorstep, and I, as the newly appointed CEO intend to ensure that relationship flourishes for the benefit of the communities and the people we serve.

The theme of this years’ Convocation is “Oral Health and Integrated Care: The Generational Challenge”.

This is a timely theme as dentistry and healthcare in general face the significant challenge of dealing with an ageing population.

An oral health survey carried out in New Zealand in 1989 showed that two thirds of older people didn’t have any of their own teeth: the most recent oral health survey carried out in 2009 shows that this position has been reversed and now two thirds of older people do have their own teeth. Whilst this is a much improved position, it allows us the challenge of managing a whole new patient group.

The importance of integration of oral health as part of general health, cannot be underestimated especially when evidence shows that poor oral health impacts on well being, and more so, if you have long term conditions such as diabetes, cardio-vascular disease or you are immune-suppressed. There is also an impact on oral health as patients take more medications throughout their lives.

It’s not just an ageing population who provide challenges to a health system. There are significant challenges to government and to organizations to meet health needs, in an equitable way, across a whole spectrum of age related, disease related, and in this part of the world, geographically challenged populations.

This all makes the role of the Royal Australasian College of Dental Surgeons more important in providing excellent continuing education opportunities by fostering a philosophy post dental school of learning for life.

The Colleges’ commitment to Dental Public Health with the new MRACDS and FRACDS in Dental Public Health and the opportunities that will open to work collaboratively with public funded services is to be applauded.

The College also has a significant role to play in credentialing and ensuring there are formal processes in place to verify qualifications, and enhance the professional standing and the attributes of practitioners. This will ensure the profession continues to provide safe, competent and high quality care to our patients.

Sound clinical governance is essential to secure and build confidence in services working across professions and organizational boundaries to always deliver the best we can.

This isn’t easy in a financially challenged world and working with fiscal constraints means that now more than ever, we need to be open to change to do things differently and to constantly innovate.

I very much look forward to working closely with colleagues in the renowned dental school in Dunedin and in facing our challenges together. The College Fellows whom I have been fortunate enough to meet so far will, I am sure, help bring innovations and improvements to the oral health of the population of my District Health Board.

Thank you for allowing me to open this convocation for you. Enjoy the next few days in this beautiful location with a comprehensive and interesting program to look forward to.

* Presented at the opening ceremony, Twenty-first Convocation, Royal Australasian College of Dental Surgeons, Skyline Gondola, Queenstown New Zealand, on Sunday 1 April 2012
TWENTY FIRST CONVOCATION
ROYAL AUSTRALASIAN COLLEGE OF DENTAL SURGEONS
QUEENSTOWN, NEW ZEALAND, APRIL 2012

MEMBERSHIP BY EXAMINATION
Elizabeth Anne Dadley Day
Wilma Jennifer Eelderink
Stephen Sung-Chan Pak
Malini Ragavan

MEMBERSHIP IN A SPECIAL FIELD

DENTAL PUBLIC HEALTH
Shun Chi Elias Chan

ORTHODONTICS
Julia Dando
Edward Peter Kosy

PAEDIATRIC DENTISTRY
Balagopal Varma
Albert Ee San Tan
Stephen Yeung

PROSTHODONTICS
Geoffrey Douglas Stacey

FELLOWSHIP BY EXAMINATION

Dwight Stuart Elvery
Jacob Reese Grieve
Amanda Margareta Hales
Peter Duc Hoang
Yudith Kartiko
Adam Nicholas Keyes-Tilley
Hugh James Lenehan
Vivian Liu
Chung Sing Jancy Lo
Alexander Yi Hun Loh
Suman Prakash Madukuri
Sirisha Penmetcha

Jyotsna Raj
Mohammed Naseem Rather
Sneha Ravindranath
Amrita Sachdeva
Eric Hiu Fung Sham
Lee Richard Staddon
Shin Yeu Ting
Aden Lu-Huy Khanh Tran
Raghunadh Vangala
Naveen Kumar Vellore Loganathan
Lisa Wong (NSW)
Cherry Zaw

FELLOWSHIP BY EXAMINATION IN A SPECIAL FIELD

DENTAL PUBLIC HEALTH
Sameer Bhole
Robin Andrew Whyman

ORAL AND MAXILLOFACIAL SURGERY
Wojciech Marek Bilski

PERIODONTICS
Danny Sai-Wah Ho
Luan Hoang Ngo

CHRISTENSEN PRIZE FOR 2011
Isaac Liau

SUTHERLAND PRIZE FOR 2011
Adam Nicholas Keyes-Tilley

SUTHERLAND PRIZE FOR 2012
Amanda Margareta Hales
NEW MEMBERS AND FELLOWS ADMITTED AT THE CONVOCATION
Professor Michael Francis Burrow is well recognised as an Academician and Clinician in the Field of Prosthodontics, as well as a mentor and teacher in many areas of Dentistry. Professor Burrow graduated in dentistry from the University of Adelaide in 1981. His further studies include the qualifications of MDS, University of Adelaide 1987 and PhD, Tokyo Medical and Dental University in 1994, both in the field of Restorative Dentistry. He completed a Master of Education at the University of Melbourne, Faculty of Education in 2003, with a thesis on Problem-Based Learning.

Professor Burrow has a long and distinguished career in Academic Dentistry. Following several years as a Clinical Tutor at the University of Adelaide Department of Dentistry, he was appointed a Visiting Researcher at the Tokyo Medical and Dental University in 1989, where he was later awarded an Honorary Lectureship. From 1995 until 2010, he has been a staff member of the Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, first as a Lecturer, then as Senior Lecturer, later as Associate Professor, and in 2007 appointed as Professor and Clinical Dean of that Faculty. He was appointed at the end of 2011 as an Honorary Professorial Fellow to the Faculty of Medicine, Dentistry and Health Sciences at the Melbourne Dental School.

Foreign language and culture have been significant interests for Professor Burrow during his Dental career. He has excelled in courses in Japanese language and Japanese Political Economy in the Faculty of Arts, University of Adelaide, followed by a Certificate in Japanese Language at the Tokyo Institute of Technology in 1989. He was enrolled in a Graduate Diploma of Arts – Chinese studies – at the University of Melbourne before moving to Hong Kong.

In August 2010, Professor Burrow took up residence in Hong Kong when he was appointed Clinical Associate Professor, Faculty of Dentistry, The University of Hong Kong, where he is the Programme Director in Operative Dentistry.

Professor Burrow has a long and distinguished record as an innovator and director of teaching systems in Dentistry. He was appointed to overall responsibility for the development of the recently introduced postgraduate level entry dental programme leading to Doctorate of Dental Surgery at Melbourne University which replaces the previous BDS degree. He generated and supervised the preparation of documentation for presentation of the new course to the various Academic committees of the University, as well as accreditation with the Australian Dental Council. He has fulfilled many roles with the Melbourne University Dental School, resulting in his appointment as Clinical Dean and Leader in Teaching and Learning, setting up innovations...
such as Problem Based Learning in the teaching of Dental Materials Science and case-based Oral Examinations in the undergraduate curriculum.

Professor Burrow has an extensive and admirable record in research, with particular interest in Dental Materials, including adhesion of resin-based materials and glass-ionomer cements to various tooth substrates as well as their clinical performance. He has been author or co-author of 164 published papers and 82 published abstracts. His research expertise has manifested in the supervision to completion of 10 PhD students and four Masters students.

In addition to his direct academic duties, Professor Burrow has found time to hold many positions of service to the Australian Dental Association, both Victorian and Federal, the Dental Technicians Qualifications Board of Victoria and Australian Dental Research Foundation.

As a tribute to his contribution to Dentistry he has been awarded Fellowship of the International College of Dentists and the Marks and Adamson Prize for Advancement of Dental Education, University of Melbourne. He became a Member of the RACDS in the special field of Prosthodontics in 2010.

Professor Burrow has given long and devoted service to the RACDS as Examiner for the Finals of Fellowship since 2007. Together with Professor Ian Meyers he has represented the College more recently as an external Examiner in the newly established Membership in General Dentistry of the Hong Kong Dental College. This contribution has been essential as part of the development of an MOU between that College and the RACDS to establish an association between the Membership programmes of the two Colleges.

At its meeting on the 19 November 2010, Council unanimously resolved that Fellowship Without Examination be conferred on Professor Michael Francis Burrow.
Dr James Alastair McLean Robertson of Melbourne, Australia is renowned for his exemplary and extraordinary initiation in Dental care in developing countries.

Dr Robertson graduated in Dentistry from the University of Glasgow in 1967. Since settling in Melbourne in 1970, he has further graduated as Bachelor of Arts with Honours in 1986 and Master of Arts with Honours in 1989, both at the University of Melbourne, and as Master of Public Health in 2009, again at the University of Melbourne.

Using his regular occupation as a general dentist in private practice in Melbourne, Dr Robertson has either launched or been involved in many significant projects in Asia and the Pacific. He was the Founder and Director of the Rotary Australian-Tibetan Dental Health Project in Himachal Pradesh, India. He was a Rotary Dentist in Uthai Thani and Nakon Sawan, Thailand and similarly as a Rotary Dentist in the Vietnamese Refugee Centre, Puerto Princesa, Philippines. He was a Founder and Director of the Rotary Australia – Vietnam Dental Health Project. He serves as a Dentist to Children First Foundation.

Additionally, Dr Robertson has provided extensive and comprehensive service to dentistry in many organizations. He is a visiting Lecturer and Clinical Demonstrator at the Melbourne Dental School. He served as Historian for the Dental Board of Victoria. His involvement in the Australian Society of Dental Anaesthesiology has been extensive, including as Councillor, Federal Vice-president and President of the Victorian Branch. He has been a member of the Board of Management, Royal Dental Hospital of Melbourne and of the Ministerial Dental Advisory Committee, Victoria.

Dr Robertson’s admirable and outstanding service to dentistry and the community has been recognized in many awards, not least as a Member of the Order of Australia in 2011. He was made a Fellow of the International College of Dentists in 1991, a Fellow of the Pierre Fauchard Academy in 1993 and of the Academy of Dentistry International in 1997. He was a Paul Harris Fellow of Rotary International in 1992, and received the Paul Harris Sapphire Distinguished Service Award in 1997. He received the ADA Victoria Distinguished Service Award in 1998.

At its meeting on the 22 July 2011, Council unanimously resolved that Fellowship Without Examination be conferred on Dr James Alastair McLean Robertson.
Dr Geoffrey William Borlase has made a significant contribution to dentistry and the Royal Australasian College of Dental Surgeons. Dr Borlase graduated Bachelor of Science at the University of Otago in 1983, followed by Bachelor of Dental Surgery, Otago, in 1987. After a period in general practice he returned to the Faculty of Dentistry, University of Otago to complete a Master of Dental Surgery in Prosthodontics, in 1993. He successfully completed his Fellowship of the RACDS in 1993.

Dr Borlase is a Specialist Prosthodontist in private practice in Sydney. Before settling in Australia, he held a number of posts in the New Zealand health system, including Maxillofacial Prosthodontic Registrar and later Head of Department, Oral Health Unit, Middlemore Hospital Auckland, Consultant Maxillofacial Prosthodontist, Auckland Hospital, Honorary Maxillofacial Prosthodontist, Head and Neck Clinic, Otolaryngology Department, Green Lane Hospital, Auckland.

The teaching experience and service of Dr Borlase is extensive. From 1990 to 1993 he was a Clinical Tutor in the Departments of Periodontology and Restorative Dentistry, Faculty of Dentistry, University of Otago. He is a Tutor in the DClinDent Prosthodontics Programme of Sydney University, including Lectures in Gerodontics, Complete Dentures and Partial Removable Prosthetodontics. He contributes his considerable expertise as an Honorary Lecturer and has been a Final Year Examiner at the Fiji School of Medicine Oral Health Department, Fiji National University, Suva.

Dr Borlase has a wide range of interests outside of Prosthodontics. He is at present enrolled in a Master of Science in Medicine (Psychotherapy), University of Sydney. He has previously studied at the Australian College of Applied Psychology, Sydney. Dr Borlase attends formal classes in painting at the National Art School, Sydney.

His service to dentistry has been recognised in the award of Fellowship of the International College of Dentists in 2001.

Within the Royal Australasian College of Dental Surgeons, Dr Borlase has made many and substantial contributions in service. From 1996 to 2002 he was Secretary/Treasurer of the New Zealand Regional Committee. He served as Secretary/Treasurer for the 2000 RACDS Convocation in Auckland.

In 2002 he was appointed an Examiner in the Finals Examination (General Stream) of the RACDS. When the Finals Examinations Workshop was developed in 2005, Dr Borlase was one of the key initiators of that project, and has continued to participate in large measure to the success and effectiveness of the Workshop. Most recently he has been a major contributor to the development of the case rather than patient centred Finals Examination process. Dr Borlase is an ideas person, an incredibly devoted worker for the College and the College appreciates his dedication and service.

At its meeting on 22 July 2011, Council unanimously agreed to present Dr Geoffrey William Borlase with the Meritorious Service Award.
Dr Philip Anthony Cockerill has made a significant contribution to Dentistry and the Royal Australasian College of Dental Surgeons. He graduated in Dentistry from the University of Western Australia in 1974. He achieved Fellowship of the RACDS in 1989. Dr Cockerill furthered his studies in 2009, obtaining a Diploma of Forensic Odontology from the University of Western Australia.

Dr Cockerill retired as a General Practitioner in private dental practice in Fremantle, Western Australia at the end of 2011, however, he retains his consultancy in Forensic Odontology with PathWest and at the King Edward Memorial Hospital, Perth.

Dr Cockerill’s status in dentistry has been well recognised in the awards of Fellowship of the Pierre Fauchard Academy in 2000, and Fellowship of the International College of Dentists in 2010.

Within the Royal Australasian College of Dental Surgeons, Dr Cockerill has made important and notable contributions: from 1990 to 2003 he served on the Western Australia Regional Committee, including terms as Student Adviser and Secretary/Treasurer and was Chairman of the Committee for six years, from 2004 to 2010 and continues to serve on the Committee. He served as the RACDS representative to the Faculty of Medicine, Dentistry and Health Sciences from 2004 – 2006.

Most significantly, Dr Cockerill served with dedication and ability as Chairman of the Local Organizing Committee of the RACDS Convocation, Perth 2010.

At its meeting on 25 February 2011, Council unanimously agreed to present Dr Philip Anthony Cockerill with the Meritorious Service Award.
Dr Hugh Trengrove graduated in Dentistry at the University of Otago in 1984. He obtained his Masters degree in Restorative Dentistry at the same University in 1992. His Fellowship of the Royal Australasian College of Dental Surgeons was achieved in 1993.

Dr Trengrove has had a continuing illustrious career in the New Zealand Defence Force. In 1985 he was appointed a Dental Officer with the NZDF. Following his postgraduate training, he was appointed Senior Dental Officer at RNZAF Base Woodbourne, Blenheim. In 1997 he was appointed Chief Dental Officer for the Southern Region, NZDF, Burnham Camp, Christchurch. In May 2000, he took time away from the Defence Forces and accepted the post of Regional Director of Dental Services for Wellington Hospital and Community Dental Services, including Clinical Head of Department. Returning to the military in 2005, Dr Trengrove was appointed Director of Defence Dental Services for the NZ Defence Force. In 2009 he was made Chief Staff Officer – Health, for Joint Forces, New Zealand Defence Force. In May of 2011, he undertook another change of direction, remaining with the Army General Staff – Part Time – as Special Projects Officer, and Part-time Associate Director – Research and Policy, New Zealand Dental Association.

During that time, he has maintained his clinical skills, either in private or hospital practice. He is a registered prosthodontist with the Dental Council of New Zealand. His service to the dental and wider community has been recognized in the award of Fellowship of the International College of Dentists in 2008 and of the Academy of Dentistry International, also in 2008.

Within the Royal Australasian College of Dental Surgeons, Dr Trengrove has been a major contributor to the Finals Examination process for the past seven years. He has served for much of that time as Convener of the Finals examination, taking on the responsibility of accreditation of examiners, and accepting a major role in the organization and presentation of the Finals Examination Workshop. Dr Trengrove, with his calm demeanour, sage advice and meaningful presentations has been a mainstay of the Finals Examination process for a long time, and the College is grateful for his input.

At its meeting on 22 July 2011, Council unanimously agreed to present Dr Philip Anthony Cockerill with the Meritorious Service Award.
Professor Bernadette Kathleen Drummond of Dunedin, New Zealand, graduated Bachelor of Dental Surgery from the University of Otago in 1976. She travelled to the USA in 1982 to study for a Master of Science degree in Paediatric Dentistry and Certificate in Paedodontics. She became a Fellow of the RACDS in 1983, and achieved a PhD at the University of Leeds (UK) in 1988. Professor Drummond was awarded a Fellowship of the Dental Society of the Royal College of Surgeons, Edinburgh, in 2011.

In 1988 Professor Drummond resumed her academic career at the University of Otago, Dunedin, as Senior Lecturer in Paediatric Dentistry. She has served as Head, Department of Oral Health, Associate Dean of Postgraduate Studies and more recently she has been appointed to the Chair in Paediatric Dentistry, University of Otago. She provides specialist Paediatric services for the Otago District Health Board.

In her academic career, Professor Drummond is a recognized and dedicated teacher. She has been involved in the supervision of many PhD and DClinDent students, as well as a long list of Masters and Postgraduate Diploma students. She was given responsibility for the introduction of the DClinDent programme in Paediatric Dentistry and was instrumental in the development of that programme for all 10 specialist disciplines at the University of Otago. Her record of publications is extensive, reflecting her clinical and research interests in Paedodontics: she has authored or co-authored eight chapters in texts on Paediatric Dentistry and other fields of Dentistry, as well as 35 published Journal articles. She has published many case reports and reviews and is a sought after International lecturer, having presented at a multitude of Conferences in Dentistry locally, i.e., Australia and New Zealand, as well as the USA, UK, Germany, Hong Kong and at FDI.

Professor Drummond’s service to Dentistry has been marked by the award of Fellowship (Honorus Causum) Royal College of Surgeons Edinburgh, Fellowship of the International College of Dentists and Fellowship of the New Zealand Dental Association for Services to Dentistry.

Professor Drummond has been active in many Dental organizations, serving a term as President of the ANZ Society of Paediatric Dentistry, as Vice President of the Australasian
Academy of Paediatric Dentistry, President of the Otago Branch of the NZDA and on committees of the International Association of Paediatric Dentistry and the IADR.

Professor Drummond has been a major strength and contributor of the College Council for more than a decade. She was elected to Council of the RACDS in 2000, was appointed Censor-in-Chief in 2004 and President-Elect in 2006. During her years as Councillor, Professor Drummond served tirelessly, representing the Council on both OMS and Perio Boards, and Committees and working parties too numerous to mention. She was a distinguished and dedicated President of the College from 2008 to 2010, initiating and progressing many of the projects and achievements which mark the progress of the College to this day.

Following the unanimous resolution on 25 February 2011 Council has the honour to formally admit Professor Bernadette Kathleen Drummond as an Honorary Fellow of the Royal Australasian College of Dental Surgeons.
THE FIFTEENTH ROBERT HARRIS ORATION

Address by Professor Timothy Raymond Naish, NZAM, BSc, MSc, DPhil*

Professor and Director of the Antarctic Research Centre, Victoria University of Wellington; Principal Scientist, GNS Science, Lower Hutt; Director, Joint Antarctic Research Institute, Wellington, RSNZ Marsden Fund Council, Earth Science and Astronomy Panel Convener.

* Presented at the opening ceremony, Twenty-first Convocation, Royal Australasian College of Dental Surgeons, Skyline Gondola, Queenstown New Zealand, on Sunday 1 April 2012

Tena koutou, tena koutou, tena koutou katoa.

Ms Carole Heatly, Professor Bischof, Distinguished guests, Fellows, Members, Ladies and Gentlemen. When Stephen Robbins rang me out of the blue to give this lecture, my first reaction was, “What?..Dentists! I don’t think so! I think you’ve made a big mistake. I told him that I have a PhD in Earth Sciences, and that I’m not a medical practitioner. Nevertheless Stephen persevered and I was to learn that previous Robert Harris Orators had not been dental surgeons either. In fact there has been a long line of very distinguished speakers including someone I had always admired, ex Prime Minister of New Zealand, David Lange. So I am very honoured to deliver the Robert Harris Oration at this Convocation of the 21st of the Royal Australasian College of Dental Surgeons.

My aim here is to impart on you some of my thoughts about the big one...that’s right, I’m going to tackle the greatest generational challenge of them all. The one that we all face as a species...that is “How do we live sustainably on this planet while maintaining a good quality of life?” Because if we can’t sort that one out, then the rest doesn’t really matter, whether it be Oral Health or Antarctic geology.

Challenge No.1. At the current rate of population growth there will be somewhere between 7.5 and 10.5 billion souls on this planet by 2050. We have just cracked 7 billion give or take a few, from a level of 1 billion, only 150 years ago at the start of the industrial revolution. Beyond 2050 there is debate about what is called the “carrying capacity” of our planet. The major limiting factor is of course natural resources. Well known environmentalist and author James Lovelock has argued that the resources of two Earth’s would be required to support the projected global population growth, that you see on this slide.

So that brings us to the next challenge. Human life, and quality of that life, is directly related to availability of energy. Our population explosion from 1 billion at the time of the industrial revolution to 9 billion today. Now I’m an Antarctic geologist and my research expertise is in Climate Change, and in particular Earth’s past climate change. So when Stephen asked me if I had any ideas how to link Antarctica and dentistry, all I could think of was “that you need good teeth to go to Antarctica!”

Anyway after some further reflection, the theme “The Generational Challenge” struck a chord with me, and I began to think about some of the challenges our generation is facing, and the challenges that our children will almost certainly be left to deal with.

So my aim here is to impart on you some of my thoughts about the big one...that’s right, I’m going to tackle the greatest generational challenge of them all. The one that we all face as a species...that is “How do we live sustainably on this planet while maintaining a good quality of life?” Because if we can’t sort that one out, then the rest doesn’t really matter, whether it be Oral Health or Antarctic geology.

OK so let’s get started.

Challenge No.1. At the current rate of population growth there will be somewhere between 7.5 and 10.5 billion souls on this planet by 2050. We have just cracked 7 billion give or take a few, from a level of 1 billion, only 150 years ago at the start of the industrial revolution. Beyond 2050 there is debate about what is called the “carrying capacity” of our planet. The major limiting factor is of course natural resources. Well known environmentalist and author James Lovelock has argued that the resources of two Earth’s would be required to support the projected global population growth, that you see on this slide.

So that brings us to the next challenge. Human life, and quality of that life, is directly related to availability of energy. Our population explosion from 1 billion at the time of the industrial revolution to 9 billion today.
of the industrial revolution to today’s population of 7 billion has solely been a consequence of the availability of cheap fossil fuel based energy - coal oil and gas.

The time of peak production of oil is upon us, where demand is currently outstripping our capacity to produce and to find more oil. In fact discoveries peaked in the late 1960s, and new discoveries since then have declined and will continue to decline even with exploration of Antarctica and the newly ice free Arctic.

Lord Ron Oxburgh, a former chairman of Shell, in October 2008 stated the issue plainly when he said…

“...it is pretty clear that there is not much chance of finding any significant quantity of new cheap oil. Any new or unconventional oil is going to be expensive.”

A major challenge is the inevitable move to an economy that must be underpinned by a new and hopefully renewable cheap energy source. However, until then as energy costs continue to rise and the cost of living continues to rise our quality of life will reduce and our priorities will change towards the more basic needs such as paying the mortgage and putting food on the table – in short we will focus on the business of survival. OK, it sounds a bit dramatic doesn’t it, but for a large number of New Zealanders earning below the average family income this is already a reality. So what does it mean for this audience - the oral health care sector. One obvious outcome is that people will not be able to afford health care, and in my experience from when I was a poor student - dental care is usually the first to go.

OK, so let’s look at another challenge which is a consequence of our dependence on fossil fuel based energy.

For the last 10,000 years, Earth’s climate has been unusually stable. Surface temperature has remained on average at 14°C – not too hot, not too cold, just right - like in “Goldilocks and The Three Bears”. It was during this Goldilocks period of equable climate that our civilisation has flourished to what it is today. The thermostat controlling such a stable climate is the greenhouse gases in our atmosphere, and in particular the most important one – carbon dioxide – because it hangs around the longest. We know from the tiny bubbles of ancient atmospheres “snap frozen” and trapped in ice core records that carbon dioxide has remained at concentrations of about 260 parts per million (ppm) for the last 10,000 years, and it is only since the industrial age that carbon dioxide levels have risen dramatically to almost 400 ppm – as today seen on this slide. In fact most of that increase has been in the 20th century and has occurred in parallel with rapid population growth and the burning of fossil-based fuels.

This slide shows a wonderful piece of science. The levels of carbon dioxide in the atmosphere have been measured almost continuously since the 1950s at an observatory on the top of Mona Loa atoll in the Hawaiian Islands. In fact New Zealand’s Bearing Head observatory has been doing a parallel set of measurements since early 1970s. Here you can see the trend of increasing carbon dioxide from 1970 to 2005, but what is incredible to me is the seasonal cycle. Al Gore referred to this as our planet breathing! During northern hemisphere summers when deciduous trees are photosynthesizing, carbon dioxide is drawn down out of the atmosphere and the concentration of oxygen in the atmosphere increases – vice versa during the winter when they lose their leaves. So there is this dynamic interplay between the amount of oxygen and carbon in the atmosphere on a seasonal basis. Let’s now look at the long-term trend. As carbon dioxide has increased in the atmosphere during the last 50 years oxygen levels have decreased. This is in part due to deforestation, but primarily is a consequence of burning fossil wood! We know this because when we analyse the type of atoms in carbon dioxide gas, it is consistent with the burning of wood - fossil fuels – that is fossilized organic matter, and is not consistent with gases from other sources such as volcanic activity. So I’m now going to say something deliberately slowly, and in no way do I mean to be patronising. “The current rise in carbon-dioxide is from the use of fossil fuels. The current rise of carbon dioxide is because of us”. This is now scientifically without any doubt,
Earth warmed by almost 1°C in the 20th century - compared to the average of the last 2000 years

“IPCC hockey stick curve”

but it still amazes me that this gets debated in the media.

So lets look at another related challenge. The world is warming and it has warmed by almost 1°C since 1850. This slide is of the infamous “Hockey Stick” temperature curve produced by the Intergovernmental Panel on Climate Change. Yes, as some of you will be aware, it has been questioned, re-examined and reviewed and re-reviewed again. Its authors have been the subject of intense scrutiny by congressional hearings and in 2011 were at the centre of “Climategate”, when less than flattering emails were leaked. Climategate triggered another round of reviews by the world’s top academic societies. Yet after all of this poking and prodding the Hockey Stick temperature curve has been vindicated and provides unequivocal evidence that the world has warmed in the 20th century, well beyond the average temperature of the last 2000 years. I’m now going to say another thing deliberately. “The 20th century warming is due to the use of fossil fuels by us”! Another incontrovertible fact that should not be debated, because to do so goes against some very basic laws of physics that have been known for more than 100 years.

I’m going to digress quickly to address an issue that I often hear from climate change sceptics. And that is “compared with 1998, earth’s temperature has not warmed in the last ten years”. In fact they say it may have even cooled. So lets have a look at average temperatures over the last 100 years. You can see that there is a long term warming trend that is undeniable and that continues to 2012, but from year to year there can be a lot of variability. So it is important when making a prediction about the coming decades, that these are not based a single year or a few years. In fact the last two years have been back above the 1998 levels, and the warming trend just continues. This is the difference between “climate” and “weather”. Weather is what you predict. Climate is what you get and is the long term average of the weather. Just to drive home the message, pardon the pun. Would you go out and buy a big gas-guzzler like a Hummer based on the fact that in late 2008 petrol prices dropped almost 50 cents a litre in ten weeks, and ignore the trend of the last 5 years. We are still in that global recession that caused the crash in 2008 petrol prices, but look where petrol prices are back up to…. Better sell that Hummer I guess.

And if you don’t believe scientists like me who say the world is warming and our climate is changing perhaps you will believe the insurance industry.

Climate change is an insurance issue now. On this graph prepared by the global insurance giant Munich Re, you can see the number of natural disaster events since 1980. First take home point is that they have doubled. Second take home point is that geophysical events such as earthquakes, tsunamis and volcanic eruptions have remained constant (the red colours). The climate-related natural disasters such as floods, droughts, tropical storms, tornadoes and heat waves have doubled. Insurance claims from climate change related natural disasters are sky-rocketing, and it is only now that the insurance industry is sheeting back the costs to individuals, local authorities and industries, we are beginning to take note.

So I’m hoping that by now you are getting the message that climate change is happening, the world is warming and it is because of us. This issue is clear and is now of little interest to scientists, and should not be the focus of public concern or debate. However, what is of scientific interest and should be of public concern is what will a warmer world be like, and what are we in for? The science is much less certain around this point.

So how warm will our world be? Depending on how we control the level of carbon dioxide in the atmosphere our world could be between 2 and 6 degrees warmer than present. For example business as usual involving the burning of all the available coal, oil and gas will put us at 5-6 degrees warmer. On the other hand an aggressive, but probably unrealistic, attempt to reduce fossil fuel emissions could
limit warming in a best case scenario to 2 degrees warmer than present. I’ll show in a minute why I say that 2 degrees is looking unrealistic. But for now I want to point out that a world 2 degrees warmer is the threshold above which the United Nations says “dangerous human interference with the climate will occur”. Wow that sounds scary? What do these United Nations Scientists really mean. Well they mean if you go above 2 degrees you will most likely get irreversible meltdown of Greenland and parts of the Antarctic ice sheets with global sea-levels rising at a rate of one metre per century. They mean increased droughts in Australia and Africa. They mean an intensified Asian Monsoon, increased frequency of catastrophic floods and cyclones…a reduced quality of life for millions of people and of course higher insurance premiums.

Yes I know what you are thinking, hey hang on here…aren’t all these future scenarios based on computer models?? How good are they anyway? Nobody believes computer models. Well you might have a point here.

So now I want take you back in time using my expertise as a geologist…to a time when our planet last had 400 ppm carbon dioxide in the atmosphere….to a time when our planet was in fact on average 2°C warmer. So what was it like. How does a warmer world work?

This sort of question gets me really excited…its what gets me out of bed in the morning…rotting gums and root canals might do it for you guys…but for me it’s this question “how does the world work?”

Author Bill Bryson sums it up nicely by saying in his book “A short history of nearly everything” “you know it sort of hit me with a bang – that my whole existence was going to be on this planet . . . so I thought at least I should understand how this one works.”

So let me take you back in my Time Machine 3 million years ago to planet Earth. In fact it looked pretty much as it does today with a large ice sheet on Antarctica, a smaller ice sheet on Greenland, and with the continents and oceans roughly in the same place as they are today. However, there are three big differences. Firstly, our genus Homo hadn’t evolved in Africa yet, and As I have already said carbon dioxide was as high as today at 400 ppm and the world was 2 degrees warmer, However, when the world warms the polar regions warm by twice as much.

That should start to ring alarm bells, because that is where 70% of the world’s fresh water is locked up in ice sheets and if it all melted global sea-levels could rise as much as 70 metres.

So in 2006 I led an international team of scientists to Antarctica to drill a hole beneath the ice into the rocks below to find out what had happened to the Antarctic ice sheets 3 million years ago. Us geologists read the layers of rock preserved under the sea-floor like pages in a history book. We are able to decipher when the ice sheets expanded and when it was that they collapsed. We can work out how warm the ocean was and what lived in it. So in this cartoon you can see our drilling rig on the Ross Ice Shelf drilling back to our future.

The results of our drilling were quite surprising. For the first time we had found evidence that 3 million years ago when the world was very much like to will be in the coming decades, that the West Antarctic Ice Sheet had collapsed, and that in the Ross Sea there was no ice and in fact the sea temperatures were up to 5 degrees warmer, whereas today they are below freezing.

We then teamed up with world’s leading computer modellers of ice sheets and asked the question. “How much ice disappeared from Antarctica?” They ran their model using climate conditions that we had discovered from our geological drill core samples. I’m now going to run the computer model for you over a 500 year period to show you that the smaller West Antarctic Ice Sheet completely melts
and is replaced by ocean. Much of the West Antarctic Ice Sheet sits below sea-level and is vulnerable to melting as the ocean warms, and the ocean is presently warming. So there is great concern presently over the stability of this part of the Antarctic Ice Sheet. OK so lets run our computer simulation of the melting of the Antarctic ice sheet 3 million years ago when the ocean was 5 degrees warmer.

So the model tells us that Antarctica lost enough ice to raise global sea-level by 8 metres. A similar model of the Greenland ice sheet implies that it also melted at this time and that global sea-levels were up 15 metres higher than present day. So it looks like the United Nations might be correct. A world 2 degrees warmer will be a world with sea-level 10-15 metres higher.

How fast will this sea-level rise occur. This is one of the most fundamentally important questions facing climate scientists and I would suggest it is a significant generational challenge. Our best estimate at the moment is a rate of sea-level rise of about 1 metre per century is likely. Certainly our prediction for the year 2100 is about 1 metre higher than present. Although that might not sound a lot, 200 million people on this planet live within 1 vertical metre of present day sea-level and would be affected. Another concern is that polar ice sheets are melting at an accelerating rate and over the last five years that rate of loss has doubled and is predicted to keep accelerating. So 1 metre per year is likely to be on conservative side.

So lets summarize...we are putting together picture for our future of an unsustainable population explosion, of a major energy challenge as we burn all the fossil fuels, of an impending climate challenge as the world warms...with this warming felt twice as strongly at the poles’ melting ice sheets and sea-levels rising at greater than 1 metre per century. Phew!! Now for some light relief.

So perhaps this petroleum company knew something others didn’t in the 1970s. At the very least its somewhat prophetic.

So is it really that scary for the next generation? In fact if this slide of my children is anything to go by, the answer might be yes!

OK so, is our civilization capable of addressing the big challenges such as climate change and sustainability? Are we capable of looking beyond an election cycle and working collectively and ultristically for the greater long term benefit, or are we all about the here and now? Will we be destined to chop down the last tree, as on Easter Island... and as Jared Diamond puts it in his book “Collapse” will society choose to succeed or fail.

OK so what’s the bottom line? If we are to keep Earth’s temperature rise to less than 2 degrees of global warming we can only put up to one trillion tonnes of carbon into the atmosphere. So the bad news is that we are already half way there from the burning of fossil fuels since the industrial revolution began. The good news is that we can still burn half of all the proven economically recoverable oil, coal and gas reserves. So that’s the challenge! Burn only half of what we know is left in the ground and then move to non-fossil-fuel energy. This would mean we could continue with business as usual – burn baby burn to 2020 and then go cold turkey on fossil fuels – that is zero emissions. And who knows perhaps technology will save us. But do we really want to take that risk?...or we can start an aggressive programme of limiting emissions now.

The reality is that even with best will in world, the emissions reduction targets have now got so challenging that it is unlikely the world can stay below 2°C and we will most likely end up 4°C warmer by the end of the century. So our challenge will be to adapt to living in this warmer world, to move to an alternative and hopefully renewable energy source and to live sustainably, healthily and happily. That’s all there is to it!

And as the English Philosopher Bertrand Russell once said. “The greatest challenge to any thinker is stating the problem in a way that will allow a solution”

Well I’m not sure I’ve done that for you tonight, but thank you for listening all the same, and enjoy the rest of this Convocation.

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During 1945, when World War 2 was beginning to move towards a successful conclusion for the Allies, two very unique young men were to graduate in dentistry from the University of Melbourne to join others from their final year in entering the Australian Armed Forces for the duration of the war and beyond. At that time the system which prevailed was based upon the premise that “the first one in was to be the first one out” and being late in entering the Service, the Kings twins found themselves serving some three years in the RAAF as young Flight Lieutenants. Following demobilization, they set up practice together and excepting for the two successive years which they spent separately in Toronto (Canada) to obtain their DDS degrees, they were inseparable as brothers, friends and colleagues.

It is indeed extremely difficult to write about Stan without also referring to Eric. They were not only identical in almost every respect, but their achievements within the profession followed the same paths in their early years, only separating slightly in their middle to later years of activity. It has been oft remarked that throughout their respective careers, Stan and Eric shared most of the senior positions in dentistry which were available to them in Australia.

Stan undertook his secondary education at Melbourne High School, being outstanding in sport (First XI and First XV11), and he was the School Captain, with Eric being the Vice-Captain in the same year. Following secondary school, the two boys attended the University of Melbourne, each graduating in 1945 (BDSc) and entering the RAAF. Following their discharge and undertaking a period in dental practice with Eric, Stan was accepted to attend the University of Toronto, where he attained the DDS in 1962, being Dux of the class. Not to be out-done by Stan, in the following year Eric followed him to Toronto, achieving the same result, DDS and Dux.

Having each attained additional qualifications, the brothers decided to commence practice in Collins Street Melbourne, where they continued their partnership until retiring in the mid 1980s. Throughout their dental careers they followed the same professional pathways with great success. However, in the administrative roles which they undertook, due to the timing of opportunities as they became available to each, it was inevitable that their paths would diverge.

Following Stan’s return to Australia, he was encouraged to enter the portals of organized dentistry through seeking election to the Council of the Victorian Branch of the Australian Dental Association. This he did in 1962 and it was to be the commencement of a most successful career in the ADA at both State and Federal levels, concluding with the Federal Presidency for the years 1982-84. During this time, he undertook many other roles, including international representation at Dental Congresses of the Federation Dentaire International and the Asian Pacific Dental Federation, ultimately as the leader of the Australian Delegation.

For his contributions to the dental profession, in 1985 he was accorded the highest award to be offered by the Australian Dental Association, that being Honorary Life Membership. Subsequently, this was followed by him being honoured with Membership in the Order of Australia (AM).

In addition to Stan’s interest in the governance of his profession and the well-being of its members, he had an
abiding interest in dental education. This drew him to the newly formed Australian College of Dental Surgeons, when in 1965 it was established with a nucleus of Inaugural Fellows who had attained additional dental qualifications. Along with other emerging leaders in dental education, Stan accepted Inaugural Fellowship, being then able to use the post-nominals FACDS. As a point of historical interest, prior to this time the founders of the College had been working with the Royal Australasian College of Surgeons, but without success, in an attempt to establish a Faculty of Dental Surgeons within their structure, parallel to those which pertain in the Royal Colleges of Britain. Since those early days when our founders decided to act unilaterally, the College has embraced within its name our cousins from New Zealand and in 1972 it attained Royal assent. From thence it has been known as the Royal Australasian College of Dental Surgeons.

In 1974 Stan stood successfully for election to the Council of the College, which launched his career at this level. In due course, positions upon the Executive Committee of Council were to become available and in 1978 he was elected to serve as a member of the Executive, initially as Censor-in-Chief and then through to 1984 in successive roles as Honorary Treasurer and Vice-President.

At the end of 1983, he was elected as President of the College for a two year term, during which he distinguished himself by facilitating the formation of the “Section” of Oral and Maxillofacial Surgery. Until then, the College had directed its attentions to the enhancement of the education of generalists in the profession, to the level of what may be termed “super generalists”. Stan’s action in expanding the education focus beyond general dentistry, not only embraced one single important group of specialist members of the profession, but it heralded the development of other specialty areas within the college structure, which continues to this day.

Following the completion of his term as President of the College, in 1989 he was awarded the highest honour which the College may confer upon its Fellows, Honorary Life Fellowship.

Having enunciated some of Stan’s achievements throughout his professional career, it is fitting that some of his personal traits are recorded. At his Memorial Service which was conducted at Christ Church, Hawthorn on 19 August 2011, these were expressed in one of the eulogies in the most simple of terms. “When memories of him are called to mind, single ‘key words’ of description seem to tumble into place - words such as: family, sport, loyalty, love, professionalism, sincerity, integrity, gentility, humour, leadership”. No matter the order, the meanings of these words provide the essence.

One can hardly imagine a more successful life and career than that experienced by Stan. His achievements were great and of more importance, they were never developed at the expense of others. He married well (Heather) and they produced three fine and successful children (David, Kate and Libby) who have in turn continued the line so well ordained by their parents. Stan was both highly regarded and loved by his friends, particularly for his great sense of humour and balanced mind. His Memorial Service overflowed beyond the confines of the church, with those who were proud to be close to him throughout life. Nobody appeared to be sad. On the contrary, there prevailed much joy for the peaceful passing of a man who not only led a good, fruitful and long life, but who left us all a legacy of countless fond memories.

Reginald Hession AM
September 2011
In Memoriam
HENRY GORDON “HARRY” LAMPOUGH
10 August 1925 - 20 April 2011

Harry was born in Edgehill, near Liverpool, the younger of two boys. His brother however died in childhood so that Harry grew up essentially as an only child.

He matriculated at the age of 15 but was unable to commence tertiary studies for a further three years. He then commenced an unspecified university course but found that it didn’t satisfy his natural curiosity. So he switched to dentistry, thus following in his father’s footsteps. After graduation he assisted in his father’s practice for a time before joining the Royal Navy. His travels took him to Australia in about 1948, where he either joined or arranged some form of transfer to, the Royal Australian Navy.

Harry married Ruth, who had followed him from England, and a few years later they drove to Perth, in what was quite an adventure over the unmade road. He set up his first practice in Cue which was, at that time, still a busy gold mining centre, some 640 km north-east of Perth. He also ran a small branch practice at Big Bell, site of a famous open cut gold mine, but now only a ghost town. Harry subsequently practised in agricultural Northam (a mere 100 km from Perth) before he purchased premises at 39 Colin St, West Perth from another dentist, the colourful Ambrose Cummins whose home it was. That was about 1954. He set about converting that house, with its spacious rooms, to a dental surgery in a suburb that was changing its character from a superior residential area to a centre of professional practices. He built up a thriving solo practice with a high reputation.

When the Australian College of Dental Surgeons was established and commenced examinations a few years later, Harry along with George Neumann and the late Justin McCarthy were among the first candidates for the Fellowship of what subsequently became the Royal Australasian College of Dental Surgeons. He was, justifiably, very proud of this achievement, and subsequently gave much back to the College.

In 1971 when a vacancy occurred on the College Council, with the departure of Ross Taylor to take up an appointment in USA, Harry was invited to fill the position. He did so, and subsequently held a number of committee positions, culminating in those of Censor-In-Chief, Treasurer, Vice President and he was elected President for 1980-1982. He was very proud to have been the first Fellow by examination to be elected College President. In recognition of his years of dedicated service Harry was elected to Honorary Fellowship, the College’s highest honour, in 1985.

Meanwhile, still in his busy practice, he found time to tutor dental therapy students, firstly in Anatomy and subsequently in dental clinical subjects. He retired from practice in 1974 and became fully involved firstly in dental therapy training and subsequently in regional management within the Dental Service of the WA Health Department. He later moved into senior positions within the Service and was appointed Acting Director and then Director of the Service in the period 1985-1988, after which he retired. Presumably because of he held English citizenship until 1984, a number of his appointments were in an acting capacity and it is typical of his wonderful whimsical sense of humour that he once remarked that he had held so many acting roles that he should seek membership of Actors’ Equity.

Throughout his busy public service career he continued to actively support the WA Regional Committee of the College and to encourage candidates for Fellowship examinations in the College.

Harry had a wide range of interests and was a good conversationalist on many topics. His natural reserve however, hid a mischievous sense of humour and of fun. He had friends from a broad spectrum of the community, all of whose company he enjoyed enormously. He was pre-deceased by Ruth, whom he had cared for over an extended period, after which he enjoyed only indifferent health himself. He died of complications from a fall.

Harry had a calm and reassuring approach to problems and he was a mentor of great common sense and encouragement. For his friends, nothing was too much trouble. He was a very special person, and the dental community is the richer for his role, as are his many friends.

Anonymous contributor
The Young Lecturer’s Award at this year’s convocation, sponsored by Colgate, was once again a highlight of the scientific programme. Unfortunately there were only two post-graduate students who presented papers as one further candidate was forced to withdraw at the last minute due to teaching commitments. Nevertheless, the judges were faced with a difficult task to decide on a winner. The candidates and their presentation titles were:

Dr Harleen Kumar (University of Melbourne), (co-authors A/Prof. Joseph Palamara, Prof. Michael Burrow, Prof. David Manton): Resin infiltration - Taking the first steps to filling the holes in cheese molars.

Dr Sonali Mistry (University of Queensland), (co-authors Prof. Kim Seow, Dr Trevor Holcombe): Evaluation of pulpotomy outcomes in primary molars using mineral trioxide aggregate as a pulp dressing and base restored with stainless steel crowns versus amalgam.†

Both presentations were of high quality and the judges commended the participants. The calibre of the research and the manner in which the lectures were delivered speaks well for the future of our dental researchers. The winner was Dr Harleen Kumar from Melbourne. She was awarded a certificate and a cheque from Ms Jenny Pearson from Colgate Oral Care (New Zealand). The runner-up, Dr Sonali Mistry was presented with a Certificate of Achievement.

* Presented at the Closing Ceremony on Wednesday 4 April 2012.
† Papers from these presentations are included in this Volume of the Annals.
ANNALS OF THE
ROYAL AUSTRALASIAN COLLEGE
OF DENTAL SURGEONS

SCIENTIFIC PROGRAMME
PAPERS AND ABSTRACTS
FROM THE
THE TWENTY FIRST CONVOCATION OF THE
THE ROYAL AUSTRALASIAN COLLEGE OF DENTAL SURGEONS

QUEENSTOWN, NEW ZEALAND 31 MARCH TO 4 APRIL 2012
PERIODONTAL DISEASES:
BASIC CONCEPTS, ASSOCIATION WITH SYSTEMIC HEALTH,
AND CONTEMPORARY STUDIES OF PATHOBIOLOGY

Panos N. Papapanou, DDS, PhD*

Current Classification of Periodontal Diseases

‘Periodontal diseases’ is a collective term used to describe the inflammatory changes of the tooth supporting structures, i.e., the gingiva, the alveolar bone, the periodontal ligament and the root cementum, that may lead to tissue destruction, reduced tooth support and, ultimately, to tooth loss. Commonly in medicine, classification systems for pathologic conditions are ever evolving schemes that are periodically revised to reflect current knowledge related to the clinical presentation, aetiology, pathobiology, treatment response or long term prognosis of the disease in question. The classification of periodontal diseases is no exception; after several revisions over the years, the currently accepted system reflects the consensus report of a 1999 International Conference. The classification recognizes eight main categories, three of which (Gingival Diseases, Chronic Periodontitis and Aggressive Periodontitis) will be involved in the present series of lectures.

The first category, Gingival Diseases, describes pathological alterations confined to the gingival tissues that have not yet resulted in loss of periodontal tissue support, i.e., in attachment loss or bone loss. These conditions are either induced by bacterial plaque and may be further modified by systemic factors, medications or malnutrition, or they may be unrelated to dental plaque accumulation.

In contrast, periodontitis is by definition a plaque-induced inflammatory disorder that has resulted in loss of periodontal tissue support. The two principal categories of periodontitis are Chronic and Aggressive periodontitis. Either condition can be further characterized as localized or generalized, depending on the number of affected teeth in the dentition.

Chronic periodontitis is the most common form. It affects individuals of all ages, it is commensurate with the level of local aetologic factors (i.e., plaque accumulation), and it usually progresses at a relatively slow pace with increasing age. In contrast, as the term indicates, aggressive periodontitis is a destructive form of periodontal disease that is characterized by rapid bone loss and attachment loss. It aggregates within families, implying that its pathobiology is strongly determined by genetic factors and common environmental exposures, and may affect young individuals, particularly in its localized form that is frequently not associated with conspicuous plaque accumulation or gingival inflammation. Localized aggressive periodontitis has been closely linked to infection by a particular periodontal pathogen, Aggregatibacter actinomycetemcomitans. In addition, patients with aggressive periodontitis have been shown to have abnormalities in polymorphonuclear leukocyte (PMN) function, although these observations have not been unanimously corroborated and are seemingly incompatible with the fact that these individuals suffer no other pathological condition besides periodontitis. The high susceptibility of these individuals to periodontitis has also been postulated to be partly due to hyper-responsive macrophages that produce high levels of pro-inflammatory mediators involved in tissue destruction. Again, it is difficult to determine with certainty if this altered cellular phenotype constitutes a pre-existing susceptibility factor or rather is a result of the disease itself.

Twelve years after the introduction of the current classification system, it has become increasingly apparent that the above scheme suffers from important shortcomings. These include lack of diagnostic precision, resulting in substantial overlap between categories, and difficulty in applying the stipulated criteria in the everyday clinical practice. For example, it is impossible to ascertain on the basis of a single examination whether the progression of the bone loss or attachment loss has been rapid or not, an assessment that is essential for the diagnosis of aggressive periodontitis. Likewise, it is difficult to determine when the second primary classification criterion for aggressive periodontitis, familial aggregation, is fulfilled, as patients are frequently unaware of the periodontal status of their siblings or parents. But more importantly, there appears to be a lack of a solid, pathobiology-based foundation for the distinction between two main disease categories, chronic and aggressive periodontitis. Therefore, further revision of the current classification seems to be both necessary and inevitable.

Epidemiology of Periodontal Diseases

Epidemiologic studies are primarily focused on the assessment of two major features of a given disease: the frequency by which the particular disease affects the population, i.e., the assessment of its prevalence, and the identification of risk factors for the onset or the progression of the disease. Typically, the former task falls within the realm of descriptive epidemiology while the latter is the focus of analytical epidemiology.

Assessing the prevalence of periodontitis in the population is not as straightforward a task as one would normally expect. Indeed, a number of key features of periodontitis render the definition of a ‘periodontitis case’...
rather complicated. The first is the fact that periodontitis is a highly site-specific disorder. In other words, the disease affects specific tooth sites in the dentition and deep pockets, attachment loss and bone loss do not occur uniformly within the affected individual. It is therefore necessary to determine specific thresholds for both the minimum number of affected sites required per subject, and the minimal severity of the defects (i.e., the magnitude of pocket depth, attachment loss or bone loss) in order to diagnose a particular individual as affected by periodontitis. In this context, it is important to realize that (i) factors other than plaque-induced periodontitis (such as traumatic tooth brushing, malposition of teeth, endodontic lesions) may also result in loss of periodontal tissue support at individual tooth sites; and (ii) the definition of periodontal pathology based on linear probing assessments must exceed the error inherent in probing measurements, in order to identify with reasonable certainty a ‘true’ loss of periodontal tissue support. Unfortunately, the periodontal research community has so far failed to establish universally accepted thresholds for periodontal pathology. Therefore, it is next to impossible to reconcile worldwide prevalence estimates from different studies in geographically and ethnically diverse populations because of the variable criteria used for case definition. An additional difficulty stems from the fact that most epidemiologic studies have used partial recording methodologies, in other words, they have carried out abbreviated examinations using probing assessments at only a subset of teeth, rather than at all teeth present. Methodological research on the impact of different examination systems has made it increasingly apparent that these partial recording protocols result in severe underestimation of the prevalence of periodontitis in the population, therefore the data quoted by these studies are most likely biased.6,7 Lastly, a major additional difficulty lies with the current classification system of periodontitis described above, and particularly with the diagnosis of aggressive periodontitis based on ‘rapid progression of bone loss and attachment loss’ and ‘familial aggregation’, criteria that are often impossible to assess in epidemiologic studies. Therefore, reliable estimates of the prevalence of chronic versus aggressive periodontitis in any given population are not currently available in the periodontal literature.

Despite these difficulties, a few conclusions related to the prevalence of periodontal diseases do emerge from the available descriptive epidemiologic studies and can be summarized as follows:

1. Signs of periodontal inflammation and attachment loss of limited magnitude are ubiquitous in all populations. It is therefore not surprising that several publications quote prevalence figures of periodontitis in excess of 70% in the population. Use of thresholds of minimal severity, e.g., loss of attachment ≥ 2 mm, can easily result in prevalence figures approaching 100% in the adult population.

2. It is likely more reasonable to focus our attention to the assessment of the prevalence of severe forms of periodontitis, i.e., of periodontitis resulting in substantial loss of periodontal tissue support that may lead to tooth loss and jeopardize function and aesthetics. Although a definition of severe periodontitis is also variable in the periodontal literature, it appears that these forms of advanced disease do not affect more than 10-15% of the adult population. Furthermore, it appears that the prevalence of these severe forms increases until the age of approximately 60 years, and then reaches a plateau because of the effect of tooth loss and edentulism.

Lastly, there is still considerable debate on whether the prevalence of periodontitis shows a worldwide decline, possibly due to improved health literacy, better access to oral health care, more effective control of risk factors, etc. There are indeed data available from some parts of the world, notably the United States of America, that are suggestive of such a trend.8 Nevertheless, data from a comparative study carried out in Sweden9 over 30 years (covering the period from 1973 to 2003) are really informative in this context, particularly because they stem from a European country of high socioeconomic status, with high levels of health literacy and easy and affordable access to health care. This particular study compared periodontal conditions in three random samples of adults drawn 10 years apart from the same geographical region using the same examination methodology (clinical probing assessments and radiographic measurements of bone loss). The periodontal status of the participants was classified using a severity scale ranging from 1 to 5, where a score of 1 indicates periodontally healthy conditions and a score of 5 indicates severe loss of periodontal tissue support. As is shown in Fig. 1, the percentage of individuals in the two most healthy groups (i.e., those with scores 1 and 2) increased significantly over the observation period, and this improvement occurred in the expense of the intermediate group (score 3) that experienced a corresponding decrease. However, the proportion of individuals who were mostly affected by periodontitis (those in groups 4 and 5) remained remarkably stable at a level ranging between 13 and 11%. These data seem to indicate that an improvement of periodontal conditions may have indeed

occurred over the past few decades, but the ‘beneficiaries’ of this improvement are largely individuals with moderate levels of periodontitis. The proportion of individuals with severe periodontitis, arguably the highly susceptible group that requires high-intensity therapeutic intervention to shift to a lower disease level is seemingly unaffected. These data appear to indicate that the current population-based strategies for the prevention and treatment of periodontitis do not fully address the therapeutic needs of the portion of the population that is highly susceptible to periodontitis.

Definition of the determinants of susceptibility to severe periodontitis is of paramount importance, as it may lead to the identification of the periodontitis-prone individuals prior to the development of irreversible periodontal tissue damage and may facilitate their enrolment in effective preventive programs. Plaque bacteria constitute the stimulus that triggers an inflammatory response at the dentogingival region that, under certain conducive conditions, may lead to destructive periodontitis. Epidemiologic studies carried out in different parts of the world have demonstrated that colonization by particular periodontal species, including Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Tannerella forsythia, and Campylobacter rectus confer high odds ratios for destructive periodontitis. Since the majority of the available epidemiologic studies that have examined the association between colonization by specific periodontal bacteria and periodontal status are cross-sectional in nature, i.e., they have assessed colonization contemporaneously with the clinical status, these data alone do not demonstrate that these bacteria are true risk factors for periodontitis. However, a relatively small number of longitudinal prospective studies extend these observations and demonstrate that colonization by certain pathogens or virulent clones ascertained prior to the manifestation of periodontal tissue breakdown indeed conveyed an increased risk for subsequent disease development. This has been elegantly demonstrated in studies examining the subgingival colonization by Aggregatibacter actinomycetemcomitans and the development of aggressive periodontitis. Pioneering research carried out by a Danish research group in Morocco demonstrated in a population-based prospective cohort study that adolescents free of periodontitis who were colonized by a particularly virulent, highly leukotoxic clone of Aggregatibacter actinomycetemcomitans had a relative risk of 18 to develop aggressive periodontitis over the subsequent two year period when compared with those not colonized by the pathogen. Similar data have been published from a longitudinal study of aggressive periodontitis in a cohort of predominantly African American, low socio-economic status individuals in the United States.

In a more global sense, the paramount role of bacteria in the pathobiology of periodontitis is demonstrated by treatment studies that have invariably shown that antimicrobial therapies are effective in the control of periodontitis. Indeed, mechanical disruption of the plaque biofilm achieved through scaling and root planing, followed by regular home care-based plaque control, predictably results in resolution of the periodontal lesion and improvement of clinical periodontal status. Furthermore, administration of adjunctive antibiotics has been shown to enhance the therapeutic outcomes. Therefore, the collective empirical evidence from treatment studies of periodontitis as well as the data from epidemiologic studies have established the role of bacteria, and that of certain species in particular, as important risk factors for periodontitis.

Beyond the bacterial component, two additional exposures are recognized as established risk factors for periodontitis: cigarette smoking and diabetes mellitus. There are multiple biologically active substances associated with cigarette smoking, and their detrimental effects on the host tissues has been established in experimental in vitro studies and in vivo animal models. Epidemiologic association studies have invariably demonstrated that smokers show inferior periodontal status and suffer more tooth loss than non-smokers. Importantly, these differences persist after adjustments for covariates such as race/ethnicity, socio-economic status and educational attainment. Likewise, prospective studies have shown a higher progression rate of periodontitis (i.e., longitudinal attachment loss and bone loss) and higher rates of tooth loss in smokers versus non-smokers. Lastly, data from treatment studies clearly demonstrate that the outcome of periodontal therapy, and particularly that of more elaborate treatment modalities such as regenerative or soft tissue grafting procedures, is inferior in heavy smokers than in non-smokers. Recent meta-analyses of the effects of smoking on the outcome of periodontal therapy support the above conclusions. Interestingly, smoking cessation appears to be associated with better outcomes, suggesting that the deleterious effect of smoking on the periodontal tissues is partly reversible.

Diabetes mellitus is a group of metabolic disorders that are characterized by abnormal glucose metabolism. In the context of periodontitis, both type 1 diabetes (characterized by deficiency in insulin production) and type 2 diabetes (characterized by impaired insulin action and utilization) appear to interfere with the ability of the host to successfully cope with the bacterial challenge through mechanisms that are increasingly delineated. In an environment of glucose excess, host proteins undergo non-enzymatic glycation and form advanced glycation end products (AGEs). Activation of the AGE receptor RAGE by AGEs and its other ligands results in a pro-inflammatory cell phenotype that has been shown to be important in the development of diabetes complications including periodontitis. In addition, diabetes appears to induce an uncoupling between bone destruction and bone repair mechanisms that may contribute to more severe alveolar bone loss. Similarly to what was discussed above for smoking, epidemiologic evidence supporting a role for diabetes as a risk factor for periodontitis stems from cross-sectional association studies, longitudinal prospective studies and treatment studies. Thus, patients with diabetes exhibit more severe attachment loss and bone loss than non-diabetic controls, show enhanced progression of periodontitis over time, and respond less favourably to periodontal therapy. With respect to the reversibility of the detrimental effect of diabetes on clinical periodontal status,
it is important to point out that patients with diabetes and good metabolic control appear to respond to periodontal therapy in a manner comparable with that of their non-diabetic counterparts. Interestingly, the negative effects of diabetes on the periodontium appear to manifest themselves at a much younger age than earlier believed: indeed, data from recent studies identified considerable periodontal pathology (in terms of bleeding on probing, pocketing and attachment loss) among children under the age of 18 years suffering from predominantly type 1 diabetes.27

As discussed above, aggressive forms of periodontitis tend to aggregate in families, suggesting that genetic predispositions may play a role in the disease process. Research data from twin studies have shown a considerable degree of similarity in periodontal status within pairs of monozygotic twins, even in situations where these genetically identical siblings were raised in different families.28,29 These data indicate that despite the distinct environmental effects that these siblings were exposed to, a substantial part of their periodontal ‘phenotype’ was still determined by their genetic make-up. Yet, the search of a ‘periodontitis susceptibility gene’ remains elusive to date, most likely because such a deterministic gene does not exist. In contrast to Mendelian diseases, in which the diseased phenotype is owed to a particular mutation in a defined gene, periodontitis is a complex disease whose genetic determinants are coded collectively by multiple (hundreds or thousands of) genes, and whose clinical phenotype is defined by an interplay between environmental and genetic factors. In recent years, particular attention has been paid to the role of genetic polymorphisms (i.e., in variations in gene sequence that occur relatively commonly in the population) as putative risk factors for periodontitis (see a recent review by Laine, Crielaard and Loos30). Studies have examined the association of periodontitis and polymorphisms in cytokine encoding genes (extensively the ones located in the interleukin 1 gene cluster, but also in the tumour necrosis factor-alpha and the interleukin-10 genes); in human leukocyte antigen (HLA) genes; in genes coding for cellular receptors involved in immunity (toll-like receptors 2 and 4, Fcg-receptor, CD14) or in metabolic processes (vitamin D receptor). With the exception of a particular mutation in the Cathepsin C gene that was shown to be responsible for the development of Papillon-Lefèvre syndrome and the accompanying pre-pubertal periodontitis (i.e., an early-onset form of periodontitis that affects deciduous teeth as well), the association of the above polymorphisms with periodontitis has been highly variable in different studies and not consistent across ethnically/racially diverse populations. Contemporary genome-wide association studies continue to identify specific single nucleotide polymorphisms (SNPs) that are associated with destructive periodontitis at variable degrees, but there is no convincing evidence available today that supports the utility of any genetic test in the identification and management of periodontitis.

Additional exposures that have been identified as potential risk factors for periodontal disease that have not been fully validated yet include psychosocial stress31,32 that can conceivably exercise a negative impact on the immune response; metabolic syndrome and obesity33,34 which are conducive to a state of systemic inflammation; osteopenia/osteoporosis35,36 and nutrition.37

Collectively, the identification of risk factors and a thorough understanding of how these exposures mediate their detrimental effects on the periodontal tissues are of paramount importance in the successful control of periodontal diseases. Although the cornerstone approach to periodontal therapy is anti-infective, control of those risk factors that are modifiable is an essential component in the prevention and management of periodontal diseases.

**Periodontal diseases and general health outcomes**

Over the past decade, considerable interest has been focused on the role of periodontal diseases as an independent risk factor for non-oral diseases. The concept as such is far from novel: approximately 120 years ago, the ‘focal infection’ theory incriminated poor oral health as the underlying cause for a broad range of diverse diseases ranging from colitis to mental depression. As a result, scores of patients were unnecessarily edentulated before the advocated postulates were critically assessed and ultimately rejected. More recently, however, the notion that periodontal infections and the accompanying local inflammation may result in a state of systemic inflammation with subsequent development of disease at extra-oral sites has been revisited. Before summarizing the current thinking regarding the association of periodontitis as an exposure with particular diseases as outcomes, it is important to outline a number of facts that substantiate the biological plausibility of such a link.

First, it must be recognized that the subgingival plaque biofilm that colonizes the root surfaces in a dentition with periodontitis is in intimate contact with the ulcerated epithelium of the periodontal pocket. In cases of generalized severe periodontitis, the total surface of the pocket epithelium is substantial and has been calculated to approximate 800-2,000 mm2.39 Therefore the plaque bacteria are in close proximity to a wound surface, a fact that allows them to gain direct access to the underlying connective tissue because of the disruption of the epithelial barrier. In addition, certain periodontal bacteria have tissue-invading properties.40-42

As a result, bacteraemias are fairly common in patients with periodontitis43,44 and have been actually shown to be triggered by considerably milder mechanical stimuli than invasive dental procedures, that have been well-recognized as bacteremia-inducing, leading to the requirement for antibiotic prophylaxis in special patient categories. Indeed, mastication and even oral hygiene procedures such as tooth brushing and dental flossing even in periodontally healthy subjects have been shown to induce bacteraemias.45 Nevertheless, it must be emphasized that these bacteraemias are transient, and of low intensity (i.e., the numbers of bacteria entering the circulation is generally low), therefore the host appears to cope with them successfully and without any untoward consequences in most cases.

An additional plausible mechanism by which periodontitis may have extra-oral adverse effects is the systemic dissemination of inflammatory mediators that are abundantly produced locally in the inflamed periodontal
tissues by cellular innate and adaptive immunity pathways. Thus, inflammatory cytokines, along with bacteria and bacterial products, can enter the blood stream and reach distant organs but, importantly, also ‘excite’ the vascular endothelium and provide the impetus for a pathobiological cascade of events that may lead to atherogenesis. Indeed, this so-called ‘endothelial injury’ leads to increased diapedesis of circulating monocytes through the vascular endothelial lining into the intimal space, where they become tissue macrophages, uptake oxidized low-density lipoprotein cholesterol (LDL) and become foam cells and contribute to the formation of fatty streaks and atheromatic plaques. Critical to the development of thrombo-embolic events such as myocardial and cerebrovascular infarctions (i.e., heart attacks and strokes) is the rupture of the atheromatic plaque that occurs when the endothelial cells that line the vasculature undergo apoptosis and expose the underlying plaque that is degraded by enzymes such as matrix metalloproteinases (see a recent review by Kebschull, Demmer and Papapanou).  

Importantly, antibacterial antibodies to certain bacterial proteins that have a high degree of homology with mammalian proteins are, in essence, functioning as auto-antibodies and contribute to the apoptosis of vascular endothelial cells. This phenomenon, termed ‘molecular mimicry’, is of particular importance in the context of periodontal infection-induced atherogenesis, as a specific heat-shock protein of the periodontal pathogen P. gingivalis (GroEL) is highly homologous with the human protein HSP60. 

Lastly, it should be remembered that several systemic conditions to which periodontitis can conceivably contribute aetiologically (such as atherosclerosis) also share common risk factors with periodontitis. This fact may lead to a confounded association between the two diseases. In other words, while periodontitis may appear to be associated with atherosclerosis, in reality the two conditions may be linked due to the aetiologic exposure that they both share, i.e., smoking. As implied above, one of the conditions that have been investigated as potentially linked with periodontitis is atherosclerosis and atherosclerosis-related clinical events. In vitro and in vivo experimental studies have examined the role of periodontal bacteria and bacterial products on the key atherogenesis-promoting processes mentioned above, including their ability to activate innate immune cell signalling pathways associated with atherosclerosis and to induce vascular endothelial activation and oxidative stress, their interactions with monocytes and tissue macrophages, as well as their pro-thrombotic, pro-coagulant and plaque-disrupting effects. Animal studies have documented the ability of specific periodontal bacteria and bacterial products such as lipopolysaccharide to accelerate atherosclerosis. Data from human studies demonstrate that patients with periodontitis have high levels of inflammatory biomarkers in their blood (including acute phase proteins such as C-reactive protein and pro-inflammatory cytokines such as interleukin-6). Importantly, periodontal therapy has been shown to result in suppression of serum inflammatory mediators and improved arterial endothelial function, suggesting that the effects of periodontitis on these surrogate markers for atherosclerosis are, to a certain extent, reversible.  

With respect to clinical events, cross-sectional and prospective cohort epidemiologic studies have shown that periodontitis is associated with higher prevalence and incidence of myocardial infarction and stroke, after adjustment for potential confounders. The associations are of modest magnitude but are fairly consistent among studies. Interestingly, similar observations have been made in studies involving never-smoking individuals, which suggests that confounding by smoking cannot entirely account for the reported associations. So far, no randomized controlled trials have been carried out to test whether the control of periodontal infections may result in a reduction in the incidence of myocardial infarction or stroke. Given the fact that atherosclerosis is a process that has its onset in relatively young age but usually requires decades until the precipitation of a clinical event, such studies are obviously difficult, time consuming and expensive to conduct. A pilot, secondary prevention trial, i.e., a study that examined the effects of periodontal therapy on the prevention of subsequent clinical events in individuals with established cardiovascular disease, showed no impact of periodontal therapy on the incidence of cardiovascular events.

Another area that has attracted considerable attention is the potential role of periodontal infections on precipitating adverse pregnancy outcomes, i.e., pre-term birth (delivery before the 37th gestational week), low birth weight (birth weight of < 2,500 g), and pre-eclampsia (a serious pregnancy complication characterized by high maternal blood pressure and proteinuria that is associated with endothelial dysfunction). Again, there is ample evidence that supports the biological plausibility of such an association and many of the pathways outlined above in the context of atherogenesis are relevant here as well. It should be noted that maternal infections such as bacterial vaginosis and chorio-amnionitis are established risk factors for pre-maturity and intra-uterine growth retardation. Conceivably, disseminating bacteria from the oral cavity may seed the placental membranes, and induce a local inflammatory response that may initiate premature contraction of the myometrium through production of prostaglandins and other inflammatory mediators. Experimental studies in the pregnant hamster have demonstrated that infection with P. gingivalis causes retardation of the growth of the foetus in utero.  

Corroborating the above, cross-sectional epidemiologic studies are largely but not universally supportive of an association between pre-term birth and low birth weight in women with periodontitis. Importantly, and contrary to what is the case in periodontitis/atherogenesis-related research, several interventions have been conducted to test whether treatment of maternal periodontitis results in improved gestational outcomes. While earlier, limited-sized or uncontrolled trials indicated that such therapy has beneficial effects, recent multicentre controlled trials that have collectively randomized approximately 4,500 pregnant women to a treatment group that received non-surgical periodontal therapy before the completion
of the second trimester, and a control group that received identical therapy after delivery, showed that this particular type of periodontal intervention does not result in reduced prematurity or low birth weight rates. However, it is important to emphasize that the results of these studies should not be over-interpreted to indicate that they provide proof of no association between maternal periodontitis and pregnancy complications. This would indeed be the wrong conclusion, as randomized clinical trials only test the efficacy of a specific intervention to modify a pre-defined health outcome. Interventions targeting a true risk factor will only lead to lower incidence of a particular outcome if the effect of the risk factor is indeed reversible. In addition, interventions against a true risk factor may still fail due to inappropriate timing (e.g., when the intervention is administered too late) or due to inadequacy of the intervention to decrease the exposure sufficiently (e.g., when the intervention fails to resolve periodontal inflammation and reinstitute periodontal health). Additional research is thus required to fully appreciate the effects of maternal periodontal infections on adverse pregnancy outcomes.

A third systemic condition investigated in this context is diabetes mellitus. The role of diabetes as an important risk factor for periodontitis was discussed above. Interestingly, a two-way association between the two diseases appears to exist: in addition to the established detrimental effects of diabetes on the periodontal tissues, periodontal infection/inflammation seems to contribute to poor metabolic control in diabetes. Indeed, recent meta-analyses of studies that have administered periodontal therapy in patients with diabetes have documented a moderate but statistically significant effect of periodontal treatment on the levels of glycated haemoglobin (HbA1C), the established measure of long-term metabolic control in diabetes management. Furthermore, recent studies have shown that a simple algorithm that combined medical history with measures of periodontal disease severity are effective in identifying patients with undiagnosed diabetes mellitus or with undiagnosed pre-diabetes (the precursor condition). Given that the estimated prevalence of undiagnosed diabetes and pre-diabetes is substantial (e.g., in the USA 3% and 7% of the population, respectively), dentists can contribute decisively to the identification of these patients, whose timely diagnosis and management are essential for the prevention of the serious complications of the disease.

Gingival tissue transcriptomes and the pathobiology of periodontitis

A genomic tool that may add to the armamentarium of approaches to study the pathobiology of periodontitis is gene expression profiling, i.e., the systematic cataloguing of messenger RNA sequences in a cell population, organ or tissue sample. In general, transcriptomes are a powerful means of generating comprehensive genome-level data sets on complex diseases and have provided enormous insights mostly in cancer research, but also in other conditions such as muscular dystrophy, Alzheimer’s disease and dementia, rheumatologic disorders, and asthma. A systematic transcriptome-based approach has not been applied so far in the study of periodontitis. Our group has initiated a series of studies to explore differences in gene expression signatures between healthy and diseased gingival tissues, and between different forms of periodontitis and to examine the association of gene expression signatures with subgingival bacterial profiles. These studies provide additional insight into the pathobiology of the periodontal lesion. Our ultimate goal with this project is to explore the feasibility of a novel classification of periodontitis based on similarities in transcriptional profiles in affected tissues.

First, in a pilot study we established that gene expression signatures of periodontitis lesions within the same patient are reasonably similar, allowing us to define the transcriptional gingival profile of a particular patient based on the averaged profile of a pair of gingival tissue samples. In our next publication, we recruited systemically healthy non-smokers with moderate to advanced periodontitis (63 with chronic and 27 with aggressive periodontitis), each of whom contributed with ≥ 2 “diseased” interproximal papillae [with bleeding on probing (BoP), pocket depth (PD) ≥ 4 mm, and attachment loss (AL) ≥ 3 mm] and a “healthy” papilla (no BoP, PD ≤ 4 mm and AL ≤ 2 mm). RNA was extracted from these tissue samples, amplified, reverse-transcribed, labelled, and hybridized with Affymetrix U133 Plus 2.0 arrays that carry 54,675 probe sets and allow characterization of more than 47,000 transcripts including 38,500 well-characterized human genes. Differential expression was assayed in a total of 247 individual tissue samples (183 from diseased and 64 from healthy sites) using a standard mixed-effects linear model approach, with patient effects considered random with a normal distribution, and gingival tissue status considered a two-level fixed effect. We summarized the expression patterns into biologically relevant categories using gene ontology analysis. A total of 12,744 probe sets were differentially expressed between gingival health and disease after Bonferroni adjustments for multiple comparisons, i.e., at an individual p-value level of < 9.15x10−7. Of those, 5,295 were up-regulated and 7,449 down-regulated in disease when compared with health. Gene ontology analysis identified 61 differentially expressed groups that included apoptosis, antimicrobial humoural response, antigen presentation, regulation of metabolic processes, signal transduction, and angiogenesis.

The transcriptomic data revealed that the most differentially regulated chemokine between states of health and disease in the gingival tissues was granulocyte chemotactic protein 2 (GCP-2/CXCL6), a molecule functionally and structurally related to the chemokine interleukin 8 (IL-8), that is involved in neutrophil recruitment and migration. GCP-2 was previously shown to be upregulated in mucosal inflammation, e.g., in inflammatory bowel disease, but had not been shown thus far to play any role in the pathogenesis of periodontitis. In a subsequent publication, we further confirmed by real time RT-PCR, western blotting and ELISA that both GCP-2 mRNA and protein showed increased expression in pathological gingival

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tissues. Immuno-histochemistry showed that GCP-2 was primarily expressed in the gingival vascular endothelium. Increased expression of GCP-2 correlated with higher levels of ‘red’ and ‘orange’ complex periodontal species and with increased probing depth, but not with attachment loss. Based on these observations, we concluded that GCP-2 appears to act as a so-far unrecognized, functional adjunct to IL-8 in diseased gingival tissues that facilitates the migration of neutrophils into the lesion.

We subsequently examined whether the transcriptomic profiles in the gingival tissues are related to the subgingival bacterial colonization profiles in the adjacent pockets. We used transcriptomic and bacterial data from 120 patients who contributed a total of 310 interproximal gingival papillae. Plaque samples from the periodontal pockets that corresponded to these papillae were analysed using checkerboard DNA-DNA hybridizations with respect to 11 bacterial species. We noticed a wide inter-species variation in the number of differentially expressed gingival tissue genes according to subgingival bacterial levels: Using a Bonferroni correction (p < 9.15x10^-7), 9,392 probe sets were differentially associated with levels of Tannerella forsythia, 8,537 with Porphyromonas gingivalis, 6,460 with Aggregatibacter actinomycetemcomitans, 506 with Eikenella corrodens and only 8 with Actinomyces naeslundii. Cluster analysis identified commonalities and differences among tissue gene expression patterns differentially regulated according to bacterial levels. These findings suggested that the microbial content of the periodontal pocket is a determinant of gene expression in the gingival tissues and provided new insights into the differential ability of periodontal species to elicit a local host response.

Next, we sought to dissect the sequential activation of genes in the gingival tissues that parallel the induction and resolution of plaque-induced inflammation. Twenty periodontally and systemically healthy non-smoking volunteers participated in a 3-week experimental gingivitis protocol, followed by debridement and 2-week regular plaque control. We recorded clinical indices and harvested gingival tissue samples from four interproximal palatal sites in half of the participants at baseline, Day 7, 14 and 21 (‘induction phase’), and at day 21, 25, 30 and 35 in the other half (‘resolution phase’). Using the same microarray platform, we demonstrated that the differential gene regulation peaked during the third week of induction and the rest four days of resolution. Leukocyte transmigration, cell adhesion and antigen processing/presentation were the top differentially regulated pathways.

Lastly, preliminary unpublished analyses based on our transcriptomic databases reveal very limited differences in gene expression profiles between gingival lesions harvested from patients with chronic or aggressive periodontitis. Interestingly, cluster analysis based on transcriptomic profiles identified relative homogeneous patient groups that shared common phenotypic characteristics, including similar levels of extent and severity of periodontitis, comparable periodontal bacterial colonization profiles and similar serum antibody patterns, suggesting that transcriptomic profiling may indeed provide the basis for a novel, pathobiology-based classification of periodontal conditions. In parallel, our current work has been extended to include the differential expression and function of microRNA sequences (miRNAs) in the gingival tissues. miRNAs are small, non-coding, single-stranded, 21-base RNA sequences, recently shown to mediate post-transcriptional regulation of gene expression through direct repression of translation initiation and protein synthesis or induction of messenger RNA degradation. Thus, miRNAs have emerged as key regulators of gene expression and protein synthesis, affecting homeostasis, health and disease. In humans, miRNA expression has been shown to affect the pathobiology of several diseases such as cancer, inflammatory conditions including lupus, rheumatoid arthritis and psoriasis. In our current work, we have first identified predominant miRNAs in healthy or diseased gingival tissues and have validated their in silico predicted mRNA targets by identifying those genes whose expression was indeed suppressed in the tissues.

Our next step is to use laser capture technology to dissect gingival tissue cell populations (epithelium, fibroblasts, infiltrating cells) and identify those that primarily account for the expression of the predominant miRNAs. Once these cell populations are identified, we intend to pursue mechanistic experiments in which we will selectively inhibit these particular miRNAs in the relevant cell populations and study the resulting phenotypic changes.

REFERENCES


36. Miller WD. The human mouth as a focus of infection. Dental Cosmos 1891;33:689-713.


the risk of preterm low birth weight in women with periodontal disease: a pilot trial. Am Heart J 2006;151:47.


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“MI” CARIES MANAGEMENT – AN OVERVIEW
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Abstract and clinical implications
Minimum intervention dentistry, with its non-operative prevention and control of disease, underpins the basis of a patient-centred, team-based approach to managing dental caries in patients, who must take an active responsibility in maintaining their personal oral health. In patients where cavities are present causing pain, poor aesthetics and/or functional problems, restorations will need to be placed. Minimally invasive caries excavation strategies can be deployed depending on the patient’s caries risk, lesion-pulp proximity and vitality, the extent of remaining supra-gingival tooth structure and clinical factors (e.g., moisture control, access) present in each case treated. Excavation instruments, including burs/handpieces, hand excavators, chemo-mechanical agents and/or air-abrasives which limit caries removal selectively to the more superficial caries-infected dentine and partial removal of caries-affected dentine when required, help create smaller cavities with healthy enamel/dentine margins. Using adhesive restorative materials, the operator can, if handling with care, optimize the histological substrate coupled with the applied chemistry of the material so helping to form a durable peripheral seal and bond to aid retention of the restoration as well as arresting the carious process within the remaining tooth structure. Achieving a smooth tooth-restoration interface clinically to aid the co-operative, motivated patient in biofilm removal, is an essential pre-requisite to prevent further secondary caries.

Keywords: Minimum intervention dentistry; minimally invasive dentistry; MID; caries; prevention; infected dentine; affected dentine; caries excavation; adhesive materials; bio-active glass air-abrasion.

Introduction
The science, art and craft of Conservative/Operative Dentistry has been taught classically with a surgical, mechanistic approach to excising damaged tooth structure and restoring teeth previously ravaged by the carious process. This approach is guided by, and dependent upon, the properties of the restorative materials used and the tooth-cutting technologies available at the time. Specific cavity designs and materials are straightforward to teach, assess and monitor outcomes both at undergraduate level as well as remunerated for within national healthcare systems. Caries prevention and control strategies are included often as a separate defined entity, but with those limitations, highlighted above at both levels, potentially devaluing this critical aspect of non-operative care in the preservation of oral health in individuals as well as populations.

With improved understanding of caries aetiology and histopathology, its relationship with bacteria (plaque biofilm) and the dentine-pulp complex bio-reaction, coupled with advances in dental technology and materials science, it is now evident caries management must be approached biologically, the “oral physician” appreciating the aetiology and effects of the disease on the patient as well as the dental tissues themselves. Minimum Intervention Dentistry (MID) is a term ascribed to this team-based, holistic approach to caring for individual patients’ oral health needs, using a 4-phase cycle of disease identification/diagnosis, lesion prevention/disease control, restoration/repair/preservation of damaged tooth structure followed by tailored recall consultations. Active patient responsibility and endeavour is pivotal with members of the dental team providing educational advice, motivation and treatment where necessary. Patients presenting with cavitated carious lesions may require minimally invasive operative intervention, where residual caries-affected dentine may be sealed long term beneath an adhesive, aesthetic restoration, so arresting the process and permitting the tooth to heal itself biologically. It does not mean unduly early operative intervention of incipient lesions which in most cases, is unnecessary as more effective and appropriate non-invasive preventive approaches exist. It is the latter definition that will be discussed further in this paper.

“Golden triangle of MID”
A thorough understanding of the interplay between three critical factors is required to achieve clinical success when using a minimally invasive operative caries management strategy (MI OCMS):
1. the histology of the dental substrate being treated,
2. the chemistry/handling of the adhesive materials used to restore the cavity and
3. consideration of the practical operative techniques available to excavate caries minimally.

Appreciation of these factors will enable the dental practitioner to embrace the contemporary oral physician’s biological approach to operative caries management as opposed to the surgeon’s mechanistic efforts of preparing cavities of a pre-determined shape, governed primarily by the properties of the chosen restorative material as opposed

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to the actual histopathology of the disease process and retention of tooth substance.3,4

**Lesion histology**

**Enamel caries**

Long term, repeated episodes of bacterial acid demineralization instigated at a susceptible tooth surface by the residing plaque biofilm results in the growth of subsurface structural porosities, eventually enlarging, if not controlled at the earliest stages by remineralization/oral hygiene procedures, coalescing and ultimately causing cavitation. Carious enamel, with its unsupported prismatic structure, is weak under stress from compressive/shear occlusal loads or from tensile shrinkage forces from photo-cured resin-based adhesive materials.3 If carious enamel is retained at the margin of the cavity and subsequently restored, deficiencies may allow the ingress of plaque biofilm bacteria through micro-pores within the defective enamel structure - cohesive microleakage. Further complications are associated with the potential of “secondary” caries developing along defective marginal interfaces where plaque biofilm stagnates, so further compromising tooth structure.3

**Dentine caries**

Carious dentine can be subdivided into two distinct histopathological zones: (1) the peripheral caries-infected zone (close to the enamel-dentine junction (EDJ)), irreversibly damaged, necrotic and softened by long standing bacterial contamination and proteolytic denaturation of collagen and acid demineralization of the inorganic component, and (2) the deeper caries-affected zone, reversibly damaged by virtue of carious process, which has the potential to repair under the correct conditions as the collagen is not denatured.3-7 The soft, wet necrotic nature of caries-infected dentine means it is an inferior chemical and physical substrate for adhesion and seal formation, whereas the potentially repairable caries-affected dentine has been shown to exhibit adequate adhesive bonding potential, especially when surrounded by a periphery of sound dentine and enamel.9

It is important to appreciate that using the principles of minimally invasive (MI) dentistry may often lead to less carious dentine excavation overall than past caries excavation rationales based on a mechanistic approach to maximize the retention and physical properties of the restorative material within the cavity.9 MI cavities will exhibit cut surfaces with different qualities of enamel and dentine histology along the same cavity surface and these tissues will require handling in different ways in order to optimize adhesive bonding. Indeed, delineating between the layers of caries-infected and affected dentine within a lesion clinically is a rather subjective process at present. Caries-infected dentine is sticky and soft to a sharp dental explorer whereas caries-affected dentine is a little more tacky (“scratchy and sticky”) in nature and blends to the hard, scratchy consistency of deeper sound dentine.7 Propylene glycol-based indicator dyes were developed to act as a marker for that carious dentine requiring excavation, but many conflicting studies exist regarding their efficacy in this regard.10 Latest developments include more specific indicators highlighting the sulphur-containing bacterial products indicative of the increased bacterial load present in caries-infected dentine but these have yet to be validated in-vivo.

**How much dentine caries should be excavated?**

The answer to the above question is specific to the individual tooth/lesion, oral cavity, patient and the dentist as there are numerous inter-relating co-factors that have to be considered.

- **Pulp status**

  The vitality (sensibility) of the pulp must be assessed from the clinical signs and symptoms and suitable investigations (a combination of electrical, thermal and radiographic). Signs of an acute, reversible pulpitis can resolve if the carious process is arrested using a sealed restoration along with effective patient control measures, so tipping the histopathological balance from the bacteria, in favour of the healing dentine-pulp complex and its acute inflammatory mediators.5,11

- **Lesion depth**

  Lesion-pulp proximity affects the level of protection afforded to the vital pulp. Indirect pulp protection (capping) conserves caries-affected dentine close to the pulp, minimizing the risk of unnecessary pulp exposure, and a suitable material (e.g., glass ionomer cement) with anti-bacterial properties as well as bonding and sealing chemically to the remaining dentine affords a potential seal, so permitting rejuvenation of the dentine-pulp complex.5,12,13

- **Extent of viable tooth structure**

  The functional and aesthetic restorability of the tooth must be assessed. A minimally invasive approach removing only caries-infected dentine will conserve more tooth structure that can help retain and support the definitive sealed restoration. The best restorative material is natural tooth substance and smaller cavities are easier to manage for both the dentist and the patient. A reduced surface area of restoration with its margins in cleansable, accessible areas will increase the patient’s ability to regularly agitate and remove the plaque biofilm, so reducing the risk of further onset of caries.

- **Patient’s caries risk assessment**

  The MI operative caries management strategy (OCMS) relies on close collaboration with successful prevention/ control regimes instigated by the patient and the dental team. These can often be linked to the overall risk assessment of the individual patient as a motivated patient has the greater potential to be converted to low caries risk. If these are in place, MI restorations have a good chance of medium to long term success.14,15 If, however, the caries risk is high in less motivated patients, then adhesive restorations may show a reduced long-term survival rate.16

- **Clinical factors**

  Practical considerations in restoration placement must play a part in deciding whether MI is a feasible option for particular individuals. These may include:

  - suitable access for instrumentation,
  - ability to control moisture levels (ideally with rubber dam isolation),
appreciation of the final position of the cavity-restoration margin (supra- or sub-gingival)
appropriate handling of adhesive restorative materials by the dental team (e.g., ensuring that dentine bonding agent bottle lids are replaced promptly after dispensing to ensure minimal evaporation of any solvent carrier; appropriate ratios of powder:liquid mixed when required etc.).

Prospective long-term randomized controlled clinical trials have assessed the validity and efficacy of minimally invasive caries removal with or without indirect pulp capping in terms of restoration longevity and pulp status. Systematic analysis of the results has concluded that as long as there is a suitable patient-dentist team-care approach to maintaining oral health, adhesive sealed restorations placed in ultra-conservative cavity preparations can last well in the functioning oral cavity. The issue of pulp capping using a separate “lining” or “base” material has been reviewed in the literature. In modern day MI OCMS, using adhesive restorative materials, the clinical need of a separate layer of pulp protection has been shown to be unnecessary (apart from the scenario where the pulp may be protected with a thin layer of GIC beneath a large amalgam restoration with close pulp proximity).

Materials science
A thorough understanding of the clinical relevance of contemporary adhesive dental materials science is required to implement successfully the MI OCMS. The physico-chemical interaction of the relevant dental substrate retained at the cavity surface with the adhesive material must be enhanced by the operator to achieve medium to long term successful outcomes. The restoration seal is reliant upon the integrity and morphology of mineral (calcium ions, micro-mechanical undercuts, supported prismatic structure in enamel) and of the collagen nano-matrix/tubular structure in dentine (hybrid zone). The clinical relevance of the individual steps in adhesive bonding (acid etch, primer and bond) have been discussed in an alternative publication. Issues regarding chemical or micro-/nano-mechanical bond mechanisms revolve around the longevity of the seal achieved which is affected adversely by physico-chemical hydrolysis and potential enzymatic degradation by indigenous, acid-activated dentine matrix metallo-proteinases (MMPs). Latest in vitro research investigates the potential use of anti-MMPs to block the activity of these indigenous MMPs, so resisting the collagen degradation in the carious process thus increasing the longevity of the peripheral seal.

Minimally invasive operative techniques
As can be seen from Table 1, there are several clinical technologies available for cutting teeth and removing caries. Most are not self-selective for caries-infected dentine and involve active discriminatory action from the operator when considering MI OCMS. Dentists are highly trained at using dental burs in slow-speed or air-turbine handpieces as well as hand excavators, and although not self-discriminatory in favour of caries-infected dentine, a good operator can still practise MI OCMS effectively using these instruments as illustrated in figures 1-6.

Ultrasound and sonic instrumentation use the principle of probe tip oscillation and micro-cavitation to chip away hard dental tissues. Lasers transfer high energy into the tooth through water causing photo-ablation of hard tissues. Great control is required by the operator in order to harness this energy effectively and the effects on the remaining enamel, dentine and pulp continue to be investigated in terms of residual strength and bonding capabilities. A recent systematic review concluded that laser caries removal is not yet a viable general dental practice option for effective caries excavation. Enzymatic (including hypochlorite-, pepsin- and papain-based) solutions have and are being investigated to help further breakdown of collagen in already softened carious dentine in the hope of developing a more self-limiting technique of removing caries-infected dentine alone. Other chemical methods include photo-activated disinfection (PAD) where tolonium chloride is introduced into the cavity, absorbed by the residual bacteria in the cavity walls and then activated using light of a specific wavelength causing cell lysis and death and ozone (gaseous ozone infused into early

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Dental substrate affected</th>
<th>Tooth-cutting technology</th>
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</thead>
<tbody>
<tr>
<td>Mechanical, rotary</td>
<td>Sound or carious enamel and dentine</td>
<td>SS, CS, diamond, TC and plastic burs*</td>
</tr>
<tr>
<td>Mechanical, non-rotary</td>
<td>Sound or carious enamel and dentine</td>
<td>Hand instruments (excavators, chisels), air-abrasion, air-polishing,** ultrasonics, sono-abrasion</td>
</tr>
<tr>
<td>Chemo-mechanical</td>
<td>Carious dentine</td>
<td>Caridex† Carisolv† gel (amino acid-based), Papacarie† gel (papain-based), pepsin-based solutions/gels</td>
</tr>
<tr>
<td>Photo-ablation</td>
<td>Sound or carious enamel and dentine</td>
<td>Lasers</td>
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<tr>
<td>Others</td>
<td>bacteria</td>
<td>Photo-active disinfection (PAD), ozone</td>
</tr>
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† MediTeam Dental AB, Göteborgsvägen 74, SE-433 63 Sävedalen, Sweden.
‡ Formula & Aqao, Sao Paulo SP, Brazil.
lesions causing bacterial death). These technologies currently suffer from a paucity of clinical evidence to validate them for routine clinical use.26

Air-abrasion

Air-abrasion is a 67 year-old dental operative technique used for the removal of enamel and dentine during cavity preparation.27,28 Air-abrasion units are capable of minimally invasive tooth preparation using 27μm aluminium oxide (α-alumina).24,29,30 However, dentists are used to the parameters of tactile feedback and an appreciation of finite cutting depth when using rotary tooth-cutting techniques, both of which the end-cutting alumina air-abrasive jet lacks. This makes the use of alumina air-abrasion highly operator-sensitive and requires careful education of clinicians to realize its potential for minimally invasive preparation and the prevention of cavity over-preparation.31 Studies have been published which characterize the efficacy of alumina air-abrasion and its cutting characteristics on both sound and carious enamel and dentine and collectively these show the technique to be efficient if specific operating parameters (e.g., air pressure, powder flow rate and reservoir volume, nozzle diameter and working distance) are regulated judiciously by the operator.32-35 Clinical studies have indicated good patient acceptance of the technology, in terms of the lack of vibration, no heat generation and the reduced need for local analgesia.36,37

An important clinical use of air-abrasion is obtaining suitable enamel access in minimally invasive preventive resin restorations. Meticulous cleaning of the occlusal surface prior to visual examination using a rotary brush or air-polishing is essential for caries detection,38 followed by the use of a small head dental bur or alumina air-abrasion for the removal of the carious, demineralized enamel. The microscopically roughened enamel surface created by alumina air-abrasion, is devoid of weakened prisms and is therefore better adapted for adhesive bonding. However, lack of substrate selectivity and no self-limiting operator feedback when using these operative technologies can result in cavity over-preparation. Innovation in abrasive powder development has resulted in the production of a commercially available bio-active glass powder capable of removing extrinsic dental stain, desensitizing exposed dentine and exhibiting an intrinsic selectivity towards carious, demineralized enamel and resin composite restorations.39-41 Research is ongoing into development of a self-selective air-abrasive powder for caries-infected dentine.
Chemo-mechanical caries removal

After the development and subsequent demise of the Caridex™ system in the 1970s, chemo-mechanical caries removal techniques were resurgent with the commercialization of Carisolv™ gel in the late 1990s. This hypochlorite/amino acid-based gel system assists the MI OCMS with special non-cutting hand instruments offering greater tactile sensitivity to the operator, so permitting selective infected and affected dentine removal. Studies indicated good patient acceptance of this technique. An example of MI caries excavation using Carisolv™ gel is given in figures 7-10. Developments in chemo-mechanical technology include the laboratory development of pepsin-based gels using specially designed nylon brushes and plastic disposable hand instruments to abrade the softened infected dentine as well as papain-based systems (see Table 1).

Conclusions

The evidence for the minimally invasive operative caries removal strategy in appropriately selected patients exists. The removal of grossly softened caries-infected dentine is recommended in most situations (except perhaps in a deep lesion overlying the pulp where its vitality assessment leans towards an acute inflammatory response and an adequate clinical seal can be achieved at the periphery of the cavity). Peripheral caries removal should extend to sound dentine where inadequate quantity and quality of enamel remains. It is at this tooth-restoration interface that the peripheral seal is critical to prevent further histopathological progress of the disease. The seal can be achieved using adhesive dental biomaterials which penetrate micro-/nano-mechanically into the mineral and collagenous components of enamel and dentine respectively. With judicious use of contemporary adhesives with their bactericidal/static properties, there is little need clinically for a separate lining or base layer to protect the pulp. A thorough understanding of the chemistry of the materials and how they relate to the histology of the tissues is necessary to ensure the best prognosis of a sealed, adhesive restoration.

Acknowledgments

Figures 1-6 have been reproduced with publisher’s permission from Chapter 9 – A large carious lesion, from Odell EW ed:Clinical Problem Solving in Dentistry – 3rd Edition; Churchill Livingstone, Elsevier, 2010.

References


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THE MUTILATED DENTITION – MANAGEMENT OF THE DEBILITATED DENTITION

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Abstract

An interdisciplinary treatment plan is often required to allow restoration of function and aesthetics in the “mutilated dentition”. Loss of teeth is associated with social and psychological impacts for the patient, however most often aesthetic requirements and financial constraints predominate in the treatment decision making. Historically, unfavourable occlusal contacts have been viewed as predisposing factors in the development of temporo-mandibular joint dysfunction (TMD). This linkage has now been refuted by many authors and it is understood that occlusion may be a co-factor only in TMD. In determining the “ideal occlusion” to restore the mutilated dentition consideration must be given to an occlusion that is physiologic for the patient, and the simplest scheme to construct from a clinical and technical viewpoint. In successfully restoring function of the teeth an aesthetic outcome can be achieved. The planning and treatment for three patients is reviewed to highlight interdisciplinary patient care from a prosthodontics perspective.

Patients present to the prosthodontist for treatment for a variety of reasons often some years after teeth are removed and after the first signs of occlusal breakdown are evident to the dentist. This may be when the ramifications of occlusal change start to impact on aesthetics, function or comfort and the treatment options have become so limited, that the dentist and the patient seek a re-evaluation of the arch and the options available.

With all the good intentions in the world the general dentist may have been helping to maintain an ailing and failing dentition while attempting to encourage the patient to embrace the broader scenario of rehabilitation. The management of the patient may require an interdisciplinary approach to allow careful planning of treatment and to provide a stable and long term outcome. The prosthodontist, although often acting as treatment co-coordinator, is unable to progress with definitive occlusal management and tooth replacement until preparatory stabilization and rehabilitation is completed by the Orthodontist and Oral and Maxillofacial surgeon and although there is not the opportunity in this presentation to cover liaison with all potential team members, this discussion does not undervalue the role of endodontists, periodontists and paediatric dentists in coordinated care for these patients.

Buschang1 reviewed studies of masticatory function and commented that in subjects with “mutilated dentitions” and to a slightly lesser degree, with a malocclusion, the masticatory performance and masticatory ability is reduced. Masticatory performance deteriorates with reduction in tooth number and surface area of contact and can be linked to quality of life.

Loss of teeth is associated with social and psychological impacts. However site of tooth loss is important in determining treatment undertaken. Aesthetics is a more important factor to patients in this decision than function.2 Teofilo and Leles concluded that the prosthodontic treatment needs are often determined by both clinical and financial factors.3 Kayser4 following a review of the literature concluded that 20 teeth (anterior and premolar) were sufficient to satisfy most of the criteria for an adequate level of oral function however this does not satisfy the aesthetic and functional requirements of all patients.

The dental profession has historically viewed “malocclusion” as a predisposing factor for Temporo-mandibular Dysfunction (TMD). Ramfjord in his text “Bruxism, an electromyographic study” helped to stimulate the suggestion that TMD was due to “unfavourable dynamic occlusal contacts”.5,6 Interferences were said to lead to parafunction, muscle pain, joint overload and dysfunction.7 McNama, Seligman and Okeson8 however, found only weak support for an occlusal aetiology in TMD as did Okeson,9 and Pullinger and Seligman10 suggested that “Occlusal factors may be cofactors… but their role should not be overstated.” De Boever, Carlsson and Klineberg7 concluded that, loss of posterior tooth support did not seem to be a significant aetiologic factor in TMD and prosthetic treatment to replace missing teeth is not appropriate for initial management of TMD patients nor is replacement of lost teeth to prevent TMD advocated. Although the relationship between TMD and occlusion remains somewhat contentious there is no-longer support for treatment aimed at reducing muscle hyperactivity by using occlusal adjustment, irreversible splint therapy, orthodontics or surgery with the expectation of TMD “cure”.

Hypodontia, trauma, caries and periodontal disease are common causes of missing teeth and tooth loss. Unrestored tooth loss, loss of inter- and intra-arch contacts between remaining teeth and loss of the anatomical contours of cusps following placement of large restorations can result in tipping, tilting and rotation of teeth, migration and over-eruption creating the “mutilated dentition”. These occlusal changes often preclude restoration until ideal space is recreated and arch levelling has been achieved. The request by the patient for a single restoration often highlights skeletal problems which have remained unmanaged while the natural dentition remained functional. Unless addressed in planning, these factors often prevent further prosthodontic care.

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**What constitutes an ideal occlusion for restoration of function and aesthetics?**

A narrow definition can be limited to describing occlusion as the arrangement of maxillary and mandibular teeth, while in a broader context occlusion can embrace the dynamic and functional relation between all the components of the masticatory system. Most of the controversy that has existed in the philosophies of occlusion over the years has revolved around which are the key components of occlusion that should be used in treatment when the dentition is severely debilitated and the dentist is unable to conform to the patient’s existing occlusal scheme. During this debate, prosthodontics has come to be recognized as a biologically and not solely mechanistically based discipline. There is now acceptance that there are significant psychosocial, functional and aesthetic implications for each patient in treatment and that an informed patient-centred decision-making process and partnerships in care should be employed. The clinician should avoid changing occlusion in healthy functioning patients. Key features of a treatment occlusion are: a mutual protection occlusion when canine support is present and adequate, an occlusion that is physiologic for the patient, and the simplest scheme to construct from a clinical and technical view point.

The ability to control active disease is a key component to the successful outcome of all prosthodontic therapy and ongoing liaison with the patient’s general dentist is an essential part of disease control and maintenance especially through the phases of pre-surgical orthodontics and surgery.

**Case reports**

To highlight some of the planning considerations required in the management of the “mutilated dentition”, three patients are briefly reviewed.

**Patient one** presented for treatment aged 43 years following many years with unrestored hypodontia. She had raised and educated three children who were settled in stable employment and she wished to address her significant concerns about the appearance of “her smile”. Function was of importance but a secondary concern and she was healthy and financially able to progress with treatment. There had been space loss in the arches and disruption of the occlusal plane. Wear was present on many remaining anterior teeth and tooth morphology varied from normal in response to genetic variation. Her care was co-ordinated with the orthodontist to optimize space distribution, level the arches and provide reduction in the overbite. Surgical management involved placement of implants into selected sites to support crowns and selected sites were restored with conventional bridges. Treatment progressed over a three year period.

**Patient two** was a 60 year old male nearing retirement who had a severe Class III skeletal and dental relationship, multiple missing teeth and a heavily restored remaining dentition. He presented on referral from his dentist of many years realizing that both the dentist and he had exhausted their avenues of stabilizing his challenging dentition and seeking options to retain his remaining teeth and restore function. Coordinated care involved pre-surgical orthodontics to decompensate the arches in preparation for orthognathic surgery. Restoration was achieved in conjunction with the placement of a distal implant in the right quadrant of the maxilla to assist in support of a removable cobalt chrome partial denture and a removable cobalt chrome base partial denture was constructed to restore missing teeth in the mandible.

**Patient three** was a 58 year old male with a heavily restored and worn dentition seeking treatment options to replace a single missing premolar in the right quadrant of his mandible. He had been a regular and conscientious dental attendee for many years. Examination indicated that restoration was not possible without arch alignment and recreation of space because of occlusal change over time. Patient management involved orthodontic arch alignment and recreation of premolar space in the right quadrant of the mandible and the surgical placement of two single implants in the left and right mandibular first premolar sites. An opposing molar tooth was crowned to complete this first phase of care.

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THE MUTILATED DENTITION – ORTHODONTIC CONSIDERATIONS

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Introduction

A mutilated dentition is one in which teeth have been extracted, traumatically lost, extensively restored or extensively worn. Patients have become more dentally aware over the years and have been led by both television and the Internet to expect instant makeovers and perfect smiles. In the USA there was an 800% increase in adults receiving orthodontic treatment between 1970 and 2003.1 Despite this, it still comes as a surprise to many adult patients that braces are effective and widely used as part of the rehabilitation process.

Diagnosis and treatment planning in such cases is complex and frequently takes longer than the actual treatment. In saying that, orthodontic treatment is usually the longest part of any interdisciplinary treatment and requires a very committed patient. When treating a mutilated dentition it is important to recognize current and potential periodontal problems, to diagnose temporomandibular joint dysfunction, to distinguish between orthodontic camouflage and skeletal management and to work cooperatively with the Prosthodontist, Periodontist, Oral and Maxillofacial Surgeon, and sometimes a Psychologist.

Goals

Determining what the patient perceives as their problem requires careful listening and questioning. There are many comprehensive proforma questionnaires available that can be used as a guide.2 After determining what the patient sees as their problem, a lot of education may be required to help them understand the complexity. A patient’s expectations must be clearly established. It is not always possible to meet all expectations, or the treatment needed to achieve these expectations may well be beyond their means or exceed acceptable risks. Any planned compromises need to be well understood.

Orthodontists have long been trained to treat to ‘the ideal’ occlusion. Moreover, research now emphasises the importance of the entire face. Since 1972, Andrews’ six keys to normal occlusion3 have been the gold standard. ‘Divine proportions’4 have been quantified and the ‘ideal smile’5 has been defined. However in the cases being discussed in this paper, the pre-existing conditions frequently interfere with achievement of the ideal in any other than patients with class I skeletal relationships, and treatment has to be customized to the individual patient. Profit6 has clearly defined the envelopes of discrepancy to give guidance as to the extent of tooth movement that can be achieved without surgery.

General goals of treatment are to provide good aesthetics, function and stability.

Specific orthodontic goals of treatment can include any or all of the following:

- Root parallelism of abutment teeth, redistribution of spaces between teeth, redistribution of occlusal and incisal forces, acceptable occlusal plane and the potential for incisal guidance at satisfactory vertical dimension, lip competency and support, improved crown/root ratios, improvement of mucogingival and osseous defects, aesthetics and function.

Diagnosis

As with any treatment, adequate data must be collected and analysed, a problem list and tentative treatment plan(s) formulated, other specialists consulted, the treatment sequence and the final plan(s) decided and patient agreement reached. The challenging and difficult cases are those with an underlying skeletal discrepancy. There are many cephalogram analyses available to determine where the exact discrepancies are but “…a descriptive analysis should consist only of those measurements that are needed to illuminate the clinically significant idiosyncrasies of the patient at hand.”7 Trial set ups and predictive tracings are very helpful both for planning and for showing the patient. One must be careful with morphed computer images as they can give the patient false hope.

Orthodontic treatment can readily exacerbate periodontal disease. Therefore periodontal awareness by both the treating orthodontist and the patient are vitally important and orthodontic treatment should not be started until the periodontal condition is stable, and the patient is cognisant of his/her status as well as the required periodontal treatment and maintenance.8 Similarly, TMD must be understood in light of its prevalence and relationship to the anticipated treatment.9

Treatment

It helps to follow a simple order. Active disease (periodontal disease and decay) must first be arrested and controlled, periodontal defects corrected, relevant structural malrelationships should be corrected (orthodontics and orthognathic surgery), restorative and reconstructive dentistry completed and optimal oral health maintained. For the orthodontist, the first decision is whether or not the skeletal problem requires surgical intervention to create a stable correction. The risks of orthognathic surgery should not be underestimated, but weighed carefully against the benefits.

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Accurate and predictable tooth positioning in most adults requires fixed appliances. The mechanotherapy is frequently complex because of reduced anchorage and less than optimal crown:root ratios. Temporary anchorage devices have simplified mechanics hugely, but there must be adequate bone before their use. Disarticulation by means of a bite plane is frequently necessary to prevent breakages and facilitate tooth movement. Sectional mechanics are often required because of a lack of teeth. Progress records are a useful adjunct during treatment, especially centric relation study models and a panoramic radiograph. It is essential to have the other specialists confirm the orthodontic endpoint before removal of the fixed appliances.

The extent of treatment undertaken will vary hugely depending on what the patient wants and can afford. In NZ there is virtually no third party financial contribution to dental treatment, and certainly none for orthodontic treatment or orthognathic surgery. Costs are a major issue for patients and are frequently a determining factor in the chosen treatment.

Retention / Maintenance

The retention requirements are often a forgotten part of the treatment plan. They are however vitally important, should have been discussed initially and recorded in the plan which had been offered for consent. Retention is important both to prevent relapse and to minimize normal ageing changes. Many authors have studied continued changes in the teeth, face and skeleton throughout life.

In an ideal occlusion, retention is routine. Without an ideal occlusion, retention may be more difficult if for example, there is a resultant overjet. It may not be possible to provide canine guidance or to stop the lower anterior segment from over-erupting without fixed palatal/lingual retainers. These however are limited by the availability of enamel and the patient’s ability to keep them clean. Lifelong wear of a removable retainer may be necessary and can often double as a bite plane to eliminate muscle dysfunction.

References


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CARIES MANAGEMENT: IS THE “SEAL THE DEAL”? 
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Abstract

A barrier to providing sealants has been the concern about inadvertently sealing over caries, but today the management of dental caries has evolved from the domain of techniques based on complete removal of carious tissue prior to tooth restoration or sealant, to include a range of techniques where some, or even all caries is sealed in beneath restorations, sealants or infiltrants. There is a significant, and growing, evidence base supporting these techniques as caries management strategies for children and adolescents. These techniques are not new but build on earlier concepts and research. These concepts offer a real way forward and departure from invasive restorative treatments. Some issues, however, are not completely resolved, and future solutions may herald a new era of restorative dentistry, perhaps with the concept of filling with no drilling since the “seal is the deal”. These techniques and issues will be considered in the New Zealand context.

Overall, the oral health of New Zealanders has improved considerably over the past 20-30 years. Dental decay remains the most prevalent chronic (irreversible) disease in New Zealand, and there are still inequalities in oral health in New Zealand.1 Approximately 50% of New Zealand five-year-olds have had caries, and substantial differences in caries experience by ethnicity, region and access to water fluoridation have been observed.2 Free, publicly-funded oral health care is available for all New Zealand children and adolescents, with the aim of them having equitable access to oral health care and good oral health status. Even so, the most recent national study has revealed inequalities3 while a study reporting on adolescents’ changes in caries experience has also shown substantial caries experience occurring between ages 13 and 16 (mean net caries increment dominated by pit-and- fissure surfaces).3 This supports findings from industrialized countries which show the prevalence of dental caries having declined,4,5 but that among school-aged children the majority of the dental caries increment has been detected on pit and fissure surfaces of first and second permanent molars.6

Many practitioners when managing caries in New Zealand children and adolescents are still concerned about inadvertently sealing over caries, whether this is with traditional operative procedures, the placement of fissure sealants or the sealing of approximal lesions. Randomized Clinical Trials (RCT) have given us growing evidence with regard to ‘complete’ versus ‘incomplete’ caries removal.7-10 For those of us teaching operative dentistry there is clear evidence that it is not deleterious to leave infected dentine and this approach is preferable.11 The challenge lies in how ‘clean’ must a cavity be before restoration? The growing evidence base supports caries management strategies from the indirect pulp cap through stepwise caries removal and partial caries removal.11 There is now evidence to support techniques involving no caries removal in the primary dentition prior to the placement of a stainless steel crown.12 The Hall Technique is a method for managing carious primary molars with decay sealed under pre-formed metal crowns without any caries removal, tooth preparation or local anaesthesia.13 In New Zealand, there are little data on outcomes of restorative care in children which is largely provided in State-funded oral health services. Preformed stainless steel crowns (SSCs) have been recommended as the treatment of choice for primary molar caries involving two or more surfaces and have been shown to be more durable than all other restorative materials in children.14,15 However, they have not been widely used in New Zealand except by specialists in paediatric dentistry. The Hall Technique presents a fundamental shift in the New Zealand primary care setting and although shown to be a predictable option in a Scottish study it requires more evidence from different populations and settings.12

While sealants were introduced in the 1960s to protect pits and fissures on occlusal surfaces it still appears that the indication of when to use them varies considerably among dental practitioners, even in paediatric dentistry teaching departments internationally.16 Sealants have been recognized as an effective approach to preventing pit and fissure caries but many questions still remain.17 From a public health care perspective there appears to be insufficient information on how effective sealants are at different caries levels.18 However, the greatest controversy for many is the concern around the ‘sealing’ of occlusal pits and fissures that exhibit carious enamel and dentine. A recent systematic review supports the findings of sealing carious occlusal pit and fissure lesions to reduce the probability of lesion progression.19 The evidence for sealing non-cavitated versus cavitated lesions was found to be stronger, although this may be accounted for by 90% of the lesions in the review being non-cavitated.19 These findings should lessen the reluctance of practitioners providing sealants, especially for non-cavitated lesions in the early carious stages but also where caries status is uncertain. Utilizing sealants not only for prevention but also as caries management tools should be included in teaching curricula.

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Research is underway with clinical trials in the USA and Europe to investigate sealants for cavitated occlusal surfaces. As dental caries also affects the smooth surfaces of teeth, data from industrialized countries indicate that the prevalence of deciduous smooth-surface caries in children is relatively high (for example, 25% and 52% of Danish 7 and 9-year-olds respectively) with similar patterns seen in other countries. Accordingly, operative treatment needs are substantial, and New Zealand is no exception.

Invasive treatment options for proximal caries involve the destruction of considerable amounts of sound tissue in order to gain access to the lesions. Moreover, restorations have only a limited lifetime and teeth frequently need to be restored repeatedly. Thus, the first operative intervention should be postponed as long as possible and for early proximal caries, it is often particularly difficult to determine the optimal treatment, with the associated risk of under- or over-treatment. Although fissure sealing is an effective method to prevent caries formation and lesion progression in occlusal carious surfaces, it has not been used for smooth-surface lesions with any great success. The sealing of smooth surfaces and use of sealants was described in the 1970s and was demonstrated in in vitro artificial lesions but not confirmed for natural lesions. Clinical studies show promise, with reduction in lesion progression, however close to 50% of the sealed surfaces in the deciduous dentition sealed after 2.5 years showed evidence of progression. Approximal sealing with a ‘patch’ takes the sealing concept but uses a pre-cured adhesive patch for protection of caries lesions. A 2-year study with this showed no clear benefit over the non-operative approach of flossing.

An alternative approach for arresting these lesions is caries infiltration. In contrast to conventional sealing, where a resin coat is applied to the enamel surface, caries infiltration aims to penetrate the porous smooth-surface lesion with resin in order to slow it down or even arrest its progression. The mechanism of action of resin infiltrates in delaying lesion progress is still not fully understood at the ultra-structural level, although recent progress in infiltrant development has resulted in a low-viscosity light-cured resin. This has been shown to be efficacious in preventing further progression in bovine enamel artificial caries lesions. The initial use of phosphoric acid to etch the enamel did not allow resin infiltration because of insufficent erosion of the surface layer, but recent work using 15% hydrochloric acid on exfoliated deciduous teeth was successful. A pilot study in Greenland (a population with high caries experience) reported that the clinical and radiographic therapeutic effect in deciduous molars (over fluoride varnish alone) was significant, with a greater than 35% reduction in the number of lesions progressing. This has also been shown in young German adults where infiltration of early carious approximal lesions was found to be efficacious in reducing lesion progression. Further evidence of the safety and efficacy of infiltration of approximal smooth-surface lesions is required.

If these new techniques are shown to be effective in reducing approximal lesion progression certain issues would have to be overcome. Particularly the cost in terms of time and materials would need to be acceptable since the time involved for the sealant and/or infiltration technique is similar to those for conventional procedures. Further research is required but Interventional studies with caries are expensive as a result of the chronicity of the disease and the time for lesion progression. A more concerted effort to clinically evaluate these promising new approaches is needed in populations that are at most risk. For New Zealand these studies are required in the community clinics where child and adolescent oral health is managed by dental therapists. If successful, these new approaches may become an effective population health strategy for managing caries and improving oral health outcomes in childhood, adolescence and into adulthood. The future solution may be a combination of approaches where we see a further shift from the classic operative approach whereby sealing becomes a routine procedure. This may herald a new era of dentistry, perhaps since the ‘seal is the deal’.

References

MOLAR INCISOR HYPOMINERALIZATION

Erin Mahoney, BDS, MDSc, PhD, FRACDS, MRACDS (Paeds)*

Abstract

Molar Incisor Hypomineralization (MIH) is a common condition in New Zealand children and children around the world and can result in a significant defect in first permanent molars. This condition inevitably leads to a large amount of dental treatment for young children and may even result in the removal of their first permanent molars. This lecture will outline the understanding of the physical properties of these teeth and provide an evidence based review of the treatment options for affected teeth.

Molar incisor hypomineralization (MIH) is a common condition in New Zealand children. A recent NZ study has found that approximately 15% of Wellington children have this condition.\(^1\) MIH is defined as a hypomineralization of systemic origin of one to four permanent first molars frequently associate with affected incisors.\(^2\) The defects usually appear as demarcated opacities or after eruption breakdown can occur resulting in a defect which mimics a hypoplastic defect (Fig. 1).

The treatment options for molars affected with MIH are different from a carious lesion as the general outline of the hypomineralized lesion does not follow the classic caries pattern. In addition, due to the inherent weakness of the affected enamel and the lack of classical etching patterns\(^3\) different restorative materials often need to be chosen. Although the choices made about restorative treatment will depend on the extent of the hypomineralized lesion, the cooperation level of the child affected, the tooth sensitivity and the wishes of the child, the choices of materials can be summarized in Table 1. The table indicates that removal of affected teeth is often required and can be a successful treatment if the timing of the extraction is accurate. When contemplating extraction, the overall state of the dentition, the age of the child and orthodontic considerations should be taken into account. If the clinician is uncomfortable with suggesting this option then referral for consultation from an orthodontic or paediatric dental colleague is warranted.

After the treatment options have been discussed and decided upon with a child and its parents, the biggest issues for the clinician when faced with dealing with affected teeth is figuring out how to get a young child to cope, often with extensive treatment. Jälevik and Klingberg showed that children with severe MIH had nearly ten times more dental treatment than a control group.\(^4\) The affected children had more dental fear and anxiety than the controls and this may have been because much of the treatment on these affected teeth was done without local anaesthetic. Teeth with MIH are more sensitive and with patients with increased anxiety, dental treatment is difficult for children. Some clinical tips to help with treating these teeth are included in Table 2.

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\( ^*\) Presented at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand, 31 March - 4 April 2012

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Table 1. Summary of restorative material choice for molars with MIH

<table>
<thead>
<tr>
<th>Material choice</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIC</td>
<td>Good as fissure sealants or as temporary restoration</td>
</tr>
<tr>
<td></td>
<td>No studies on effectiveness as a long term restoration</td>
</tr>
<tr>
<td>Composite resin</td>
<td>Appropriate for replacement of small hypominerlized defects in non load bearing areas</td>
</tr>
<tr>
<td></td>
<td>Helpful to have some ‘unaffected’ enamel for bonding</td>
</tr>
<tr>
<td>Amalgam</td>
<td>Not indicated in most situations</td>
</tr>
<tr>
<td>Stainless steel crown</td>
<td>Excellent long term restoration for moderate to extensive lesions</td>
</tr>
<tr>
<td></td>
<td>Will need replacement in teenage years</td>
</tr>
<tr>
<td>Cast restorations</td>
<td>Appropriate for moderate lesions with cuspal involvement in older children</td>
</tr>
<tr>
<td>Extraction</td>
<td>Appropriate in many cases with appropriate work up- usually between the ages of 8 and 10 years. Orthodontic considerations must be taken into account.</td>
</tr>
</tbody>
</table>

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Fig. 1. – Molar incisor hypomineralization of a) first permanent molar and b) incisors.
Incisor teeth are often affected with MIH (Fig. 1). Post eruptive breakdown is uncommon but does occur. Opacities are usually full thickness and although bleaching of these defects has been proposed, in general when a child requests that the opacities be restored for aesthetic reasons, the lesion must be removed down to dentine. Some of the more modern resin composites with opaquers may be used with varying success if you do not wish to remove the entire opacity.

Overall the treatment of teeth with MIH is complex but managing the patient as well as the teeth appropriately will minimize the distress and maximize the clinical outcome for the patient.

### References

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<table>
<thead>
<tr>
<th><strong>Tip</strong></th>
<th><strong>Reasoning</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber dam</td>
<td>Rubber dam as this will isolate the rest of the mouth and other affected teeth that may be sensitive to the air and water used to restore the isolated tooth.</td>
</tr>
<tr>
<td>Orthodontic Separators</td>
<td>Prior to placement of stainless steel crown, placement of orthodontic separator to limit the amount of tissue removal proximally</td>
</tr>
<tr>
<td>Radiographs</td>
<td>Panoramic radiographs are important if contemplating extraction. Radiographs often underestimate the extent of the hypomineralized enamel.</td>
</tr>
<tr>
<td>Adequate Local Anaesthetic</td>
<td>Affected teeth are often sensitive and require adequate local anaesthetic. The use of Articaine may be useful although no studies have been done on the different local anaesthetics available</td>
</tr>
<tr>
<td>Definitive treatment</td>
<td>Placement of multiple temporaries such as the use of GIC can be used if very small hypomineralized lesion but if extensive treatment needed, carrying out definitive treatment as soon as possible will minimise sensitivity and number of appointments for child. Children and their parents do not like having multiple appointments for a single tooth!</td>
</tr>
<tr>
<td>Sedation: Nitrous oxide/oral etc…</td>
<td>Although will not reduce pain and adequate LA is needed, sedation can reduce anxiety significantly in this group of children.</td>
</tr>
<tr>
<td>General Anaesthesia</td>
<td>Young children who require extensive treatment such as multiple extractions or stainless steel crowns and are unable to cope can have this treatment under GA.</td>
</tr>
</tbody>
</table>
ADVANCES IN GASTROENTEROLOGY - OPPORTUNITIES AND CHALLENGES FOR THE DENTAL PRACTITIONER.

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Abstract

As the oral cavity marks the beginning of the gastrointestinal tract (GIT), it is not surprising that it frequently mirrors disease that occurs lower in the GIT. Increasingly, clinical signs in the oral cavity are recognized as future predictors and prognostic indicators of GIT and, indeed, other systemic disease. This paper discusses recent advances in the overlap area of Oral Medicine and Gastroenterology and the significant role of the dental practitioner in the management of these patients.

The oral cavity is the uppermost and most easily visualized part of the gastrointestinal tract. Some systemic diseases manifest in the mouth. Gastrointestinal diseases, in particular, fall into this category and oral lesions may be either a primary or secondary marker of gastrointestinal disease.

Gastrointestinal diseases may give rise to nutritional deficiencies as a result of malabsorption or chronic bleeding. Orofacial disease commonly occurs as a result of deficiencies of Iron, Vitamin B12 and Folic acid. Gastrointestinal Diseases that are associated with primary oral lesions include Crohn’s Disease(CD), Coeliac Disease and Ulcerative Colitis. Liver disease is classified as a Gastrointestinal Disease and Hepatitis C, for example, is associated with oral complications.

This paper discusses the oral aspects of these gastrointestinal diseases, but concentrates particularly on Oral Crohn’s Disease (OCD) in terms of oral manifestations, oral complications of management and recent research in this field.

Crohn’s Disease (CD) is known to affect any part of the gastrointestinal tract from the mouth to the anus. Dudeny, in 1969, first reported a case of a 36 year old male with intestinal CD, who presented with a lesion of the buccal mucosa that macroscopically demonstrated a “cobblestone” appearance and was histologically identical to intestinal CD. Since then, the connection between specific oral lesions and CD has been widely reported. There is, however, considerable debate on the clinical significance of such oral lesions in CD.

The typical clinical of Oral Crohn’s Disease (OCD) is one of a spectrum of orofacial signs, of which some or all may be present at any one time. These include recurrent persistent lip swelling, oral ulceration, particularly in the buccal sulcus (the lower “folds” of the inner cheek), a “full-width” gingivitis, which is a widespread erythema of the gums, cobblestoning of the buccal mucosa (inside of the cheek), oral mucosal tags, cracks at the corners of the mouth, known as angular cheilitis and characteristic swelling of the submandibular salivary duct orifices (staghorning). The palate is rarely involved but the tongue can be fissured (lingua plicata) and, if associated with recurring facial palsy and swelling of lips, has been described as Melkersson-Rosenthal syndrome.

The condition termed Orofacial Granulomatosis (OFG) was first described by Wiesenfeld in 1985. These orofacial appearances, with histological evidence of oral granulomas, may present specifically in the absence of any recognized systemic condition. However, many patients with OFG, when investigated, have been found onto have subclinical intestinal CD, whilst in others, OFG may precede the development of intestinal CD.

The reported prevalence of disease specific oral lesions in CD varies from 0.5% to 48%. The presence of oral lesions presents the gastroenterologist with two issues, namely, the management of troublesome oral lesions in a patient with intestinal disease, and, secondly, how to interpret the prognostic significance of oral lesions in a patient with Inflammatory Bowel Disease (IBD). Whereas this second point is less clear, Harty reported a 41.7% prevalence of OCD in a prospective study of children with CD. There was a statistically significant association of OCD with perianal disease compared with those children who had CD, but did not manifest OCD. Additionally, regardless of whether the child continued to suffer from OCD or OCD occurred only at the time of initial presentation of CD, those children in whom OCD was present at the time of diagnosis of CD suffered a much more severe disease burden during the follow up period. This small study proposed that the presence of OCD in children at the time of diagnosis of CD is a marker for a more severe CD phenotype. The authors emphasized the need to incorporate oral examination into the diagnostic protocol for CD, in view of the possible prognostic significance of OCD.

The OFG group presents different diagnostic and management challenges for the Dental Surgeon. OFG patients present with orofacial lesions alone. OFG can precede the onset of CD by up to 10 years. Plauth reported that oral signs preceded CD in 60% of patients in a case series of 79 patients. It is difficult to state what proportion of Disease specific oral lesions…

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of OFG cases progress to intestinal CD, as much of the literature on the topic comprises of case reports. A recent study by Campbell\textsuperscript{12} estimated the risk of progression to CD in a relatively large series of cases of OFG was 20\% over a median follow up of 5 years, which concurs with the earlier report by Field\textsuperscript{13} on the 10 year follow-up of small cohort of OFG patients. Campbell\textsuperscript{12} also reported that lesions of the buccal sulcus were predictive of likely future intestinal CD. A London study demonstrated that when endoscoped, OFG patients demonstrated low grade gut inflammation, insufficient to define as CD and unlikely to progress to CD.\textsuperscript{14}

The precise significance of oral lesions as a predictor of future CD and the prognostic value of oral lesions in CD patients at the time of diagnosis are still uncertain due to the lack of a clear evidence base. However, these very topics are currently being investigated in prospective research projects which will hopefully clarify the nature of the relationship between the mouth and the remainder of the gastrointestinal tract in CD in the very near future.

References

DIAGNOSIS AND MANAGEMENT OF POTENTIALLY MALIGNANT ORAL DISORDERS

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Abstract

The optimum management strategy for potentially malignant disorders remains a constant challenge as our present knowledge is still short of being conclusive. In spite of its shortcomings as an accurate predictive marker, the assessment of the severity of epithelial dysplasia continues to be useful in risk assessment. It is important to use a combination of epidemiological, clinical and histopathological input when deciding on the most appropriate management for an individual patient. Advanced research exploring molecular markers for diagnosis and risk predictions appear to be promising. However, these tests have not evolved to a stage that they could be used for routine diagnostics at the clinical setting.

Introduction

It is well known that many oral cancers may have clinically identifiable forerunners. Recently a group of experts found that the widely used terms precancer, precancerous lesion and premalignant condition to be somewhat misleading since, not all lesions and conditions progressed to cancer in a definable period of time. Further, cancer sometimes occurred in apparently normal mucosa outside the boundaries of the clinically diagnosed premalignant lesion. The group felt that the term “Potentially Malignant Disorder”(PMD) would better identify the risk state and should replace both premalignant lesions and conditions.1 Leukoplakia, the most commonly seen PMD was redefined as “white plaque of questionable risk having excluded (other) known disorders that carry no increased risk for cancer”. Erythroplakia, palatal lesions in reverse smokers, Oral Submucous Fibrosis (OSF), Oral Lichen Planus (OLP), oral lesions of Discoid Lupus Erythematosus (DLE) and Actinic Keratosis constitute the other well known PMDs.

Epidemiology and aetiology

The prevalence of oral PMDs vary significantly in published studies. Petti (2003)2 performed a meta-analysis of 23 carefully selected studies from 17 countries which used internationally accepted criteria. Using a statistical calculation, he estimated a global prevalence of 2.6% for PMDs while conceding the existence of a significant heterogeneity between different studies. The large population based studies generally come from the developing countries where the incidence is comparatively low an

is a major cause, heavy smokers being 4-7 times more likely to be affected compared with non-smokers.3,6 Alcohol, while being a risk factor on its own, may synergistically enhance the risk when combined with concurrent tobacco consumption.7 In fact the alcohol content in antiseptic mouth- washes could be a concern if they are used regularly over a lengthy period of time.8 Betel quid chewing is a major aetiological factor for most PMDs seen in the South-East Asia and in the Indian sub-continent.9,10 There is conflicting evidence to the role of human papilloma virus in the aetiology of PMDs.11

Diagnosis

Most PMDs and even early stage carcinomas could often remain asymptomatic for long periods. It is common for them to be detected as an incidental finding at a routine dental check-up. Unfortunately, 1.1% to 17.5% of PMDs will progress to oral cancer over a period of time.3 Therefore the most important goal in the management of PMDs would be to halt this progression. Clinicians should be able to prevent or if not decrease the high morbidity and mortality associated with Oral Squamous Cell Carcinoma (OSCC) if they could detect the PMDs, identify those which would progress to cancer and treat them at an early stage.

Health education using mass media and clinical examination in population based screening has been shown to be an effective tool for identification of PMDs particularly when undertaken for the high risk groups.12 In developed countries where the incidence is comparatively low an opportunistic screening by dentists and general medical practitioners could be of value.

PMDs of similar clinical appearance could have varying histopathology. Some PMDs may demonstrate the presence of dysplastic changes in the epithelium. In general, erythroplakias and non-homogenous leukoplakias tend to have more dysplastic features compared with leukoplakias with homogenous appearance.13 For a long period, the light microscopic assessment of the presence and grading of severity of dysplastic features continued to be the most reliable marker to predict the likelihood of malignant transformation.14 However, many studies have cast doubts on

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the reliability of this approach by demonstrating significant intra and inter-examiner variability in dysplasia grading\textsuperscript{15} and also by the fact that OSCC being shown to develop in previously non-dysplastic epithelium.\textsuperscript{16} Further, in some PMDs the dysplastic features were found to have regressed completely or partially with both active treatment or more importantly with no treatment. Research has focussed on molecular biology techniques to explore molecular markers in PMDs which could be used to predict their behaviour. A multitude of molecular markers have been studied and the results are encouraging. However, these tests have not evolved to a stage where they could be used for routine diagnostics at the clinical setting.\textsuperscript{16} In spite of the shortcomings in its predictive value, assessment of the degree of dysplasia from a specimen obtained through an incisional biopsy still remains the most valuable investigation to indicate the relative risk for a malignant transformation. Since most treatment decisions are likely to be based on the severity of dysplasia, a two tier system featuring a “low risk” and a “high risk category” has been proposed recently, to reduce the ambiguity of dysplasia grading.\textsuperscript{14}

Management

Management strategies can be broadly classified as surgical, medical and observational. Decision to treat actively is usually made on the basis of extent and the clinical appearance of the lesion, presence or absence of risk behaviours like smoking, betel chewing and alcohol consumption, and on the degree of severity of dysplastic changes determined by the light microscopic examination of an incision biopsy specimen.\textsuperscript{14}

A complete surgical excision provides an opportunity to enhance the accuracy of detecting the presence of oral epithelial dysplasia and grading its severity. The site of incisional biopsy is usually determined by clinical examination. It is well known that an incision biopsy may not provide a true representative sample of a lesion and more severe changes may lie in an area outside the domain of the sample obtained.\textsuperscript{17} Such inaccuracies may prevent the clinician from appreciating the true risk and may lead to over treatment or inadequate treatment.

Both, scalpel excision and laser ablation are widely used with each having its merits and demerits.\textsuperscript{18,19} Laser ablation permits excision of more widespread areas of leukoplakia with lesser side effects, but histopathological examination could be compromised. Cryo-ablation has been reported but has failed to gain acceptance to the same level, largely due to the frequent side-effects.\textsuperscript{20}

However, it has been shown that surgical excision of a lesion by whichever method may not eliminate the risk of developing a malignancy or a recurrence of the lesion.\textsuperscript{21} Yet, a complete excision, if possible to be performed, still has value in that it provides the entire lesion for histopathological assessment and eliminates the risk of under assessment of the severity including the possibility of missing out on an early invasive carcinoma within the lesion. The prognosis of OSCC is markedly influenced by the clinical stage at initial diagnosis, the presence or absence of lymphovascular spread and cervical lymph node metastasis.\textsuperscript{22} The complete excision of a PMD may provide an opportunity to detect an OSCC in its very early stage and pave the way for initiating prompt treatment.

Not all PMDs are amenable to surgical excision. Large lesions and more generalized conditions may warrant a non-surgical approach for management. Chemoprevention both topical and systemically administered is a non-surgical treatment strategy used in the management of PMDs. Topical bleomycin, ketorolac as a mouth wash, systemic betacarotenes, Vitamin A, retinoids and many other agents have been tried as medical treatment for PMDs but none has achieved consistent treatment outcomes to be of significant value to prevent malignant transformation.\textsuperscript{20} Most of these medical measures have been shown to encounter high recurrence.\textsuperscript{23} Medical management is more applicable for patients with OLP, DLE and OSF since the disease process is more generalized. However, a recent Cochrane review on treatment of oral lichen planus failed to identify any treatment as being significantly superior to others.\textsuperscript{24}

An alternative approach may be to simply place the PMD under strict clinical and histopathological surveillance and to intervene at the earliest possible stage should a malignancy develop. This approach is usually combined with encouragement to abandon any adverse health habits like tobacco, betel quid or alcohol use. In a group of patients who were using smokeless tobacco, cessation of the habit was rewarded with a 97.5% resolution rate for leukoplakia.\textsuperscript{25}

Conclusion

To date there is no definitive treatment capable of reliably eliminating the risk of malignant transformation of PMDs. The effective management of PMDs are somewhat crippled by the lack of consistent, reliable and predictable indicators to identify those lesions which will progress to an OSCC. Until more accurate molecular biological predictors emerge through research and become available for use in the routine clinical setting, a histopathological diagnosis to grade the severity of epithelial dysplasia is likely to remain the favoured investigation to formulate and underpin subsequent management plans. Following diagnosis and risk assessment, a regime of counselling to eliminate any adverse health habits present, a complete surgical excision of the lesion when feasible to do so and an aggressively monitored periodic follow-up constitutes a feasible approach in the present context of knowledge. The newer developments in optical spectroscopy, molecular biology and photodynamic therapy hold promise for the future.

References

4. van der Waal I. Potentially malignant disorders of the oral and oropharyngeal mucosa; terminology, classification and present concepts of management. Oral Oncology 2009; 45; 317-23.
5. Axell T. Occurrence of leukoplakia and some other oral white lesions


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Synopsis

Obstructive sleep apnoea syndrome (OSAS) and bruxism are the sleep disorders most relevant to dentistry. OSAS affects 4% of adults and up to 2% of children.1 Although 40% of OSAS can be attributed to maxillofacial/dental risk factors an epidemic of obesity has led to a significant rise in OSAS prevalence, particularly in New Zealand Maori, Pacific Islanders and lower socio-economic groups.2 The assessment pathway begins with a thorough clinical assessment by a sleep medicine clinician who completes a sleep history, examination and determines the optimum investigation strategy. Portable/home sleep testing pathways are being increasingly used3,4 for diagnosis in patients with high pre-test probability and to monitor the treatment response. Continuous positive airway pressure (CPAP) is a first line therapy for moderate to severe OSAS. Success is highest when delivered as part of a clinical pathway. Acceptance is lower in Maori and disadvantaged socio-economic groups.5

Oral appliances are being successfully used to treat mild to moderate OSAS and snoring in selected patients. Clinical predictors of MAS success include positional or mild OSAS, lower weight (BMI < 32 kg/m²), and adequate dentition. Tongue stabilizing devices also have a role but retention is an issue. Follow-up studies are recommended to objectively assess the response. Funding levels, a lack of workforce planning and inflexible service structures represent a significant barrier to accessing treatment options. The ADA's policy statement (6.7)6 provides a useful summary of professional issues in the use of Dental appliances promoting the view that medical and dental expertise are both required to manage patients who are candidates for dental appliance therapy for snoring and sleep apnoea.

Clinicians with specialized interests and training in the field of sleep are needed to provide appropriate care for patients presenting with symptoms of a sleep disorder. Training pathways have been developed for physicians wanting to specialize in sleep medicine. Sleep services are now looking to bring together clinicians with a broad range of expertise. Currently the Sleep Physician and Sleep Investigation Centre are central to the model of care. In future, the field will be best served by structures that successfully harness multi-disciplinary expertise.

References

4. Collop NA; Anderson WM; Boehlecke B; Claman D; Goldberg R; Gottlieb DJ; Hudgel D; Sateia M; Schwab R. Clinical guidelines for the use of unattended portable monitors in the diagnosis of obstructive sleep apnoea in adult patients. J Clin Sleep Med 2007;3:737-47.

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OBSTRUCTIVE SLEEP APNOEA
Investigations, diagnostic techniques and predicting surgical success
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Dr Gillingham is an oral and maxillofacial surgeon working as a consultant for Hutt Valley Health and Midcentral District Health Boards in New Zealand. He consults and operates in private practice from a number of sites in the Wellington Region.

Abstract
Obstructive sleep apnoea (OSA) is diagnosed using a sleep study or Polysomnogram. The paper discusses the role of imaging and other examination techniques to assess the nature of OSA and what treatment you can offer a patient. When should a patient be offered a mandibular advancement splint? What type should be used? How do we know it is working?

Surgical treatment of OSA is a controversial area. This paper provides an understanding of which patients may benefit from surgery and when is an appropriate time to refer. An overview of the three main types of surgery and their outcomes are discussed. Less experienced practitioners will feel better able to talk to patients about OSA and for those with a special interest in OSA there is new material to stimulate further discussion.

Introduction
There are three main objectives of this paper:
1. Investigations and diagnostic techniques for OSA apart from a sleep study or Polysomnogram (PSG)
2. Summary of Interventions for OSA excluding Continuous Positive Airways Pressure (CPAP) machines.
3. Treatment protocol for OSA when patients do not wish to use CPAP

Investigations and Diagnostic Techniques

Cephalometrics
The role cephalometrics plays in diagnosing OSA is minimal. It is not a diagnostic tool for OSA and cannot be used as a screening tool.¹ Airway changes before and after surgery to not correlate with success of surgery to treat OSA. The role of cephalometrics is to identify those people who have a craniofacial disproportion. Patients with an abnormal skeleton will fail to respond to most surgical techniques for treatment apart from maxillomandibular advancement. Patients with a normal facial skeleton will have standard success rates for the range of surgical procedures that are available for OSA. Therefore cephalometrics predicts which group of patients will fail treatment, unless treatment is aimed at correcting their facial skeleton.²

³D Volumetric Analysis
Volumetric analysis is the gold standard of airways assessment for OSA. There is variation in airway anatomy when a patient is awake, asleep, upright, supine, mouth open or closed and the timing of the ventilatory cycle but standardized imaging still gives useful data. Location of the obstruction, analysis of craniofacial disproportion and a range of volume and fluid dynamics can be calculated. Unlike cephalometrics, volume changes before and after surgery correlate with success.³ Conebeam CT imaging is rapidly becoming a useful tool for OSA imaging. Alternative imaging such as MRI and sleep fluoroscopy are useful as a research tool but do not add to the information required for day to day practice.

Manometry and Acoustic Reflection
Manometry helps identify upper airways resistance syndrome and gives different data on wake and sleep. Acoustic reflection is a rapid means of assessing volumes. Both measures are used predominantly in research and not clinical practice.⁴

Pharyngoscopy
Flexible nasal endoscopic examination gives no OSA relevant information apart from seeing collapse or narrowing of the lateral pharyngeal walls. This information is also available from a CBCT. Hence there is no role for pharyngoscopy in the assessment and treatment decisions for OSA.⁴

Interventions for OSA
Surgical cure is defined as an Apnoea Hypopnea Index (AHI) < 5; surgical success is defined as AHI < 20 with > 50% reduction.⁵ There are three groups of surgical procedure:
1. Airway bypass or tracheostomy
2. Soft Tissue Surgery
3. Hard Tissue Surgery

Tracheostomy provides a mortality benefit but does not result in a surgical cure or success.

Soft tissue surgery has a variable rate of outcomes, procedures will be successful in some patients but it is unknown what the selection criteria are. In summary, nasal procedures have no role to play in OSA surgery apart from allowing easier CPAP use. Uvulopalatopharyngoplasty (UPPP) has a success rate of 52% and cure rate of 16% but 50% of patients will relapse to their pre-surgical AHI within four years of surgery. Transpalatal advancement is a hard tissue variant of the UPPP and carries a higher cure rate of

⁴ Presented at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand, 31 March - 4 April 2012
35% with likely longer lasting effect. Surgical procedures on the tongue have a variable outcome but are generally unpredictable and poor. With all soft tissue procedures relapse is a major complicating factor and initial successes may relapse over some years to the pre-surgical AHI.6

Hard Tissue Surgery is more stable with reliable long term outcomes. Genioglossus advancement is a commonly used procedure usually combined with UPPP with a cure rate of 52% but only in selected patients. Maxillary expansion cures 70% of cases when the patient has a narrow palate.

Maxillomandibular advancement (MMA) is now seen as the gold standard treatment for OSA. With adequate advancement and work up the cure rate is > 95%. When patients have undergone a UPPP and MMA, most patients report the MMA as preferable in terms of recovery, pain and certainly efficacy; 95% of patients are satisfied with surgery and no deaths have been reported over the past 60 years.7

Mandibular advancement splints (MAS)

There are three basic designs – titratable, fixed and tongue suction devices. Fixed appliances give a 56.5% cure rate vs titratable devices with a 74% cure rate due to the ability to advance the jaw further over a number of weeks.8 The decision to stop advancing the device is made by what the patient can tolerate. Laboratory controlled titratable devices allow rapid assessment of a patient’s response to an advancement splint but do not reliably give a measure of advancement required to cure apnoea.9

Advancement splints can be used as a treatment in themselves instead of CPAP. They are also a useful guide for surgical intervention. Determining the advancement required to cure OSA can then be used to determine the surgical shifts required to treat OSA. This method gives a reliable and predictable way of surgically treating OSA.

OSA Management Protocol

- Diagnosis and assessment at a sleep clinic with use of Polysomnogram (Sleep Study).
- Patient may trial CPAP and decide if an alternative is wanted.
- Consultation with an oral and maxillofacial surgeon with a special interest in OSA.
- Conebeam CT or suitable alternative for 3D volumetric analysis.
- Fitting of a mandibular advancement splint and titration to maximal advancement.
- Repeat of the sleep study three months after splint insertion.

A decision tree is followed (Fig. 1). Seventy-five per cent of patients will achieve a cure and most will decide to continue with wearing a MAS. Some will decide to undergo surgery and the MAS is used as a surgical guide to provide certainty of surgical outcomes. Some patients may only need a mandibular advancement if the guide demonstrates a cure and the shift is within the bounds of the dental occlusion. Twenty per cent of patient will achieve a partial response and most will respond well to MMA due to both jaws being advanced. Some may decide to continue wearing the MAS and supplementing their treatment with CPAP set at a much lower and tolerable pressure. The final 5% group of patients are an unknown and no certainty can be given to successful surgical outcomes.

Conclusion

Obstructive Sleep apnoea must be diagnosed by a sleep or respiratory physician using a polysomnogram. Once the diagnosis is made then treatment falls into three areas. CPAP, mandibular advancement splint or surgery. 3D volumetric analysis indicates which treatments will not work and helps determine the nature of the airway narrowing. Mandibular advancement splints play a role in treatment but also in predicting success of skeletal surgery. From a checkered past, surgery for Obstructive Sleep Apnoea has entered a new era of predictability and long term success utilising maxillomandibular advancement as the gold standard treatment.

References


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THE CHANGING COMPLEXITY OF GERIATRIC HEALTH CARE
AND THE IMPLICATIONS FOR ORAL HEALTH CARE
FOR THE INDIVIDUAL AND COMMUNITY

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Abstract

Geriatric healthcare has already changed. We are living longer and we are enduring those additional years with more severe chronic disease and a greater number of chronic diseases.

Current mechanisms to improve oral health care for individuals and the community are considered in this paper. We are still yet to measure the effectiveness of these changes. Even more complex is the confusion and conjecture about what we should be measuring and whether what we measure actually has an impact on the quality of life.

We are living longer

This simple observation and measurable fact is something that is so very much of our lifetime(1)(Table 1). As suggested by the Australian Bureau of Statistics:1 “High life expectancy at birth indicates low levels of infant mortality, a safe environment in which to live, a good health care system, sufficient food, and the adoption of preventative health measures.”

We are more moribund

Our longevity is not a particularly attractive place to be when we experience more severe chronic disease over an extended period of time.2 There is a demonstrable increase in morbidity and disability with increasing age. This has implications for the individual and consequences for the community. There is a spiralling increase in the workload of the health care system and demand for suitable accommodation. The cost to meet these demands is a burden that governments and the private sector cannot continue to afford.

We have to change

We know that there has been a dramatic change in the ageing population in our lifetime. It is axiomatic that these changes cannot continue unchecked. We must look at changing the way we prepare future dental practitioners while they are still in undergraduate training programs. We must examine the dental workforce and look at the roles that non-traditional dental providers may provide. Service delivery models should be investigated, with the view to assist dentists to work outside traditional dental practice settings. Governments and private sector providers should work collaboratively to provide services in partnership.

Undergraduate Training Programs

The importance of introducing geriatric training programs at pre-doctoral or undergraduate level, while dental students are still at dental school has been recognized for a long period of time. Ettinger3 and Dolan4 note that in the United States, initiatives launched in the 1990s resulted in a white paper on oral health,5 which made specific recommendations, identified expected outcomes and set up a timetable to achieve these goals. Some of these recommendations include:

• Develop, implement, and evaluate geriatric dentistry clinical competencies and education standards
• Require dental school accreditation standards for geriatrics education
• Establish core competencies in national dental and dental hygiene boards and regional/state licensure board examinations
• Educate all health professional students in the principles of interdisciplinary team management and include the oral needs of older patients
• Employ continuous quality improvement in dental education and in the dental care of older patients.

These goals have been further developed by the International Association of Disability and Oral Health Education Committee. In a recent report,3 the Committee identified specific Aims and Objectives:

• To develop core consensus curricula in Special Care Dentistry for countries planning to develop undergraduate and postgraduate programmes
• To encourage IADH member countries to develop educational programmes sensitive to local needs
• To present undergraduate and postgraduate core consensus Curricula to the IADH Congress in 2012
• To develop Special Interest Groups in Special Care Dentistry.

What, exactly a core consensus curriculum will look like is yet to be determined.6-10 MacEntee11 has suggested that “the ontology and theory of science, which provides definitions of health and disease, legitimizes research methods, and influences the role of the clinician”, yet the very nature of geriatric practice must address the psychosocial aspects of disability and chronic disease. Geriatric education programs are very likely to embrace a coalescence of the science and the humanities if dentists are to effectively address the needs of an ageing population.
TABLE 1
Population aged 65 and over, by age and sex, 2006 to 2036

<table>
<thead>
<tr>
<th>Age (years)/Sex</th>
<th>2006*</th>
<th>2016†</th>
<th>2026‡</th>
<th>2036§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>730,000</td>
<td>1,091,000</td>
<td>1,368,000</td>
<td>1,498,000</td>
</tr>
<tr>
<td>75–84</td>
<td>547,000</td>
<td>624,000</td>
<td>957,000</td>
<td>1,207,000</td>
</tr>
<tr>
<td>85+</td>
<td>225,000</td>
<td>330,000</td>
<td>418,000</td>
<td>653,000</td>
</tr>
<tr>
<td>Total females 65+</td>
<td>2,045,000</td>
<td>1,502,000</td>
<td>2,744,000</td>
<td>3,357,000</td>
</tr>
<tr>
<td>Total females</td>
<td>10,330,000</td>
<td>11,441,000</td>
<td>12,469,000</td>
<td>13,306,000</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>700,000</td>
<td>1,057,000</td>
<td>1,294,000</td>
<td>1,424,000</td>
</tr>
<tr>
<td>75–84</td>
<td>425,000</td>
<td>536,000</td>
<td>849,000</td>
<td>1,057,000</td>
</tr>
<tr>
<td>85+</td>
<td>108,000</td>
<td>191,000</td>
<td>272,000</td>
<td>456,000</td>
</tr>
<tr>
<td>Total males 65+</td>
<td>1,233,000</td>
<td>1,784,000</td>
<td>2,416,000</td>
<td>2,937,000</td>
</tr>
<tr>
<td>Total males</td>
<td>10,225,000</td>
<td>11,368,000</td>
<td>12,405,000</td>
<td>13,230,000</td>
</tr>
<tr>
<td>Persons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>1,430,000</td>
<td>2,147,000</td>
<td>2,663,000</td>
<td>2,922,000</td>
</tr>
<tr>
<td>75–84</td>
<td>972,000</td>
<td>1,160,000</td>
<td>1,806,000</td>
<td>2,264,000</td>
</tr>
<tr>
<td>85+</td>
<td>333,000</td>
<td>521,000</td>
<td>690,000</td>
<td>1,108,000</td>
</tr>
<tr>
<td>Total persons 65+</td>
<td>2,735,000</td>
<td>3,829,000</td>
<td>5,159,000</td>
<td>6,294,000</td>
</tr>
<tr>
<td>Total persons</td>
<td>20,555,000</td>
<td>22,808,000</td>
<td>24,873,000</td>
<td>26,536,000</td>
</tr>
</tbody>
</table>

Census-adjusted estimated resident population, 30 June 2006.
† Projections based on 2001 Australian census data.

Dental Workforce

Dentists, Dental Specialists, Dental Prosthetists, Dental Hygienists, Dental Therapists and Oral Health Therapists provide clinical care within a defined scope of practice to dental patients in Australia.12 The role of these dental workforce members, both here and in other countries, has a wide range of variation11 and is the subject of ongoing debate.14 Even the most resistive countries, the most notable being the United States,15,16 are creating training programs and defining clinical competencies for complimentary dental health care providers. These more recent developments have occurred because of the realization that dentists alone cannot provide adequate and timely care to vulnerable populations, including geriatric patients, now or in the future without additional support. Whether these additional dental providers should operate independently of a traditional provider or not is beyond this paper, but there is already published evidence that, albeit in a pilot study, there is a potential for allied dental health providers to provide treatment independently with a highly acceptable understanding of the clinical risks involved.18,19

Practice Settings

Domiciliary oral healthcare has been described as a service that reaches out to care for those who cannot reach a service themselves.20,21 Certainly in the United Kingdom, there has been a number of publications and guidelines on domiciliary care22,23 but anecdotally, there continues to be significant difficulties for general dental practitioners to incorporate out-of-surgery practice as part of their usual routine.

Some of the obstacles to domiciliary care pertain to the providers themselves.24,25 Wilwert et al.24 in a recent study of provision of dental care to a group of Iowa residents notes that the dentists surveyed indicated that their professional education did not adequately train them to meet the clinical, psychosocial, communication, or spiritual needs of hospice patients.

There is a perceived difficulty as to the availability of appropriate domiciliary equipment and difficulties transporting it, but in reality the great majority of general practice work can be done with a minimum amount of extra expense, effort and outlay.

Other issues that have been identified include:
• Poor financial remuneration27
• Lack of time28
• Inability to provide a high standard of work29
• Concerns about adequate infection control30
• Concerns about access to emergency drugs30

These difficulties, barriers and issues, although accurate enough in terms of current concerns, are not insurmountable and therefore appear as a collection of excuses to deny the isolated frail elderly access to appropriate care. One solution to address these barriers is to further develop public-private partnership schemes.
Collaborative Partnerships

Partnerships between Governments, communities and health providers are well established. There has been a long and well documented collaboration between key stakeholders and fluoridation of water supplies.\textsuperscript{31} Government administered dental funding schemes for private sector providers, such as The Australian Government Department of Veteran’s Affairs Dental Scheme\textsuperscript{32} are well utilized. Providers become familiar and comfortable with the idea that a collaborative arrangement exists for certain groups within the population. However, we need to develop more intricate systems to provide clinical support that is more tailored to the frail elderly population and less focussed solely on the funding to support such a scheme. The United States’ Surgeon General’s report on America’s Oral Health\textsuperscript{33,34} published over ten years ago, suggested a continuing importance to participate in private/public partnerships\textsuperscript{35-37}. These ideas were based on successful delivery models such as The Central Massachusetts Oral Health Initiative (CMOHI)\textsuperscript{38} and others. To date, there are a number of ad-hoc, pilot and more sophisticated partnerships throughout Australia but on the whole they are dislocated and isolated from one another and have not been assessed for their effectiveness in the delivery of oral care to specific geriatric population groups. Private-Public Partnerships offer real challenges and opportunities to provide oral care to the home-bound frail elderly in the future.

Change for the future

We have achieved our goal of longevity, and will probably continue on that path for the foreseeable future. Our next goal is quality. Our first challenge in that goal is to establish what this quality is going to look like. How will we measure it? What exactly is “Quality of life”? Various authors have conducted studies exploring the relationship between oral health and quality of life (OHRQOL)\textsuperscript{39} but what is actually being measured, and what that measurement means to geriatric oral health has been challenged by other authors.\textsuperscript{40,41}

Once we have identified quality, we can then measure lack of quality. As dentists, we will be held accountable to observe and record this poor quality, which at some time will be recognized as elder neglect and abuse.\textsuperscript{42}

References


32. The Australian Government Department of Veteran’s Affairs Dental Scheme.  


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With advances in Health Care and our standard of living, we are living longer than ever before. The number of people who are alive as a result of sophisticated medical interventions is ever increasing, and people are living longer after these interventions.

Some return to a quality of life similar to their life before the medical intervention. For many however, they continue to live longer with higher levels of disability and dependency.

We also have a population of developmentally disabled adults who are aging, and also have an increasing life expectancy.

This poses many challenges for oral health professionals.

We are learning more about the interplay between oral and general health. We are challenged by the oral effects of our patients’ medical conditions. This affects daily preventive oral care as well as the way we provide professional dental services to this group of patients. Clinical treatment planning becomes more complex.

Our patients may have physical disabilities, movement disorders, or cognitive disabilities in addition to their medical and medication issues. Our clinics will require good disabled access, and a willingness to treat patients in a variety of settings. In the clinic, some patients will require a more upright position in the dental chair. Our patients may need to be treated in a wheelchair, or a domiciliary setting. While the primary relationship is between the dentist and the patient, we also find ourselves increasingly working with families, carers, residential care facilities, other health care providers, third party providers, and legal representatives.

It is helpful to classify elders in respect to their level of functioning, rather than by their chronological age. Higher levels of dependency, as well as the patient’s medical conditions change the way we approach managing our patients.

The three groups commonly used in classification are Functionally Independent Older Adults, Frail Older Adults, and Functionally Dependent Older Adults.¹

Patients will be managed differently depending on which category they fall into, even though they may have the same medical diagnoses. We also live in an age of Minimum Intervention Dentistry. This means that increasingly we are using preventive methodologies to manage dental disease.²

Frail and functionally dependent older adults often have physical and cognitive disabilities, and rely on carers to assist or provide oral health care, and nutrition. This makes preventive oral health care much more complex. There have been initiatives to help provide information, support and training to carers in oral health, but currently the oral health status of frail and dependent older adults remains poor.³

The incidence of edentulism in the community as a whole is dropping, and this is also reflected in projected edentulous rates for the elderly. It is estimated⁴ that the incidence of edentulism will drop in 70-74 year olds from 23.3% in 2004-6 to 7.5% in 2021 and 0.3% in 2041. Amongst Australians 85+ years old, the percentages will drop from 42.7% to 23.3 and 3.9% respectively.

In respect to aged care facility residents,⁵ there are high levels of oral disease and conditions experienced by many of these residents, including coronal and root caries, gingivitis, plaque accumulation, oral mucosal lesions and denture problems.

Many of these problems are evident soon after admission, meaning that the deterioration in oral health has often started prior to admission to aged care facilities.

There is a trend towards providing support services to keep frail and dependent elderly people in their homes for as long as possible, and this group also suffer from increased oral health problems.⁶ Perhaps of most concern were the very high levels of plaque accumulation on residents’ natural teeth and dentures, which places them at high risk for developing aspiration pneumonia.

Barriers that frequently impede residents’ access to dental treatment, involve dental professionals, administrators, nurses and care staff barriers.

There has been a great variety of oral hygiene care strategies, programs and staff educational/training initiatives. However, very little of this research has shown long-term maintenance or improvement of residents’ oral health status.

Many dental professionals continue to struggle to provide dental treatment, institute preventive oral care recommendations, and reduce the progression of caries and other oral diseases and conditions for their institutionalized patients, especially those with dementia.

There are three components common to all the strategies: oral hygiene care, dental treatment and regular oral assessment.

There is a need to delineate the responsibilities for these three key components, to avoid perceived confusion.
The solution to high-quality oral health services in long-term care facilities may be considerably more complex than simply providing on-site services, routines, and resources. Attention is needed to the individual facility organizational culture, philosophical values and communication patterns. A more prominent role for dental personnel on the health-care team of the facility probably offers the greatest likelihood of improving oral health through increased visibility, active participation, and regular evaluation of results.

The need to monitor residents’ oral health is also reflected in the Australian Commonwealth Residential Care Standard 2.15 Oral and Dental Care, which requires that residents’ oral health must be maintained.5

In conclusion, medically compromised older adults comprise an increasing proportion of our population. This group is an increasingly dentate population and as a group, they have a disproportionately high level of oral health needs. They are living longer in a disabled state, and their level of disability and dependency, in addition to their medical problems pose us with challenges about how to adequately provide for their dental care.

References
5. Aged Care Accreditation Standards 2.15 Oral and dental care. Residents’ oral and dental health is maintained. Produced by the Aged and Community Care Division of the former Commonwealth Department of Health and Family Services (now the Department of Health and Ageing) 05/03/2008.

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INFORMED CONSENT, DEMENTIA AND ORAL HEALTH CARE PROVISION

Graeme Ting MSc, MDS, FRACDS, DABSCD, FICD

Abstract

Managing patients with dementia requires a practitioner to exercise diverse skills. Communicating with the patient (as their dementia allows), relatives, caregivers and medical personnel are essential elements in the care process. Diagnosis of oral health problems may not be straightforward, clinical examination and treatment planning may be hampered by poor cooperation from the person with dementia.

Practitioners must view any treatment from the patient’s perspective and balance this with the requirements for sound clinical care. The consent process must be approached in a manner that fulfils the ethical responsibilities that acknowledge patient rights. This can be difficult when managing a patient with dementia.

This paper will explore issues surrounding the consent process and the provision of oral health care to people suffering from dementia. It is hoped that readers will be stimulated to review their practice; especially related to informed consent, whether they routinely manage patients with dementia or not. Such practice evaluation should consider the wants and needs of patients and families on a broader than clinical basis and thus enhance the care that is brought to this group of interesting and often challenging patients.

Introduction

This paper is intended to provoke thought related to issues surrounding consent and the provision of oral health care to people suffering from dementia. It is not intended to be an extensive treatise on law related to informed consent and dementia, since there are specific publications devoted to this. It is also not intended to be a cookbook for dementia care since all patients are individuals whose circumstances are different and constantly changing. Much of what has been written here on oral health and dementia is a result of more than 10 years of experience by the author, in caring for dementia sufferers. It is hoped that readers will be stimulated to think over their practice, the wants and needs of their patients and families and use this paper as a stimulus to evaluate their practice related to care provision for this group of challenging patients.

Background

The phenomenon of the ageing population is well described. The age demographic of our population is changing when compared with the past. People are living longer and with more complex medical conditions than before. Advances in health care and medical technology along with improved social and living conditions have contributed to this.

As the proportion of older people in our population increases so will the proportion of older people with dementia in this cohort. Oral health practitioners are likely to be increasingly asked for advice on the management of a person with dementia or they may even be asked to provide treatment for such a person.

Dementia - a brief overview

Dementia is not a disease in its own right but is a diagnosis that is invoked after the effects of a number of disorders affecting the brain become apparent. People diagnosed with dementia have impaired cognitive function that in some way impacts on normal living and personal relationships. Affected people lose analytical ability and can be emotionally labile. They may become agitated, delusional and suffer from hallucinations. Importantly for the oral health team they may have behavioural problems that can affect home care, the delivery of care at the dental surgery and the people associated with this aspect of daily living. A diagnosis of dementia is made if more than two intellectual functions, for example: cognitive skills – analysis, reasoning and judgment; language skills – speech and comprehension; or memory, are significantly impaired. Memory loss is a common symptom of dementia, but memory loss per se does not indicate dementia.

Classification of Dementia

Dementia may be classified based on the part of the brain affected and the progressiveness of the disease. A patient’s diagnosis of dementia may involve several aspects of the classification system; for example: Alzheimer’s disease is thought of as a progressive and cortical disorder. The table below provides a broad overview of the thought process behind the classification systems currently in use (Table 1).

Other conditions with associated dementia are listed below for completeness but since it is outside the brief of this paper to describe dementia in detail, will not be discussed further. The interested reader is encouraged to source further information on the topic (Table 2).

The responsibility of assuming the perspective of care.

What are the key components of good oral health care for a patient? In particular what are the key components of good care for a patient with dementia and do these differ from care provided to patients without dementia? It is essential to ask these question when caring for people with dementia because very often these patients cannot communicate their wants or...
patients perceive they have been listened to, there are fewer
view care from the patient's perspective. If this is done, then
"patient engagement" and this will allow the clinician to
relationships is that a health practitioner should embrace
dementia. Of course, this becomes more complicated when the patient has
different treatment, other times a treatment need may be perceived
by a care-worker or a medical practitioner. Therefore the
dentist/oral health practitioner takes on the responsibility
of assuming the patient's perspective to determine what
good care is and what are valid and reasonable treatment
options or courses of treatment. In some instances, this is
straight forward but in many cases (even for patients without
dementia) our training to select from the clinician’s point of
view, the “best” treatment, may not coincide with what the
patient perceives as the most appropriate course of care. Of
course, this becomes more complicated when the patient has
dementia.

Contemporary thinking for optimum patient-practitioner
relationships is that a health practitioner should embrace
“patient engagement” and this will allow the clinician to
view care from the patient’s perspective. If this is done, then
patients perceive they have been listened to, there are fewer
consumers against care providers, there is greater patient
collaboration with care plans and more efficiency in healthcare
delivery due to better outcomes achieved in concert with an
“engaged” patient.

In 2004 Judith H. Hibbard, from the University of
Oregon and colleagues, presented a concept involving
primary care, patient activation and trust in the physician.¹
What does this mean? It means that a care provider views the
health interventions from the patient’s perspective. This
means that when patients review the intervention they feel
they have been listened to since the approach, process and
outcome are in line with their expectations. Hibbard and
colleagues found the following key points were identified
by both patients and care providers as key components for
optimum "engagement" and thus the best outcomes (Table 3).

<table>
<thead>
<tr>
<th>TABLE 1</th>
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</thead>
<tbody>
<tr>
<td><strong>Classification of dementia</strong></td>
</tr>
<tr>
<td><strong>Primary Dementia</strong>: a dementia such as Alzheimer’s disease that is not the result of trauma or any other disease.</td>
</tr>
<tr>
<td><strong>Secondary Dementia</strong>: arises secondarily to trauma or other pathology.</td>
</tr>
<tr>
<td><strong>Cortical Dementia</strong>: affects the cortex of the brain and manifests itself in problems with memory, language, cognitive function and social interaction.</td>
</tr>
<tr>
<td><strong>Subcortical Dementia</strong>: affects the brain below the cortex causing changes in emotion, movement and can be accompanied by memory loss.</td>
</tr>
<tr>
<td><strong>Progressive Dementia</strong>: each of these dementias may or may not be slowly or rapidly progressive resulting in increasing loss of brain function with time.</td>
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</tbody>
</table>

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<thead>
<tr>
<th>TABLE 2</th>
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</thead>
<tbody>
<tr>
<td><strong>Conditions associated with dementia and dementia-like symptoms</strong></td>
</tr>
<tr>
<td>Alzheimer’s Disease, Vascular (Multi-Infarct) Dementia, Lewy Body Dementia; Frontotemporal Dementia; HIV-associated Dementia, Huntington’s Disease, Dementia Pugilistica, Corticobasal degeneration, Creutzfeldt-Jakob Disease.</td>
</tr>
<tr>
<td>Dementia or dementia-like symptoms may also be associated with: side effects to medications; metabolic problems and endocrine abnormalities such as thyroid disease, hypoglycaemia, hyponatraemia or hypercalcaemia, or the inability to absorb vitamin B12 (pernicious anaemia); nutritional deficiencies such as thiamine (vitamin B1), B6, or B12 and severe dehydration; infections such as meningitis, encephalitis, untreated syphilis, and Lyme disease; subdural haematomas; poisoning such as exposure to lead or other heavy metals, alcohol, recreational drugs or other poisonous substances; brain tumours; anoxia/hypoxia for example myocardial and cerebral infarction.</td>
</tr>
</tbody>
</table>

needs. Sometimes it is a family member who is requesting
treatment, other times a treatment need may be perceived
by a care-worker or a medical practitioner. Therefore the
dentist/oral health practitioner takes on the responsibility
of assuming the patient’s perspective to determine what
good care is and what are valid and reasonable treatment
options or courses of treatment. In some instances, this is
straight forward but in many cases (even for patients without
dementia) our training to select from the clinician’s point of
view, the “best” treatment, may not coincide with what the
patient perceives as the most appropriate course of care. Of
course, this becomes more complicated when the patient has
dementia.

Contemporary thinking for optimum patient-practitioner
relationships is that a health practitioner should embrace
“patient engagement” and this will allow the clinician to
view care from the patient’s perspective. If this is done, then
patients perceive they have been listened to, there are fewer

<table>
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<tr>
<th>TABLE 3</th>
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<tbody>
<tr>
<td><strong>Hibbard criteria for successful patient engagement</strong></td>
</tr>
<tr>
<td>Transfer of knowledge</td>
</tr>
<tr>
<td>Ability to self-manage problems</td>
</tr>
<tr>
<td>Ability to maintain function and prevent decline</td>
</tr>
</tbody>
</table>

Underlying successful engagement is the practitioner’s
ability to transfer knowledge to the patient so the patient
can self-manage problems, maintain function and prevent
decline and thus have an element of control over the health
outcomes. This implies that the practitioner has ensured the
patient’s knowledge is coupled with an appropriate skill set
in these areas. The practitioner must also assess and ensure
the patient has the skills to appropriately collaborate with the
provider in order to ensure treatment success. Significantly,
it was acknowledged by both patients and practitioners that
the patient plays the key role in achieving this.

For patients with neurological impairment, it is essential
that the care team be sufficiently informed, trained and
motivated to provide these core skills and carry out appropriate
“home” management. In 2008, Edwards confirmed other
earlier studies that have shown that providing oral health
training for carers in nursing home situations, greatly
improves oral health outcomes.² It is essential that family
and caregivers of people with dementia are trained and able
to provide the best oral care possible in the home setting.

Informed Consent

This concept of choices centred on a course of care as
outlined above, melds deeply with the principles of informed
consent. Informed consent can be problematic for patients
with dementia who may rely on other people for appropriate
decision-making and “self-management” of health issues.
Unfortunately the consent process is often viewed as a
mechanical procedure involving getting the patient to sign
a consent form. Informed consent is more than this. The
consent signing process is the endpoint that acknowledges
a process has taken place. It is essential that this process has
provided the patient with sufficient information enabling an
informed decision to be made about the treatment. Through
this communication process, a patient has been able to
rationalize the treatment options and their risks and benefits,
choose and agree to a procedure. This should be a patient-centred process which results in the patient feeling confident that enough information has been given to make a choice and thus agree to undergo a specific medical intervention. Often patients with dementia cannot do this.

What were once purely ethical obligations for practitioners in the informed consent process are now legal requirements in many places. This acknowledgement of fundamental patient rights appreciates the independence of the patient and that doctor-patient interaction is for the patient’s well-being. Complaints against practitioners and aspects of their practice have set legal precedents that have moved the consent process from one of ethics to law.1

For an appropriate choice to be made by a patient, a practitioner is obliged to discuss as best as possible, the risks, benefits and costs of treatment. This information should be given at the level of competence and understanding of the patient and so it is necessary that the practitioner is aware of their patient’s level of comprehension. For patients with dementia this may be impossible. In this case, the practitioner is obliged to undertake this discussion with whoever is acting for the patient and is signing the consent form.

If a treatment is experimental or part of a research project, or the patient will be under a general anaesthetic, there is significant risk of adverse effects, then the consent must be in writing. Other than in extreme emergencies it is also a requirement of the World Health Organisation Patient Safety Checklist to ensure a written and signed consent form is completed prior to any operative procedure. The checklist is likely to be introduced into all New Zealand hospitals.

During the discussion process, patients must be given the chance to ask questions to improve their understanding and clarify any areas of uncertainty. It is best practice for the operator (and not a delegated representative) to inform and discuss the following (Table 4):

The standard for informed consent is that which a reasonable patient might expect rather than what a reasonable doctor might think (Rogers v Whitaker 1992).5

<table>
<thead>
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<th>TABLE 4</th>
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<tr>
<td><strong>Practitioners should discuss with the patient: A diagnosis (if known); the nature and purpose of the treatment or procedure; the risks and benefits of the proposed treatment or procedure; any alternatives to this treatment or procedure (regardless of their cost or availability) and the risks and benefits of the alternative treatment as far as you know them; and the risks and benefits of not receiving or undergoing a treatment or procedure.</strong></td>
</tr>
</tbody>
</table>

| **Patients have the right to:** Consider the information given; ask for clarification and ask for time to consider the information; consult with family and others; give consent or decline to give consent; waive the right to discuss the details of treatment; after having given consent, change their mind and withdraw the consent. |

and failure to comply with these requirements may be considered as medical misconduct. In New Zealand, all dentists and doctors must be familiar, and comply with, the Code of Health and Disability Services Consumers’ Rights 1999, its amendment in 2003 and subsequent reviews in 2004 and 2009.5 In Australia, practitioners should follow the Australian Charter of Health Care Rights that while not legally enforceable, mirrors generally accepted common law standards. Australian practitioners should also be aware of the Consent to Medical Treatment and Palliative Care Act, 1995. The rights of people with a mental incapacity are governed by the Guardianship and Administration Act, 1993.

In addition to this legislation Australian practitioners should also be aware of the regulations in their own state along with specific regulations and practices for their workplace.6 In both Australia and New Zealand, practitioners should also be aware of guidelines published by their governing Dental Council and Dental Association.

**When is informed consent not necessary?**

There may be rare occasions when it is not necessary to get informed consent. Practitioners should be aware of the statutes in their practising country. In New Zealand, legislative requirements about patient rights and consent are summarized nicely in a document on the NZ Medical Council website.7 For example: some treatments under the Mental Health Compulsory Treatment Act 1992, and under the Health Act 1956 to prevent the spread of infectious disease.

Right 7 Section (4) of the Code of Health and Disability Services Consumers’ Rights specifies the circumstances when it is possible to proceed with treatment without consent.5 Every consumer must be presumed competent to make an informed choice and give informed consent, unless there are reasonable grounds for believing that the consumer is not competent.5

Where a consumer has diminished competence, that consumer retains the right to make informed choices and give informed consent, to the extent appropriate to his or her level of competence.5

Where a consumer is not competent to make an informed choice and give informed consent, and no person entitled to consent on behalf of the consumer is available, the provider may provide services where:

(a) it is in the best interests of the consumer; and

(b) reasonable steps have been taken to ascertain the views of the consumer; and

(c) either

(i) if the consumer’s views have been ascertained, and having regard to those views, the provider believes, on reasonable grounds, that the provision of the services is consistent with the informed choice the consumer would make if he or she were competent; or

(ii) if the consumer’s views have not been ascertained, the provider takes into account the views of other suitable persons who are interested
in the welfare of the consumer and available to advise the provider.5

Who can give consent on behalf of another?

In New Zealand the only individuals who are entitled to grant consent on behalf of a patient are legal guardians (welfare guardians under the Protection of Personal and Property Rights Act, or parents/guardians under the Care of Children Act 2004 or someone with enduring power of attorney). A spouse or next of kin cannot consent to or refuse medical treatment on behalf of an incompetent person unless an enduring power of attorney is held or they are their welfare guardian. The individual with that authority can make all healthcare decisions, except for the legal ability to refuse consent for lifesaving treatment or medical experimentation. Section 18(1)(c) of The Protection of Personal and Property Rights Act 1988 specifically forbids the person who has enduring power of attorney from refusing consent “to the administering ... of any standard medical treatment or procedure intended to save [the patient’s] life or to prevent serious damage to that person’s health”.8

When dealing with patients with dementia, it is important to reiterate that where they have diminished competence, they still retain the right to make informed choices and give informed consent, to the extent appropriate to their level of competence.5 Usually, though, a practitioner is prudent to determine if they have an enduring power of attorney. This power of attorney can have powers in relation to property, or personal care, or both. A delegated person with enduring power of attorney over personal care is the most appropriate person to approach in regard to giving consent for health care.

If, in emergency, immediate action must be taken to preserve the life or health of a patient, then you can provide the key services without consent. Only those treatments that are necessary to preserve life or health should be done at this time. Any procedure that can reasonably be delayed should be delayed until an opportunity can be given for the patient to consent.

Occasionally, when a patient is unable or refuses to consent to treatment, a legal opinion should be sought with a view to seeking authority from the High Court.

Oral Health Care

One of the most important factors influencing oral health in persons with dementia is the severity with which they are affected by dementia. A person with severe cognitive impairment often lacks the insight and ability to communicate a treatment need, consent to a procedure, cooperate with care and often requires complex care provision under general anaesthesia. They also have problems receiving important home care on a daily basis. This, coupled with potential problems of high carbohydrate intake and the xerostomic effects of medications can result in a rapid decline in oral health status. The motivation, knowledge and willingness of care workers to provide daily oral hygiene is also an important factor.

Past interventions (for example, a heavily restored dentition), poor diet, untreated periodontal disease, caries and xerostomia all have a negative impact and reduce the likelihood of a person with dementia maintaining good oral health.

Assessing the treatment needs and treatment planning for a person with dementia relies on more than just the traditional intra-oral examination and accompanying special tests such as radiographs. While some patients with dementia may be cooperative for such assessments, in others a clinical examination is not so straightforward. Determining if a person with dementia has dental pain can be very problematic.

The person’s behaviour and the family and caregivers’ perceptions of treatment needs are also key to treatment planning. For example, for non-verbal, poorly cooperative persons with dementia; they may seem to lose their appetite, become restless, hit out or become more vocal, not wear dentures that were previously worn or not allow mouth care such as tooth brushing where they previously did. These factors along with a thorough intra-oral examination all contribute to making a diagnosis and to treatment planning for care.

Commonly, with patients with severe dementia, an anaesthetic assessment by an anaesthetist is required to ensure the patient is fit enough for general anaesthesia. Sometimes, with poorly cooperative patients with dementia, family and caregivers may be required to wait adjacent to the operating rooms so that treatment planning can be discussed after intra-oral examination and x-rays have been performed. This should be planned, discussed and allowed for in the consent process.

Patients with dementia and some degree of cooperation can be treated in a conventional dental setting. These treatment sessions often need to be short since a patient’s attention span may be limited and sometimes treatment needs to be postponed if the patient is having an “off” day. Communication techniques such as prompting, event and concept linking are effective for some patients with dementia and can facilitate treatment provision and home care. Planning for review and follow up is also an integral part of the treatment sequence.

Important treatment aims are to eliminate pain, allow the patient to eat and drink, prevent acute problems and encourage stable long term oral health. This minimizes the need for acute intervention, repeated general anaesthetics and thus the risks associated with general anaesthesia. Providing dental treatment that allows for easy home maintenance, is durable, prevents relapse of caries and periodontal problems are important clinical goals. Caregiver education, motivation and assistance with home care are important for successful outcomes.

Summary

At the core of good oral care is a practitioner with good communication skills. These skills are used to interact with family, caregivers and other health care providers such as nurses and medical practitioners to ensure the best outcome for patients with dementia. In particular, families have a key part to play in long-term dementia care since they are often
aware of the spiritual and cultural history of the person with dementia and can provide valuable insight into the patient’s life and alongside other care providers contribute to their loved one’s care.

When these communication skills are used to create a situation where all parties agree on sound treatment goals; this enables the practitioner to execute the best treatment options. The result is predictable, stable and maintainable oral health for our patients with dementia.

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References


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Abstract

It is a well-understood fact that the world’s population is ageing. Concomitant with that is an increase in the chronicity of disease including dental disease. The challenges faced by the dental profession in managing patients as they age are becoming increasingly important. What do we know and understand about diseases and their impact on dental health in the elderly? What role do salivary dysfunction and biofilms play and how are these integrated with general and oral health? Are we really prepared to manage the impact of these factors and what is the profession doing to better equip itself for the inevitable change to dental practice that is likely to ensue? Dental education in Special Needs Dentistry and in particular geriatric care expands beyond the realms of the University setting. There is potential to expand knowledge in dental care amongst the elderly through continuing professional development that is now mandatory across Australia and New Zealand. Training should not be limited to University curricula. It should extend to include medical and allied health staff, staff in aged care facilities and all those involved in policy and decision making for the elderly.

The aim of this paper is to address where education in geriatric oral health is currently placed and the role to be played by all key stakeholders from University to Community arenas.

Introduction

We live in an ageing population where chronicity of disease will increase over the coming years. The impact of dental status on oral health related quality of life shows quite clearly that for example the ability to chew or the perception of dry mouth are significant in ones overall general well being.1,2 There is clear evidence to support the link between oral health and general health with aspiration pneumonia being one of the key causes of comorbidity in the elderly which is linked directly to oral status.3-7 Together with this it is well documented that individuals are retaining their teeth longer.8 Hence there is a significant need today and into the future to address issues related to aged care and in particular dental care from both medical and dental perspectives. Dental health in the elderly is unique. It is influenced by multiple factors such as complex and chronic medical histories, polypharmacy, impaired or limited mobility, frailty and variations in cognitive ability. It is also important to consider inclusion of individuals who are chronologically young and have significant medical comorbidities such that they have fall into the criteria of geriatric.

The focus of dentistry is also changing to a more integrated medical and social model where medicine and dentistry must be more closely aligned. Education at all levels needs to keep up to speed with all these changes. It was recognized 20 years ago that geriatric dental education itself needed to be interdisciplinary in order to be able to meet the potential challenges for this group of patients.9 Dental professionals need to be more involved in interdisciplinary education in order to ensure optimal oral health care of their patients as they age and as such education needs to impact at all levels where oral health is a factor.

Geriatrics is concerned with the health care of the elderly and includes clinical, preventive, remedial and social aspects of illness.10 Ageing impacts on cellular function leading to disrupted organ function and ultimately cessation of life.11 Older individuals can be subdivided according to the older adult, the frail elderly and the functionally dependent all of whom can have complex dental needs. In general, if an individual ages and has little or no medical issues then routine dental treatment should pose no extended challenges for the dental profession.12 However if medical issues arise or individuals becomes physically disabled or cognitively impaired as they age then this impacts on oral health and in turn dentistry.

Geriatric dentistry itself pertains to dental care for those with “one or more chronic, debilitating, physical or mental illness with associated medications and/or psychosocial problems”.12

Workforce education

The oral health needs of individuals as they age are the responsibility of the whole dental profession. Ettinger and Beck classified individuals and the respective levels of dental care required and reported that the older adult should be managed by the general dentist, the frail elderly by those with further training and the functionally dependent by those specifically trained to meet the complex needs of hospitalized, home bound and institutionalized individuals, perhaps today, the Special Needs Specialist.12 This task is not difficult as long as we have an understanding of rational care and treatment planning. Part of the role we as a profession need to engage in is educating all key stakeholders involved in the care of these patients. Furthermore we need to address ways of measuring competency in dental geriatric education at all levels to ensure consistency across all domains. Teaching should not be limited to a classroom setting as we all have different learning styles. Information can be

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disseminated through a range of formats including lectures, interactive multimedia, videoconferencing, role plays, webcasting, internet broadcasting and virtual simulations.\(^{11}\)

**University dental curricula**

Education in geriatric dentistry is fundamental to dental practice especially as we are living in an ageing population and individuals are retaining teeth well into their senior years. If we are to consider educating our non-dental colleagues we need to first look at our own current level of understanding. Dental students should be exposed to ageing patients and be given sufficient didactic training to manage them and have insight into the importance of caring for this patient cohort.\(^{14,15}\)

A number of dental schools worldwide offer varied didactic and clinical training in geriatric dentistry and core competencies have been identified in some Centres.\(^{16-21}\) At the Melbourne Dental School undergraduate dental students and Bachelor of Oral Health students are taught geriatric dentistry as part of Special Needs Dentistry. Other dental schools support the concept of geriatric dentistry as part of the dental curriculum but the amount of teaching is restricted by staffing levels, competing curricula and financial constraints.\(^{22,23}\) This is no different at the Melbourne Dental School and would be the case at all Dental Schools globally. In some circumstances, geriatric dentistry is considered a lower priority compared with other dental disciplines.\(^{24}\) In contrast, some Universities offer a Doctor of Philosophy qualification specific to geriatric dentistry.\(^{16}\)

**Continuing Professional Development**

In order to ensure adequate oral health care exists in the ageing population it is essential to determine the level of understanding of all key stakeholders. The dental team includes dentists, oral health practitioners, dental prosthetists, dental assistants and practice managers and these are certainly key persons in the delivery of dental services to the elderly. However, they are not the only individuals involved in the management of the elderly patient. Medical practitioners, geriatricians, Directors of Nursing, carers, nurses, nursing assistants, aids, kitchen staff, pastoral care workers and family members also play a key role in ensuring individuals maintain good oral health well into old age. The level of knowledge amongst each of these groups is varied but it is important that commonality exists in order to ensure that the individual’s oral health is optimal.

Continuing professional development (CPD) would be the optimal method of delivery of appropriate material in dental aged care. Such courses should be available to all facets of the dental profession.\(^{13}\) There is however very little information on the level of CPD offered across the dental profession. For instance, little is known regarding CPD activities amongst prosthetists with one pilot study unable to determine consensus on CPD policy let alone course content.\(^{25}\) Kress analysed the role of CPD in geriatric dentistry and reported that lack of demand was the greatest barrier to geriatric CPD amongst dentists.\(^{26}\) Lack of appropriately trained teachers and avoidance of the elderly were also cited. Interestingly some respondents reported that material regarding dental needs of the ageing were covered in other CPD courses.\(^{26}\)

There is considerable variability worldwide in terms of types and delivery of CPD in dentistry and whether it should constitute attendance at courses or simply reading of scientific literature.\(^{7,27-29}\) Buck and Newton showed that the majority of those surveyed in a single UK study reported that the main form of CPD (87%) consisted of reading of journals.\(^{28}\) Reading, together with informal interactions with colleagues, has also been shown to be the main methods for keeping up to date with dentistry where CPD requirements were not mandatory.\(^{30}\) Interestingly, those surveyed chose to read local journals, maybe due to language barriers, rather than international journals thereby questioning the quality of what Italian dentists were reading.\(^{30}\)

The level of CPD one undertakes is also governed by whether the CPD is mandatory or voluntary with lower uptake in the latter case.\(^{31}\) In addition, it is unclear whether CPD in and of itself produces change in overall dental practice or guarantees competence or improved standards of practice and what form of CPD produces better clinical outcomes or in fact one’s overall motivation for participating in such programs. It has been shown in some countries CPD is only considered beneficial in terms of improving promotion capabilities rather than being seen as improving better clinical outcomes.\(^{29}\)

In the context of mandatory CPD it is also worth considering the next level, that is, within this framework what individual courses should be mandatory. One study reporting that only CPR and infection control should fall into this category.\(^{32}\) This however makes it difficult when determining how CPD marries with clinical practice. A range of different CPD courses are offered but what governs topics and contents is unclear other than to assume it is driven by current trends in clinical practice. Topics often range from popular areas such as Restorative Dentistry and Endodontics with hands on components to improve clinical skills in favour of less popular areas such as Special Needs Dentistry including geriatric oral health.\(^{31,32}\) It is impossible to do every CPD course available, however perhaps they should be categorized with dental health professionals having to choose a set number in different categories. This would allow for a broader case mix of the types of course one selects.

Whilst CPD within the profession is essential, oral health education should not be restricted to us alone. Those at the forefront of managing aged patients should also have access to oral health education with the converse following that oral health practitioners should acquire knowledge regarding overall medical and allied health care. An interdisciplinary approach to improving oral health care for the elderly would benefit all key stakeholders and result in improved care for patients.\(^{33}\) Not all are in agreement with this concept. Physicians for example reported that dentists were not relevant in patient care centred discussions despite pushes for interdisciplinary integrated health care models on a broader platform.\(^{34,35}\) Interestingly, a survey on inter-professional education highlighted geriatric care clinics as one of the most common interdisciplinary clinics involving
dentists. Disappointingly also was the admission of a lack of willingness by some health care professions in academia to move to inter-professional education citing reasons such as lack of scientific evidence for its effectiveness. As with CPD in the dental profession and dental education at the university level, issues of time management, crowded curricula, infrastructure and expertise in content delivery are issues that face delivering such courses within aged care facilities and the community at large. There have been recommendations that oral health education be integrated into in-service training at aged care facilities. In aged care facilities the amount of oral care provided is governed by the mindset of the staff and, in particular, the priorities set by the directors. In aged care facilities Directors of Nursing felt less informed about the oral health needs of residents and oral health care was often left to nursing assistants or registered nurses with tooth brushing being by far the most performed dental intervention. Oral health care was less important where time constraints, finances or physical limitations were an issue. Furthermore, the role played by nursing assistants and aids in oral health care of residents in aged care facilities revealed concerns for oral care centring around behavioural issues with time constraints and staffing levels significant factors in provision of oral care. Despite this, however, most nursing assistants felt able to provide oral care despite some having no oral health education. Some nursing staff (54%) reported poor knowledge of current oral health whilst others reported lack of available education in oral health care as well as poor communication between themselves and dentists. It is unclear how knowledge is measured or what training if any the nursing assistants receive or what ongoing training is available.

Another key stakeholder in geriatric patient care is the physician. Despite this, however, their understanding of the oral cavity and its links with general health can be varied. One study reported that only 17% of physicians felt the “the oral cavity was primarily an integrated part of the body” and 22% felt it was not “part of their profession”. Interestingly, a large number felt oral health training would be of value in managing these patients.

Conclusion

Oral health care for the elderly is a multifactorial issue involving key stakeholders across a broad range of disciplines. CPD aimed at improving knowledge and better dental health care for the elderly should be delivered at a number of differing forums. It is imperative that oral health education for elderly citizens keeps pace with current trends including the evidence base for clinical practice.

References

15. Anehorus GV, Nadiger RK. Evaluation of understanding levels of Indian dental students’ knowledge and perceptions regarding older adults. Gerodontology 2010 ePUB.


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PERIODONTAL TREATMENT AND SYSTEMIC CONDITIONS

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Abstract

It has been reported that patients with periodontal disease have a greater prevalence of systemic disease than the general population. Furthermore, we are faced with an ageing population that is retaining its teeth for longer, and tends to present for periodontal management with a variety of systemic conditions. There is ample evidence to show that periodontal treatment results in a systemic response, which includes bacteraemia and systemic inflammatory cytokine release. Certain systemic conditions present unique challenges in the treatment of periodontal disease. These conditions include cardiovascular disease, diabetes mellitus and cancer. The various treatment modalities for these systemic diseases can impact on periodontal treatment, and conversely periodontal treatment can influence systemic conditions and their management. Close collaboration with the treating physician and timely provision of periodontal treatment are important considerations of managing the systemically compromised patient.

Introduction

Periodontitis is a highly prevalent chronic inflammatory disease. The prevalence of periodontitis and the extent of attachment loss both increase considerably with age. The association of periodontitis with a variety of systemic conditions, including cardiovascular disease, diabetes mellitus and adverse pregnancy outcomes, has been established, although a causative relationship is yet to be confirmed.

Periodontitis progression is characterized by periodontal attachment loss and apical extension of epithelium, creating a periodontal ‘pocket’. In untreated periodontitis, the epithelium in the periodontal pocket is ulcerated and permeable. During periodontal treatment, which involves mechanical debridement of the root surface, the ulcerated epithelium lining is disturbed resulting in bacteraemia and systemic inflammatory cytokine release. Given that the total area of ulcerated epithelium in untreated periodontitis may be up to 4000 mm², it is biologically plausible that periodontal treatment may have a systemic effect. Furthermore, periodontal treatment may be influenced by systemic diseases, such as cardiovascular disease, cancer and diabetes, or the therapeutic management of these diseases. This review examines issues related to the bi-directional relationship between periodontal treatment and systemic disease, with a particular emphasis on the management of medically compromised patients.

Incidence of systemic disease in periodontally compromised patients

Several studies have investigated the incidence of systemic disease in patients with periodontal disease. Generally, it has been reported that approximately 50% of these patients suffered from a systemic disorder, and the frequency of systemic diseases increased with increasing age. In a study comparing general practice and specialist periodontal practice patients from both private and public practices in Brisbane, periodontal patients were found to have a higher prevalence of systemic diseases. Furthermore, patients with periodontitis also took more medications and were more likely to suffer from multiple conditions compared with the general dental population.

Systemic effects of periodontal treatment

It is recognized that periodontal treatment can lead to bacteraemia, with even the process of full mouth probing inducing bacteraemia in 40% of patients with periodontitis. Furthermore, the incidence and magnitude of bacteraemia after scaling was significantly higher in periodontitis than in gingivitis patients and healthy control individuals.

Subjects with periodontitis present with elevated levels of inflammation in their bloodstream as demonstrated by higher numbers of circulating neutrophils or a higher concentration of acute-phase markers such as C-reactive protein (CRP). The magnitude of this difference is clinically significant as it is large enough to shift subjects between the identified classes of CRP-associated cardiovascular risk.

It has been shown that periodontal therapy can result in a dose-dependent improvement in systemic inflammatory markers. Furthermore, the better the clinical outcome of periodontal therapy, the larger the magnitude of the decrease in systemic markers of inflammation. These findings reiterate the positive systemic effects of periodontal treatment on systemic health. However, although the ultimately lower levels of inflammation may result in decreased incidence of systemic disease, the short term increases in inflammatory burden is a consideration particularly in systemically compromised patients.

When considering the interaction of periodontal and systemic health, an over-arching paradigm is that periodontal treatment, consisting of professional debridement, good personal oral hygiene and regular supportive periodontal therapy, results in periodontal disease resolution and reduced inflammation, and hence is paramount in mitigating the effects of periodontal disease and treatment on systemic disease.
Treatment of Systemically Compromised Patients

Cardiovascular disease

The primary management goal for the patient with cardiovascular disease during periodontal therapy is to ensure that the cardiovascular capacity of the patient is not exceeded as a result of periodontal treatment. This is best achieved by minimizing the impact of treatment on alterations of blood pressure, heart rate, heart rhythm, cardiac output, and myocardial oxygen demand. Additionally, psychological and physiologic stresses during periodontal treatment have the potential to significantly alter hemodynamic stability. Consequently, a stress reduction protocol should be implemented for patients with significant cardiovascular disease. This approach could include shorter appointments preferably in the morning when the patient is well rested, the use of adequate local anesthesia to minimize discomfort, preoperative and/or intraoperative conscious sedation, and adequate postoperative analgesia. The above guidelines are recommended for patients with hypertension, stable angina, and treatments undertaken more than six months following myocardial infarction. It is noteworthy however that these recommendations present a ‘common sense approach’ based on consensus opinion established by experience and informed clinical judgment, and have not necessarily been validated by controlled clinical trials.

There are certain severe cardiovascular conditions which contraindicate elective periodontal therapy. These include severe/uncontrolled hypertension, uncontrolled angina, uncontrolled arrhythmias and treatment within six months following myocardial infarction. If emergency dental care is needed in these patients, the treating physician should be consulted. It may be necessary to provide preoperative anxiolytic medication for stress reduction, closely monitor the patient’s haemodynamic status and oxygen saturation before and during treatment, administer supplemental oxygen and provide intravenous access for the administration of intraoperative sedative agents. This therapy may best be provided in a controlled medical environment such as a hospital setting. Acute dental needs should be addressed definitively, since continued pain may potentiate haemodynamic alterations or dangerous cardiac arrhythmias.

Prophylactic Antibiotic Therapy

Antibiotic prophylaxis has been routinely used in the past to prevent infective endocarditis in patients with valvular disease, and post-operative infection in patients receiving hip prostheses. However, these prophylactic guidelines were not based on controlled clinical studies. Indeed, there has never been a blind, placebo-controlled human study on antibiotic prophylaxis for the prevention of endocarditis. Furthermore, evidence for the use of prophylactic antibiotic therapy in the joint replacement patient is primarily in the form of case reports.

A Cochrane Systematic review published in 2008 examined the question ‘Does prophylactic antibiotic administration before invasive dental procedures in people at increased risk of bacterial endocarditis influence mortality, serious illness or endocarditis incidence?’ Despite a comprehensive review of the literature, only one case-control study met the inclusion criteria, and no significant effect of penicillin prophylaxis on the incidence of endocarditis could be seen. The authors concluded that there was no evidence about whether penicillin prophylaxis is effective or ineffective against bacterial endocarditis in people at risk who are about to undergo an invasive dental procedure.

Following a revision of UK and USA guidelines in 2006 and 2007 respectively, which considerably reduced the categories of cardiac conditions which required antibiotic prophylaxis for dental or other mucosal invasive procedures, new Australian guidelines for the prevention of infective endocarditis were published in July 2008. These guidelines outline a limited list of conditions that require antibiotic prophylaxis: a) prosthetic cardiac valves, b) previous infective endocarditis, c) congenital heart disease but only if it involves unrepaird cyanotic defects, completely repaired defects with prosthetic material during the first six months after the procedure, and residual defects at or adjacent to the site of a prosthetic patch or device, d) cardiac transplantation with the subsequent development of cardiac valvulopathy, and e) rheumatic heart disease in Indigenous Australians only. The guidelines also outline dental procedures which always, sometimes and never require antibiotic prophylaxis for the abovementioned procedures. Notably, several procedures commonly carried out in periodontal practice are in the category where prophylaxis is always required and these are periodontal procedures including surgery, subgingival scaling and root planing, as well as extractions and implant placement. Dental procedures where prophylaxis is recommended only in the presence of periodontal disease include full periodontal probing and supragingival calculus removal/cleaning.

Anticoagulant Therapy

Anticoagulant therapy is widely used for the prevention and complications of cardiovascular disease. These medications can influence surgical periodontal treatment by increasing post-operative bleeding. However, decisions to change anticoagulant therapy regimes should be taken with care as a key issue is to balance the risk of bleeding from a dental wound compared with the risk of intravascular thrombi and emboli leading to stroke. Close consultation with the treating physician is important, with consideration of the coagulation status of the patient as measured by the ‘prothrombin time’ and reported as an International Normalised Ratio (INR) value.

Commonly utilized anti-platelet drugs, such as aspirin, do not affect the INR but can increase bleeding times. They do not usually require changes to the normal routine prior to periodontal treatment, although care should be taken with surgical techniques. More elaborate planning is necessary for patients taking the commonly utilized anti-coagulant warfarin and requiring periodontal surgery or extractions. In these cases, an INR reading should be obtained within 24 hours of the surgical procedure. If the INR is less than 2.2, the patient can be treated as per normal routine, while if the INR is over 4, surgery is contraindicated. If the INR is between 2.2 and 4, surgery can be carried out with appropriate
Planning and care, adequate suturing and possibly the use of a local haemostatic agent. Additionally, an antifibrinolytic (trexanexic acid) mouthwash is prescribed to be used four times daily for 2 minutes, for up to 5 days.

Cancer treatment

As the population ages, an increasing number of cancer patients will require dental treatment to maintain oral health. Both chemotherapy and radiation therapy produce a wide range of oral complications.12-15,16 Patients undergoing radiation therapy may develop dermatitis, mucositis, loss of taste, xerostomia, radiation-induced caries, hypovascularity, osteoradionecrosis, and a variety of bacterial, fungal, and viral infections. Due to the cytotoxicity of the agents used, mucositis may be even more severe during chemotherapy. Chemotherapy may also cause xerostomia, but, unlike that associated with radiation therapy, it is generally reversible following administration of chemotherapeutic agents. Secondary infection of areas with ulceration or mucositis may lead to septicemia.

It is critical that dental treatment needs be assessed as soon as a definitive diagnosis has been rendered and a decision is made to initiate a radiation or chemotherapy protocol. Early involvement by the periodontist in the overall treatment protocol provides particular benefit to patients undergoing cancer therapy. Patients embarking on chemotherapy or radiation therapy protocols need a complete dental examination and treatment to eliminate potential sources of infection and establish a personal oral hygiene regimen compatible with long-term health.

Once dental extractions become unavoidable after radiotherapy they can be performed by specialists with appropriate surgical techniques, adjunct therapies and rigorous follow-up after the surgical procedures. In general, hyperbaric oxygenation and antibiotics have been considered favourable when used as adjuvants in dental extractions after radiotherapy, contributing to a low frequency of complications.16 If periodontal treatment is needed during chemotherapy, it is best done the day before the drugs are given, when white cell counts are relatively high. Thus, coordination with the oncologist is critical.

Drugs which have received increasing attention in recent years belong to the bisphosphonate group, which are ‘bone-sparing’ medications used in the treatment of osteoporosis, bone cancers and Paget’s disease. Bisphosphonate use, especially intravenously, has been associated with the condition ‘Bisphosphonate Related Osteonecrosis of the Jaw (BRONJ)’.17 This newly emerging condition usually occurs following tooth extraction in patients being treated with intravenous nitrogen-containing bisphosphonates and the osteonecrosis that results is usually untreatable. The treatment approach to the prevention of BRONJ is similar to that taken with patients about to undertake radiotherapy for cancer, in that early involvement of a dental practitioner/specialist as part of a multi-disciplinary team is paramount, and definitive treatment is indicated. If extractions are required after a patient commences intravenous bisphosphonates, then this should be carried out with minimal trauma and antibiotic prophylaxis, with full coverage of the socket being preferable. Orthodontic extrusion is also an option for tooth removal in these patients. Notably, the incidence of BRONJ in patients taking oral doses of bisphosphonates (e.g., Fosamax taken once weekly) for the management/prevention of osteoporosis is relatively rare, and likely linked to the duration of bisphosphonate treatment and local factors such as the quality of self-performed oral hygiene. Informed consent, risk assessment and careful surgical technique are important considerations in these patients.

Diabetes Mellitus

There is a strong association between both diabetes mellitus types I and II and periodontitis.19 Therefore, evaluation of the potential impact of diabetes mellitus on periodontal treatment planning requires accurate assessment of the level of metabolic control, duration of disease and types of medications used. The advent of ‘at-home’ blood glucose monitoring and glycosylated haemoglobin assays have improved the ability to objectively determine the degree of both short- and long-term metabolic control. However, the mere existence of diabetes does not necessarily result in a less favourable response to periodontal therapy, nor does it suggest an absolute need for alterations in the periodontal treatment plan. The well-controlled diabetic patient is similar to non-diabetic individuals relative to treatment planning and expected response to therapy. On the other hand, patients with poorly controlled diabetes experience significantly greater periodontal attachment loss compared with patients with well-controlled diabetes or those without diabetes.

Notably, there is emerging evidence of a two-way relationship between periodontitis and diabetes—diabetes can lead to poor periodontal health, and poor periodontal health can make it difficult to control diabetes.19 Indeed, periodontal treatment intervention studies in diabetes patients have shown that treatment for periodontitis may improve glycaemic control; however, further studies are needed to confirm these findings.

Conclusions

There is a well established association between periodontal status and a variety of systemic conditions, especially cardiovascular disease and diabetes. Periodontitis has been shown to increase the systemic inflammatory ‘burden’, and periodontal treatment aimed at achieving periodontal health is paramount in our efforts to mitigate the effect of periodontitis on systemic disease. Close interaction with treating physicians, timely management of periodontal problems prior to embarking on ‘immunosuppressive’ treatment, and control of factors which may influence the outcome of periodontal treatment (such as glycaemic control in diabetes patients), are all important considerations in the periodontal treatment of medically compromised patients.

References


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THE ROLE OF THE DENTIST IN THE MANAGEMENT OF SYSTEMIC CONDITIONS

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Abstract

The rates of lifestyle-related diseases are increasing. Worldwide there is an obesity epidemic, one of the consequences of which is an overwhelming increase in type 2 diabetes, not only in adults, but also in children and adolescents. Many cases are currently undiagnosed resulting in serious complications and placing individuals at increased risk for cardiovascular disease. As many diseases share common risk factors, the current emphasis is on primary prevention and risk assessment by all health care providers to enable detection and early intervention. Lifestyle factors that impact on oral health can also have an impact on general health, and lifestyle behaviours that promote better oral health can decrease the risk for chronic disease. In this context, changing oral health behaviour to promote better oral health may directly impact on improving general health for all age groups. Risk assessment for systemic diseases in the dental setting is explored to provide dental professionals with a framework for promoting better overall health for their patients.

Introduction

Should the dentist become involved with risk assessment, primary prevention or risk management of systemic diseases? Whilst our primary role is the treatment and prevention of oral diseases and conditions, a recent survey has shown that dentists in the United States are indeed willing to screen for medical conditions.1 In terms of oral diseases, dentists already address risk assessment and risk reduction strategies for lifestyle factors that are also risk factors for obesity, diabetes and cardiovascular disease, such as diet and smoking. Thus reinforcement of the healthy lifestyle message by dentists may also have broader ramifications in reducing risk for obesity, diabetes and cardiovascular disease.2

Dentists are recognized by the medical profession for having a long history of prevention, with patients accepting of this preventive approach and accustomed to regular dental recalls. Dentists are also in a position to reach many patients who are unaware of their overall health status, as traditionally medical consultation is often only sought after the appearance of symptoms. For this very reason and due to the enormous projected future financial and societal burden of the consequences of diabetes and cardiovascular disease, dentists and other primary health care practitioners are being encouraged to assist in identifying those at increased risk for these diseases.

Diabetes

Currently it is estimated that more than 200,000 New Zealanders have Type 1 or Type 2 diabetes with the highest prevalence among Pacific people (10.1%), followed by Asian (8.4%), Maori (8%) and Europeans (2.9%).3 Maori and Pacific people have a high prevalence of risk factors such as obesity, physical inactivity, insulin resistance and metabolic syndrome.4 It is estimated that by 2021 approximately 15% of the health budget will be spent on treating the complications of Type 2 diabetes in New Zealand.3 In Australia diabetes is the fastest growing chronic disease with approximately 1 million people currently diagnosed with diabetes and 100,000 new diagnoses per year. It is also recognized that there are many people with undiagnosed diabetes and pre-diabetes. Indigenous Australians are at greater risk than non-Indigenous Australians, as are those from North Africa, the Middle-East and Asian countries compared with their Australian born counterparts.4 Estimates of expenditure likely to be incurred in the not too distant future on treating diabetes and its consequences are causing concern worldwide. This further highlights the need for widespread early screening for diabetes and pre-diabetes to prevent, detect and manage these conditions, particularly as many cases can be prevented or the onset delayed.

A study by Ellison et al.7 reported on HbA1c (glycosylated haemoglobin) screening for undiagnosed diabetes in New Zealand. HbA1c reflects glycaemic levels over the lifespan of the erythrocytes (2 - 3 months), as in the presence of chronic hyperglycaemia glucose attaches to haemoglobin. In non-diabetics the HbA1c level should be ≤ 6% which equates with a mean plasma glucose level of 7.5 mmol/L. In this study 50,000 individuals who were not known to have diabetes were screened and 12% were found to have HbA1c levels > 6%. These authors concluded that HbA1c can be used as an opportunistic screening test for diabetes and glucose intolerance.

The Department of Health and Ageing in Australia has put out a risk assessment tool, The Australian type 2 diabetes risk assessment tool (AUSDRISK), that was developed from the findings of the national Australian Diabetes Obesity and Lifestyle study (AusDiab).6 AusDiab examined approximately 6,000 Australian adults on two occasions five years apart. AUSDRISK is aimed at assisting patients and health professionals to assess the risk of developing type 2 diabetes within the next five years. The tool is a relatively simple, straightforward questionnaire that is suitable for use in the dental setting. Patients can complete it either with or without the assistance of a health professional,
therefore patients who may be resistant to such screening in the dental setting can be given a copy to complete at their leisure. AUSDRISK can be downloaded from the Diabetes Australia website (http://www.diabetesaustralia.com.au/en/Understanding-Diabetes/Are-You-at-Risk/) or used as an online interactive tool (http://www.health.gov.au/internet/main/publishing.nsf/Content/chronic-diab-prev-aus). Based on the total score, risk level is graded as low, intermediate or high with intermediate risk indicating that an improvement in lifestyle may help reduce the risk of developing type 2 diabetes. Those scoring in the high risk category are advised to see their doctor for a fasting blood glucose test as they may have undiagnosed diabetes or be at high risk of developing diabetes. It is important that dentists refer or encourage these patients and those with diabetes to consult their medical practitioner and adhere to medical recalls. It is recommended that all adults over 40 years use AUSDRISK every three years. Others considered to be at high risk for undiagnosed type 2 diabetes are Aboriginal and Torres Strait Islanders aged 35 years or more, Maori, Pacific Islanders, people from the Indian subcontinent, people of Chinese origin and those 40 years or older who are obese, or have hypertension or cardiovascular disease (myocardial infarction, angina, stroke or peripheral vascular disease). Obese women with polycystic ovarian syndrome and people on antipsychotic drugs are also considered to be at high risk. Antipsychotic drugs can interfere with glucose metabolism. Several studies have now shown that the dental setting provides an opportunity to identify undiagnosed diabetics, with the best predictors being waist circumference and age, together with self-reported oral health, self-reported weight and self-reported race or ethnicity. Further information on periodontal status and family history of diabetes was also found to be helpful. The probability of diabetes was increased in periodontal patients over 45 years with a family history of diabetes, hypertension, high cholesterol, overweight/obese. These patients then had a periodontal examination and an HbA1c test followed by fasting plasma glucose at their next visit. Interestingly, the presence of at least 26% pockets of 5 mm or more, or four or more missing teeth identified 73% of the true diabetes cases. With the addition of HbA1c ≥ 5.7%, 92% of diabetes cases were identified. Similarly, Table 1 shows data from a study conducted in a low socioeconomic area near Brisbane with all the determinants of poor oral and general health. Over 500 individuals on a public dental clinic waiting list or attending for emergency dental care were tested for HbA1c level and lipid profile. Approximately 15% were found to have HbA1c values above the normal reference range, with some being new diagnoses of diabetes and others having uncontrolled diabetes. Further, up to 40% of these patients were also found to be at risk for cardiovascular disease with elevated lipid profiles.

Patients with diabetes are now encouraged to take an active role in the management of their diabetes. The dental team is also well positioned to support them in this. Whilst treating any oral infection will contribute to improved glycaemic control, so too will the dietary advice customarily given within the dental setting regarding reducing dietary intake of high energy snacks and beverages. Any reduction in energy intake may result in weight loss and many studies have shown that even weight loss of around 5 to 20% can improve glycaemic control, blood pressure and lipid profiles. Educating patients about the role of diet in the management of diabetes is also well positioned to encourage diabetic patients to adhere to medical recalls as dental practices have traditionally had more efficient recall systems than medical practices.

### Cardiovascular Disease

A recent study by Lalla et al. in which they examined new dental patients (n = 601) without a history of diabetes or pre-diabetes found that 535 of them had at least one of the following self-reported diabetes risk factors: family history of diabetes, hypertension, high cholesterol, overweight/obese. These patients then had a periodontal examination and an HbA1c test followed by fasting plasma glucose at their next visit. Interestingly, the presence of at least 26% pockets of 5 mm or more, or four or more missing teeth identified 73% of the true diabetes cases. With the addition of HbA1c ≥ 5.7%, 92% of diabetes cases were identified. Similarly, Table 1 shows data from a study conducted in a low socioeconomic area near Brisbane with all the determinants of poor oral and general health. Over 500 individuals on a public dental clinic waiting list or attending for emergency dental care were tested for HbA1c level and lipid profile. Approximately 15% were found to have HbA1c values above the normal reference range, with some being new diagnoses of diabetes and others having uncontrolled diabetes. Further, up to 40% of these patients were also found to be at risk for cardiovascular disease with elevated lipid profiles.

| TABLE 1 |
| Diabetic control and lipid profiles of dental patients in a low socioeconomic area |

<table>
<thead>
<tr>
<th></th>
<th>Reference Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean (SD)</th>
<th>% above reference range</th>
<th>% below reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c (%)</td>
<td>&lt; 6.0</td>
<td>4.3</td>
<td>13.6</td>
<td>5.6 (0.9)</td>
<td>14.8</td>
<td></td>
</tr>
<tr>
<td>TC (mmol/L)</td>
<td>&lt; 5.5</td>
<td>1.0</td>
<td>11.8</td>
<td>5.3 (1.1)</td>
<td>40.5</td>
<td></td>
</tr>
<tr>
<td>LDL (mmol/L)</td>
<td>2.0-3.4</td>
<td>0.8</td>
<td>6.5</td>
<td>3.1 (0.9)</td>
<td>33.1</td>
<td>8.7</td>
</tr>
<tr>
<td>HDL (mmol/L)</td>
<td>0.9-1.6</td>
<td>0.4</td>
<td>2.9</td>
<td>1.4 (0.4)</td>
<td>20.8</td>
<td>4.1</td>
</tr>
<tr>
<td>TG (mmol/L)</td>
<td>&lt; 2.0</td>
<td>0.4</td>
<td>20.4</td>
<td>1.9 (1.5)</td>
<td>32.5</td>
<td></td>
</tr>
</tbody>
</table>
be a risk factor for periodontitis in young individuals (18-34 years), reduced salivary flow, and caries. The Australian National Heart Foundation (NHF) Guidelines recommend that overweight or obese adults without known CVD or already known to be at high risk should be assessed for absolute CVD risk, as obesity is a strong independent risk factor for cardiovascular events and death. These guidelines are for use by primary care health professionals to assess the absolute CVD risk of adults before they show any symptoms of CVD. Absolute CVD risk predicts the risk of a cardiovascular event over the next 5 years and is also recommended for all adults aged 47 - 74 years who are not already known to be at increased risk. Web-based calculators can be found at www.cvdcheck.org.au or www.nzgg.org.nz. However, in diabetics under 60 years and obese individuals not already known to have CVD or to be at high risk, the risk may be underestimated, therefore these patients should be referred for medical assessment.

Lifestyle behaviours that promote oral health, such as improved diet and tobacco cessation, also decrease the risk for chronic disease. It has been shown that by following a single healthy behaviour, disease risk can be reduced by approximately 50%. Therefore, by providing advice on diet and smoking cessation dentists can help patients optimize their oral health and prevent systemic disease. While the nature of the association between oral disease and CVD is controversial and remains to be fully elucidated, the role of the dentist as a primary health care provider in risk assessment for systemic disease is being increasingly recognized. In this context dentists should be actively engaged with medical practitioners in providing the best possible outcomes for their patients.

References

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NON-PRESCRIPTION MEDICATIONS:
CONSIDERATIONS FOR THE DENTAL PRACTITIONER.

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ABSTRACT

The widespread availability of non-prescription medications has a significant potential impact on dental practice. Dentists are trained to provide scientifically-based advice on the appropriate use of medications, but it is not uncommon for patients to take matters into their own hands, especially if it is felt that the treatment provided is not solving a specific problem, or is insufficient. Well-meaning but often ill-informed family and friends frequently have an opinion as to what should be done. Not only may the suggested treatment not be effective, it may also be harmful. Over-the-counter medications can easily be obtained, and there is nothing to stop individuals exceeding recommended doses, and if this occurs, there could be adverse medical sequelae. Patient compliance in taking prescription medications is known to be problematic, and when combined with the ready availability of complementary medications, probiotics and illicit drugs, the risk of self-harm can be seen to be a distinct possibility. To compound the position, sometimes there seems to be, in a practical sense, little regulation on the advertising and marketing of non-prescription medications, which can leave consumers not only confused but potentially vulnerable.

While complementary medicines may not have a significant role in dental practice in 2012, that may not always be the case as research continues, and reference is made to some aspects of ongoing work. Non-prescription medications are discussed, and some effects on oral health are considered.

In many households, over-the-counter analgesics are kept to deal with contingencies of discomfort such as headaches, from which everyone suffers from time to time. To control dental pain, paracetamol, codeine and ibuprofen are widely used, and many preparations of these drugs are available without prescription. Therefore the opportunity for misuse or abuse is always present, although probably, in percentage terms, the risk is relatively small. Paracetamol is hepatotoxic, and a common cause of acute liver failure. Codeine, whose efficacy in clinical trials has been shown to be modest and yet continues to be widely recommended for dental pain, has a number of well-known side-effects. Ibuprofen is arguably the best drug to control dental pain, but is contraindicated in patients with peptic ulcers and some asthmatics. Further, a recent report documented morbidity with over-the-counter codeine-ibuprofen analgesics.

The compound most closely implicated in causing dental caries, sugar, is, ironically, a component of most paediatric medications. It is included in antacid tablets, antifungal agents, many liquid medications, cough drops and chewable tablets including vitamins. While it is important to make preparations palatable for this age group, it is clearly desirable for them to be composed of substances which will not cause collateral harm. The problem is magnified when it is necessary for them to be taken long-term.

The effects of deficiency of individual vitamins are well-known and have been for many years. Rectification by eating a healthy and balanced diet is usually effective where there is a medically diagnosed problem, yet the widespread and occasionally aggressive marketing of multivitamin preparations by commercial enterprises (and outside conventional medical practice) appears to proceed without restriction. This arguably sows the seeds of doubt into the minds of many consumers regarding what they need and what they do not. Reference ranges vary as knowledge and technology improves, but it is a moot point to consider whether or not economic interests ever play a part. Whatever the reasons, it is well documented that the complementary medicines’ industry is worth very large sums of money so many people believe it to be beneficial. There is however good reason for caution with these preparations - the Iowa Women’s Health Study has reported on just under 40,000 individuals followed over 20 years and found an increased mortality with taking multivitamins, vitamin B6, folic acid, iron, magnesium and copper. Calcium was the only supplement associated with decreased risk in this study.

There is another group of products which accounts for billions of dollars in global revenue, and which is poised for rapid and continued expansion: probiotics (therapeutics consisting of live micro-organisms). However, no probiotic product was, as at early 2011, licensed in the United States as a biological drug product for use in the treatment, prevention, cure, mitigation or diagnosis of a specific human disease. The claimed benefits are made on the basis of limited or controversial data. However, it is important not to eliminate probiotics as being beneficial in the future as it has been found that the bacterium Lactobacillus rhamnosus (which is used as a nutritional supplement in yoghurt) secretes a soluble protein which prevents the death of mouse intestinal

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Clinical experience has shown that antiseptic mouthwashes are widely used. Many contain substantial quantities of alcohol, and a possible link with oral cancer has been suggested. Further, while they are claimed to destroy pathogenic bacteria, they are not selective in their actions and thus must have some effect on commensals, upsetting the balance of the oral environment. If used over long periods, it is in effect similar to the chronic administration of antibiotics – there is increasing awareness of the problem of antibiotic resistance. A former Nobel Prize winner pointed out the magnitude of the latter problem, noting that 100,000 succumbed to MRSA each year, more than AIDS. Yet antiseptic mouthwashes are not only available over-the-counter without prescription, they are heavily promoted by their manufacturers, and while they may have a role in, for example, those unable to care for their mouths, e.g., the elderly in nursing homes, they are unnecessary for healthy individuals where mechanical cleansing (tooth brushing, flossing) is effective.

Many texts address the practice of Phytotherapy (the use of plants or plant extracts for medicinal purposes). For example, one includes a number of references to remedies for oral conditions, such as citrus seed extract as a mouthwash to treat oral bacteria and to reduce plaque and tooth decay, licorice as being beneficial for plaque reduction, and the number and healing of mouth ulcers, and thymol having, first, the ability to kill cariogenic and pathogenic bacteria and, second, having been recorded as resolving Kaposi’s Sarcoma. While some of these claims have been referenced, none has been accepted as conventional treatments and has not, to date, been taught to dental students. Further, there have been concerns with the use of herbal products – prior to surgical procedures, 22% were found to be taking herbal medications, 32% of patients in an ambulatory medical setting admitted to using herbal medications regularly, and 70% of herbal users did not describe their use to their health care provider. Eight commonly used herbal products have been identified as having the potential to cause adverse effects when undergoing medical-surgical procedures (Table 1). Advice regarding surgical procedures has been suggested which includes ceasing Ephedra a minimum of 24 hours before surgery, Gingko biloba a minimum of 36 hours before surgery, and Garlic and Ginseng, 7 days before surgery. In summary, care in dental practice is necessary, especially with respect to post operative bleeding, impaired wound healing, and drug interactions (notably sedatives).

A considerable number of compounds contain coumarin, including arnica, celery and chamomile. Therefore they may potentiate warfarin activity. Others may interact with warfarin, for example, St John’s Wort, some Chinese herbs, papaya and green tea.

Herbal Medicines caused at least 10 deaths in Japan in the two-year period 1994-1996 (Japanese Ministry of Welfare). Side effects caused by herbal therapies are common elsewhere in Asia, but are overlooked. There are a number of problems with herbal preparations, and doctors are advised to:-

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**Table 1**

<table>
<thead>
<tr>
<th>Herbal Product</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echinacea</td>
<td>Immunosuppression, Poor wound healing, Opportunistic infection, Hepatotoxic</td>
</tr>
<tr>
<td>Ephedra</td>
<td>Cardiac toxicity, Central Nervous System effects, Enhances noradrenaline release from sympathetic neurons</td>
</tr>
<tr>
<td>Garlic</td>
<td>Platelet aggregation inhibitor</td>
</tr>
<tr>
<td>Gingko biloba</td>
<td>Platelet inhibitor, Care with periodontal surgery, root planing etc.</td>
</tr>
<tr>
<td>Ginseng</td>
<td>Platelet aggregation and other coagulation problems</td>
</tr>
<tr>
<td>Kava</td>
<td>Potential to enhance effects of sedative and general anaesthetic agents, Has been the subject of a warning by FDA, Banned in some countries (hepatotoxicity).</td>
</tr>
<tr>
<td>St John’s Wort</td>
<td>Alters drug metabolism, Photosensitivity, Care with dental sedation e.g., benzodiazepines, Also may affect warfarin, digoxin, non-steroidal antiinflammatory drugs (NSAIDs)</td>
</tr>
<tr>
<td>Valerian</td>
<td>Potential to enhance effects of sedative and general anaesthetic agents</td>
</tr>
</tbody>
</table>


(a) check hepatic and renal function before the first prescription is issued, and 3-monthly after that,

(b) check blood pressure at least fortnightly,

(c) inform patients of the early side effects of treatment, and if they occur, cease taking the herbal preparation, and then contact the prescribing doctor.

The need to consider specifically modifying dental treatment for patients on herbal supplements has been highlighted.

It is not as though there has been no attempt by herbal medicine professionals to address the safety of these therapies and the issues have been summarized. It seems reasonable to expect that proponents of the herbal therapies must be able to prove a specific treatment is at least equal to, and preferably better than, conventional medical management,
and by being subject to the same rigorous testing as prescription drugs are before release onto the market. It is perplexing to read that one authority appears to suggest that the benefit-risk ratio which is applied to modern drugs should not be applied to herbal therapies20 – it is not so much that all treatments should immediately be discarded simply because they are herbal, more that, as in all therapies, it is important to be able to demonstrate clinical benefit. Indeed, there is potential in one clinical problem very topical in dentistry in the early part of the 21st century: the risk of Bisphophonate osteoclasts, but none on osteoblasts or chondrocytes.21 While herbal products have been screened in Japan with a view to providing a possible alternative approach to the management of osteoporosis, and three (Melia azedarach, Corydalis turtschaninovii, and Cynanchum atratum) were found to have growth-inhibitory and/or apoptosis-inducible effects on osteoclasts, but none on osteoblasts or chondrocytes.21 While this is early work, it shows there could be a future clinical application in the management of osteoporosis.

Illicit drug use is widespread and causes many problems, both social and medical. The adverse effects on the oral cavity of some of the commoner substances include the following: cannabis (dry mouth, oral malignancy), cocaine (dry mouth, bruxism, tooth erosion, gingival ulceration), ecstasy (dry mouth, bruxism), heroin (dry mouth, bruxism, craving for sweet foods leading to caries), and methamphetamines (dry mouth, bruxism, caries).22

In summary, over-the-counter preparations provide significant support to enable the public to obtain medications without attending healthcare professionals, and also when problems occur outside normal business hours, e.g., weekends and late nights. It does nonetheless require individual personal responsibility to ensure appropriate usage – the lack of restrictions as to the quantity of non-prescription drugs that can be obtained provides the opportunity for misuse, abuse and consequent self-harm. With respect to many complementary medicines, it is difficult not to think that some of the science behind the therapies has not been sufficiently rigorous, and when this is considered alongside the monetary value of the industry, it does not compute in the age of evidence-based medicine. This may change in the future, but although the public are increasingly well-informed about the risks of some of the commoner substances include the following: cannabis (dry mouth, oral malignancy), cocaine (dry mouth, bruxism, tooth erosion, gingival ulceration), ecstasy (dry mouth, bruxism), heroin (dry mouth, bruxism, craving for sweet foods leading to caries), and methamphetamines (dry mouth, bruxism, caries).22

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References


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ADVERSE DRUG REACTIONS:
ORAL AND DENTAL MANIFESTATIONS AND COMPLICATIONS

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* Presented at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand, 31 March - 4 April 2012

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Abstract

Adverse, that is unintended untoward effects of medications, are increasing in incidence and their severity, given the aging of the Australian and New Zealand population and associated drug use. Not only are the number of agents that our patients are using increasing, including the increased use of “alternate” or “complimentary” medications, but also their complexity, with the advent of potent, targeted, biological agents. The result is an increasing number of our patients will be at greater risk of adverse effects from their medications. These adverse effects include the impeding of the safe delivery of dental treatment and the adverse oral and dental manifestations and complications related to the use of medications.

Key words: adverse drug reactions (ADRs), classification, identification, prevention.

Introduction

Adverse Drug Reactions (ADRs) have been defined as “a response to a drug that is noxious and unintended and occurs at doses normally used in man for the prophylaxis, diagnosis or therapy of disease, or for modification of physiological function”.1 A more recent definition defines ADRs as: “An appreciably harmful or unpleasant reaction, resulting from an intervention related to the use of a medicinal product, which predicts hazard from future administration and warrants prevention or specific treatment, or alteration of the dosage regimen, or withdrawal of the product”.2 Both these definitions emphasize that ADRs are, in general, initially unpredictable, but once such ADRs are known their occurrence is predictable and therefore avoidable, by the knowledgeable, educated clinician not using drugs associated with severe ADRs, or by the clinician putting in place measures to ameliorate, or prevent such ADRs from occurring.3 ADR’s range in their severity from mild to troublesome, but can be life threatening, or even fatal.

ADR’s have been classified into eight broad categories (Table 1).

The dental/oral health practitioners’ role in regards to the management of ADRs, is firstly to maintain a high level of clinical awareness and acumen in recognizing and diagnosing ADRs, especially when such reactions have distinct oral and dental manifestations. This is particular concern in recognizing and then administrating vital first aid in cases of immediate hypersensitivity reactions (anaphylaxis) that can occur with any of the drugs administered during the course of the dental care to patients. Oral health practitioners can prevent ADRs by having and developing good history taking skills, to identify previous ADRs, as reported by the patient, thereby avoiding administering the causative drug, or addressing the adverse reactions by interventions, such as additional drugs, so as to prevent or lessen their severity, and especially those that are known to have an adverse impact on the oral and/or dental health. Importantly, dental/oral health practitioners, in knowing what drugs their patients are taking, and being aware of their established ADRs appropriately modify the dental treatment the patient requires, to ensure it is delivered safely, with no harm to the patient. A current and topical example is the ADR seen with the use of potent bisphosphonate agents, given to prevent bony complications of malignancy, such as metastases and pathological fractures. Caution is required in undertaking dental extractions in patients taking bisphosphonate agents

<table>
<thead>
<tr>
<th>Table 1. Classification of Adverse Drug Reactions (Rosenheim ML, Moulton R. 1958).2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overdosage</td>
</tr>
<tr>
<td>2. Intolerance</td>
</tr>
<tr>
<td>3. Side-Effects</td>
</tr>
<tr>
<td>4. Secondary Effects</td>
</tr>
<tr>
<td>5. Idiosyncratic Reactions</td>
</tr>
<tr>
<td>6. Teratogenic Effects</td>
</tr>
<tr>
<td>7. Hypersensitivity</td>
</tr>
<tr>
<td>8. Drug Interactions</td>
</tr>
</tbody>
</table>
given the risk of them developing osteonecrosis of the jaws (ONJ). Another role for dental/oral health practitioners that should be further developed and encouraged, is Point of Care Testing, to ensure patient compliance with their medications and ensure the agents’ intended medical benefit for the patient has been satisfactorily achieved. Examples include checking if patients International Normalised Ratio (INR) is within the required therapeutic range for patients taking warfarin, monitoring of patients’ blood pressure, for those patients who are taking antihypertensive agents and patients’ BSL for patients who require oral anti-glycaemic agents and/or insulin, in the setting of diabetes mellitus.

**Adverse drug reactions: Specific oral/dental manifestations and/or complications.**

**Epidemiology**

All drugs, whether they be prescribed, over the counter, herbal (complimentary) or illicit, commonly give rise to a great range of specific oral/dental manifestations and/or complications, of which the most frequent is that of a dry mouth (xerostomia and/or salivary hypofunction). Dysgeusia (taste disturbance) is less common, as is the development of stomatitis, that is oral mucosal ulceration.

The incidence of ADRs is increasing and is expected to further increase with the ageing of the Australian population and consequent associated need for medical intervention, especially for the chronic diseases, such as hypertension, coronary artery disease, heart failure, diabetes mellitus and osteoarthritis, as well improved survival of patients who have had cancer.

**Classification**

Given the range and extent of ADRs and their impact on the oral and dental structures, classification is difficult. ADRs can manifest oral and/or dentally “directly” as to their site of presentation, or by the adverse effect such reactions can have on the oral and dental tissues and structures. ADRs can also affect the stomatognathic system and tissues “indirectly” by one of two mechanisms: firstly, by complicating and/or adversely affecting the safe provision and undertaking of dental treatment; thereby impairing the maintenance and health of the oral and dental structures and tissues; and, secondly, by adversely affecting the cells, tissues, secretions (principally saliva), and organs that protect and/or maintain the integrity and health of the stomatognathic system.

These ADRs can also be further classified by the effects on either the “hard” tissues, of the stomatognathic system, comprising the dentition, periodontium and supporting jaw bones - the maxilla and mandible, and temporomandibular joints (TMJ) and/or the “soft” tissues. The soft tissues, consist of the lips, gingiva, oral mucosa, salivary glands (major and minor), the collagogenous constituents of the periodontium and TMJ’s, muscles used in the functions undertaken by the mouth and teeth (including the gag and swallow reflexes), nerves, including the special sensory system that conveys taste, lymphatic system and the vasculature (Tables 2 and 3).

**Point of Care (PoC) Testing**

An aspect of ADRs that oral health professionals need to increasingly consider in their day-today clinical practice is “Point of Care (PoC) Testing” ensuring that patients are achieving the intended therapeutic targets with respect to the medications they need to take to maintain their health. The ever-improving sophistication of these testing devices and their increasing affordability, entails that all oral health practitioners need to consider providing this service to their patients. Common examples include, PoC Testing for patients taking the anti-coagulant medication, warfarin, to ensure patients are within the required therapeutic range (as measured by the International Normalised Ratio (INR)). Patients who are over-coagulated, in general are thought to be of greater concern, given the risk of uncontrolled haemorrhage, especially if undertaking invasive dental procedures such as extractions. However, patients who are under-coagulated, as identified by a sub-therapeutic INR,
are at risk of potentially fatal, thrombo-embolic events, such as stroke. Other examples include monitoring of patient’s blood pressure that need anti-hypertensive medications and patient’s blood sugar level (BSL) for those patients being treated for diabetes mellitus. In regards to the latter example, hypoglycaemia, with a BSL less than 2.8 mmol/L is associated with the imminent risk of coma, and possibly death.12

However, if committed to providing PoC Testing, practitioners need to be conscientious in recording the results of such testing and acting appropriately on the finding of abnormal results. The finding of a patient with severely abnormal, or potentially, immediately life-threatening abnormal results on PoC Testing, requires the patient to be directed straightaway to the Emergency Department of the nearest hospital, and it is best that the patient is accompanied by a letter briefly highlighting the abnormal results and the concerns regarding the health of the patient. Abnormal results that are less severe, and pose no immediate concern to the patient’s wellbeing, also need to be acted on, by directing the patient to see their treating physician or their regular general medical practitioner, but again an accompanying letter flagging the abnormal results and concerns should accompany the patient. This practice of acting on the finding of abnormal results on PoC Testing is not only sensible, but it can be argued is a medico-legal necessity, that also serves to protect the practitioner. The development of simple, “form letter” with “tick-a-box” features to identify the abnormal results, and what actions the patients has been directed to undertake, with the inclusion of the practice contact details, may readily attend to this issue.

Conclusions

All oral health practitioners, but especially dentists, need to be aware that with the increasing drug use, of prescribed, illicit, over the counter and herbal (complimentary) medications, the incidence of ADRs is increasing and will continue to increase. These ADRs will have a direct effect and indirect effects on the tissues and structures of the stomatognathic system, as well as having the potential to dangerously complicate the delivery of dental treatment and care. Good history taking and awareness of ADRs, will lead to the appropriate treatment planning and the modification of treatment so that it can be undertaken safely, with little risk of morbidity or mortality to the patient, and ensure the provision of a dentition, that can be easily maintained by the patient.

References

2. Rosenheim ML, Moulton R. Council for International Organizations of Medical Sciences 1958 Springfield, Ill., Thomas. Sensitivity reactions to drugs; a symposium organized by the Council for International Organizations of Medical Sciences, established under the joint auspices of UNESCO and WHO [held in Liège, July 9-12, 1957] Eds.

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ATTRITION AND EROSION: ASSESSMENT AND DIAGNOSIS

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Abstract

The management of patients with extensively worn and badly broken down dentitions presents a difficult challenge in dental practice and restorative treatments are often complex, time consuming and costly to implement, so careful case selection and treatment planning is essential. Ultimately the success of any restorative intervention is very dependent on the stability of the oral environment and the status of the remaining tooth structure. Prior to the commencement of any restorative treatment an understanding of the importance of the disease process, the risk factors in the mouth, and the intrinsic and extrinsic factors which affect the oral balance is critical. While there is a growing range of materials and techniques available for cost effective and conservative management of these cases, failure to take a systematic approach to assessment and stabilization may result in early restorative failure, rapid recurrence of the problems and a repeat restoration cycle. Therefore successful management of these patients must include an appropriate mix of preventive and restorative strategies.

Despite the overall trend towards improved oral health and reduced dental caries incidence over the last decades, epidemiological evidence is supporting the contention that tooth wear is increasing in severity and prevalence, not only amongst older people who are living longer and retaining more teeth, but also amongst those in the early decades of their adult life.1-3 This growing incidence of tooth wear has increased the demand on dental practitioners to provide a range treatment alternatives for the replacement of the lost tooth structure to cater for the range of individuals presenting with varying degrees of tooth wear. In recent years there has been an increasing trend toward the restoration of severely worn and broken down dentitions using more conservative approaches with adhesive restorative materials.4-6 These approaches aim to preserve as much remaining tooth structure as possible and provide a cost effective management option for patients. It is essential however that any restorative treatment is only undertaken after careful diagnosis of the causative factors, stabilisation of the oral environment and prevention of further tooth destruction, and remineralisation of the remaining tooth structure to enhance adhesive bonding.7,8

In the diagnosis and treatment planning phase it is important to understand and take into consideration the differences in the process of demineralization and tooth material loss in tooth wear cases compared with dental caries. While dental caries is a localized event with plaque producing relatively weak acids which demineralize tooth tissue over a prolonged period of time, tooth erosion from stronger extrinsic or intrinsic acids usually occurs in relatively short periods of time and can be quite extensive.9-11 Prevention of this acidic demineralisation in the absence of plaque is very dependent on the ability of saliva to stabilize and buffer the acidic challenges in the mouth. Patients with reduced salivary flow or reduced salivary buffering capacity will be at greater risk, and frequently are those demonstrating signs of tooth erosion.12-15

Hyposalivation is a growing concern in dental practice and may be due to a multitude of factors including diet and lifestyle factors, medication side effects or underlying systemic conditions.16,17 As our population ages and individuals keep their teeth longer we are faced with the ever increasing geriatric dentate population with a greater risk of hard tissue dental disease. Combine this with an increasing number of medications being provided to this older population and the overall hyposalivation and xerostomia concerns become more pronounced.18 Consequently the potential for irreversible tooth surface loss, other than by caries, becomes an important aspect of patient oral health management.

Thorough patient risk assessment is essential and requires that all predisposing factors are considered and risks minimized. There are many diagnostic templates and proformas available to assist in this process,19-21 but it is important to be aware that no two individuals will be the same and consideration must be given to individual circumstances. As such it is important to accept that there is no, one single ‘off the shelf’ treatment suitable for all patients, but similar strategies of management can be employed. It is essential to not only recognize the presence of tooth wear, but more importantly to determine the activity status of the process. Many patients will present with tooth surface loss and, while for the sake of record taking it can be classified as showing patterns of erosion, abrasion, attrition or abrasion, there is often no knowledge of how or when this occurred. Determining if tooth wear is a result of past history and now stabilized, or if it is currently still actively occurring becomes central to determining management strategies. Most patients will demonstrate a range of factors contributing to their overall wear, and while many long standing concepts of ‘tooth brush abrasion’ or ‘bruxism’ have been linked with tooth wear, these are often only part of the problem and there is frequently an underlying erosive process which accelerates the process beyond the normal

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physiological range. While there are a number of proposed tooth wear indices and scoring criteria published, there is currently no real consensus on an ideal method of recording and evaluating tooth wear, so it falls on individual operators to make their own clinical decision on when and how to evaluate, record and determine management options.

There are however a number of clinical indicators for active tooth wear and these should be carefully assessed prior to the commencement of any restorative treatment. Visual clues such as decreased surface lustre on enamel can be an indicator of acid dissolution of the tooth surface, similar to tooth etching. In active erosion cases, exposed dentine is often quite sensitive due to dissolution of any protective smear layer and the opening of dentine tubules thereby allowing tubule fluid flow and sensitivity to stimulus. Patients with active tooth erosion often complain of tooth sensitivity, particularly after consuming certain acidic foods or beverages, and this should be taken as a clear indicator of a shift in oral balance from remineralization to demineralization and removing the surface protection on dentine. The presence of calculus, particularly on the lingual of the lower incisors teeth, should always be assessed in patients with tooth wear as the absence of calculus may be an indicator of unsaturated saliva with insufficient ability to mineralize. The formation of calculus is a mineralizing event and will not occur when there is a balance towards demineralization in the mouth. The evaluation of salivary flow, viscosity, pH and buffering capacity becomes critical in these cases, not just for the clinician, but for the patient to assist them in developing an understanding of the risks present. Placement of restorations in an oral environment where there are uncontrolled risks will undoubtedly lead to early restoration failure.

Active tooth erosion will produce a demineralized tooth surfaces which will not provide a reliable or predictable bond with adhesive restorative materials. A severely compromised tooth surface may in fact be more prone to cohesive failure of the tooth rather than adhesive failure at the restoration tooth interface. To ensure the maximum benefits from adhesive restorative materials it is essential that the oral environment is stabilized, risk factors reduced, and the tooth surface remineralized to the best possible condition prior to repair. Strategies for remineralization should include reduction of acids and underlying risk factors where possible, and the inclusion of various remineralization agents. Fluoride has been accepted as an effective agent for enhancing remineralisation and reducing demineralization, but it must be remembered that its action is very dependent on the availability of sufficient calcium. Most current remineralization strategies include recommending the use of calcium and phosphate enhanced remineralization products.

Once stabilized the technical task of rehabilitating a severely worn dentition can proceed, and the range of available restorative materials enables the selection on a number of different approaches. While complex reconstructions with ceramics, crowns, bridges and implants may be considered the best option, many patients are unable to afford the cost associated with this extensive work. Consequently many patients look at less costly options using direct and semi-direct tooth coloured adhesive restoratives and these can often be a quite successful and conservative option. These less invasive treatments can also follow on from the initial stabilization phase and be used to evaluate long term patient compliance prior to undertaking more complex indirect procedures.

References


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ATTRITION AND EROSION:
RESTORATIVE PLANNING AND PERFORMANCE

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Abstract

The number of patients presenting with severe attrition and associated erosion is increasing in frequency. Treatment of this patient group is very challenging as it is simply not just a case of replacing lost tooth tissue, but also trying to identify and then eliminate the aetiological factors responsible for the loss of tooth structure.

In most cases restorative treatment involves extensive rehabilitation of the dentition to restore the aesthetics and function and also to prevent further tooth loss. Such treatment often involves a multidisciplinary approach to eliminate and/or reduce causative factors prior to definitive restoration of teeth.

Treatment needs to focus on quick intervention when the problem has been identified and diagnosed. Restorative treatment involves careful if not complex planning culminating in the establishment of a well defined and ongoing maintenance plan. Long-term success of treatment is centred on the maintenance phase.

Current restorative options include the use of extensive resin composite build-ups. This is often the best initial starting point as it allows for adjustments, as well as being a reversible and more conservative procedure. The use of indirect restorations is likely to provide a longer lasting outcome after initial stabilization, whether it is metal- or ceramic-based or a combination.

Introduction

The attrition and erosion of teeth is becoming an ever increasing problem for practitioners to manage.1,2 This loss of tooth structure was once relegated to more mature patients but recently has become almost independent of age. Often these patients were left in the “too hard basket” for treatment, thus allowing the problem to continue. However, as there is an ever-increasing number of young adults presenting with erosive loss of tooth structure, treatment has become essential to ensure they can maintain a long lasting dentition as well as to uphold current treatment philosophies of minimal intervention dentistry. Thus one of the critical points for treatment is to first identify patients exhibiting a tooth loss problem. The research is still sorely lacking,3 thus making treatment somewhat experimental and published reports are mostly anecdotal rather than controlled treatment studies.

The aetiology of tooth loss is usually multifactorial being a combination of abrasion, erosion, bruxism or some other parafunctional occlusal habit. Identifying the individual factors causing the tooth loss is possibly the most important aspect of treatment as a means to slow the loss of hard tissues. Abrahamsen1 published a useful table outlining some of the factors that will aid diagnosis of tooth loss. It is generally thought that all patients should be considered at risk. Therefore any new patient should be assessed not only for all aspects of the oral cavity we now examine, but observation for tooth wear/loss should be included.1 It can also be said that once identified, tooth wear can be halted or at least slowed considerably.1

The one question that must be answered is when should the tooth wear be considered excessive compared with the physiological wear, which we all experience. Often the determination of normal or pathological tooth loss is based on a patient’s attendance to a dental practice desiring an aesthetic solution for unattractive anterior teeth or problems associated with function and/or tooth sensitivity.3 The other aspect for diagnosis of tooth loss is based on the dentist’s observation that the degree or extent of wear is excessive for the patient’s age.

Once is has been determined that the tooth wear is greater than ‘normally’ expected for the patient’s age, then the next step is to determine the cause. Clinically, it is most likely the cause is not due to one factor alone but a combination of factors working simultaneously. The systematic review paper by Van’t Spilker et al.5 concluded that the number of adults presenting with severe tooth wear at age 20 years was approximately 3% and increased to 17% at 70 years of age. Hence, it is expected that tooth wear will be observed in older patients, which is an increasingly larger patient pool needing more complex care.

It has been noted, however, that there seems to be an increased observation of younger patients presenting with erosion.3 This is due to increased consumption of carbonated drinks as well as other causes.

Management

The management of a patient who presents with what could be termed ‘pathological’ tooth wear is complex from the starting point of a diagnostic decision, then determination of aetiological factors, modifying these factors before undertaking any definitive treatment to replace lost tooth structure. It is also necessary to note the extent of the wear,
as this will influence how extensive and complicated the treatment plan may need to become. Tooth loss or wear can range from just one or two teeth, to the whole anterior segment with little posterior wear or vice versa, or the whole dentition.

The recent series of papers by Mehta et al.5-9 provides a comprehensive overview of assessing a patient who presents with tooth wear and how it can be managed. They reiterate the importance of obtaining an excellent history and examination and ensuring the patient is made to understand exactly what the problem is. Monitoring is also an important part of the overall treatment, especially during the period prior to undertaking restorative rehabilitation. This monitoring is necessary to determine if the aetiological factors have been controlled, without which, any rehabilitation will be less successful.

One aspect that must be determined at examination is the occlusal vertical dimension (OVD) of the patient.10 In some cases the teeth will continue to erupt to compensate for the loss of tooth structure. Hence, the freeway space and rest vertical dimension should be obtained as part of the diagnosis. It will also provide a wealth of information with respect to how any restorative management may be undertaken, and from when to start to plan the rehabilitation phase of treatment.

To develop a comprehensive treatment plan this patient group will need an extensive examination beyond that which we may do for the ‘average’ patient. Points mentioned above, such as OVD, the occlusal relationship, TMJ function, and articulated study casts, intra-oral radiographs, sensibility tests, analysis of the saliva and diagnostic wax-up are all needed before a treatment plan is presented to the patient.11 One of the current drawbacks is the distinct lack of a classification system and a screening tool that may aid practitioners to determine if the wear is in, or close to, the ‘pathological’ range. This would be a great aid in the treatment planning process and at which point to intervene.

Treatment to aid prevention of further tooth loss includes conservative means such as prescribing the use of fluoride mouthwashes and now remineralizing agents such as casein phosphopeptide amorphous calcium phosphate (CPP-ACP) to modify tooth surfaces to become more acid resistant, thus reducing the effects of erosive agents. The fluoride and CPP-ACP containing agents will also assist with eliminating sensitive teeth. Hypersensitivity can also be managed to some extent by modification of tooth-brushing habits, use of desensitizing toothpastes or even the application of resin-based adhesives. In this latter case, the self-etching materials are likely to be simpler to apply to the tooth surface.

Once the aetiological factors of the individual patient’s tooth loss have become better understood, then it is also important to educate the patient about the effects of diet.7-9 The consumption of low pH foods should be avoided, but when this is not possible then the patient must be taught how to reduce the effects of demineralization from such foods and beverages. This can be as simple as rinsing the mouth after consuming acidic food/fluids, or chewing sugar-free gum, which may also contain CPP-ACP.

Often the early phase of treatment will include the use of splint therapy, especially if TMJ symptoms are present. Care must be taken if the patient has gastric reflux or has an ‘erosive’ diet. It must be ensured that the splint does not become a reservoir for the acidic fluids and hence exacerbate the problem. It can also be useful to use the splint as a vehicle to expose teeth to remineralizing agents, thus serving a dual purpose.5

Once the conservative phase and stabilization of the patient’s condition has been achieved then the rehabilitative phase of treatment should commence. This usually means the replacement of lost tooth structure often associated with increasing the vertical dimension. This is especially the case where the anterior teeth have been severely worn but compensated by continued eruption. In such a case the posterior teeth have often changed little. There is currently little research on the clinical longevity of restorations placed in this group of patients. In the past, treatment often incorporated the preparation of teeth to receive indirect restorations such as pinledges, onlays and crowns. Fortunately with the advent and great improvement of adhesive restorative materials a much more conservative and potentially reversible treatment options can now be implemented.12

In the case where a few teeth have been affected by wear and have an existing enamel margin with loss of the dentine surface, typically seen on lower incisors, and there is no reduction in OVD, then a conservative approach aimed at protecting the exposed, and occasionally sensitive, dentine is to cover it with either glass ionomer cement or resin composite. The longevity of such restorations is often limited and patients should be informed of this. However, it is a very simple and quick method to solve the problem. The glass ionomer cements tend to wear and chip at the margins more frequently than resin composite but can often be longer lasting due to chemical adhesion to the underlying sclerotic dentine. When a good enamel margin exists, then bonded resin composites are a good alternative. Should chipping of the composite occur they can be easily repaired. Either a three-step etch and rinse or two-step self-etching adhesive system is preferred based on the clinical evidence showing these two groups of adhesives bond well to sclerosed dentine. A recent laboratory study did show that in the case of a self-etching adhesive it may be useful to lightly roughen the dentine to enhance the adhesion if it has been eroded.13 This has not been tested clinically, but there are studies of bonding to non-curious cervical lesions with the more recent all-in-one adhesives where only the tooth surface has been cleaned with pumice and water. The retention rate of the restorations has been shown to be very good with this treatment.14 However, should the tooth surface be burnished and glassy in appearance, then it would be advisable to roughen this tooth surface prior to bonding. Another alternative is the use of a resin-modified glass ionomer adhesive and resin composite. The author has had some clinical success with this method. This technique combines the adhesion of glass ionomer and strength and wear resistance of composite.

A number of papers have appeared in recent times outlining the clinical processes of how to restore patients'
teeth that have been severely worn. One of the common methods, particularly for anterior teeth that have undergone severe wear is to use the concept originally published by Dahl.\textsuperscript{15,16} His work used cemented cast restorations on the anterior teeth that have been severely worn. One of the common composite materials having been developed to the point of an aesthetic restoration of some type. With adhesive resin space in the anterior segments allowing the placement of an 'open bite' in the posterior region. The aim of such treatment was to slightly intrude the anterior teeth as well as to allow the posterior to erupt into occlusion. This then 'gained' space in the anterior segments allowing the placement of an aesthetic restoration of some type. With adhesive resin composite materials having been developed to the point of being relatively wear resistant and also having good strength,\textsuperscript{17} they have now superseded the use of metal restorations in many cases. A ten-year survival analysis using ‘Dahl’ type resin composite restorations to treat anterior tooth wear was conducted on 26 patients with 283 restorations.\textsuperscript{18} The median survival of the restorations was 5.8 years and 4.75 years for those restorations that required replacement. The study showed that material, incisor relationship and the opposing dentition had a significant effect on survival. Another study treating the same form of tooth wear with resin composite build-ups in 31 patients with 225 restorations showed that major failure requiring replacement was ”uncommon within the first five years”.\textsuperscript{19} The median survival of restorations in this study was 4 years 9 months, which is little different from the other study. The latter study did show that those patients with a Class II Division 2 occlusion exhibited a higher failure rate of restorations, whereas Class II Division 1 had a higher survival rate. No doubt this relates to the amount of stress placed on the restorations during function. A further recent paper also concluded that hybrid resin composite restorations on posterior teeth performed well in cases with increased OVD in severely worn teeth over time.\textsuperscript{20}

One of the concerns is what occurs when the anterior teeth are built up leaving the posterior out of occlusion. Several papers have shown that the posterior teeth can take from 4-6 months to erupt into occlusion whereas the Poyser et al.,\textsuperscript{21} stated it may take 18-24 months in some cases. Occasionally the teeth do not completely erupt into occlusion. However, these teeth can easily be modified with the addition of resin composite. When undertaking such treatment, patients must be fully informed and cognizant that there will be a period when mastication may be difficult until the posterior teeth erupt back into occlusion.

The papers by Dietschi and Argente,\textsuperscript{21,22} provides a comprehensive overview for the treatment of tooth wear caused by abrasion and erosion. Table 1 outlines their recommendations for restoration based on the amount of tooth loss. Where possible a conservative approach should be the first option as it would seem this form of treatment can be quite successful, at least in the short to medium term. It is reversible; restorations can be easily repaired and thus can reduce the cost for patients. Most of the authors reporting on the restoration of worn teeth also advise the use of a night guard to assist in prevention of restoration fracture and reduction of wear.

When treating posterior teeth, the use of resin composite is more likely to be an intermediate step prior to a more permanent restoration. Although resin composites have improved with respect to wear and fracture resistance, it is still an issue for long lasting restorations when considering this patient group.\textsuperscript{9} Thus it is prudent to consider the placement of metal crowns or an aesthetic material such as ceramic or ceramo-metal crowns at some later stage. Adhesive and self-adhesive resin cements such as Super Bond C & B’ or Panavia have now made it much easier to prepare very conservative preparations on molars to modify OVD and give the patient a retentive restoration leaving a lot of sound tooth structure. The metal crowns can be either a gold-based alloy or nickel-chrome. Metal restorations can be made in thin section, so in the case where OVD may only

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Region & Tooth condition & Treatment & Alternative treatment \\
\hline
Posterior teeth & No caries or restoration & Direct resin composite & Onlay \\
& Small caries lesion, small –moderate sized restoration & Direct resin composite & Onlay \\
& Large caries lesion, large restoration, non-vital tooth & Onlay or overlay – either gold or tooth coloured & Complete crown \\
\hline
Anterior teeth & No caries or restoration & Direct composite & Ceramic/Composite veneer with resin composite \\
& No caries lesion, no restoration but labial enamel lost/damaged & Veneer and direct composite & Complete crown \\
& Small caries lesion, small –moderate sized restoration & Direct composite & Ceramic/Composite veneer with resin composite \\
& Large caries lesion, large restoration, non-vital tooth and discoloured & Veneer and direct resin composite & Complete crown \\
\hline
\end{tabular}
\caption{Treatment alternatives based on tooth condition where enough tooth remains for placement of an adhesive restoration.}
\end{table}

\footnotesize
\textsuperscript{1} Sun Medical, Japan \\
\textsuperscript{2} Kuraray Medical, Japan
need a slight increase or the patient is unable to tolerate a larger change, then these materials are ideal. Where patients also have a bruxing component in the wear, then metal restorations are excellent due to their wear resistance but also they will not wear the opposing dentition. Ceramic restorations can be another alternative. However, ceramic restorations need bulk and adequate thickness to prevent fracture, can more easily abrade the opposing dentition, and are difficult to repair simply.

This patient group seems to be increasing, hence it is likely the treatment of the warn dentition will become more common. It is essential to accurately diagnose the problem and determine the underlying causative factors. A good knowledge of occlusion is essential. Where possible a conservative approach to rehabilitation should be undertaken by the use of adhesive resin-based materials to ‘rebuild’ teeth. The use of the traditional type of restoration such as crowns increases loss of tooth structure through preparation, may compromise pulp vitality and is often more difficult to adjust and repair. It is also essential to maintain constant monitoring of patients after treatment is undertaken to circumvent further problems from eventuating.

References

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Pulp, root canal and periapical conditions are the most common reasons for patients to present to dentists for emergency or urgent management. These conditions will be either inflammatory in nature or due to infections, with infections also causing inflamed tissues. In order to accurately diagnose such conditions and to then manage them appropriately, it is essential that dentists have a thorough knowledge and understanding of the various conditions that affect the pulp, the root canal system and the periapical tissues. Traditionally, many dentists have used vague and misleading terms to indicate pulp diseases – such as ‘vital’ and ‘non-vital’ pulps. However, these terms are very inaccurate and meaningless as they do not accurately indicate the state of the pulp (only the presence or absence of blood supply) and they do not indicate the management options. For example, the pulp of a tooth that responds to pulp sensibility tests and is therefore designated as ‘vital’ could have any one of 12 different conditions if a more comprehensive diagnostic classification is used.1 These 12 conditions require different management – such as no treatment (e.g., for a clinically normal pulp), caries removal or restoration replacement (e.g., for acute reversible pulpitis), root canal treatment (e.g., for acute irreversible pulpitis) or extraction (where the tooth is not suitable for further restoration). Similarly, a tooth that does not respond to pulp sensibility testing and was previously designated as ‘non-vital’ could have any one of 10 different pulp or root canal conditions which require different management. In addition to considering the pulp and root canal conditions, the diagnosis must also include assessment of the periapical tissues, ideally also using a comprehensive diagnostic classification2 that includes all of the possible tissue changes that can occur throughout the life of a tooth. Overall, there are 17 different pulp/root canal conditions and 14 different periapical conditions in these two classifications. When diagnosing any tooth, both tissues must be considered (because the state of the pulp/root canal determines the periapical condition) and therefore there are many permutations and combinations that must be considered.

The diagnostic process is extremely important and must be followed for every case. It begins with obtaining a thorough history which should enable the dentist to formulate a provisional diagnosis. Then the clinical examination, pulp tests and radiographs should lead to a definitive diagnosis which should also include an assessment of the cause(s) of the disease(s).12 Periapical radiographs are usually sufficient to diagnose pulp, root canal and periapical conditions provided they have been taken with appropriate techniques, angulations and processing. However, in some cases, other imaging techniques may be required – such as computed tomography or cone beam volumetric tomography. These can be used to assist diagnosis as well as to provide information to assess the feasibility of treatment, and at times the tooth’s prognosis. However, the potential benefits and disadvantages (especially radiation levels and costs) must be carefully considered before ordering such images. The popularity or excitement of using new technology should not be the determining factor; rather the patient’s welfare and whether the imaging is likely to be of benefit should be paramount. In many (especially routine) cases, these imaging techniques do not change the diagnosis or the management required and therefore they will not be beneficial to the patient.

Prior to commencing root canal treatment, it is essential that dentists consider the prognosis of the tooth. Most endodontists, dentists and research studies have focused either on the technical aspects of treatment or whether the periapical tissues heal following treatment. There is ample evidence to show that the presence of a periapical radiolucency is a significant factor associated with post-operative healing when assessed radiographically.3 It is also well-accepted that periapical radiolucencies indicate that the root canal system is infected and if the bacteria can be eliminated from the root canal system, then healing is very likely to occur.4 The small number of cases that do not heal are usually due to persistent intra-radicular infection, a periapical scar, an extra-radicular infection, a periapical true cyst or a foreign body reaction.4 The latter three conditions require surgical treatment whilst the first requires retreatment of the root canal system and possibly surgery if still no healing. Periapical scars do not require any treatment but they should be regularly reviewed since they usually have the same radiographic appearance as the other conditions and cannot be accurately diagnosed clinically. Notwithstanding these periapical conditions that can occur in a small number of cases, most teeth will demonstrate healing if adequate anti-bacterial measures are incorporated into the root canal treatment protocol. Many cases will even heal without the root canal treatment being completed – that is, following an emergency appointment where some initial root canal treatment is performed along with removing the cause of the disease (e.g., caries, cracks, defective restorations) and the placement of an adequate interim restoration.3 Hence, root canal treatment is reasonably predictable if scientific principles are followed.

The above consideration of prognosis is only concerned with healing. This is obviously a very important aspect, but a key factor that has been missing in assessing prognosis is
the longevity of the tooth. In other words, how long will the tooth remain in the mouth in a stable, healthy and functional state following root canal treatment and restoration?

This will depend on how long the restoration can prevent bacteria entering the tooth, whether any other problems develop (e.g., caries, cracks, etc.) that allow bacterial entry into the tooth, and the periodontal status. The latter is important and can be assessed pre-operatively whereas the former two factors cannot be assessed prior to root canal treatment. The key determinant for these will be the amount and quality of the remaining tooth structure as this will dictate firstly whether the tooth should be restored, secondly whether it can be restored, and thirdly what restoration(s) can be provided.

In order to assess the amount and quality of the tooth structure, operators need to visualize the tooth itself and not the tooth with a restoration. Hence, all existing restorations need to be removed prior to commencing root canal treatment along with all caries, cracks and any other entry point for bacteria. Furthermore, it is impossible to determine by clinical and radiographic examination whether an existing restoration has marginal breakdown allowing bacterial entry. It is also impossible to accurately determine whether there are cracks and/or caries in a restored tooth without first removing the restoration. Hence, complete removal of all possible pathways for bacterial penetration not only removes the possibility of further bacterial contamination during treatment, but it also allows the operator to assess the prognosis and longevity of the tooth far more accurately. This phase of treatment has been called “investigation” of the tooth and it should form an integral part of all root canal treatment. Tooth investigation leads to better case selection since only teeth that are suitable for further restoration will be treated. If the tooth is not suitable for further restoration then it should be extracted and a prosthesis can be considered.

In summary, the outcome of root canal treatment can be greatly enhanced by understanding the disease processes involved, an accurate diagnosis and good case selection. The latter can only be predictably achieved following investigation of the tooth to determine its suitability for root canal treatment and further restoration by removing the existing restorations, caries, cracks and any other cause of the diseases. Good case selection will lead to more predictable treatment outcomes and only teeth with predictable longevity will be chosen for treatment.

References
2. Abbott PV. Classification, Diagnosis and clinical manifestations of apical periodontitis. Endo Topics 2004;8:36-54.

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PERSISTENT ENDODONTIC INFECTION - RE-TREATMENT OR SURGERY?

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Abstract

Management of a tooth with persistent periradicular disease primarily involves management of persistent intraradicular infection. Conventional endodontic re-treatment is the main modality that will manage this condition although endodontic surgery with or without retreatment is a viable option in cases. Case selection involves an appreciation of the disease aetiology and expected outcomes and consideration of patient, tooth and clinician factors. Both conventional endodontic re-treatment and surgery have high long-term success and survival rates and it has been shown that an endodontically treated tooth with persistent periradicular pathology that can be managed by conventional endodontic re-treatment or surgery and restoration has comparable, and potentially more beneficial, outcomes to treatment options involving tooth loss and rehabilitation, such as an implant supported crown. As such endodontic re-treatment should be the prime treatment modality unless a tooth has reached a stage where these techniques cannot manage ongoing disease and/or structural integrity.

Introduction

Persistent endodontic infection is a biofilm disease usually located within the root canal system that induces an inflammatory response in the periradicular tissues leading to the development of the two most common inflammatory lesions of the jaws – periapical granuloma and radicular cyst. When treatment planning the management of persistent endodontic disease a clinician should take into consideration a number of factors. These will be briefly considered.

Criteria for Evaluation of Endodontic Outcome

When evaluating endodontic treatment outcome there are three general criteria that a clinician should consider: adequate clinical function, histological evaluation, and radiographic evaluation. Adequate clinical function relates to the absence of clinical signs of infection for example, absence of pain, swelling, draining sinus, and the retention and function of a tooth. These criteria must be met and could be considered as survival for an endodontically treated tooth. Histological assessment of healing of periradicular tissues is the most demanding criterion and in practical and ethical terms is unable to be determined. However, previous studies have shown us that a radiographic assessment using standardized technique and assessment criteria based on the normal width and contour of the periodontal ligament space can accurately determine healing of the radicular tissues, and as such radiography is an important tool in assessing outcome.

Time-course for Radiographic Evidence of Healing

It is important to have an understanding of how long healing of periradicular pathology may take in order to determine successful outcome. In general, complete healing of periradicular pathology of endodontic origin may take four to five years. However, Ørstavik has shown that approximately half of these lesions may completely heal in one year post-treatment and the majority (86%) will heal within two years. Importantly Ørstavik also showed that radiographic signs of definite, but incomplete, healing were apparent at one year post-treatment in the majority (89%) of lesions that subsequently fully healed indicating that observation of healing on a radiograph is a strong predictor of total healing. This information may allow a clinician to accurately determine the status of a periradicular radiolucent lesion and the ultimate success of the endodontic treatment.

It should be noted that these data are related to the analysis of periapical radiographs. It is likely that new technology, such as Cone Beam Computed Tomography will detect the presence of periradicular lesions sooner in a disease process and for longer in the healing phase due to its higher specificity. As such clinicians will have to be wary in diagnosing “non-healing” lesions from CBCT imaging.

Biological Reasons for Persistent Periradicular Pathology of Endodontic Origin

Periradicular pathology of endodontic origin is a bacterial biofilm disease modulated by the host inflammatory response that results in the most common types of lesions of endodontic origin – periapical granuloma and radicular cyst. Generally there are three main reasons why periradicular disease persists after endodontic treatment.

Intraradicular Infection

This is characterized by infection within the treated root canal system (root canal space and radicular dentinal tubules) and is the most common cause of persistent disease. It may be associated with a number of factors such as re-infection via coronal microleakage or the presence of residual bacteria that were not eradicated during chemomechanical instrumentation e.g., due to missed canals, inadequate technique, root canal morphology, or therapy resistant bacteria. As such the treatment of choice to remove the cause(s) is conventional endodontic re-treatment.

Extraradicular Infection

In a small number of cases endodontic bacteria, primarily Propionibacterium spp. and Actinomyces spp, can colonize

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the external surface of an endodontically well-treated root (usually within areas of cementum/dentine resorption) and can sustain an infection. Endodontic surgery is required to eradicate the cause. However, clinically it is impossible to detect if this has occurred.

**Radicular cyst**

There are a number of types of lesions that can mimic a periradicular lesion of endodontic origin. However, the most common persistent lesions caused by endodontic biofilm are the inflammatory lesions of periapical granuloma and radicular cyst. Traditionally it has been assumed that a true radicular cyst will not resolve after conventional endodontic treatment, compared with a bay/apical pocket cyst due to the cyst “being under its own growth control” and endodontic surgery is required to remove the lesion. However, recently this has been questioned as it has been shown that radicular cysts from teeth with persistent periradicular lesions express Toll-Like-Receptor 2 that indicates the presence of a Gram-positive bacterial antigen and a host inflammatory response to the antigen. This suggests that the true radicular cyst may resolve when bacterial stimulation is removed i.e., by conventional root canal re-treatment. Further research in this area is warranted.

The presence of extraradicular foreign material e.g., non-surgical endodontic materials, food particles has been identified as another cause of persistent periradicular disease and highlights the concept of maintaining instrumentation within the root canal with no violation of the periradicular tissues and providing a coronal seal from exogenous material.

**Case Selection**

In treating persistent endodontic disease the guiding principle is that conventional re-treatment is the treatment of choice as it can provide the best ability to eliminate the primary aetiology of persistent infection i.e., intraradicular infection. However, other patient, tooth, and clinical factors should be considered when choosing the best treatment option.

Patient considerations (Table 1) also include medical, anatomical, and aesthetic considerations. Tooth considerations are primarily focussed on determining whether a clinician can gain access to the whole root canal system and adequately manage the infected root canal system. Management of the biofilm may be hampered by canal anatomy (e.g., intercanal communications, canal location), procedural errors (ledge, zip, perforation), or obstructions (un-negotiable ledge, posts, canal blockage by materials). Conventional re-treatment should be considered in the first instance. However, endodontic surgery alone or in combination with conventional re-treatment may be the best option particularly if the apical portion of the root canal cannot be gained by conventional re-treatment. As with all treatment modalities, a clinician’s skill and experience and the use of contemporary materials and techniques must be considered.

**Treatment Options**

Although conventional endodontic treatment and endodontic surgery are technically possible treatment options to manage persistent periradicular pathology, clinicians should be confident that they can provide good outcomes to a patient. Similarly, if a clinician considers an alternative option of extraction and rehabilitation (e.g., removable partial denture, fixed partial denture, implant supported crown) rather than retaining a tooth by endodontic means, he/she must be confident that it provides a clear long-term benefit to the patient.

It has been shown in rigorous systematic reviews that conventional endodontic treatment and restoration of a tooth results in high (> 90%) long-term success and survival rates. In comparison, tooth extraction and replacement with an implant supported crown provides no better survival rates, while a fixed partial denture (bridge) offers poorer success and survival rates. Clinicians should also take into account other considerations on treatment type when treatment planning e.g., single implant supported crowns require approximately five times more post-treatment interventions compared with endodontically treated teeth.

Similarly, systematic reviews report high long-term success and survival rates for teeth treated by conventional endodontic re-treatment (87%) or endodontic surgery (94%) similar to fixed partial denture (89%) and single implant supported crown (94.5%). Additionally, Kim and Solomon undertook a cost-effectiveness analysis of treatment options and showed that endodontic surgery and conventional re-treatment undertaken by either a general dental practitioner or specialist were the most cost-effective options (Table 2) i.e., lowest cost treatment with similar outcome to other options.

These results indicate that a tooth compromised by any structural or pathological disorder that can be endodontically treated and restored should be the prime treatment option as it will provide long-term benefits to a patient. Tooth extraction and replacement e.g., by a fixed partial denture or implant supported crown should only be considered when a tooth has reached “end-stage tooth failure” where a tooth with a pathological state or structural deficiency continues to exhibit progressive pathological changes and clinical dysfunction that cannot be managed by endodontic and restorative treatment.

**Conclusion**

Management of a tooth with persistent periradicular pathology of endodontic origin should follow the principle of optimal elimination of disease aetiology with minimal biological cost. A tooth that can be re-treated by conventional
re-treatment and/or endodontic surgery offers high long-term success and is the primary treatment option.

References

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<table>
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<th>Ranking</th>
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<th>Specialist</th>
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<tr>
<td>1</td>
<td>Endodontic surgery</td>
<td>Endodontic surgery</td>
</tr>
<tr>
<td>2</td>
<td>Conventional re-treatment + crown</td>
<td>Conventional re-treatment + crown</td>
</tr>
<tr>
<td>3</td>
<td>Conventional re-treatment + crown + post/core</td>
<td>Conventional re-treatment + crown + post/core</td>
</tr>
<tr>
<td>4</td>
<td>Conventional re-treatment + crown + crown lengthening</td>
<td>Conventional re-treatment + crown + crown lengthening</td>
</tr>
<tr>
<td>5</td>
<td>Conventional re-treatment + crown + post/core + crown lengthening</td>
<td>Conventional re-treatment + crown + post/core + crown lengthening</td>
</tr>
<tr>
<td>6</td>
<td>Extraction + fixed partial denture</td>
<td>Extraction + fixed partial denture</td>
</tr>
<tr>
<td>7</td>
<td>Extraction + single implant crown</td>
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TIMING OF IMPLANT PLACEMENT: PLANNING AND PROCEDURES FOR PREDICTABLE CLINICAL AND AESTHETIC OUTCOMES

Michael Danesh-Meyer, BDS, MDS(Perio)*

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Abstract

The placement of dental implants is dependent on a number of factors relating to both the patient and the site in which implant placement is contemplated. Additionally, there has been a general trend towards immediacy in implant therapy. This paper considers case selection and clinical decision-making and treatment guidelines in cases where immediate implant placement is contemplated. Treatment alternatives, including site preservation, early and delayed implant placement are also discussed.

The timing of dental implant placement relative to tooth extraction is dependent on a number of factors relating to both the patient and the site into which implant placement is contemplated. In recent years there has also been much emphasis and a general trend toward immediacy in implant therapy. The challenge for the clinician is to determine what staging is appropriate for which case. The timing of implant placement relative to the removal of a tooth has been the subject of interest since the early 1990s.1-3

Generally, the timing of implant placement can be divided into three main categories: immediate, early and late. However, until recently it has been difficult to interpret the literature due to the variation in the definitions of what constitutes “early” placement with some authors suggesting this indicates implant placement within weeks of tooth extraction and others suggesting a number of months. In 2008, the ITI treatment guide published a comprehensive overview of what constitutes immediate, early and late implant placement. Table 1 represents a modified form of the classification proposed for the time of implant placement after tooth extraction.

Immediate implant placement

This is where the implant is placed at the same time as tooth extraction. Case selection is critical and immediate implant placement should generally be avoided in cases with a high aesthetic demand and thin gingival biotype (high aesthetic risk). The advantages of immediate implant placement are as follow:

• Reduced treatment time with fewer surgical appointments.
• No need for transitional removable/fixed prosthesis where an immediate provisional crown in provided.
• Immediate aesthetics and function (with immediate provisionalization)

The main disadvantages of immediate implant placement include:

• More clinically demanding (higher level of surgical and prosthetic skill).
• Higher aesthetic risk especially in thin Biotype cases.
• Strict patient compliance is required with immediate loading/ provisionalization
• Can not be undertaken when Guided Bone Regeneration (GBR) is also required due to need for primary soft tissue closure.
• Implant site is required to have good bone support, good bone density and sufficient bone height apically to allow primary fixation of the implant.
• No significant periapical pathology or apical cyst.

One of the more intriguing questions relating to immediate implant placement in recent years, is whether or not the placement of a dental implant into an extraction socket will help to preserve and maintain the bone of the socket, particularly the labial bone, which has a direct bearing on the aesthetic outcome of the case. Studies involving both animal models and clinical work have shown that the placement of dental implant into an extraction socket does not prevent loss of the bundle bone that constitutes the labial plate and that it will still undergo resorption as part of remodelling post extraction regardless of whether or not there is an implant present. This loss of buccal plate is manifest clinically through tissue shrinkage and apical settling of the marginal gingival (recession) which can be of concern aesthetically. More recent research suggests that if the space between the labial plate of bone and the implant within the extraction socket is augmented with a slowly resorbable allograft, the negative effects of labial plate bone loss on gingival recession and the subsequent aesthetic result can be minimized.4,5

Early Placement

In cases where immediate implant placement is not indicated, post tooth extraction early placement may be indicated. Acute periapical infection, high aesthetic cases, insufficient apical bone/poor bone density and proximity of anatomical structures (maxillary antrum, mental nerve, inferior alveolar nerve) may all preclude immediate implant placement. Early placement refers to implant placement 4-8 weeks after tooth extraction. It allows for primary soft tissue healing over the extraction site. Early placement carries a lower aesthetic risk relative to immediate implant placement. Early implant placement is often undertaken in conjunction with simultaneous GBR. The success of GBR in these cases is greatly enhanced by the relative ease of primary soft
Recent retrospective and prospective clinical studies suggest favourable and predictable aesthetic outcomes following early placement protocols. In cases with severe bony defects either block or onlay grafting (autogenous or allograft) or GBR with bone particulate and GTR membranes may be used to reconstruct the alveolar ridge prior to implant placement. Grafting the maxillary antrum using a lateral wall approach has also shown to be very effective and predictable at increasing vertical bone height in the posterior maxilla, thereby assisting in implant installation.

**Summary**

Each of the abovementioned treatment approaches are valid options in clinical practice depending on the presenting condition of the case. A recent Cochrane systematic review comparing the outcomes of these different treatments concluded that there was no strong evidence that one placement method was significantly better than another. This study also pointed out the fact that it was difficult to draw any strong conclusions as most of the studies reviewed had low power and exhibited bias. Despite the limitations, the authors suggested that immediate implant placement may have a higher risk of failure and complications (including aesthetic) compared with later placement. But they also commented that overall aesthetic results may be enhanced by placing implants soon after tooth extraction.

### Table 1

<table>
<thead>
<tr>
<th>Classification</th>
<th>Descriptive terminology</th>
<th>Period after tooth extractions</th>
<th>Desired clinical situation at implant placement</th>
</tr>
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<tbody>
<tr>
<td>TYPE 1 Immediate</td>
<td>Immediate placement</td>
<td>Nil</td>
<td>Fresh intact extraction site</td>
</tr>
<tr>
<td>TYPE 2 Early</td>
<td>Early placement with soft tissue healing</td>
<td>Typically 4 to 8 weeks</td>
<td>Post extraction with soft tissue healing no bone healing</td>
</tr>
<tr>
<td>Type 3 Early</td>
<td>Early placement with partial bone healing</td>
<td>Typically 3-4 months</td>
<td>Post extraction with healed soft tissue &amp; significant bony healing</td>
</tr>
<tr>
<td>Type 4 Late</td>
<td>Late placement</td>
<td>6 months or longer after extraction</td>
<td>Complete osseous healing post extraction.</td>
</tr>
</tbody>
</table>


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**IMPLANT COMPLICATIONS: RISK EVALUATION, DIAGNOSIS, MANAGEMENT AND OUTCOMES**

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*Dr Peake is a periodontist practising in the ACT. His practice is limited to implant surgery and associated procedures.*

Abstract

Dental implants and their restorations have become an accepted and predictable modality of treatment. The literature reflects excellent long-term survival rates. However, survival of an implant does not necessarily translate to success, and in between these two outcomes lies the world of implant complications.

Complications associated with dental implants occur with both the restorative and surgical components, with the restorative component complications being more frequent and to some extent, more easily managed.

Surgical complications are difficult to manage, and can be the result of many aspects of the implant surgery. Potential complications can arise from poor planning, poor case selection, and poor execution. Complications can also occur where no technical or surgical errors are apparent, but where biology and the fundamental flaw of the trans-mucosal design of dental implant prostheses, adversely affects the outcome.

This presentation outlines the nature of potential complications and looks at practical and pragmatic methods, first to try to prevent complications, through improved case selection and execution; secondly, it discusses the most effective methods to prevent complications in implants already installed, by adequate maintenance programmes. Lastly, it deals with those cases which require clinical management of the complications.

This presentation provides the clinician with a greater understanding of the difficulties in managing implants that are not progressing as we, the clinicians, and the patients, had originally expected.

Dental implants and their associated restorations have become a widely used treatment modality. A recent retrospective study of 511 titanium implants with a sandblasted and acid etched surface indicated a survival rate of 98.8% after 10 years. This patient cohort was partially edentulous and restoration consisted of single crowns and fixed bridges. The reported success rate in this study, also at 10 years was 97%. This reported success rate is high and, in contrast with a number of other studies, these other studies show a gap between the survival rate and the success rate of dental implants. Success has been defined as 'the element (implant or reconstruction) is present at the follow-up examinations and complications are absent'. Survival is defined as 'the element (implant or reconstruction), is present at the follow-up examination, but its condition is not specified'.

The wide use of implant survival as a measure of a positive clinical outcome is misleading because no clinical factors are assessed in survival rates, apart from the absolute presence or absence of the implant. Whilst survival rates accurately reflect implant attachment, they do not give us a true picture of the clinical situation of the implant or the complications which may have occurred or are occurring, or the treatment that may have been necessary to deal with any complications. The measure of implant success and details of clinical complications is a more accurate reflection of the health of dental implants.

Implant complications seem to occur frequently. Complications with the restorations on implants will occur more often than complications with the implants. This is somewhat comforting. Managing restorative complications is often less invasive and clinically can give a good outcome.

In assessing implant complications in this presentation, we will look at risk evaluation, diagnosis, management and outcomes.

**Risk evaluation**

For accurate assessment of risk, we can apply the 3P principle, to assess:

*The Practitioner*

Surgical placement of dental implants can sometimes be quite straight-forward. Very often the surgery can be very challenging. An escalation of difficulty can occur quickly, if each stage of the surgical procedure is not performed adequately. Disasters in dental implant surgery are rarely the result of one catastrophic incident, but usually the result of smaller complications, not adequately assessed, and addressed at the time. Similar outcomes are often noted in general aviation. Accidents occur when multiple small errors go uncorrected and contribute to an adverse outcome. The importance of adequate surgical training and surgical prudence cannot be over-emphasized.

*The Procedure*

The use of the SAC treatment planning guide, developed by the ITI is a useful tool for classifying the degree of the difficulty of a surgical or restorative implant procedure. A clinician should progress from straight-forward to advanced and then to complex, when satisfactory outcomes of a number of implants at each level are performed successfully by the practitioner.

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* Presented at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand, 31 March - 4 April 2012
The Patient

Patient related risk factors need to be considered. Liddelow and Klineberg\(^6\) reviewed some of the relevant literature in their review paper and indicated that there was good evidence for increased risk of failure of implants for smokers, patients with a history of radiotherapy and where local bone quality and quantity was compromised. Weaker evidence exists for those with a history of periodontitis, and patients who had taken bisphosphonate medications. This paper also suggested that there is a correlation between genetic traits and disruption of osseointegration. Mayfield and Huynh Ba indicated increased risk of peri-implantitis in smokers and those suffering from chronic periodontitis.\(^7\)

Diagnosis

The literature indicates that technical complications will occur more frequently than biological complications in implant supported restorations. A supportive programme, involving regular scheduled examination should occur for every implant. A successful implant should be treated in the same way as a periodontally compromised tooth. Regular reviews of each implant should involve:

1. pocket depth recording
2. radiographic assessment
3. bleeding on probing and suppuration assessment
4. occlusal assessment of fixed restorations
5. implant-specific plaque control instruction.

Management

The management of complications is case-specific. Papaspyridakos et al.\(^8\) followed 281 implant-supported complete dental prosthesis. Their conclusions indicated that large percentages of the restorations had complications, with only 8.6% of restorations being complication-free at 10 years post-placement. The most significant biological complication for dental implants in the longer term, is peri-implantitis, with high rates reported. Fransson et al.\(^7\) reported peri-implantitis rates at 28%. Koldsland et al.\(^3\) at 47% and Zitzmann and Berglundh\(^9\) had rates of greater than 56%. Buser\(^1\) in his recent study indicated a rate of peri-implantitis at 10 years at 1.4%. The current controversy and variability in reported rates does appear to be related to the definition of peri-implantitis, with Buser et al.\(^1\) requiring suppuration to be included as a defining characteristic, whereas other authors used only increased probing pocket depths and bleeding on probing. A useful tool in the management of peri-implantitis was developed by Lang et al.\(^10\) and established as a formalized treatment protocol for the varying clinical health of the peri-implant tissues. The Cumulative Interceptive Supportive Therapy model is easily applied to all implants.

Outcomes

Outcome data for implants affected by peri-implantitis are limited. Only two papers are noted, with differing outcomes. Heitz Mayfield et al.\(^11\) followed 36 implants in 24 patients. One hundred percent survival was recorded at 12 months, following treatment which involved plaque control instruction, antibiotics, open flap debridement and regular reviews. Leonhardt et al.\(^12\) followed peri-implantitis affected implants for five years following surgery, debridement and antibiotic therapy. Seven of the 26 implants studied were lost due to peri-implantitis at or before the five year follow-up, indicating ongoing progression of the disease, despite surgical intervention.

Summary

Dental implants provide a reliable modality of treatment, but complications are frequent and biological complications, particularly peri-implantitis are poorly managed. Rocuzzo et al.\(^13\) summarized our current dilemma as ‘the approach for multiple preventive dental extractions and implant placement, based on the assumption that implants perform better than teeth, should be followed with extreme caution’.

References


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THE IMPACTED CANINE – AN ORTHODONTIC PERSPECTIVE

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ABSTRACT

The impacted canine is relatively common in incidence and can often lead to difficult treatment planning decisions. Cone Beam Computed Tomography (CBCT) imaging has improved diagnosis and treatment planning of impacted canines. In particular, this technology has allowed the clinician to accurately locate and visualize these teeth better than ever before, as well as greater appreciate the degree of damage to neighbouring teeth such as lateral incisors. Improved diagnosis and treatment planning with CBCT has therefore resulted in improved treatment outcomes.

The objective of this presentation will be to cover the incidence, complications and management of impacted canines from an orthodontic perspective. Impacted canines are commonly cited as occurring in 1% of the population. Complications of impacted canines include root resorption and devitalization of the adjacent lateral incisor, ankylosis, cyst formation and prolonged retention of the deciduous canine. Interceptive management of impacted canines may include the removal of the deciduous canine. Management of impacted canines also include either their removal or orthodontic movement into their correct position.

Introduction

Impacted teeth can be defined as those teeth that are delayed in eruption or that are assessed as unable to erupt spontaneously. Maxillary canines are the second most frequently impacted teeth in the dental arch after third molars. The diagnosis and treatment of this problem is often challenging, requiring a multi-disciplinary approach to treatment planning and management.

Incidence, Aetiology and Complications

The maxillary impacted canine is reported to occur between 0.9% and 3% of the general population. They are twice as common in females compared with males and the unilateral/bilateral occurrence is 5:1. In 61% of canine impactions, the tooth is located palatally in the dental arch. Mandibular canine impaction is less common occurring in 0.35%.

The most common causes of impacted canines relate to local factors such as crowding, prolonged retention or early loss of the deciduous canine, ectopic position of the tooth bud, presence of an alveolar cleft, ankylosis, cystic neoplastic formation, or dilacerations. Other possible factors may involve the guided eruption of the canine by the lateral incisor or genetic factors.

A number of complications may arise from an impacted canine such as displacement of neighbouring teeth, internal resorption, cyst formation, referred pain. The most significant complication is the external root resorption of the adjacent teeth which is very common (48%) in ectopically erupting maxillary canines.

Diagnosis

The clinical features of an impacted canine may include delayed eruption of the permanent canine, prolonged retention of the deciduous canine, absence of a canine bulge of palpation of the buccal alveolus, a palpable canine bulge ectopically such as palatally, and excessive distal tipping of the adjacent maxillary lateral incisor.

Radiographic evaluation of an impacted canine usually is performed with a panoramic radiographic view. Localization of the canine can be determined with periapical radiographs with a tube shift technique or more recently with a CBCT. In addition to accurate localization, CBCTs allow for the clear assessment of external root resorption in neighbouring teeth.

Treatment Options

The decision to treat a developing impacted canine may be based on a patient’s age, position of the impacted canine, condition of the retained deciduous canine, the presence of pathology such as resorption and ultimately, the patient’s preference for treatment. If the decision is made to not treat, then periodic follow up is required to assess the presence of developing complications.

Interceptive treatment of a developing impacted canine may improve its eruption path. It has been shown that interceptive removal of a retained deciduous canine could improve the angulation and eruption path of an ectopic canine in 78% of cases. The likelihood of improved angulation was correlated to age of the patient (≤ 11 years) and the degree of overlap of the canine over the root of the lateral incisor in radiographs. The rate of angulation improvement was 91% for canines that overlapped less than half the lateral incisor root, and 64% for those that overlapped more than this (Fig. 1).

Surgical exposure of an impacted canine is a common treatment option most commonly performed in combination with orthodontic treatment to move the impacted tooth into the dental arch. This can be performed as an open or closed exposure with or without a bonded attachment placed at the time of surgery. Predictability of achieving the desired
treatment outcome is an important consideration when selecting this treatment option. The advantage of surgical exposure and orthodontics is that the ideal occlusion, aesthetics and function can be achieved. The risks are that orthodontic treatment is often prolonged, iatrogenic root resorption may occur (particularly to the adjacent teeth), gingival recession may occur on the impacted canine, and on rare occasions there may be ankylosis of the exposed canine.

Surgical removal of an impacted canine can also be considered. Indications for removal may include severe displacement of the canine (beyond the scope of orthodontic movement), root resorption or dilaceration of the canine, anticipated poor patient compliance with orthodontic treatment, acceptable position and prognosis of the adjacent first premolar or pathology associated with the impacted canine. The advantage with surgical removal is that orthodontics may be avoided or treatment time may be reduced. The disadvantages are that the adjacent teeth may be damaged during removal, the first premolar may not perform as an ideal replacement for the canine, or the canine may need to be replaced with a prosthetic tooth. In such circumstances, the deciduous canine may be kept if its prognosis is deemed adequate.

Autotransplantation of the impacted canine is a less common treatment option. This initially involves that delicate surgical removal and temporary placement in the sulcus during bone healing. Subsequent site preparation, tooth insertion and fixation are performed. Anecdotally the failure rate of this option is high, however some published data are more promising finding an 83% survival rate and 38% success rate over a 14 year follow up.

Conclusions

Impacted canines are a common dental anomaly with the potential to cause a number of complications. Early diagnosis is important in achieving improved outcomes through interceptive removal of deciduous canines. Clinical examination including the palpation of canines will aid the diagnostic process. Radiographic examination including CBCTs aid localization and treatment planning. The main treatment options for impacted canines are surgical exposure and orthodontics or surgical removal.

References


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THE APPLICATION OF SKELETAL ANCHORAGE IN THE CORRECTION OF ANTERIOR OPEN BITE AND SKELETAL CLASS III MALOCCLUSION: A PARADIGM SHIFT

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Abstract

In recent years orthodontic treatment has been revolutionized by the introduction of skeletal anchorage or temporary anchorage devices (TADs). Many malocclusions, which have been previously only treatable through orthognathic surgery, such as skeletal open-bites, can now be managed non-surgically with less biological cost to the patient. Furthermore the recent application of TADs in the treatment of growing skeletal Class III patients is not only minimizing the need for obtrusive appliances, such as head gear and face masks, but it is also proving to deliver better and superior results to conventional growth modification protocols with more patient acceptance and less need for compliance. This overview covers the applications of TADs in the treatment of skeletal open bites and skeletal Class III malocclusions with reference to current evidence and clinical case presentations.

Introduction

Temporary anchorage devices have steadily made their way into mainstream orthodontics over the past decade. Although there have been sporadic reports in the literature previously1,2 it is only recently that the use of skeletal anchorage has made its way into becoming an everyday part of orthodontic practice. Cope in 20073 defined them: “(TAD) or a temporary anchorage device is a device that is temporarily fixed to bone for the purpose of enhancing orthodontic anchorage by supporting the teeth of the reactive unit or by obviating the need for the reactive unit altogether and which is subsequently removed after use .”. They can be divided into two main groups: anchorage plates and miniscrews. Anchorage plates usually involve the elevation of a flap and a surgical plate is secured to the bone using two or more screws with an attachment point for force application protruding through the mucosa into the oral cavity, whereas mini-screws are usually single titanium screws placed transmucosally and in the majority of cases do not require any flaps or incisions. In both cases the TADs are removed after treatment.

The indications for use of TADs in orthodontics are numerous and it can be said they have introduced a paradigm shift in orthodontics greatly expanding the horizon of what is achievable through orthodontic treatment for both adults and children. In many cases they may preclude the need for orthognathic surgery. This can be seen in the management of skeletal anterior open bite and skeletal Class III malocclusions.

Anterior Open bite treatment with skeletal anchorage

Anterior Open bite malocclusion has always been considered one of the more difficult ones to treat in orthodontics. It is present “where the upper incisor crowns fail to overlap the incisal third of the lower incisor crowns when the mandible is brought into full occlusion” according to Mizrahi.4 Skeletal open bites5 can be defined as a deviation from the normal vertical relationship of the maxillary and mandibular dental arches. The reason for the lack of contact is a deviation in the orientation of the basal bones of the maxilla and mandible in relation to each other,6 and it can be present combined with a dual occlusal plane. In many cases it is associated with the facial features of the long face syndrome.7

Although the aetiology and features of open bite can be variable, traditionally skeletal open bites have been corrected by restricting the vertical development of the molar segment, usually in a growing child, or by attempting to intrude the molar segment. This usually employed obtrusive appliances utilizing extra-oral anchorage such as high-pull headgear8 (Fig. 1a), vertical pull chin cups9 or the use of acrylic bite blocks.10,11 In many cases the results were limited by patient compliance and the difficulty in continuous wear of such devices due to their interference with the patient’s daily activities and social interactions. In most adults surgical impaction of the maxilla was the treatment of choice. The treatment usually aimed to intrude the posterior maxillary segment thus allowing mandibular auto-rotation resulting in anterior tooth contact and closure of the open bite. Full fixed appliances with intermaxillary elastics12 and/or extractions13 have also been advocated although the treatment camouflaged the skeletal discrepancy through dental movements rather than addressing the skeletal aspect, which sometimes results in less than ideal facial aesthetics.

With the introduction of skeletal anchorage using the TADs as a point of force application, molar intrusion can be achieved reliably using intraoral and compliance free orthodontic mechanics. The molar intrusion allows mandibular autorotation and closure of the open bite without the need for extra oral devices or surgical maxillary impaction. This can be done through maxillary molar intrusion, mandibular molar intrusion or a combination of both. The first published reports on molar intrusion used anchorage plates, fixed to the buccal cortical bone around

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the apical regions of the lower first and second molars on both the right and left sides, to intrude mandibular molars for open bite correction. This was followed by several reports on maxillary molar intrusion using anchorage plates placed in the zygoma. In all cases the result was successful closure of the anterior open bites. With mini-screws gaining popularity several studies successfully used them as TADs for molar intrusion in open bite treatment with placement locations varying from buccal, palatal and combinations of both. Mini-screws offer the advantage of being simpler to insert and remove with less surgery involved compared with surgical plates. Overall the amount of molar intrusion reported varied between 3-5 mm in a treatment duration of 4-10 months depending on the study. Almost all of the studies report successful closure of the open bites with various degrees of mandibular auto rotation of 1.7-4 degrees.

In a recent prospective clinical study at the University of Sydney, Foot et al. treated 16 patients with anterior open bites using mini-screws and a specially designed intrusion spring (the SIS Sydney Intrusion Spring). The SIS aims to provide a specifically designed force application mechanism that is both hygienic, easy to use and does not require frequent reactivation to minimize patient discomfort. The open bite was corrected in all subjects in a period of 4.9 months on average with a mean molar intrusion of 2.9 ± 0.8 mm resulting in a 1.2° ± 1.3° counterclockwise rotation of the mandible. There was also an effect to elongate and upright the upper incisors with no significant extrusion of the lower molars. The authors concluded that the SIS used in conjunction with TADs is an effective means of correcting anterior open bites.

The long-term stability of open bite correction reported in the literature is very variable with some degree of relapse expected regardless of the treatment modality. With traditional orthodontic mechanics relapse was reported in up to 33% of cases while others have reported negligible relapse. Profitt et al. examined surgical treatment results up to 3 years post treatment and reported a 10% chance a patient will have 2-4 mm relapse in the overbite. They speculated it might be due to incomplete adaptation of the tongue posture to the correction. Molar intrusion with TADs as treatment for open bites is a relatively new treatment modality, therefore there is little published literature on the long-term stability of the correction. The most comprehensive follow up to date was by Baek et al. looking at nine adult patients three years post treatment. They found that molar intrusion relapsed.

<p>| Table 1 |
| Cephalometric analysis (Sydney-Geneva). Most of the vertical parameters highlighted in bold font indicate skeletal open bite patterns. | |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Norms</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA*</td>
<td>82 ± 4°</td>
<td>74.6°</td>
</tr>
<tr>
<td>SNB†</td>
<td>79 ± 2°</td>
<td>69.9°</td>
</tr>
<tr>
<td>ANB‡</td>
<td>2.6° ± 2.4°</td>
<td>(4.7%)</td>
</tr>
<tr>
<td>S-Go'/N-Me (J%)§</td>
<td>64%</td>
<td>57.9%</td>
</tr>
<tr>
<td>N-ANS / ANS-Me¶</td>
<td>45%</td>
<td>42.1%, 57.9%</td>
</tr>
<tr>
<td>SN-PP**</td>
<td>8 ± 2°</td>
<td>12.8°</td>
</tr>
<tr>
<td>PP-MP††</td>
<td>23 ± 4°</td>
<td>35.7°</td>
</tr>
<tr>
<td>SN-MP‡‡</td>
<td>31 ± 3°</td>
<td>48.4°</td>
</tr>
<tr>
<td>SN-OP¶¶</td>
<td>15 ± 3°</td>
<td>24.5°</td>
</tr>
<tr>
<td>Gonial angle</td>
<td>122 ± 4°</td>
<td>129.7°</td>
</tr>
<tr>
<td>Y axis¥</td>
<td>68 ± 4°</td>
<td>79.5°</td>
</tr>
<tr>
<td>SN-FH***</td>
<td>7.8 ± 2.4°</td>
<td>13.6°</td>
</tr>
<tr>
<td>SN-Ba†††</td>
<td>130 ± 4°</td>
<td>128.2°</td>
</tr>
<tr>
<td>Witz ‡‡‡</td>
<td>0 ± 2</td>
<td>3.4</td>
</tr>
<tr>
<td>1/-SN ††</td>
<td>103 ± 7°</td>
<td>94.2°</td>
</tr>
<tr>
<td>1/-PP</td>
<td>111 ± 6°</td>
<td>106.9°</td>
</tr>
<tr>
<td>/1-MP¶¶¶</td>
<td>92 ± 9°</td>
<td>88.8°</td>
</tr>
<tr>
<td>1/l</td>
<td>134 ± 13°</td>
<td>128.6°</td>
</tr>
<tr>
<td>Overjet</td>
<td>1-3 mm</td>
<td>5.9</td>
</tr>
<tr>
<td>Overbite</td>
<td>1-3 mm</td>
<td>-2.5</td>
</tr>
</tbody>
</table>

* SNA: SN for Sella –Nasion the line represents the anterior cranial base and A for (A-point) the anterior limit of the maxillary base. The angle denotes the relationship between the maxilla and the cranial base in the antero-posterior plane.
† B is B-point for the anterior limit of the mandibular base and SNB is the angle denoting the relationship between the mandible and the cranial base in the antero-posterior plane.
‡ ANB the angle denotes the relationship between the maxilla and mandible in the antero-posterior plane.
§ S-Go’/N-Me (J%) ratio between Sella-Gonion, distance denoting posterior face height, and Nasion-Menton, the distance denoting the anterior face height.
¶ N-ANS/ANS-Me ratio between upper anterior face height and lower anterior face height where ANS is anterior nasal spine.
** SN-PP angle between the cranial base line and PP palatal plane.
†† PP-MP angle between mandibular base and palatal plane.
‡‡ SN-MP angle between cranial base line and mandibular plane usually a strong indicator of the vertical skeletal pattern.
¥ Y axis angle denoting the relationship between the maxilla and mandible in the antero-posterior plane.
§§§ SN-FH angle between anterior cranial base and Frankfurt horizontal plane.
††† SN-Ba angle denoting the relationship between the maxilla and mandible as evident on the occlusal plane.
‡‡‡‡ Witz appraisal denotes the antero posterior relationship between maxilla and mandible in the antero-posterior plane.

by 0.45 mm after 2.39 mm of intrusion on average over the three-year period. Furthermore the overbite was increased in treatment by an average of 5.56 mm and relapsed by only 1.2 mm over the retention period. They concluded that molar intrusion with TADs was a valid treatment modality providing long-term stability comparable with conventional orthodontics and orthognathic surgery. Their results also indicate the need for over correction during treatment as well as perhaps some form of active retention.

**Case reports**

**Case 1:** 19 year old female presented with Class II malocclusion with an anterior open bite (Fig. 2), an increased lower anterior face height and a long face, as evident from the increased mandibular plane angle and vertical skeletal parameters (Fig. 3) (Table 1). There was also a slight cant in her smile line with more gingival exposure on smiling on the right hand side (Fig. 2). When surgical maxillary impaction was declined by the patient, molar intrusion using mini-screws was planned in both maxilla and mandible followed by full fixed appliances with the extraction of all third molars. The objective was to intrude the molar segments thus allowing mandibular autorotation to achieve anterior tooth contact eliminating the open bite and improving the vertical facial proportions at the same time. In order to prevent molars from tipping buccally with the intrusive forces a rigid transpalatal bar was constructed between the maxillary first molars with rested on the second molars (Fig. 4). In addition a 4 mm clearance between the bar and the palatal mucosa was left in order to allow room for intrusion without palatal impingement. In the lower arch a rigid lower lingual bar connecting the mandibular first molars with rests on the second molars was cemented (Fig. 4). Sectional fixed appliances were also bonded on the premolars and second molars to unite the buccal segments. Five TADs were placed in total. One mini-screw was placed on the buccal side between the second premolars and first molars in all four
quadrants and one mini-screw was placed in the midpalate (Fig. 4). The TADs were immediately loaded by connecting NiTi coil springs with a force of 150 g buccally and palatally attached to the first molars. The intrusion period continued for a period of 10 months in which a positive overbite of 5 mm was achieved (Fig. 5b). Full fixed appliances were then placed and the TADs were passively tied to the first molars to maintain the molar intrusion. Superimposition of lateral cephalometric tracings after molar intrusion using Bjork’s stable structures shows successful maxillary and mandibular molar intrusion with subsequent mandibular auto rotation (Fig. 6). Profile photographs also demonstrated a significant profile improvement with improved chin projection and a more pronounced soft tissue chin appearance following the reduction of the lower anterior face height (Fig. 5). Treatment was continued with fixed appliances correcting the smile line and finishing with a Class I molar and canine relationship with normal overjet and overbite. Fixed retainers were placed in the maxillary and mandibular anterior segments (Fig. 7) and the patient was also issued with clear vacuum formed retainers for night time wear.

From the above it appears that TADs in open bite treatment offer a predictable method for the correction of open bites with limited need for patient compliance and with completely intraoral mechanics. It also allows the correction of skeletal open bites without the midfacial changes associated with maxillary impaction surgery, which are not always desirable.

However it must be emphasized that the application of TADs does not provide a universal solution for open bite malocclusion problems and that diagnosis and assessment of the aetiology behind the open bite is of paramount importance for success and long-term stability of the outcome but is beyond the scope of this manuscript. Factors such as thumb sucking habits and abnormal tongue posture must be addressed as a priority. Furthermore it needs to be
remembered that facial balance and harmony are the main aim of modern orthodontics and dentofacial orthopaedics and should be the main guiding parameters behind decision-making. Particular attention must be paid to the smile line and incisal/gingival display at rest and on smiling in order to decide whether molar intrusion will indeed provide the desired effect. TADs and molar intrusion present a new treatment modality that should be used when indicated by the facial and occlusal goals.

Class III correction with skeletal anchorage:
Correction of skeletal Class III malocclusion is among the more challenging malocclusions to treat in the orthodontic office. Class III malocclusion according to Angle26 occurs when the lower teeth occlude mesial to their normal relationship with the maxillary teeth the width of one premolar or more. Skeletal Class III malocclusion occurs when the mandibular base is more mesial than the normal in relation to the maxilla and this can be due to a deficient maxilla, prognathic mandible or a combination of both.27 It is generally believed that the majority of Class III malocclusions will have an element of maxillary deficiency as a common feature.28 Treatment modalities in growing children have typically aimed to stimulate sutural growth of the maxilla, restrain the growth of the mandible or attempt a combination of both.

Treatment timing for Class III malocclusion in growing children is considered paramount29 as patency of the sutures is necessary for successful maxillary protraction. Maxillary sutures become more complex with age making protraction less effective.30 Therefore it has been advocated that treatment using reverse pull head gear (RPHG) or a protraction face mask (Fig. 1b) should be employed early between ages 7-10 years old to utilize the growth potential of the maxillary sutures. It is believed that simultaneous rapid maxillary expansion aids in activation of the circummaxillary sutures or to somewhat “disarticulate” the maxilla, although the evidence in this regard is equivocal.31,32 In addition to the importance of treating early, success with RPHG is highly dependent on patient compliance usually involving the use of the cumbersome extra-oral appliance for 14-16 hours per day for a period of 10-12 months.30 The protraction facemask therapy leads to both dental and skeletal effects including desirable forward movement of the maxilla but also downward and backwards movement of the mandible with proclination of the maxillary incisors and retroclination of the mandibular incisors, which are considered undesirable dental compensations that detract from the skeletal correction.30 The amount of forward movement of the maxilla (A-point) and therefore skeletal correction is significantly higher if treatment is done early, before age 10, ranging around 2-3 mm, while the benefits of treatment is greatly reduced for older children dropping to 1-2 mm after the age of 10 years.31 In recent years two treatment modalities have changed the face of Class III growth modification treatment. The first was when Liou et al.33 introduced a protocol of alternating rapid maxillary expansion and contraction (ALT RAMEC) prior to maxillary protraction. The aim of the technique was to improve the efficiency of the treatment through disarticulation of the maxilla by repeated cycles of expansion and contraction thus facilitating maxillary protraction. In addition he used an intra-oral compliance free spring thereby eliminating the need for RPHG and the compliance issues associated. The results were very impressive, with a forward movement of the maxilla (A-point) of 5.8 mm over a period of 2-3 months. This amount of maxillary forward movement is almost 2-3 fold what the literature30-34 on RPHG demonstrates and in one third of the treatment time. In addition he treated patients who were considered late in terms maxillary protraction at 11.5 years old and the results were stable two years after treatment. DeClerk et al.35 introduced another treatment modality. The technique applies Class III intermaxillary elastics to titanium mini-plates placed in the zygoma and the anterior mandible to correct maxillary deficiency. The group36 compared the results of their treated patients with what is expected from
untreated Class III controls and found on average 4 mm more of maxillary forward movement and 2 mm of restrained mandibular growth. This was almost double the amount produced by RPHG treatment.\textsuperscript{29-31} In addition the results were achieved in a group of children who were 11 years old, which would be considered past the ideal time for RPHG treatment.\textsuperscript{29-31} They\textsuperscript{37} then compared the mini-plate and Class III elastics protocol with a sample of cases treated with RPHG and found that the skeletal anchorage group showed on average 2-3 mm more maxillary advancement while the effects on mandibular growth were comparable with those of the RPHG. Furthermore the vertical control with the skeletal anchorage group was better with no backwards rotation of the mandible and no lower incisor retroclination. The technique does not involve any tooth borne appliances.

A recent prospective study\textsuperscript{38} at the University of Sydney examined the effects of combining both Alt-RAMEC and skeletal anchorage with Class III elastics in the treatment of skeletal Class III maxillary deficiency in growing children. In order to eliminate the need for flap surgery and general anaesthesia the study used mini-screws instead of anchorage plates. A group of 14 (7 male and 7 female) Class III patients with maxillary deficiency aged 12.5 years on average were treated with Alt-RAMEC and TADS with Class III elastics. Two mini-screws were inserted on either side of the mid-palatine suture and two mini-screws were inserted into the anterior mandible between the canines and lateral incisors. The palatal TADS\textsuperscript{39} were attached to a modified bonded rapid palatal expander and the lower TADS were fixed to a modified bonded lingual arch (Fig. 8). The maxilla was then expanded at 1 mm/day for a period of seven days followed by constriction of the maxilla at 1 mm/day for 7 days. This protocol was repeated for nine weeks. Following this Alt-RAMEC protocol intermaxillary Class III elastics (Fig. 8) were worn 24 hours per day and protraction was ceased when an overjet of 2 mm was achieved. The results were promising with the 2 mm overjet achieved in all subjects after an average of 8.6 weeks. The maxilla moved forward by 3.3 mm on average (Fig. 9), twice as much as what would be expected at this age with RPHG and in only a third of the treatment time.\textsuperscript{29-31} The results are also comparable with those achieved by the De Clerck\textsuperscript{35} protocol with less treatment duration. However, there were dental compensations experienced such as proclination of maxillary incisors and retroclination of mandibular incisors as well as backward rotation of the mandible. This can be attributed to the fact that the appliances were tooth borne and indirectly supported by skeletal anchorage and the inherent flexibility of the wires used would have allowed some dental movement. Nevertheless, the combination of Alt-RAMEC with TADs and Class III elastics for the correction of Class III malocclusions appears very promising. It offers an alternative to conventional RPHG that is completely intraoral with improved patient acceptance. In addition to offering superior results in shorter duration it also allows effective treatment for patients who previously would be considered too old to benefit fully from RPHG therapy. However long term stability of the changes still need to be evaluated. This study is part of an ongoing project at the University of Sydney aiming to improve the efficiency and efficacy of Class III correction in growing individuals.

From the above it appears that the incorporation of TADs in orthodontic treatment has significantly changed the way modern orthodontic treatment is approached. TADs have widened the possibilities of what can be done with orthodontic treatment alone. They have enabled the elimination of many cumbersome and obtrusive appliances as well as reduced the need for patient compliance in many aspects of treatment, making treatment simpler and more predictable. It can also be said that the research so far has merely scratched the surface in the field of skeletal anchorage.

Acknowledgments:
The author would like to acknowledge Dr Stephen Bartley and Ms Naomi Cook for proofreading this manuscript.

References:

Fig. 8. – From Al-Mozany et al. (with permission).\textsuperscript{38} A. Pretreatment B. post protraction.
RESIN INFILTRATION- TAKING THE FIRST STEPS TO FILLING THE HOLES IN CHEESE MOLARS

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Abstract

Molar incisor hypomineralization (MIH) involves enamel hypomineralization of systemic origin affecting one or more first permanent molars (FPM) and is often associated with other teeth, particularly the incisors. A challenging condition for both the clinician and the patient, MIH affected teeth are often subjected to repeated treatments and frequently the decision to extract one or more FPM is made. At present, there are no clinical reports of available restorative materials that are able to provide consistently adequate restorations on hypomineralized teeth. The concept of resin infiltration, which involves occluding incipient enamel carious lesions with low viscosity resins to arrest or slow the development of caries has the potential to be applied to hypomineralized enamel. Successful penetration of resin infiltrant into MIH affected enamel may aid in improving its micromechanical properties.

Introduction

In 2001, Weerheijm et al. first defined “molar incisor hypomineralization” as enamel hypomineralization of systemic origin of one to four permanent first molars frequently associated with affected incisors.1 Typically, the permanent first molars are the most frequently affected teeth with possible involvement of the incisors, second primary molars, second permanent molars and the permanent canines.2 Individuals with MIH-affected teeth present with white, yellow and/or brown demarcated opacities of the enamel, with normal enamel thickness and a confluent surface at eruption. Numerous attempts have been made to describe and classify enamel hypomineralization which mainly affects the molars and incisors, leading to a plethora of names in the literature, including: “cheese molars”, “hypomineralized permanent first molars”, “idiopathic enamel hypomineralization”, “dysmineralization of first permanent molars”, “non-fluoride hypomineralization”, and “idiopathic molar hypomineralization”.3-5

The clinical relevance of molar incisor hypomineralization

The management of MIH can present several challenges to both the clinician and patient, including problems associated with post-eruptive enamel breakdown (PEB), the rapid development of caries, difficulty in achieving pulp anaesthesia and the predisposition for marginal breakdown of restorations leading to frequent re-treatment.2,6 There may also be aesthetic concerns, especially if the incisors are involved.2,7,8 A survey of the Australian members of the Australian and New Zealand Society of Paediatric Dentistry highlighted a lack of consensus on the restorative management of MIH teeth, with many practitioners reporting difficulty in providing adequate and long-lasting restorations.3

The probability of undergoing restorative treatment amongst children with MIH affected molars has been reported to be ten to eleven times more often than unaffected children.7,9 High restorative failure rates may be explained by a decrease in mineral content of the affected enamel that has a more porous prism structure and significantly higher protein content and subsequently reduced strength and hardness of MIH affected teeth.10,11 The inherent weakness in hypomineralized enamel may result in marginal breakdown of restorations, and adversely affect adhesive strengths of resin composite bonded to hypomineralized enamel.12,16

Children with affected teeth often complain of hypersensitivity to common oral and mechanical stimuli such as heat, cold, sweet and tooth brushing.1 The increased sensitivity can cause children to avoid brushing hypomineralized teeth which leads to increased plaque stagnation, demineralization and caries development.17 Often, during a dental examination, children respond intensely to air blowing, and plaque is visible around the FPM in a mouth with otherwise good oral hygiene. A histological study of hypomineralized enamel found that even apparently intact enamel surfaces of some MIH teeth had bacterial presence in the dentinal tubules with a zone of reparative/reactive dentine formed at the pulpal surface.18 The pulp was free from bacteria, with one coronal pulp containing inflammatory cells indicative of an inflammatory reaction. This suggests that if bacterial penetration of the dentinal tubules does occur in MIH teeth it is likely that an inflammatory reaction is initiated in the pulp and probably contributes to the hypersensitivity of the affected teeth.

* Young Lecturer presentation at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand. 31 March - 4 April 2012
Practitioners often experience difficulty achieving adequate pulpal anaesthesia in children affected by MIH. This may be due to chronic sub-clinical inflammation of the pulpal cells due to increased enamel porosity and subsequent bacterial penetration of the dentinal tubules leading to inflammation and therefore hypersensitivity to oral stimuli. Preventive materials such as resin composite or glass ionomer cement (GIC) fissure sealants, mineralizing agents, or resin infiltration of the enamel and possibly dentine, may be a treatment option to prevent ingress of bacteria and decrease hypersensitivity.

Increased sensitivity to oral stimuli, poor anaesthesia during restorative procedures, repeated treatment or extraction of MIH teeth has the added disadvantage of often leading to patient ‘burnout’, behaviour management problems and increase in the risk of developing dental fear and anxiety in children. This creates substantial challenges to the clinician and early detection, prevention, and development of an appropriate therapeutic approach may aid in minimizing repeated interventions. The stated detrimental outcomes may be avoided or reduced in severity by further investigations into the removal of enamel proteins to enhance bonding and resin penetration, agents to increase mineralization, and novel infiltration materials that reduce leakage of restorations and improve the restorative micromechanical properties and bond strengths of MIH teeth.

New research areas for molar incisor hypomineralization

Sodium hypochlorite (NaOCl) is an oxidizing agent and degrades protein. In a case-report, improved resin bonding of orthodontic brackets onto hypocalciﬁed amelogenesis imperfecta affected enamel by pre-treating the tooth with 5% NaOCl was reported. The authors proposed that the qualitative and quantitative effects of CPP-ACP (Tooth Mousse) application for 20 minutes nightly on MIH molars. Polyvinylsiloxane impressions and 15 cusps or tooth side biopsies of the teeth were taken at the start and end of the three year test period and were examined by scanning electron microscopy (SEM). The SEM images revealed increased enamel re-mineralization and homogenization of the enamel, and a more geometric and mineralized rod structure of the Tooth Mousse-treated enamel compared with defective crystal organization of the baseline MIH enamel. Limitations of this study include the limited number of controls and the request for the subjects to not brush or use toothpaste for the three year test period presumably to eliminate confounding variables such as fluoride. In addition, enamel biopsies of some teeth were taken from areas adjacent to temporary restorations. The type of restoration used was not mentioned and if fluoride releasing materials were used these may have had an effect on the properties of the MIH enamel. However, the study is the first to provide in vivo results of the efficacy of a remineralizing agent on MIH affected teeth.

Mildly affected MIH teeth without enamel breakdown may benefit from fissure sealants to help reduce or postpone PEB, caries and subsequent treatment. Polyvinylsiloxane impressions and 15 cusps or tooth side biopsies of the teeth were taken at the start and end of the three year test period and were examined by scanning electron microscopy (SEM). The SEM images revealed increased enamel re-mineralization and homogenization of the enamel, and a more geometric and mineralized rod structure of the Tooth Mousse-treated enamel compared with defective crystal organization of the baseline MIH enamel. Limitations of this study include the limited number of controls and the request for the subjects to not brush or use toothpaste for the three year test period presumably to eliminate confounding variables such as fluoride. In addition, enamel biopsies of some teeth were taken from areas adjacent to temporary restorations. The type of restoration used was not mentioned and if fluoride releasing materials were used these may have had an effect on the properties of the MIH enamel. However, the study is the first to provide in vivo results of the efficacy of a remineralizing agent on MIH affected teeth.

At present, there are no reports of restorative materials in the market that are able to provide consistently adequate restorations on hypomineralized teeth. The major problem in restoring MIH affected teeth is determining the quality of the remaining enamel. Improving the mechanical properties of the enamel in MIH teeth would be critical to their successful restoration. Occluding incipient enamel lesions with low viscosity resins to arrest or slow the development of proximal and smooth surface caries is not a new concept and has been explored over the years.

Icon is a micro-invasive caries treatment that reportedly penetrates the inter-rod spaces of dental hard tissues with a low viscosity light curable resin infiltrant. Icon has been developed to treat white spot lesions on smooth surfaces and early non-cavitated approximal carious lesions extending...
to a maximum radiological lesion progression into the outer third of dentine.33 Its use aims to postpone or prevent invasive restorative procedures, especially interproximally, where the ratio of carious to healthy hard tissue removal can be unfavourable.34 The process of infiltration involves occlusion of the enamel pores with a light polymerized resin in order to block the diffusion of acids into the lesion body and ions out of the enamel, therefore inhibiting carious demineralization.34 Successful blocking of caries progression via infiltration has been demonstrated in both artificial and natural carious lesions.35-38 This is different from fissure sealing caries which creates a diffusion barrier only on the lesion surface,34,39

Icon® has proved to be effective in almost complete penetration of natural enamel caries in an in vitro study with penetration depths of the infiltrant reaching values greater than 500μm.39 The efficacy of resin infiltration, however, depends on the cavitation status of caries lesions. The above results were for non-cavitated enamel porosities. Under in vitro conditions, cavitated approximal lesions are negligibly infiltrated irrespective of the International Caries Assessment and Detection System (ICDAS) codes and cavity sizes of the lesions.37 Paris et al. postulated this may be due to weak capillary action in cavitated lesions as opposed to demineralized porous enamel that can readily allow infiltration of the resin due to strong capillary forces. Other reasons for failure may include unintentional removal of the resin before light curing when the excess is cleaned off, or air bubbles within the cavitation may have prevented penetration of the liquid resin due to its resultant surface tension.37 By inference from these findings, it is possible infiltration of MIH affected lesions may be limited to those not associated with caries or PEB.

The development of a micro-invasive restorative material led researchers to study its applicability in areas other than blocking caries progression. White spot lesions as a result of dental caries, developmental defects of enamel (DDE) and post-orthodontic demineralization around orthodontic brackets present problems associated with not only progression of demineralization but compromised aesthetics. An in vivo study investigating the effect of resin infiltration with Icon on white spot lesions after debonding fixed orthodontic brackets found a 65-80% improvement in the masking of the lesions with a significant improvement in colour.40 Another in vivo study assessing the effect of Icon on white spot lesions of teeth with DDE and teeth with post-orthodontic decalcification found complete masking of the lesions in 25% of the DDE teeth, and 61% of the post-orthodontic specimens.41 From the DDE and post-orthodontic groups, 40% and 6% of the teeth respectively did not show any changes after resin infiltration. Failure of masking of a large proportion of lesions from the DDE was attributed to their depth which may be greater than the infiltration range, and of the lesion activity where older/active lesions may have had a thicker surface layer that was only partially removed with etching and thus incompletely penetrated with resin infiltrant. The authors commented resin infiltration may be more suited for active, shallower and younger lesions where the surface layer is relatively thin.41

It is postulated that the advent of Icon® may aid in altering the micromechanical properties of hypomineralized enamel via resin infiltration. However, differences may exist between the infiltration of carious versus hypomineralized enamel. Evidence suggests up to 21 times more protein is present in MIH affected enamel compared with normal enamel which may not allow adequate etching and hamper the infiltration process similar to the caries model.42,43 It is not known how the penetration depth of the light-cured resin infiltrant will be affected by the retained proteins.

In vitro infiltration of a fissure sealant and various adhesives into sub-surface bovine enamel lesions has been described as successfully improving the resistance of subsurface lesions against cariogenic challenge.35,38 Based on these results, it is postulated that infiltration of hypomineralized enamel may inhibit or reduce the progression rate of demineralization and ultimately reduce caries risk, improve sensitivity to oral stimuli, and increase bond strength of composite resin to the infiltrated surface.

Final considerations

The ideal restorative material for hypomineralized teeth would be one that could provide restorations with a good prognosis. However, the problem lies not with the restorative material itself but with the affected enamel of MIH teeth. Improving the mechanical properties of the enamel in MIH teeth seems critical to their successful restoration. This may be by utilizing currently available products such as NaOCl, CPP-ACP, resin and glass ionomer based fissure sealants, resin infiltrants; or by developing new products more suited to the mechanical properties and microstructure of hypomineralized enamel.

Infiltrating hypomineralized hard tissue with a low viscosity light curing resin may pave the way for delaying or preventing restorative intervention, creating a less destructive restorative procedure, increasing hardness of the lesion and preventing or reducing PEB. It may also allow improved bond strength of a restoration on the infiltrant surface and reduce its marginal breakdown risk. Clinically, infiltrating hard tissue may reduce sensitivity to oral stimuli and improve the appearance of demarcated opacities on affected incisors. A simplified restorative procedure, whereby the patient experiences less sensitivity and the reduced need for restorations may in turn improve patient behaviour and compliance.

References


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EVALUATION OF PULPOTOMY OUTCOMES IN PRIMARY MOLARS USING MINERAL TRIOXIDE AGGREGATE AS A PULP DRESSING AND BASE, RESTORED WITH STAINLESS STEEL CROWNS VERSUS AMALGAM – A pilot study

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Purpose
The objective of this study was to evaluate the outcomes of mineral trioxide aggregate (MTA) as a pulp dressing and base in primary molars restored with stainless steel crowns (SSC) and compare them with those restored with amalgam.

Methods
Fifty-eight carious primary molars in 33 children were treated with the conventional pulpotomy technique. A minimum of 3 mm of MTA was placed against the remaining pulp to serve as a pulp dressing and base. The pulpotomized teeth were assigned to either the SSC or amalgam group for restoration. Clinical and radiographic follow-up ranged between 3-58 months.

Results
The clinical success rate for teeth available at follow-up was 100% at 54 months and 98% at 58 months. Recurrent caries, tooth fractures and revisits to restorations were more frequently encountered in the amalgam group. The radiographic success rate was 100% at 18 months, 98% at 42 months and 96.5% at 54 months. Pulp canal obliteration and dentine bridging were the most common outcomes and were observed at all recalls. Some teeth presenting with internal root resorption showed calcific metamorphosis of the resorbed area at subsequent recall. At all recall periods, there was no statistically significant difference in pulpotomy outcomes between the groups (p > 0.05).

Conclusions
MTA is a clinically successful pulp dressing and base for primary teeth pulpotomy. SSC perform better than amalgam for pulp treated teeth. A larger series of patients and histological evaluations are recommended to establish definitive success rates.

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* Young Lecturer presentation at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand. 31 March - 4 April 2012
ABSTRACTS OF PRESENTED PAPERS*

Editor’s note
A number of presenters indicated that they were unable to provide manuscripts for this volume of the Annals. For the sake of completeness, the Abstracts from the Convocation booklet are included in this section.

THE MUTILATED DENTITION – SURGICAL APPROACHES
Jocelyn Shand, MBBS(Melb), MDSc(Melb), BDS(Otago), FDSRCS(Eng), FRACDS(OMS)*

Dr Jocelyn Shand is a Consultant Oral and Maxillofacial Surgeon at The Royal Children’s Hospital of Melbourne and is in part-time private practice in Melbourne.

The approach to the compromised dentition and occlusion can be challenging and complex. The optimal management of these patients should involve assessment and planning within a multidisciplinary team. The management of the skeletal discrepancy with orthognathic surgery, bone grafting for augmentation and implant therapy can be undertaken as required as part of the combined approach. With an ageing population the underlying medical condition of the patient may also have significant implications on planning. The assessment, treatment options and the factors that influence and impact upon planning are discussed along with the treatment outcomes in the contemporary literature.

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ORAL HEALTH AS THE CANARY IN THE COALMINE
Ritchie Poulton, PhD*

Professor Richie Poulton is Director of the Dunedin Multidisciplinary Health and Development Research Unit and Co-director of the recently established National Centre for Lifecourse Research at the University of Otago, Dunedin, New Zealand.

The Dunedin longitudinal study is one of the most detailed studies of human health and development ever undertaken. It is a multidisciplinary, longitudinal study of 1,037 babies born in Dunedin during 1972/73. The study members have been followed up since birth, at age three, then every two years to age 15, and at ages 18, 21, 26, and 32. The latest assessment phase, at age 38, is currently underway (2010/2012). For each follow-up phase, the Study members are brought to the Dunedin Unit where they undergo numerous assessments and measures of their health and development. Recent assessments have included a broad range of studies in the psychosocial, behavioural medicine and biomedical research areas. The age 32 assessment phase (2003/2005) was an outstanding success with 96% of the surviving Study members being assessed.

A review of findings from this Dunedin Multidisciplinary Health and Development Study is followed by an in-depth examination of oral health research from this cohort. Links are made between oral health and a range of other health outcomes, including those related to cardiovascular biomarkers, inflammation and early life risk factors including psychosocial exposures. The study asks and begins to answer the question “is oral health an early warning sign for poor overall health and well-being?”

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* Presented at the Twenty-first Convocation of the Royal Australasian College of Dental Surgeons, Queenstown, New Zealand, 31 March - 4 April 2012
MUCO-GINGIVAL DEFECTS: RISK, EVALUATION, MANAGEMENT AND OUTCOMES
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Dr English is a specialist periodontist. She established Nelson Periodontics, the only private specialist periodontal and dental implant surgery practice in the top of the South Island, New Zealand.

As our society becomes increasingly more aware of the health and function of their dentition and the aesthetics of their smile, muco-gingival defects such as recession or lack of attached gingiva are of growing concern to patients. These defects may be congenital, developmental, or acquired, and can occur around natural teeth, implants, or in edentulous ridges. Although frequently localized to soft tissues, they are also often associated with defects in the underlying bone and will show different degrees of severity depending on the individual biology and aetiology. As a result, muco-gingival defects form one of the challenges that both the general dentist and specialist practitioner face.

Risk assessment and identification are critical components of the clinical decision-making process and are vital in optimizing delivery of patient care. This paper examines the existing methods available to assess the likelihood of future progression of muco-gingival defects, along with discussion of an evidence-based clinical assessment pathway to aid treatment planning and determine which defects require intervention and why. The current techniques (including both conservative approaches and periodontal plastic surgical procedures) utilized in the management of problematic muco-gingival defects are examined. Finally, the expected success outcomes of each interventive strategy and the long-term prognosis of muco-gingival defects following treatment are reviewed.

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FURCATION INVOLVEMENT: TOOTH ASSESSMENT, PROGNOSIS AND MANAGEMENT. WHEN IS IT TIME FOR IMPLANTS?*
Andre Bendyk, BDS(Adel), FRACDS(Perio), DClinDent(Perio)*

Dr Andre Bendyk maintains a full time specialist private practice limited to Periodontics and Implant Dentistry in Adelaide. He is a past president of the Australian Society of Periodontology (SA Branch) and lecturer in Periodontology at the University of Adelaide.

The anatomy of the furcation favours retention of bacterial deposits and makes both oral hygiene and periodontal debridement difficult. Whilst furcation involvement is a risk factor for future tooth loss it has been shown conclusively that with appropriate treatment and then thorough ongoing periodontal maintenance most furcation involved teeth can be maintained in the longer term. This presentation discusses furcation anatomy and local factors which predispose to periodontal furcation involvement. Clinically applicable treatment options are presented in detail along with their limitations. Periodontal regeneration techniques currently have a narrow range of usefulness in furcation defects, limited predominantly to isolated Grade II furcation involvement.

Long-term prognosis of furcation involved teeth depends on multiple factors but is largely influenced by the trajectory of the disease process in each individual patient. Whilst each case must be considered individually evidence does not currently support the principle of early removal of furcation involved molars for implant replacement.

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A case report of an interdisciplinary management spanning over 20 years is presented. The case follows the patient with complex medical and dental conditions from birth to adulthood. It highlights the need for careful planning, constant review and a preparedness to change treatment plans as outcomes evolve and the patient needs alter. Above all, it emphasizes the role of a team approach and good communication between all disciplines involved and the patient and the family.

Susan Needham has been a consultant orthodontist to the Royal Children’s Hospital, Melbourne since 1996. Her areas of interest are hypodontia, cleft care and naso-alveolar moulding, a type of infant pre-surgical orthopaedics. She also maintains a private specialist orthodontic practice in Brighton, Melbourne.

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