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Canadian Journal of
Restorative Dentistry & Prosthodontics

The official publication of the Canadian Academy of
Restorative Dentistry and Prosthodontics

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Journal canadien de
dentisterie restauratrice et de prosthodontie

Publication officielle de l'Académie canadienne
de dentisterie restauratrice et de prosthodontie

**Dental Materials /
Matériaux dentaires**
**Oral Medicine /
Médecine buccale**
**Practice Management /
Gestion de cabinet**
**Micro Restorative
Dentistry /
Micro Dentisterie
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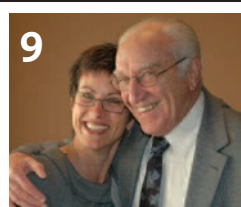
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Content/Sommaire

DECEMBER / DÉCEMBRE 2008

- 4 Share your Knowledge / Mise en commun de votre savoir
- 5 Message from the Editor-in-Chief
- 6 Message du rédacteur en chef
- 8 CARDP Committee Structure and Members /
Structure des comités et membres de l'ACDRP



ACADEMY NEWS / NOUVELLES DE L'ACADÉMIE

- 9 CARDP-APC 2008 Scientific Meeting in Review /
Revue du congrès ACDP - APC 2008

FEATURES/ARTICLES

Dental Materials / Matériaux dentaires

- 12 Composite Core Build-Up with
Prefabricated Posts: An In Vitro
Study

By Dr. Glauber Vieira Duarte DDS, MSc; Dr.
Gustavo Pinheiro de Freitas, DDS, MSc; Dr. Cornell
H. Driessen, DDS, MSc, PhD; Dr. Maria Jacinta
Moraes Coelho Santos, DDS, MSc, PhD; Dr.
Anderson Pinheiro de Freitas, DDS, MSc, PhD; and
Dr. Gildo Coelho Santos Jr., DDS, MSc, PhD

Médecine buccale

- 17 Comment mettre l'eau à la
bouche d'un patient souffrant de
xérostomie: principes généraux
Par Dre Michelle Bourassa, B Pharm, MSc, DMD et
Dr. Rénald Pérusse DMD, MD, LMCC, FRCD(C), C.S.
(ODQ)

Oral Medicine

- 24 Making Their Mouths Water:
General Principles for Treating
Xerostomia Patients
By Dre Michelle Bourassa, B Pharm, MSc, DMD and
Dr. Rénald Pérusse DMD, MD, LMCC, FRCD(C), C.S.
(ODQ)

Practice Management / Gestion de cabinet

- 28 Vital Interactions: The Chemistry
of a Championship Dental Team
By Mr. Peter Barry, CMC, RRDH

Micro Restorative Dentistry / Micro dentisterie restauratrice

- 35 Operating Microscopes and Zero-
Defect Dentistry
By Dr. David J. Clark, DDS



INDICATES PEER REVIEWED/
INDIQUE REVUE DES PAIRS

The cover of this issue is an image of Cabot
Tower on Signal Hill, a Canadian National
Historic Site in St. John's, Newfoundland.

NEW SECTION / NOUVELLE SECTION

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SHARING YOUR KNOWLEDGE

Dear fellow Members,

The Academy's *Journal* welcomes your written contributions as an additional source of information for our readership.

Have you recently read a professional article or textbook and wish to share your appreciation of its content and impact on your practice? Take a moment to e-mail your comments and recommendations to the Editor at hgaucher@sympatico.ca. Share your knowledge.

We look forward to your input.

The Editorial Board.

MISE EN COMMUN DE VOTRE SAVOIR

Chers membres,

Notre *Journal* vous invite à contribuer vos évaluations écrites afin d'offrir une source additionnelle d'information à nos lecteurs.

Vous avez récemment fait lecture d'un article ou d'un livre portant sur la Médecine dentaire et vous souhaitez partager votre appréciation de son contenu et de son impact sur votre pratique? Prenez un moment pour transmettre par courriel vos commentaires et recommandations à notre Rédacteur à hgaucher@sympatico.ca. Partagez votre savoir.

Nous apprécions votre participation.

L'équipe éditoriale



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Greetings to Our Easternmost Colleagues

This past September our Academy hosted a resoundingly successful annual meeting in Vancouver. Thanks to the meeting co-chairs, Les Kallos and Ash Varna, plus numerous dedicated committees of our members, the scientific and social programs were topnotch, as were the Industry exhibits that benefited members and guests alike.

Turning our sight from West to East in this gigantic country of ours, I would like to salute our colleagues from Canada's easternmost province, Newfoundland and Labrador, and inform them of our Academy's activities as well as our upcoming 2009 annual scientific meeting to be held in Montréal next September 23–26.

The cover of this Issue of our Journal features the capital, St. John's. I have had the good fortune of becoming acquainted with Newfoundland and can safely say that it is one of Canada's best kept secrets. It is now my pleasant mission to promote this Atlantic province and to invite its restorative and prosthodontic confederates to keep abreast of our activities and announcements by regularly visiting our Academy's website at www.cardp.ca

One of the editorial board's main objectives is to circulate scientific content to its readers as well as acquaint them with other current issues liable to be of interest and use to them. In so doing, we strive to increase contributions and services to all Canadian dentists and to ultimately welcome them into our Academy.

Before I introduce the articles appear-

ing in this Journal, I would like to sincerely thank our contributors for submitting their work, several of them for the second or third time.

In this Issue, the third Oral Medicine article on xerostomia, presented by Drs Michelle Bourassa and Rénald Pérusse, focuses on related therapies including salivary substitutes, sialogogues, and the preventive measures required to reduce sequelae.

In our Practice Management series Mr. Peter Barry reminds us that our "people skills" are just as important as our technical competence. Conflict resolution is passé as a concept and has transitioned to "connection management," a "proactive" tool that emphasizes teamwork.

Dr. David Clark's second article underlines the evolution of triage in the assessment of dental pathologies. Restorative dentistry now being inextricably linked to implant dentistry, we are short changing our practice by not availing ourselves of microscope technologies.

Might I beseech Dr. Clark to follow up, with a subsequent article on the practice management concerns related to introducing microscope technologies into a restora-

tive/prosthodontic practice?

The section on Dental Materials features Dr. Gildo Santos and his co-authors' original in vitro assessments of the effect of specific pre-fabricated posts on the related strengths of resin composite core build-up. The authors recommend caution when using these pre-fabricated posts in clinical cases presenting adequate sound tooth structure.

This seems an appropriate place to call upon our readers to contribute their own experiences with various therapies and by doing so, jumpstart our new section: **Share Your Knowledge / Mise en commun de votre savoir**. The goal is to facilitate the flow of valuable information and opinion (using e-mail) generating from your own practice.

As 2008 winds down, and during the hectic upcoming Holidays, let's not forget how very fortunate we are, and that luck had at least something to do with our getting here. So many others have not been as blessed as they wrestle with economic hardship or struggle to achieve peace. Our Editorial Board members join me in wishing you and yours a fulfilling Holiday Season.

Dr. Hubert
Gaucher
Editor-in-Chief



Salutations à nos collègues de l'Est

En septembre dernier, notre Académie a tenu sa réunion annuelle à Vancouver. Grâce aux efforts concertés de Les Kallos et Ash Varna, ainsi qu'aux nombreux comités de membres dévoués, ce fut un succès éclatant. Les présentations scientifiques et les programmes d'activités sociales étaient de premier ordre. Aussi, les membres et invités ont pu profiter des expositions de très haut calibre de l'Industrie dentaire.

En survolant du regard notre immense pays de l'ouest à l'est, j'aimerais saluer nos collègues de la province canadienne la plus orientale, c'est-à-dire Terre-Neuve et Labrador, et leur communiquer les activités de notre Académie ainsi que de notre réunion scientifique annuelle qui aura lieu à Montréal du 23 au 26 septembre prochain.

Sur la couverture de ce numéro du JCDRP figure la capitale, St-John's. J'ai eu la chance de connaître Terre-Neuve et je peux affirmer sans la moindre hésitation que c'est l'un des secrets les mieux gardés du Canada. J'ai maintenant l'heureuse mission de promouvoir cette province de l'Atlantique et d'inviter nos acolytes en dentisterie restauratrice et prosthodontique à se tenir au courant de nos activités en visitant régulièrement le site de notre Académie à www.cardp.ca

L'un des objectifs principaux de notre comité de rédaction est de diffuser un contenu scientifique à ses lecteurs et de les mettre au diapason d'autres questions d'actualité qui pourraient les intéresser et leur être utiles. Ce faisant, nous cherchons à augmenter notre contribution et nos services à tous les dentistes canadiens et, ultimement, les inviter à rejoindre les rangs

de notre Académie.

Avant de vous présenter les articles qui paraissent dans ce numéro, j'aimerais remercier tout particulièrement ceux et celles qui y ont participé, certains pour la deuxième ou troisième fois.

Donc dans ce numéro, le troisième article de la médecine buccale portant sur la xérostomie, rédigé par les Drs Michelle Bourassa et Rénald Pérusse, accentue les traitements qui y sont associés, notamment les substituts salivaires, les sialogogues et les mesures de prévention nécessaires à la réduction des séquelles possibles.

Dans notre série de gestion de la pratique, M. Peter Barry nous rappelle que nos aptitudes en relations humaines sont aussi importantes que notre compétence technique. La résolution de conflits est chose du passé en tant que concept et est maintenant remplacée par la gestion de connexion, un outil pro-actif qui favorise le travail d'équipe.

Le deuxième article du Dr David Clark met en évidence l'évolution du triage dans l'évaluation de pathologies dentaires. Puisque la dentisterie restauratrice est aujourd'hui indissociable de l'implantologie, nous serions perdants si nous ne profitions pas des techniques de la microscopie.

Puis-je solliciter du Dr Clark un autre article sur les enjeux de la gestion de pratique concernant l'introduction de ces techniques microscopiques dans un cabinet de dentisterie restauratrice et prosthodontique?

La section sur les matériaux dentaires rédigée par le Dr Gildo Santos et ses co-auteurs discute des évaluations in vitro de l'effet de pivots préfabriqués spécifiques sur la force des résines composites. Les auteurs recommandent la prudence lors de l'utilisation de ces pivots préfabriqués dans les cas cliniques présentant une structure dentaire adéquate et saine.

Voici l'endroit idéal pour demander à nos lecteurs de nous communiquer leurs expériences personnelles avec divers traitements et ce faisant, nous lançons notre nouvelle section : **Share Your Knowledge/Mise en commun de votre savoir**. Ainsi, au moyen du courrier électronique, vous pourrez échanger vos avis et commentaires et nous transmettre des résultats obtenus dans votre propre pratique.

Comme nous approchons la fin de l'année 2008, et durant cette période des Fêtes, il ne faudrait surtout pas oublier que nous sommes particulièrement privilégiés et qu'il y a toujours une part de chance dans notre cheminement. D'autres, beaucoup moins fortunés, se heurtent contre des obstacles pécuniaires insurmontables ou livrent bataille pour assurer la Paix. Les membres de notre comité de rédaction se joignent à moi pour vous





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COMMITTEE STRUCTURE AND MEMBERS STRUCTURE DES COMITÉS ET MEMBRES



The Canadian Academy of Restorative Dentistry and Prosthodontics

CARDP consists of many volunteers that donate a lot of their time and talents. Below is an outline of the council and committee structure of the academy.

The main governing body is made up of the executive council, which consists of: The President, President Elect, Past President, Vice President, and Secretary Treasurer.

This year, these positions are filled by:



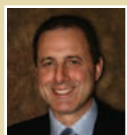
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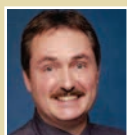
President Elect
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Vice President
Dr. Kim Parlett



Past President
Dr. Michael Racich



Secretary Treasurer
Dr. Les Kallos

The next governing body below this is the group of councillors made up of representatives from the different regions of Canada.

They are:

Dr. Maureen Andrea representing the Atlantic Region.

Dr. David Blair representing Quebec and Nunavut.

Dr. Kim Parlett representing Ontario.

Dr. Terry Kolteck representing Manitoba and Saskatchewan.

Dr. Doug Lobb representing Alberta and the Northwest Territories

Dr. Myrna Pearce representing British Columbia and the Yukon.

Below this is the group of committee chairs and their committee members.

The committees that exist at this point in the academy are:

CONVENTION COMMITTEE

Dr. Ash Varma, Powell River, BC and

Dr. Les Kallos, Burnaby, BC (Co-Chairs)

ADMISSIONS COMMITTEE

Dr. Mary Currie Pointe-Claire, QC
(Chair)

Dr. Maurice Wong, Vancouver, BC
Dr. Myrna Pearce, Vancouver, BC

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Dr. Robert David, Montreal, QC

Dr. Dennis Nimchuk, Vancouver, BC

PUBLICATIONS

Dr. Gorman Doyle, Halifax, NS (Chair)

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(Chair)

Dr. Gerald Skea, Thunder Bay, ON

Dr. Patrick Arcache, Montreal, QC

PHOTO-ROSTER COMMITTEE

Dr. Peter Woolhouse, Westmount, QC
(Chair)

Dr. Baxter Rhodes, Ithaca, NY

Dr. Les Kallos, Burnaby, BC

SPECIAL FUNDS COMMITTEE

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Dr. Andrew Tynio, Toronto, ON

Dr. Larry Pedlar, Burlington, ON

Dr. Ed McIntyre, Edmonton, AB

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Dr. David Blair, St. Lambert, QC

Dr. Brian Friesen, Winnipeg, MB

CONTINUING EDUCATION COMMITTEE

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Dr. Ed McIntyre, Edmonton, AB

HISTORIAN

Dr. William Sehl, Waterloo, ON

CORPORATE LIASON COMMITTEE

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Dr. Ed McIntyre, Edmonton, AB

Dr. Cary Letkemann, Ancaster, ON

Dr. Larry Pedlar, Burlington, ON

Dr. Maureen Andrea, Chester, NS

Dr. E.J. Rajczak, Hamilton, ON

LOCAL ARRANGEMENTS COMMITTEE (Appointed by the President)

Dr. Robert David, Montreal, PQ
(Chair)



CARDP–APC 2008 Scientific Meeting in Review / Revue du congrès ACDRP–APC 2008

September 10-13th, Vancouver, BC / 10-13 septembre, Vancouver, CB

In Vancouver this past September, the Canadian Academy of Restorative Dentistry and Prosthodontics (CARDP) was proud to host its 16th annual Scientific Session –this year with the distinct pleasure of also having the participation of the Association of Prosthodontists of Canada.

Meeting Co-Chairs Drs. Les Kallos and Ash Varma put together an outstanding array of pre-conference social and academic activities. From ocean kayaking about the Pasley Islands and sturgeon fishing on the Fraser River to a hands-on-course at the University of British Columbia, opportunities to interact with other delegates abounded. Other events such as the golf tournament, the Vancouver Culinary Experience, the Experience Vancouver: Reception and Dinner, and the President's Gala rounded out the social possibilities.

Scientific and Clinic Chairs Drs. Ron Zokol and Myrna Pearce organized a talented group of academicians, clinicians, and manufacturers for a stimulating two days of learning, sharing, and exploring. The terrific line-up of speakers featured:

Dr. Harry Rosen on "The Blending of Art and Science in Dentistry"

Mr. Tom Lee on "Simplified Articulation for Esthetics and Function"

Dr. Loïc Legendre on "Restoration and Prosthodontics in Veterinary Patients"

Dr. Dennis Nimchuk on "Dogma and Controversies in Implantology"

Dr. Sonia Leziy on "The Next Dimension in Implant Aesthetics: An Architectural Plan and Vision for Success:"

Dr. Terry Donovan on "Evidence-Based Selection of Contemporary Ceramic Systems"

Dr. Robert Miller on "Oral Implantology: Yesterday, Today, and Tomorrow"

Dr. Yvan Fortin on "Implant Restoration of the Moderate to Severely Resorbed Edentulous Maxilla without Bone Grafting"

Dr. Charles Goodacre on "A new Era for Occlusion: The Use of 3D digital Technology to Enhance Education and Understanding"

Dr. Maxwell Anderson on "Good Plaque and Management of Dental Diseases"

Dr. Byoung Suh on "Research-Based Adhesion Dentistry"

Dr. Dorin Ruse on "Adhesive Dentistry – What and How Based on Understanding Why"

Dr. Edward Lowe on "Modern Esthetic Restorative Materials – clinical Challenges and Considerations"



CARDP members and guests gathering for a day of kayaking.



The one that didn't get away!



President Dr. Stanley Blum supported by President - Elect Dr. Vernon Shaffner (left) and Past President Dr. Michael Racich (right) at the President's Gala.



Secretary-Treasurer, Dr. Les Kallos greeting one of our Montréal members, Dr. Patrick Arcache, at the President's Dinner-Gala.



Mr. Ron Suh, Bisco Dental sharing his insights with Dr. Dorin Ruse, UBC Faculty of Dentistry.



Dr. Harry Rosen getting a warm reception from Dr. Myrna Pearce.



Learning from Table Clinics.



We hope you enjoyed this year's CARDP meeting and the exciting city of Vancouver

Nous espérons que vous avez apprécié le congrès annuel de l'ACDRP ainsi que l'excitante ville de Vancouver.

We look forward to seeing you again at next year's CARDP meeting in the dynamic city of Montréal.

Nous espérons vous revoir lors de notre congrès annuel de l'ACDRP l'an prochain dans la dynamique ville de Montréal.

Join us in Montréal this September!



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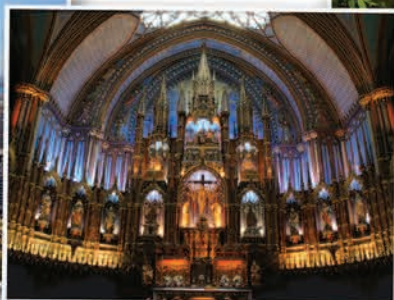


APC

Mark your Calendar for the 17th Annual
CARDP and APC Joint Scientific Meeting

Tomorrow's Dentistry Today

Montréal, Québec: September 23rd - 26th, 2009



Soyez des nôtres en septembre prochain à
Montréal pour le congrès annuel conjoint de
l'ACDRP et de l'APC. Notez-le à votre agenda.

La dentisterie de demain...aujourd'hui

Montréal, Québec : du 23 septembre au 26 septembre 2009

LE WESTIN
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More Info / Plus d'information : www.cardp.ca

Strength of a Resin Composite Core Build-Up with Prefabricated Posts: An In Vitro Study

By Glauber Vieira Duarte, DDS, MSc; Gustavo Pinheiro de Freitas, DDS, MSc; Cornell H Driessen, DDS, MSc, PhD; Maria Jacinta Moraes Coelho Santos, DDS, MSc, PhD; Anderson Pinheiro de Freitas, DDS, MSc, PhD; Gildo Coelho Santos Jr., DDS, MSc, PhD

ABSTRACT

Purpose: Determine the diametral tensile strength (DTS) of a resin composite core (Filtek Z250 - 3M) bonded to glass and carbon fibre posts of varying diameter.

Material and Methods: Part I, cylindrical samples of resin composite (C), measuring 6 mm × 3 mm, were fabricated ($n = 10$). Another two groups consisted of 1.5 mm glass-fibre posts (Reforpost - Angelus) (GF1.5) and 1.5 mm carbon-fibre posts (Reforpost - Angelus) (CF1.5) bonded to the resin disks. Part II, specimens were made using 1.1 mm glass-fibre post (GP1.1), and 1.1 mm carbon-fibre post (CF1.1). Specimens were light cured for 40 seconds each side, stored in 37°C distilled water for 7 days and submitted to a DTS test in a universal testing machine (EMIC DL2000). Data was recorded and analyzed using ANOVA with post-hoc pairwise test. Results revealed a statistically significant difference ($p < .001$) among the groups.

Results: Part I, the mean force (MPa) required to fracture the specimens for each group was: C: 52.33 (± 5.97), GF 1.5: 33.46 (± 4.35), CF 1.5: 35.74 (± 4.49). Control Group was significantly greater than the experimental groups but there was no difference between the two experimental groups. Part II, the mean force (MPa) for each group was: GF 1.1: 37.81 (± 4.46), and CF 1.1: 32.93 (± 3.53). Group GF 1.1 was significantly greater than GF 1.5 and CF 1.1, similar to GC 1.5,

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Correspondence may be directed to Gildo C. Santos Jr. He can be reached at: gildo.santos@schulich.uwo.ca.



and CF 1.1 showed a lower value statistically significant difference to CF 1.5.

Conclusion: The fibre posts used in this study have a negative effect on the fracture resistance of the resin composite material.

Clinical Implications: If the tooth has adequate sound structure, the use of prefabricated posts should be avoided.

RÉSUMÉ

Objectif : Déterminer la force de tension diamétrale d'un noyau de résine composite (Filtek Z250 - 3M) lié à des pivots en fibre de verre et en fibre de carbone de diamètre différent.

Matériel et méthodes : Partie I, des échantillons cylindriques de résine composite (C), mesurant 6 mm sur 3 mm, ont été fabriqués ($n = 10$). Deux autres groupes étaient composés de pivots de 1,5 mm en fibre de verre (Reforpost - Angelus) (GF 1,5) et de pivots de 1,5 mm en fibre de carbone (Reforpost - Angelus) (CF 1,5) liés à des disques en résine. Partie II, les spécimens ont été fabriqués en utilisant un pivot de 1,1 mm en fibre de verre (GP 1,1), et un pivot de 1,1 mm en fibre de carbone (CF 1,1). Les spécimens ont subi une photopolymérisation de 40 secondes de chaque côté, ont été conservés dans de l'eau distillée à 37 °C pendant 7 jours et soumis à un test de force de tension diamétrale dans une machine universelle (EMIC DL2000). Les données ont été enregistrées et analysées selon la méthode ANOVA et le test par paires a posteriori. Les résultats ont révélé une différence statistiquement significative ($p < 0,001$) parmi les groupes.

Résultats : Partie I, la force moyenne (MPa) requise pour entraîner la rupture des spécimens de chaque groupe était : C: 52,33 ($\pm 5,97$), GF 1,5: 33,46 ($\pm 4,35$), CF 1,5: 35,74 ($\pm 4,49$). Le groupe témoin était significativement plus important que les groupes expérimentaux, mais il n'y avait pas de différence entre les deux groupes expérimentaux. Partie II, la force moyenne (MPa) pour chaque groupe était : GF 1,1: 37,81 ($\pm 4,46$), et CF 1,1: 32,93 ($\pm 3,53$). Le groupe GF 1,1 était significativement plus important que le groupe GF 1,5 et CF 1,1, semblable à GF 1,5, et CF 1,1 a démontré une différence statistiquement significative de valeur inférieure à CF 1,5.

Conclusion : Les pivots utilisés dans cette étude ont un effet négatif sur la résistance de rupture de la résine composite.

Conséquences cliniques : Si la dent a une structure solide, l'utilisation de pivots préfabriqués devrait être évitée.

Cast posts have been used in restorative dentistry for more than 100 years.¹ The main disadvantage of cast posts is the high modulus of elasticity of the metal, which exceeds by 8 to 15 times the modulus of elasticity of the dentin. This leads to a high incidence of fracture of the root due to a high stress concentration at the tooth-post interface.² Moreover, cast posts require more frequent clinical sessions, more extensive removal of dental structure, and may stain the adjacent root area.³

Prefabricated posts are now widely available and are made of carbon, glass, or quartz fibres. These posts have a modulus of elasticity similar to the dentin and allow the post to have the same flexion pattern

as the tooth, thereby providing a homogeneous distribution of stress on the root and minimizing the incidence of root fractures.^{4,5}

The advantages of prefabricated posts are: they involve less tooth removal, require less time to prepare, are easily removed, are more esthetic, are available in different diameters, and adhere better to the dental structure and the crown.^{3,6}

When non-metallic prefabricated posts are used in the restoration of endodontically treated teeth, a crown restoration can be prepared at the same appointment as the resin core is being built and the two components can be bonded together to form a single unit.^{7,8}

Fokkinga et al.⁹ investigated the frac-

ture resistance and failure mode of crowns fabricated with fibre posts bonded to a resin composite core. The types of posts used were: (1) prefabricated metallic posts, (2) prefabricated fibreglass posts (3) cast posts, and (4) no posts (disks of solid resin composite). A static load was applied until the fracture of the samples using a universal testing machine. Results were similar for fracture resistance and failure mode among the groups, which suggests that posts did not decrease the fracture resistance of the crowns.

Heydecke et al.¹⁰ studied the fracture strength and survival rate of endodontically treated crowned maxillary incisors with proximal class III cavities and different core build-ups including titanium posts,

zirconia posts; hybrid composite filling partially the root canal, and access opening restored with resin composite. They found that the cementation of posts was comparable, but there was no evidence of advantageous fracture resistance when compared to the restoration of the endodontically treated tooth with composite alone.

The purpose of this study was to determine (1) the DTS of resin core material when bonded to prefabricated posts with different fibres, (2) the DTS of a resin core bonded to prefabricated posts with different diameters.

The null hypothesis is that there is no difference in DTS of the resin composite core material when bonded to glass fibre or carbon fibre prefabricated posts, or to posts with different diameters when compared to the resin core material alone.

Materials and Methods

Part I – Effect of Type of Fibre

Two commercial, fibre-reinforced, composite posts were tested. Materials used are listed in Table 1.

Thirty disc specimens were fabricated with a resin composite material (Filtek Z250 – 3M/ESPE) using a two-part, stainless steel dye. The inferior portion, measuring 80 mm in diameter with a central perforation of 2 × 1 mm, was used to position the pre-fabricated posts (Figure 1). The superior portion, measuring 70 mm in diameter, had a central perforation of 6 mm in diameter and 3 mm in depth. The central perforation of the inferior portion allows the positioning of a prefabricated post into the center of the specimen that is formed in the superior portion.⁵ Three groups of resin composite core specimens were prepared with this device, each consisting of 10 specimens. Resin composite discs without posts served as control group (Group C). The remaining specimens were made using either glass or carbon-reinforced post and resin composite core combinations as follows: Reforpost (Glass Fibre) 1.5 mm diameter glass fibre post (Group GF 1.5) and Reforpost (Carbon

Fibre) 1.5 mm diameter carbon fibre posts (Group CF 1.5).

Group C specimens were fabricated by inserting the resin composite (Filtek Z250 – 3M ESPE) into the stainless steel dye using a spatula and then the resin was light-cured for 40 seconds (Optilight Plus QTH unit – Gnatus – 540mW/cm²). The samples were removed from the dye, light-cured on the opposite surface for another 40 seconds and then stored in 37°C distilled water for seven days.



Figure 1. Metallic matrix.

Group CF 1.5 and Group GF 1.5 specimens were prepared using an additional step. Prior to their insertion into the lower portion of the dye, the posts were cleaned with 97% ethyl alcohol in accordance with the manufacturer's instructions to prevent contamination. Silane (Silane Agent – 3M/ESPE) was applied to the cleaned posts for 60 seconds, air-dried and a layer of adhesive (Single Bond 2 – 3M/ESPE) was applied and gently air-dried to facilitate solvent evaporation and light-cured for 40 seconds (20 seconds in each side of the post). The fibre post was then placed into the central perforation of the inferior part of the dye and a resin composite was fabricated similar to Group C and light-cured for 40 seconds (Figure 2). The resin disc with the fibre post was removed from the mould, the bottom surface was light-cured for another 40 seconds and then stored in

37°C distilled water for 7 days.

After seven days of distilled water storage, specimens were subjected to compressive loading in a universal testing machine (EMIC DL2000) with a load cell of 2.000 kg at 1 mm/min of crosshead speed. Each sample was oriented horizontally on the platform of the machine and a DTS test was performed. Load was applied until failure of the resin core specimen occurred. The force (N) needed to fracture the sample disc was converted into megapascal (MPa).



Figure 2. Light-curing a sample.

A one-way analysis of variance (ANOVA) was used to determine whether there was any difference among the three groups means (C, GF 1.5, and CF 1.5). The Tukey-Kramer test was used for pair-wise comparisons. A *p* value <.05 was considered to be statistically significant and a 25% difference in effect size was considered to be clinically significant.

Part II – Effect of Diameter of Fibre

In part II, new specimens were made, using 1.1 mm diameter glass fibre post and resin composite core (Group GF 1.1), and using 1.1 mm diameter carbon fibre post and resin composite core (Group CF 1.1) following the same procedures described above.

Results

The results of the DTS test are presented in Table 2. In part I, Group C (control group) displayed the highest mean DTS value, while Groups CF 1.5 and Group GF 1.5 presented similar, but showed lower fracture resistance values. The fracture resistance of Group CF 1.5 was slightly greater than that of Group GF 1.5. The amount of

Table 1. Materials Used

Brand	Composition	Manufacturer
REFORPOST	Fibreglass post (1.5 mm and 1.1 mm)	Angellus
REFORPOST	Carbon fibre post (1.5 mm and 1.1 mm)	Angellus
Filtek Z250	Composite resin – Type II	3M ESPE
Single Bond	Bonding agent	3M ESPE
Silane	Silane	3M ESPE

force required to fracture the resin disc was 31.7% less for Group CF 1.5 and 36% less for Group GF 1.5 when compared to Group C.

The ANOVA indicated that the mean force required to fracture the resin disc was statistically significant among the groups ($p < .001$). Post hoc, pairwise comparisons using the Tukey-Kramer test revealed a statistically significant difference in mean fracture resistance of both Group CF 1.5 and Group GF 1.5 compared to the control group ($p < .05$). The difference in mean fracture resistance between Group CF 1.5 and Group GF 1.5 was not statistically significant ($p > .05$). All assumptions respecting ANOVA were satisfied.

In part II, the reduction of the glass fibre post diameter increased the fracture resistance of the resin core, while the reduction of the carbon fibre post diameter decreased the final strength of the core.

The amount of force required to fracture the resin disc was 27.7% less for Group GF 1.1 and 37.9% less for Group CF 1.1 when compared to Group C. These differences were deemed to be statistically significant.

Post hoc, pairwise comparisons using the Tukey-Kramer test revealed that the fracture resistance of Group GF 1.1 was significantly greater than that of Group GF 1.5 and CF 1.1 ($p > .05$). The comparison of the mean fracture resistance between Group CF 1.1 and Group CF 1.5 showed a statistically significant difference ($p < .05$). There were no statistical difference between Groups GF 1.1 and CF 1.5.

The SEM image of the surface of a fragment of a specimen made with glass fibre post at 500× magnification showed a cohesive failure of the post occurred, thus exposing the fibres (Figure 3). All of the specimens bonded to a post and fractured at the same point within the post material adjacent to the bond between the post and the resin core.

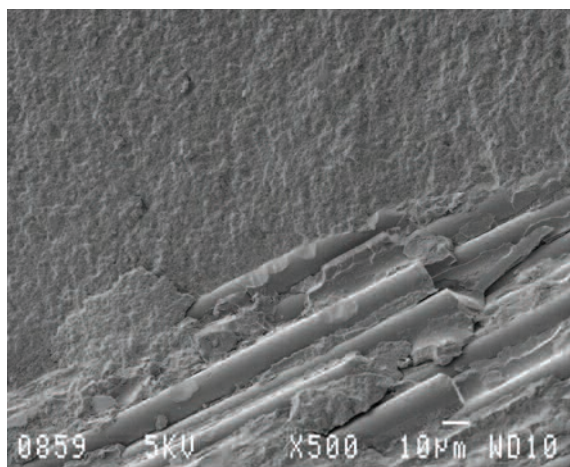


Figure 3. Fibre Post – 500 x original magnification showing post and resin composite.

The scanning electron microscope (SEM) image of a fragment of a specimen made with carbon fibre post at 500× magnification displays cohesive failure also occurred with this type of post as evidenced by a peeling of the surface layer of the post occurred upon fracture (Figure 4). This image shows that the carbon fibres are relatively smaller in diameter when compared to the glass fibres.

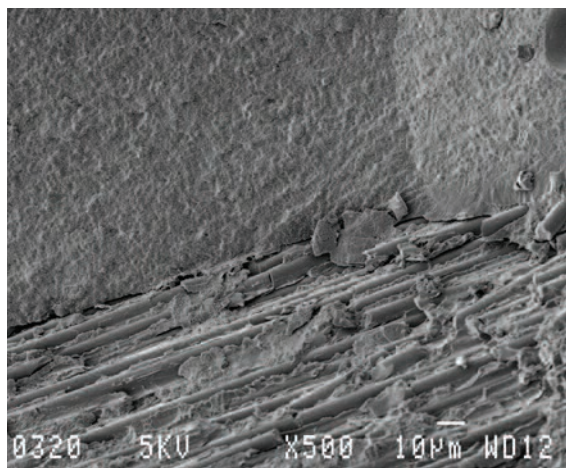


Figure 4. Carbon Post – 500x original magnification showing post and resin composite.

Discussion

Different mechanical tests have been used to evaluate the bond strength of fibre posts when bonded to a resin composite build-up core.¹¹ The DTS is an evidence-based testing method because of its simplicity, uniformity and reproducibility. It is considered an important assay for simulating in-vitro, the tensile stress to which dental restorations are subjected in the oral cavity.^{11,12}

Thermocycling was not applied to the specimens.

According to Purton et al. thermocycling should be given less

emphasis in tests for the retention of root canal posts cemented with resin cements.¹³

In another study investigating the effects of pre-treatment on bond strength between resin cements and various posts including prefabricated glass fibre posts and Interpenetrating Polymer Post (IPN post, Stick Tech), it was found that thermocycling had no significant influence.¹⁴

Cho et al.¹⁵ verified the DTS of two resin composites (XRV Herculite and Prodigy) for core build-up. They tested samples with the same diameter as the specimens evaluated in this study (6 mm × 3 mm) and reported average DTS values of 51 MPa and 55 MPa, respectively. Santos Jr. et al.⁵ also investigated a resin composite core build-up material (Tetric-Ceram) and reported mean values of DTS of 54 MPa. Those results are similar to our study where the average DTS value for the resin composite core (Z250) was 52.3 MPa.

In this study, the use of glass fibre and carbon fibre posts decreased the fracture resistance of the core build-up material by 31.7% for CF 1.5 and 36.1% for GF1.5 respectively. Results demonstrated that the resin composite core material provides higher fracture resistance when used as a solid block.

The use of carbon fibres or glass fibres to prepare the posts did not result in any difference of strength of the samples, although there was difference in width of the fibreglass fibres compared to the carbon fibres.

Table 2. Mean force (MPa) required to fracture core specimen, by group

Group	Mean	SD	SE	% Difference from Control	HG
Group (C)	52.33	5.97	1.88		a
GF 1.1	37.81	4.46	1.41	-27.75%	b
CF 1.5	35.74	4.49	1.42	-31.70%	bc
GF 1.5	33.46	4.35	1.37	-36.10%	cd
CF 1.1	32.93	3.53	1.11	-37.08%	d

HG = Homogeneous Groups – Different letters means statistic difference among groups.

The reduction of the post diameter to 1.1 mm (GF 1.1) increased the DTS values when compared to the 1.5 mm glass fibre posts (GF 1.5). This may be explained due to the increasing on the final volume of the core material.

The behaviour of Groups CF 1.5 and CF 1.1 which results demonstrated that the bigger the diameter the higher the DTS (statistically significant) probably can be explained because of the relatively smaller diameter of the carbon fibres compared to glass fibres and the higher number of the fibres per volume.

All resin composite samples with bonded fibre posts demonstrated cohesive failure. The failure occurs predominantly within the fibre-reinforced post along the interface between the resin matrix and the post. This finding suggests that the bond between the composite core material and the post surface was stronger than the bond between the internal fibres and the resin matrix of the post.

This study showed a decrease in fracture resistance of resin composite core build up material when used in conjunction with these particular glass and carbon fibre prefabricated posts. This finding indicates that the glass fibre or carbon fibre posts used in this study do not strengthen resin composite core build-up materials. Thus, if the tooth has adequate sound structure, the use of prefabricated posts should be questioned.

Conclusion

The use of carbon fibre and glass fibre prefabricated posts utilized in this study, bonded to resin composite core build-up material decreased the fracture resistance of resin core material by about one third.

Both carbon fibre and glass fibre posts with 1.5 mm diameter displayed similar behaviour to compressive forces but differs when 1.1 mm fibre posts were used.

The increasing on the diameter of the glass fibre post decreases the fracture resistance of samples.

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Disclosure

The authors declare no competing financial interest.

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Comment Mettre L'eau à la Bouche d'un Patient Souffrant de Xérostomie:

PRINCIPES GÉNÉRAUX

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RÉSUMÉ

La xérostomie est une plainte fréquemment rapportée par les patients qui consultent en médecine dentaire. En plus de causer un inconfort, la diminution du débit salivaire a un impact négatif sur la qualité de vie en affectant différentes fonctions dont la mastication, la déglutition, l'élocution et peut être la source de nombreuses complications buccodentaires de nature infectieuse.

Elle peut être associée à certaines conditions systémiques, principalement à caractère auto-immun, la plus fréquente étant la maladie de Sjögren ou résulter de la destruction des acini glandulaires suite à la radiothérapie cervicofaciale. Mais la cause la plus fréquente demeure les médicaments pourvus d'une action anticholinergique et ceux qui modifient certaines composantes biologiques.

L'approche thérapeutique consiste premièrement à un examen soigneux allant à la recherche de la cause afin de la corriger lorsque possible. Dans le cas contraire, il y a lieu de recourir à des



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mesures palliatives et de mettre en place des mesures préventives afin de minimiser le risque de complications ou d'en retarder l'apparition.

Les premières mesures visent des éléments de la vie quotidienne et consistent à éviter les facteurs aggravant, à favoriser l'hydratation des muqueuses par un apport hydrique suffisant, sans oublier l'humidification de l'air ambiant. De plus une plus grande production de salive peut être induite par la prise plus fréquente de repas, la mastication de gomme à base de xylitol ou la consommation de bonbons sans sucre. Pour certains patients le recours à un des agents de remplacement, appelé salives artificielles, peut aider à réduire l'inconfort. Dans les cas les plus sévères, l'utilisation d'un sialogogue peut être bénéfique.

Dans tous les cas, un suivi très étroit de la condition du patient est indiqué. Des mesures d'hygiène buccale strictes devraient être instaurées, accompagnées d'une diète à faible pouvoir cariogène et généralement du fluor sous une forme adaptée à la situation du patient.

Condition souvent rencontrée dans la pratique dentaire, la xérostomie est un symptôme résultant d'une diminution de la quantité de salive et d'une modification de sa composition.¹⁻³ L'hyposalivation traduit une réduction réelle du débit salivaire alors que la xérostomie est en soi une expérience subjective de sécheresse de la bouche fréquemment, mais pas toujours, associée à une réduction du débit salivaire. Généralement, les patients commencent à ressentir de la

xérostomie avec une réduction de moitié du débit salivaire habituel.²

Dans la lancée des articles de la présente série, celui-ci fera tout d'abord une brève révision de principes généraux relatifs à l'étiologie de ce désordre. Par la suite, les modalités thérapeutiques non pharmacologiques et pharmacologiques seront présentées. La dernière portion suggérera des interventions ayant pour but de prévenir ou de retarder les complications qui y sont associées.

Complications associées à une réduction du débit salivaire

La salive joue un rôle important à plusieurs égards dont entre autres, dans les fonctions gustatives, masticatoires et d'élocution, ainsi que dans la prévention des infections des muqueuses et des dents.^{1,3,4} Les lecteurs désireux d'en connaître davantage au sujet des conséquences possibles de la xérostomie sont

Algorithme du traitement de la xérostomie

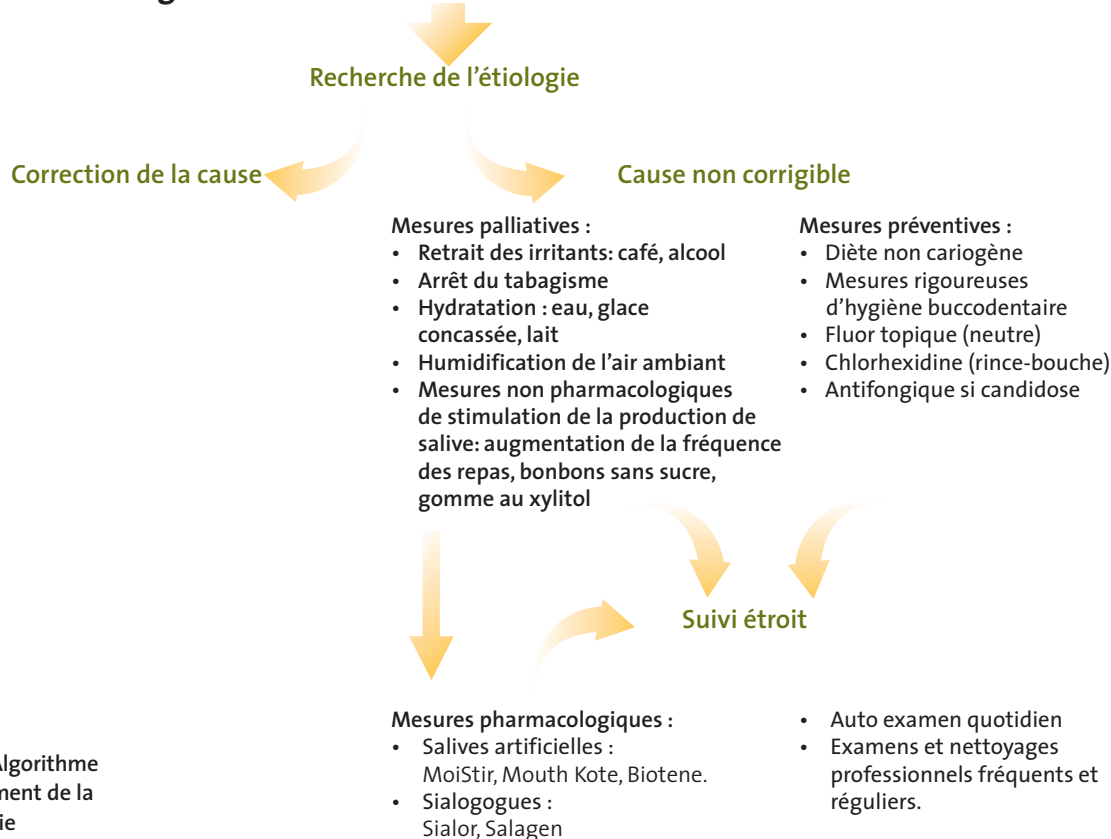


Figure 1. Algorithme du traitement de la xérostomie

Tableau 1 : Classes de médicaments pouvant causer de la xérostomie (adapté de 1,5-7)

Classe pharmacologique	Exemples
Anticholinergics	Atropine, benzotropine, oxybutynin, scopolamine, trihexyphenidyl
Antidépresseurs	
Tricycliques	Amitriptyline, doxépin, desipramine, nortriptyline
Sélectifs de la recapture de la sérotonine	Citalopram, fluoxétine, paroxétine, sertraline, venlafaxine
Hétérocycliques	Imipramine, mirtazapine
Inhibiteur de la monoamine oxydase	Phenelzine, moclobémide
Antidépresseurs atypiques	Bupropion, nefazodone
Antipsychotiques	
Neuroleptiques	Chlorpromazine
Atypiques	Clozapine, olanzapine, quetiapine
Sédatifs et anxiolytiques	Lorazepam, diazepam, alprazolam, flurazepam, temazepam, triazolam, bromazepam, clonazepam
Antihypertenseurs	Captopril, enalapril, lisinopril, clonidine, méthildopa, prazosin, terazosin
Diurétiques	Hydrochlorothiazide, furosemide, triamterene, spironolactone
Anti-arythmique	Disopyramide
Bronchodilatateurs	Ipratropium, salbutamol
Antihistaminiques	Hydroxyzine, chlorpheniramine, diphenhydramine, loratadine, cetirizine
Décongestionnant	Pseudoéphedrine
Antémétique	Meclizine
Antiparkinsoniens	Biperiden, selegiline, carbidopa/levodopa
Anticonvulsivant	Gabapentin, carbamazépine
Relaxants musculaires	Cyclobenzaprine, baclofen, orphenadrine
Analgésiques	
Opiacés et autres agissant au SNC	Codeine, méperidine, méthadone, morphine, pentazocine, propoxyphène, tramadol
Anti-inflammatoires non stéroïdiens	Diflunisal, ibuprofène, naproxène, piroxicam
Inhibiteurs de la pompe à protons	Omeprazole, esomeprazole, lansoprazole, rabeprazole
Médicament contre l'acné	Isotretinoïne
Médicament contre l'incontinence urinaire	Tolterodine
Produit pour arrêt du tabagisme	La gomme de nicotine

invités à consulter l'article paru dans l'édition précédente de cette revue.

Étiologie

La cause la plus fréquente de xérostomie est sans contredit la prise de médicaments pourvus d'effets anticholinergiques. Des médicaments possédant des mécanismes d'action autres peuvent aussi induire une réduction de la production de salive. Une liste non exhaustive des classes pharmacologiques d'agents ayant été associés à cet effet secondaire est présentée au tableau 1.1,5-7 Bien que la maladie de Sjögren soit fréquemment responsable de la xérostomie, d'autres conditions systémiques ont

aussi été reconnues pour leur potentiel d'induire de la xérostomie par différents mécanismes; le tableau 2 en dresse une liste.^{1,2,5,7} La destruction des acini des glandes salivaires, conséquence fréquente de la radiothérapie de la tête et du cou, peut aussi être responsable d'une réduction du débit salivaire possiblement sévère et irréversible dans cette situation.^{1,4,5,7,8} Fréquemment rencontrée chez les personnes âgées de plus de 65 ans, la réduction de la fonction salivaire ne résulterait pas de l'âge en soi mais serait plutôt associée à la présence d'un désordre systémique ou à la prise de médicaments inducteurs de xérostomie.^{1,4,6}

Traitement

La première mesure consiste à tenter d'établir l'étiologie de la xérostomie, afin de contrôler la pathologie sous-jacente lorsqu'elle est identifiée, ou encore de consulter le médecin traitant pour modifier la médication lorsque cette dernière est suspectée en tant qu'agent causal de la xérostomie.^{4,9}

Dans l'éventualité où la cause ne peut être corrigée, l'approche prend 2 volets, le premier étant de nature palliative afin de procurer le soulagement des symptômes et le second visant la prévention des complications buccales associées à la réduction de salive.

Mesures palliatives

Des mesures générales et simples peuvent aider à diminuer la sensation désagréable de bouche sèche. L'eau est la salive artificielle la plus fréquemment utilisée et présente plusieurs avantages.¹ Tout d'abord, un apport hydrique adéquat, un minimum de 2 litres par jour est recommandé, à moins que le patient souffre d'une condition justifiant une restriction liquidienne.^{7,9} L'apport peut se faire, par exemple, par de petites gorgées d'eau prises fréquemment au cours de la journée.^{1,5} Également, l'action de croquer ou sucer des morceaux de glace peut aider à réduire l'inconfort chez certains patients.^{5,7} Au cours de la nuit, la production de salive étant généralement réduite, la xérostomie est ainsi souvent plus marquée pour le patient et l'utilisation d'un humidificateur au chevet peut aider à réduire la sécheresse buccale et en diminuer l'inconfort associé.⁴⁻⁶ De façon générale, une augmentation de l'humidité des muqueuses buccales peut aider à réduire les infections opportunistes.⁵

De part ses propriétés physiques et chimiques, le lait peut aussi être considéré comme un bon substitut salivaire tout en contribuant à un bon apport liquidien. Son contenu en calcium et phosphate peut contribuer à la reminéralisation de l'émail. D'autres bénéfices sont tirés de son pouvoir tampon pour neutraliser l'acidité de la salive qui favoriserait la déminéralisation de l'émail et aussi de sa capacité à lubrifier et humidifier les muqueuses asséchées.¹

Aussi, tout agent irritant devrait être évité soit : café, alcool (incluant les rinçages à base d'alcool) qui peuvent assécher davantage les muqueuses et empirer les symptômes de xérostomie ainsi

Tableau 2 : Conditions systémiques associées à la xérostomie (adapté de 1,2,5)

Conditions systémiques ou génétiques pouvant altérer la fonction salivaire

Maladie de Sjögren	Dysplasie ectodermique
Arthrite rhumatoïde	Thyroïdite auto-immune
Lupus érythémateux	Pancréatite chronique
Sclérodermie	Maladie coeliaque, maladie de Crohn
Cirrhose biliaire primaire	Fibrose kystique
Hépatite auto-immune	Syndrome de Down
Hémochromatose	Maladie de surcharge en glucocérébroside
Sarcoïdose	Dystrophie myotonique
Diabète (type I et II)	Syndrome de Papillon-Lefèvre
VIH	Syndrome de Prader-Willi
Cytomégalovirus et virus de l'herpès	Maladie de Gaucher (surcharge en glucocérébroside)
Hépatite C	Amyloïdose systémique
Anxiété	Transplantation de moelle osseuse
Dépression	Réaction du greffon contre l'hôte

Conditions ou maladies causant un désordre métabolique pouvant induire de la xérostomie

Déshydratation
Désordres alimentaires (anorexie)
Insuffisance rénale terminale
Déficits nutritionnels

que le tabagisme qui contribue à réduire la production de salive.^{1,5-7}

Compte tenu que certains facteurs psychologiques peuvent contribuer ou aggraver la xérostomie, tels que le stress et l'anxiété, des interventions devraient être envisagées pour aider le patient à mieux gérer ces états psychologiques.⁹

Stimulation salivaire

Lorsque les glandes salivaires sont encore en mesure de fabriquer et de produire de la salive, il est possible de les stimuler mécaniquement ou encore chimiquement. Cette mesure est importante pour limiter l'atrophie des glandes salivaires qui a été observée chez des patients dont la mastication était réduite.¹ La prise de repas plus fréquents, la consommation de limonade ou de breuvage acide, de bonbons durs sans sucre, l'action de mâcher de la gomme à base de xylitol sont des mesures qui peuvent induire la production de salive et ainsi contribuer à réduire la sensation de bouche sèche chez un bon nombre de patients.^{1,4-6,9} Le recours aux produits acides devrait être réservé à un usage de courte durée car le pH acide de la salive contribue à la décalcification de l'émail dentaire.¹⁰

Bien que certains acides organiques,

tels que l'acide ascorbique, l'acide malique et l'acide citrique, aient le potentiel d'induire une salivation réflexe leur usage fréquent et à long terme est à proscrire puisqu'ils ont aussi un potentiel de déminéralisation et d'érosion de l'émail qui conduit à des caries dentaires.^{1,6}

Substituts de salive

Lorsque les mesures précédentes n'ont pas contribué à améliorer la production de salive, il est possible de faire appel à des agents de remplacement. Leur principale propriété est d'humidifier et de lubrifier les muqueuses. Ils procurent au patient une sensation de muqueuse buccale hydratée, réduisant ainsi l'inconfort associé à la sécheresse de la bouche mais n'affectent pas la quantité de salive produite.⁸ Le soulagement obtenu est temporaire et généralement d'une durée limitée, soit au mieux quelques heures.^{1,5,8} L'administration doit donc être répétée au besoin. Certains patients trouveront des bénéfices à y avoir recours juste avant d'aller au lit ou avant de prendre la parole.⁵

Ces solutions aqueuses contiennent différents ingrédients dont des glycoprotéines ou des mucines, des enzymes salivaires (peroxidase, glucose oxydase ou

lysozymes) et des polymères tels que du carboxyméthylcellulose ou de l'hydroxyméthylcellulose.^{9,11} Les bénéfices obtenus proviennent de l'humidification des muqueuses et de la gorge, de la protection des tissus mous et de leur capacité à enlever les débris et bactéries des surfaces dentaires.^{1,9,11}

Les produits disponibles au Canada sont : MoiStir (solution à vaporiser), Mouth Kote (solution), Oral Balance (gel). Les 3 produits peuvent être obtenus à la pharmacie sans prescription.

Ces produits devraient être déposés sur la langue ou directement sur les surfaces affectées puis dispersés partout dans la bouche. De façon générale, ils soulagent rapidement la sensation de bouche sèche et ils protégeraient également contre les irritations et les sensations de brûlure pour quelques heures.¹ Il est important d'informer les patients de ne pas rincer la bouche après l'application de ces produits.¹ Ils peuvent aussi être appliqués sous les prothèses dentaires pour en faciliter l'insertion.⁹

Malheureusement, peu d'études ont été effectuées pour permettre de comparer leur efficacité et d'établir la supériorité d'un agent par rapport à l'autre. Le choix repose donc actuellement sur la disponibilité du produit et les préférences du patient.⁵ Le principe important à retenir est de choisir un produit à faible pouvoir érosif pour l'émail, c'est-à-dire dont le pH est le plus neutre possible.⁵ Les patients sont souvent contraints à en essayer plus d'un pour découvrir celui qui est le plus efficace et le mieux adapté à leur situation.⁸

Sialogogues

Lorsque les mesures citées précédemment n'ont pas apporté les résultats souhaités ou satisfaisants, les sialogogues deviennent une solution à envisager. Les 2 agents disponibles au Canada sont des agonistes des récepteurs muscariniques : Anétholtritione (SialorMD) et Pilocarpine (SalagenMD).

Le premier agent, Anétholtritione (SialorMD) est disponible depuis de nombreuses années. Son mécanisme d'action n'est pas clairement élucidé mais il semble avoir un effet cholinergique et agirait directement sur les cellules sécrétoires des glandes salivaires.³ Les patients l'ayant utilisé ont rapporté au moins une amélioration subjective des symptômes de bouche

sèche.³

La dose recommandée est de 25 mg à chaque 8 heures. Les effets secondaires principaux affectent le système gastro-intestinal avec de la flatulence.³

Pour sa part, la pilocarpine (SalagenMD) est un agoniste muscarinique avec une faible activité B-adrénergique. Son usage résulte en une stimulation des glandes exocrines chez l'humain.^{1-3,8}

L'action de la pilocarpine sur les acini des glandes salivaires se traduit par une augmentation de la production de salive résultant de la stimulation du débit d'eau et d'électrolytes et possiblement des autres composantes telles que la mucine.¹⁻³ L'effet de ce médicament n'est démontrable que s'il reste une fonction résiduelle du tissu glandulaire.²

D'un point de vue subjectif, les patients avec peu de fonction salivaire restante peuvent ne pas ressentir une amélioration notable des symptômes. Par contre, des patients avec une destruction sévère rapportent souvent une amélioration des symptômes et un soulagement avec une augmentation modeste du débit salivaire.³ D'autres études ont objectivé une augmentation significative du débit salivaire et une amélioration subjective de la sensation de sécheresse de bouche chez des patients se plaignant de xérostomie légère à sévère.⁸

Dans les études cliniques, l'efficacité de la pilocarpine est reconnue pour le traitement de la xérostomie sévère secondaire à la maladie de Sjögren, à la radiothérapie cervicofaciale et à la transplantation de moelle osseuse.^{1,2,9,12}

Le produit est disponible sous forme de comprimé dosé à 5 mg et la dose initiale recommandée est de 5 mg à prendre trois fois par jour (1 heure avant chaque repas) ou quatre fois par jour.¹⁻³ La dose maximale ne doit pas dépasser 30 mg par jour. Le début d'action est d'environ 30 minutes et l'effet persiste environ 2 à 3 heures.¹⁻³ Il peut s'écouler plusieurs semaines avant que les bénéfices soient perçus par le patient.^{1,8}

D'autres formulations, telles que rince-bouche à 1% et 2%, solution 0.04% à vaporiser sous la langue, ont aussi été utilisées mais des études manquent pour supporter leur efficacité et décrire les réponses obtenues.^{2,9} Ces formulations permettaient l'usage topique de la pilocarpine avec possiblement moins d'effets secondaires systémiques.

De par son mécanisme d'action, la pilocarpine peut altérer la conduction cardiaque. Donc, l'utilisation devrait être évitée chez patients atteints de maladie cardiaque ou pulmonaire significative.^{1,2,5} Les effets secondaires les plus souvent rapportés sont : sudation, « flushing », tachycardie, bradycardie, augmentation des sécrétions bronchiques, vision brouillée, incontinence urinaire et effets gastro-intestinaux.^{1,2,12} Une attention doit être portée aux patients avec une histoire d'ulcère peptique.⁹ Parmi les contre-indications à son usage on retrouve : asthme mal contrôlé, bronchite chronique, maladie obstructive pulmonaire chronique, maladie cardiaque, infarctus du myocarde, glaucome à angle étroit, uvéite, insuffisance hépatique sévère, cholélithiase, néphrolithiase et allergie à la pilocarpine.^{1,3,9}

Mesures préventives

En présence de xérostomie, la prévention des caries revêt une importance primordiale. Une attention rigoureuse doit être portée à l'hygiène orale quotidienne. De plus, les habitudes alimentaires du patient devraient être revues de façon à établir et adhérer à une diète à faible potentiel cariogène.^{4-6,8} La mise en place de scellants de puits et fissures est également une mesure à considérer lorsque la situation s'y prête.⁵

Un meilleur contrôle de la plaque dentaire et de la gingivite peut être obtenu avec l'usage quotidien de rince-bouche à la chlorhexidine 0.12%.^{1,4,6,9}

La protection des structures dentaires passe aussi par l'utilisation du fluor topique.^{1,5} Cette mesure a été prouvée efficace pour aider à la prévention des caries et possiblement renverser la décalcification débutante.^{1,8} Le fluor est disponible sous plusieurs formes dont rince-bouche, gel, comprimé à mâcher et vernis. Les patients devraient être informés de brosser leurs dents aux moins 2 fois par jour à l'aide d'une brosse à soies souples et d'un dentifrice aux propriétés peu abrasives et à base de fluor.^{4,6,7} De plus, l'usage quotidien d'un rince bouche de fluorure de sodium peut aider à réduire la déminéralisation dentaire.⁷ La méthode la plus appropriée est l'application quotidienne de fluorure neutre dont la concentration peut varier de 0.4 à 1.25% sous forme de gel à l'aide de gouttières confectionnées sur mesure.⁶

Le type de fluor choisi devrait être adapté à la gravité de la condition et à l'activité carieuse du patient.¹ Le fluorure de sodium neutre est reconnu pour être la mesure la plus importante et la plus efficace pour prévenir les caries rampantes chez les patients après la radiothérapie de la tête et du cou.^{1,8}

Les patients porteurs de prothèses souffrant de xérostomie sont plus susceptibles de développer des problèmes tels que douleurs associées à l'irritation des muqueuses et une diminution de la rétention de la pièce de prothèse.^{1,5} Ces patients devraient être encouragés à retirer leurs prothèses la nuit.^{6,7} De plus, ils sont exposés à un plus grand risque de développer de la candidose buccale, ce qui peut contribuer à aggraver l'inconfort causé par la réduction de la salive.⁴ Un traitement à l'aide d'un antifongique topique donne généralement de bons résultats. Le recours aux antifongiques systémiques devrait être réservé aux patients dont la candidose est réfractaire au traitement topique et aux patients immunocompromis.⁴ À ne pas oublier que les prothèses sont généralement colonisées par *Candida albicans* et requièrent également un traitement par trempage dans une solution d'eau contenant un antifongique ou par l'application d'une crème antifongique.⁴

Autres mesures

Selon les études disponibles, le recours à l'acupuncture a donné des résultats inconstants et conflictuels.^{2,8,13} Présentement il n'existe pas d'évidence pour supporter l'efficacité de l'acupuncture pour le soulagement de la xérostomie.

Suivi étroit

Des examens fréquents sont indiqués pour permettre la détection précoce des complications buccales. Les patients devraient eux-mêmes procéder à un examen méticuleux quotidien de leur cavité buccale pour déceler les ulcères, lésions ou caries et consulter dès l'apparition de signes inhabituels.^{4,6} Les examens dentaires devraient être prévus au moins à tous les 6 mois et des radiographies aux 12 mois pour la détection précoce des caries.⁴

Conclusion

La xérostomie est un symptôme fréquem-

ment rencontré et a effet négatif sur plusieurs aspects de la qualité de vie des patients ainsi que sur leur santé buccale. Une diminution de la production salivaire peut souvent être un effet secondaire d'un médicament, une manifestation d'une maladie de Sjögren ou d'une autre maladie, ou encore une complication de la radiothérapie. L'identification de la cause demeure une étape clé vers un traitement efficace. Lorsque la cause n'est pas corrigable, jusqu'à présent le traitement se limite principalement à une intervention palliative. Quelques patients peuvent bénéficier de la stimulation salivaire à l'aide des agents cholinergiques.

Tous les patients devraient être sensibilisés à adhérer à des mesures d'hygiène buccale très méticuleuses et des auto-examens réguliers de leurs dents et tissus mous. Les suppléments de fluor demeurent des aides précieuses dans la prévention des caries. Des traitements quotidiens sont indiqués pour réduire la prévalence des caries rampantes après des traitements de radiothérapie.

L'examen dentaire approfondi et le nettoyage professionnel sont à prévoir

régulièrement et à intervalles rapprochés pour permettre des interventions précoces et limiter les complications associées à la xérostomie.

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Making Their Mouths Water:

GENERAL PRINCIPLES FOR TREATING XEROSTOMIA PATIENTS

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ABSTRACT

Xerostomia is a complaint frequently reported by patients of dental medicine. In addition to causing discomfort, the reduction of salivary secretion has a negative impact on quality of life as it affects various functions including mastication, deglutition, and diction and causes many infectious oral complications.

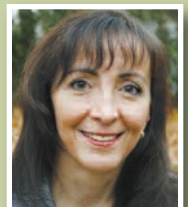
Xerostomia may also be associated with some systemic, primarily autoimmune, conditions, the most frequent one being Sjögren's syndrome. It can also result from the destruction of glandular acini by cervico-facial radiotherapy. Yet the most frequent cause continues to be anticholinergic medication and the medications that modify certain biological components.

Therapy first involves a careful examination to determine the cause so the condition can be corrected, if possible. If it cannot be corrected, mitigative and preventive measures should be implemented to minimize the risk of complications or delay them.

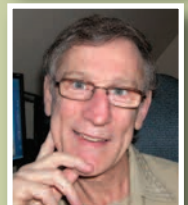
The primary therapeutic measures focus on elements of the patient's day-to-day life and are designed to eliminate aggravating factors and stimulate mucosa hydration through adequate fluid intake and the humidification of ambient air. In addition, saliva production may be stimulated by eating more frequently, chewing xylitol gum, or eating sugar-free candies. For some patients, the use of saliva substitutes, called artificial salivas, may help to reduce discomfort. In

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the most severe cases, use of a sialogogue may be advantageous.

In all cases, very close monitoring of the patient's condition is indicated. Strict oral hygiene measures should be instituted, accompanied with a low cariogenic diet and, generally, a fluoride application in a form suited to the patient's situation.

A condition often encountered in dentistry, xerostomia is a symptom of reduced saliva production and of altered saliva composition.¹⁻³ Hyposalivation refers to the objective reduction of salivary secretion, while xerostomia is a subjective experience of dry mouth that is frequently, but not always, associated with reduced salivary secretion. In general, patients begin to notice xerostomia when their usual salivary secretion is halved.²

As a continuation of the series of articles on xerostomia, this article first briefly reviews the general etiological principles of this disorder. It then presents the pharmacological and non-pharmacological therapies. The last section suggests measures designed to prevent or delay the complications associated with xerostomia.

Complications Associated with Reduced Salivary Secretion

Saliva plays an important, varied role in the taste, chewing, and speech functions and in the prevention of mucosa and teeth infections.^{1,3,4} Readers wishing to know more about the possible consequences of xerostomia are invited to consult the related article in the previous issue of this journal.

Etiology

The most frequent cause of xerostomia is unquestionably the taking of anticholinergic medication. The action mechanisms of other medications can also lead to reduced saliva production. Table 1 provides a non-exhaustive list of the pharmacological classes of agents associated with this side effect.^{1,5-7} Although Sjögren's syndrome is a frequent cause of xerostomia, other systemic conditions are also known to be potential causes through various mechanisms; they are listed in Table 2.^{1,2,5,7} The destruction of the salivary gland acini, a frequent outcome of head and neck radiotherapy, can also cause a severe, possibly irreversible reduction of salivary secretion.^{1,4,5,7,8} Although frequently observed in patients over 65 years of age, reduced salivary function has nothing to

do with age but is associated instead with the presence of a systemic disorder or the use of medications that cause xerostomia.^{1,4,6}

Treatment

The first step in treatment is to try to establish the etiology of the patient's xerostomia with a view to controlling the under-

lying pathology once it is identified, or to consult the referring physician to change a medication suspected to be the cause (Figure 1).^{4,9}

If the cause cannot be corrected, treatment follows a twofold approach, the first being mitigative to relieve the symptoms and the second being preventive to forestall the oral complications associated with saliva reduction.

Table 1. Classes of medications that can cause xerostomia (adapted from 1,5 7)

Pharmacological class	Examples
Anticholinergics	Atropine, benzotropine, oxybutynin, scopolamine, trihexyphenidyl
Antidepressants	
Tricyclic antidepressants	Amitriptyline, doxepin, desipramine, nortriptyline
Selective serotonin reuptake inhibitors	Citalopram, fluoxetine, paroxetine, sertraline, venlafaxine
Heterocyclic antidepressants	Imipramine, mirtazapine
Monoamine oxidase inhibitors	Phenelzine, moclobemide
Atypical antidepressants	Bupropion, nefazodone
Antipsychotics	
Neuroleptics	Chlorpromazine
Atypical antipsychotics	Clozapine, olanzapine, quetiapine
Sedatives and anxiolytics	Lorazepam, diazepam, alprazolam, flurazepam, temazepam, triazolam, bromazepam, clonazepam
Antihypertensives	Captopril, enalapril, lisinopril, clonidine, methyldopa, prazosin, terazosin
Diuretics	Hydrochlorothiazide, furosemide, triamterene, spironolactone
Anti-arrhythmics	Disopyramide
Bronchodilators	Ipratropium, salbutamol
Antihistamines	Hydroxyzine, chlorpheniramine, diphenhydramine, loratadine, cetirizine
Decongestants	Pseudoephedrine
Antiemetics	Meclizine
Antiparkinsonians	Biperiden, selegiline, carbidopa/levodopa
Anticonvulsants	Gabapentin, carbamazepine
Muscle relaxants	Cyclobenzaprine, baclofen, orphenadrine
Analgesics	
Opiates and other drugs acting on the central nervous system	Codeine, meperidine, methadone, morphine, pentazocine, propoxyphene, tramadol
Non-steroidal anti-inflammatories	Diflunisal, ibuprofen, naproxen, piroxicam
Proton pump inhibitors	Omeprazole, esomeprazole, lansoprazole, rabeprazole
Acne treatments	Isotretinoin
Urinary incontinence medication	Tolterodine
Smoking cessation products	Nicotine gum

Mitigative Measures

Some general, straightforward measures can help lessen the discomfort caused by dry mouth. Water is the most frequently used artificial saliva, and it has several benefits.¹ First, adequate fluid intake (a minimum of 2 litres per day) is recommended, unless the patient has a condition that calls for a fluid restriction.^{7,9} Fluid intake can include, among other things, sipping water frequently during the day.^{1,5} Also, chewing or sucking on ice cubes may help reduce discomfort in some patients.^{5,7} Because saliva production is usually reduced when a person sleeps, which can aggravate xerostomia, the use of a bedside humidifier may help lessen dry mouth and its discomforts.⁴⁻⁶ In general, increasing the moistness of oral mucosa can help counter opportunistic infections.⁵

Given its physical and chemical properties, milk may also be both a good saliva substitute and a good contributor to fluid intake. Its calcium and phosphate content may help to remineralize tooth enamel. Its other benefits derive from its buffering capacity for neutralizing the salivary acidity that would otherwise demineralize enamel and also from its capacity for lubricating and moistening

Table 2. Systemic conditions associated with xerostomia (adapted from 1,2,5)

Systemic or genetic conditions that can alter salivary function

Sjögren's syndrome	Ectodermic dysplasia
Rheumatoid arthritis	Autoimmune thyroiditis
Lupus erythematosus	Chronic pancreatitis
Scleroderma	Coeliac disease, Crohn's disease
Primary biliary cirrhosis	Cystic fibrosis
Autoimmune hepatitis	Down syndrome
Hemochromatosis	Glucocerebroside overload
Sarcoidosis	Myotonic dystrophy
Diabetes (types I and II)	Papillon-Lefèvre syndrome
Human immunodeficiency virus	Prader-Willi syndrome
Cytomegalovirus and herpes	Gaucher's disease (glucocerebroside overload)
Hepatitis C	Systemic amyloidosis
Anxiety	Bone marrow transplant
Depression	Graft-versus-host reaction

Conditions or diseases causing a metabolic disorder that can induce xerostomia

Dehydration
Food disorders (anorexia)
End-stage renal failure
Nutritional deficit

dry mucosas.¹

Also, all irritants should be avoided, such as coffee and alcohol (including alcohol-based mouthwashes), which can

aggravate mucosa dryness and worsen the xerostomia; tobacco use too contributes to reduced saliva production.^{1,5-7}

Because stress, anxiety and other psy-

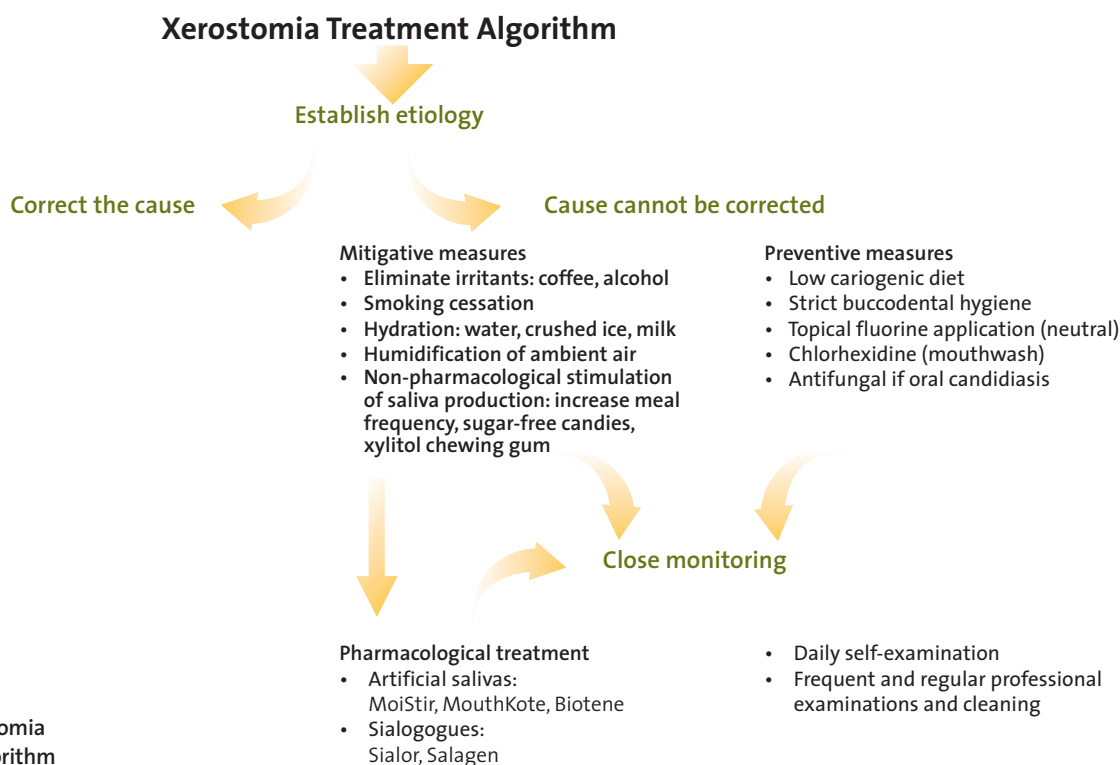


Figure 1: Xerostomia Treatment Algorithm

chological factors can contribute to or aggravate xerostomia, treatment should be designed to include helping the patient better manage these factors.⁹

Salivary Stimulation

Salivary glands that are still able to produce and secrete saliva can be stimulated mechanically or even chemically. Salivary stimulation is important for limiting the salivary gland atrophy observed in patients with limited chewing function.¹ For many patients, eating more frequently, drinking lemonade or some other acidic beverage, eating hard sugar-free candies and chewing on xylitol gum are ways to induce saliva production, and reduce the discomforts of dry mouth.^{1,4-6,9} The consumption of acidic products should be restricted to brief periods of time because an acid saliva pH is a factor in the decalcification of tooth enamel.¹⁰

While some organic acids, including ascorbic acid, malic acid, and citric acid can potentially stimulate the salivary reflex, they should not be used frequently in the long term because they too can contribute to the demineralization and erosion of enamel and the ensuing caries.^{1,6}

Saliva Substitutes

If the mitigative measures do not improve saliva production, patients can turn to saliva substitutes. They serve mainly to moisten and lubricate mucosa. By providing the patient with the feeling that the oral mucosa is hydrated, they reduce the discomfort associated with dry mouth, but they have no effect on the quantity of saliva produced.⁸ The relief they offer is temporary, of a limited duration, and generally lasts a few hours at most.^{1,5,8} They must therefore be used repeatedly as required. Some patients find it helpful to use them before going to sleep or before speaking.⁵

These watery solutions contain a variety of ingredients, including glycoproteins or mucins, salivary enzymes (peroxidase, glucose oxidase, or lysozymes) and carboxymethylcellulose or hydroxymethylcellulose polymers.^{9,11} They help by moistening the mucosae and throat, protecting soft tissue, and removing debris and bacteria from tooth surfaces.^{1,9,11}

The products available in Canada are: MoiStir (moisturizing spray), MouthKote (solution), and Oral Balance (moisturizing gel). All three products can be purchased

at a drugstore without a prescription.

These products are placed on the tongue or are applied directly to the affected areas and then dispersed throughout the mouth. In general, they quickly relieve the dry-mouth feeling and also prevent irritations and burning sensations for a few hours.¹ It is important to warn patients not to rinse their mouths after applying these products.¹ They can also be applied to dental prostheses to facilitate insertion.⁹

Unfortunately, few studies have been done to compare and rank their effectiveness. The choice therefore now depends on product availability and the patient's preferences.⁵ An important principle to keep in mind is to choose the product least likely to erode tooth enamel, i.e., its pH must be as neutral as possible.⁵ Patients often have to try different products to determine which one is the most effective and best suited to their situation.⁸

Sialogogues

If the above-mentioned measures do not obtain the desired results or have unsatisfactory results, sialogogues have to be considered. The two agents available in Canada are muscarinic receptor agonists: anetholtrithione (Sialor) and pilocarpine (Salagen).

The first agent, anetholtrithione (Sialor), has been available for many years. Its action mechanism is not fully known but it seems to have a cholinergic effect and to act directly on the secretory cells of the salivary glands.³ Patients who have used it have reported at least a subjective improvement of their dry mouth symptoms.³

The recommended dose is 25 mg every 8 hours. The most common side effects are related to the gastrointestinal system, including flatulence.³

As for pilocarpine (Salagen), it is a low-level b-adrenergic muscarinic agonist. It is used to stimulate a patient's exocrine glands.^{1-3,8}

The action of pilocarpine on the salivary gland acini increases saliva production through the inducement of water and electrolyte flow and possibly other components, such as mucin.¹⁻³ This drug has a demonstrable effect only in patients with residual glandular function.²

From a subjective point of view, patients with little residual salivary function will not necessarily feel a noticeable

improvement in their symptoms. However, patients with a severe destruction often report an improvement in their symptoms and some relief thanks to a modest increase of salivary secretion.³ Other studies have objectivised a significant increase of salivary secretion with a subjective improvement of the dry mouth feeling among patients presenting slight to severe xerostomia.⁸

Clinical studies recognize the efficacy of pilocarpine for treating severe xerostomia secondary to Sjögren's syndrome, cervico-facial radiotherapy, and a bone marrow transplant.^{1,2,9,12}

The product is available in 5-mg tablets, and the initial recommended dose is 5 mg three times daily (1 hour before each meal) or four times per day.¹⁻³ The maximum dose must not exceed 30 mg per day. The medication begins to take effect after about 30 minutes and is effective for about 2 to 3 hours.¹⁻³ Several weeks may elapse before the patient perceives any benefits.^{1,8}

Other formulations, such as a 1% or 2% mouthwash, or a 0.04% solution that is sprayed under the tongue, have also been used, but there are no studies available to indicate their effectiveness or results.^{2,9} These formulations apparently make it possible to use pilocarpine topically with potentially fewer systemic side effects.

Pilocarpine's action mechanism can alter cardiac conduction. Its use should therefore be avoided by patients with significant heart or lung disease.^{1,2,5} The most commonly reported side effects are sweating, flushing, tachycardia, bradycardia, increased bronchial secretions, blurred vision, urinary incontinence, and gastrointestinal effects.^{1,2,12} Attention must be given to patients with a history of peptic ulcer.⁹ Its use is contraindicated in the presence of, among others: poorly controlled asthma, chronic bronchitis, chronic obstructive pulmonary disease, heart disease, myocardial infarction, narrow-angle glaucoma, uveitis, severe hepatic insufficiency, cholelithiasis, nephrolithiasis, and allergic reaction to pilocarpine.^{1,3,9}

Preventive Measures

Because caries prevention is of vital importance for xerostomia patients, they must be scrupulous in their daily oral hygiene. Their dietary habits must also be reviewed and reshaped so they can follow a low cario-

genic diet.^{4-6,8} The application of pit and fissure sealants is another measure to be considered when the situation lends itself to it.⁵

A better control of plaque and gingivitis can be achieved through the daily use of a 0.12% chlorhexidine mouthwash.^{1,4,6,9}

Dental structures can also be protected through a topical fluorine application.^{1,5} This measure has been proven effective in helping caries prevention and possibly reversing first-stage decalcification.^{1,8} Fluorine is available in several forms, including mouthwash, gel, chewable tablets, and varnish. Patients must be told to brush their teeth at least twice daily with a soft-bristle brush and a mildly abrasive fluorine toothpaste.^{4,6,7} The daily use of a sodium fluoride mouthwash can help to reduce tooth demineralization.⁷ The most appropriate method involves the daily application of a gel with a concentration of neutral fluoride ranging from 0.4 to 1.25% by means of a made-to-measure tray.⁶

The type of fluorine chosen should be based on the severity of the patient's condition and caries activity.¹ Neutral sodium fluoride is recognized as being the most important and most effective measure for preventing rampant caries in patients who have received head and neck radiotherapy.^{1,8}

Xerostomia patients with prostheses are more likely to develop problems such as painful irritation of the mucosa and weakened prosthesis retention.^{1,5} These patients should be encouraged to remove their prostheses before they sleep.^{6,7} They are also at greater risk of developing oral candidiasis, which can aggravate the discomfort caused by reduced saliva production.⁴ Treatment with a topical antifungal agent generally gives good results. Systemic antifungals should be used only with patients whose candidiasis does not respond to the topical treatment and with immunocompromised patients.⁴ It must be kept in mind that prostheses are generally colonized by *Candida albicans* and must therefore be treated by soaking in an antifungal solution or by the application of an antifungal cream.⁴

Other Measures

According to the available studies, the use of acupuncture has inconsistent and conflicting results.^{2,8,13} There currently is no evidence demonstrating the effectiveness of acupuncture for relieving xerostomia.

Close Monitoring

Frequent examinations are indicated to permit the early detection of oral complications. Patients themselves should meticulously examine their buccal cavity daily to detect ulcers, lesions, or caries and consult as soon as any unusual signs appear.^{4,6} Dental examinations should be scheduled at least every 6 months, with radiographies every 12 months, for the early detection of caries.⁴

Conclusion

Xerostomia is a frequently encountered symptom. It has a negative effect on many aspects of a patient's quality of life and oral health. Reduced saliva production can often be a side effect of a drug, a manifestation of Sjögren's syndrome or another disease, or even a complication of radiotherapy. Identifying its cause continues to be a key step for effective treatment. When the cause cannot be corrected, the currently available treatment options are mainly mitigative. Some patients may benefit from cholinergic agents that stimulate salivary production.

All xerostomia patients must be made aware of the importance of very strict oral hygiene and regular self-examination of their teeth and soft tissue. Fluorine supplements are still valuable aids in caries prevention. Daily applications are indicated for reducing the prevalence of rampant caries after radiotherapy treatments. Thorough dental examinations and professional cleaning must be regularly scheduled at close intervals to permit early treatment and to limit the complications associated with xerostomia.

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Vital Interactions:

The Chemistry of a Championship Dental Team

By Mr. Peter Barry, CMC, RRDH

ABSTRACT

It has been stated by many in history who are known for their wisdom that the quality of your life is determined by the quality of your "RELATIONSHIPS." Low quality relationships lead to a low quality of life! High quality relationships lead to a high quality of life! The quality of your relationships in turn is determined by the quality of your "COMMUNICATION." This correlation between our communication, our relationships, and our overall satisfaction in life is powerful yet it very often it doesn't get the attention it deserves. Most human resource experts will tell you that "happiness in the workplace" has a huge impact on your overall effectiveness and success as a team. Just think; the average dentist spends 8–10 of his or her waking hours each work-day at the office. This can be extrapolated to mean that for the average clinician most of your non-sleeping time Monday to Friday is actually spent with your co-workers/employees. As a result; the quality of your relationships with these people is going to have a dramatic impact on your overall personal happiness and professional effectiveness. This article will examine strategies for minimizing and managing conflict as a means to strengthen team harmony and success.

RÉSUMÉ

Il a été mentionné dans l'histoire par plusieurs personnes qui étaient reconnues pour leur grande sagesse que la qualité de vie est déterminée par la qualité de nos « RELATIONS ». Des relations de mauvaise qualité engendrent une qualité de vie médiocre! Des relations d'excellente qualité entraînent une meilleure qualité de vie! Par contre, la qualité de nos relations est déterminée par la qualité de notre « COMMUNICATION » avec les autres. Cette corrélation entre la communication, les relations et la satisfaction générale est puissante mais très souvent elle n'attire pas toute l'attention qu'elle devrait avoir. La plupart des experts en ressources

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humaines vous diront que « le bonheur au travail » a un impact considérable sur votre efficacité et votre réussite en tant qu'équipe. Réfléchissez un peu : le dentiste moyen passe entre 8 et 10 heures chaque jour à son cabinet. Ce qui signifie que le clinicien moyen passe la plus grande partie de son temps du lundi au vendredi avec ses collègues ou ses employés. Le résultat : la qualité de nos relations avec ces personnes aura un impact extraordinaire sur le bonheur personnel et l'efficacité professionnelle. Cet article passera en revue les stratégies pour gérer les conflits dans le but de faire régner l'harmonie et d'assurer le succès de l'équipe.

It is extremely important to get along well with the people you spend most of your time with because how you feel while you are around these people not only impacts your performance at work, it also impacts other areas of your life. Some might say that they can leave work at work and home at home. But is this really possible? For example; when you are in love with someone can you file your love for them away when you arrive to work in the morning and by the same token when you experience a human dynamic tension at work can you suddenly eject those feelings and keep them from coming home with you? No way! Your feelings follow and stick to you like glue. Your heart stays in your chest where ever you go. Our intellectual mind might tell us otherwise. But at the core of our essence we are human and contrary to popular belief human beings are not really intellectual logical creatures. Human beings are "EMOTIONAL CREATURES" who use logic and intellect to justify and understand their emotions. This concept is also true of our patients when they make buying decisions in our practice. Patients shop with emotions (their hearts). They then use logical reasoning to justify their buying decision. This is why it is important to develop and nurture a positive emotional climate in our workplace. Emotions are powerful. Emotions are infectious. Emotions affect everyone including our patients. How we feel while we do what we do is at the core of our effectiveness. Emotions affect our ability to lead, to sell, and to feel united and passionate about our service. For most dentists, however; the concept of "leading people and keeping them emotionally united and aligned" was not something they signed up for when applying to dental school. Many clients tell me they wish for workplace harmony but they just don't have the time, the energy, or the patience to babysit the emotional climate in their practice.

I guess it would help to look at team chemistry as more than just "babysitting" emotions. Dentistry is not only a medical profession that serves the human condition it is also a business where influencing customer's decisions and profitability are a necessity. Your team's level of unity plays a huge factor in their ability to collectively influence customers. Imagine coming to your office in the morning and feeling like you are surrounded by a bunch of enthusiastic confident positive people who like each other, support each other and are all working together on behalf of a future they have all committed themselves to. Is this possible? If it is already happening in your practice, can it happen at a higher level? It is my experience that it can. At the end of the day everything we experience in life is related to people in one way or another. Relationships in the dental office can be a source of daily misery and frustration or they can be a beautiful thing that fills your heart and soul on a daily basis. Just think of a very emotional time in your life where you felt a strong emotion such as happiness, sadness, anger, or fear. If you look at it carefully the situation probably had something to do with or involved other people. People affect people in a big way. The Greek philosopher Plato said that the greatest need of the human soul is the need to feel heard, understood, and appreciated by others.

Now let's examine the emotional climate in your practice for a moment. Are team conflict and egos getting in the way of your goals? Are differences and self-centredness dividing your team and causing you headaches? Are tensions and adversity weakening your team and its performance? Leading organizations today are realizing that it's difficult to achieve the level of teamwork needed to really excel as a business unless you first deal with the all too common destructive behaviours that fuel unresolved conflicts in the workplace.

Far too many people trade their life, and a bit of their soul, for a paycheck. They tolerate endless hours of meaningless work, disappointing relationships, conflicts, gossip, and frustration so they can have fun on the weekend and during their two-week vacation. Similar frustrations hold true for managers and practice owners; far too many go home at night feeling frustrated and disappointed because of the conflicts at work, the lack of creativity and productivity, and the loss of progress and profits. For many in the game of dentistry this is what they endure and live with each day at the office. Keep in mind these conflicts do not just exist at an adversarial level. You can like a co-worker and still experience unmet expectations or little discourtesies that fester and build frustration into your work environment over time.

Things don't have to be this way. Feeling connected and getting along is the most important ingredient on the path to functioning as a high performing team that achieves collective results. Before game 1 of a recent 7 game NBA finals series the announcer, in an interview with retired basketball legend the great "Doctor J" Julius Irving, asked him his pick to win the series and what he felt the keys to victory would be. Doctor J's response was compelling. In an impassioned and spirited pre-game tone he said either team can win the series, "the key to victory will be 10 players who play in sync with each other, in sync with the coach, in sync with the organization and with one goal." Wow; is this requirement any different when we are playing the game of dentistry with our coworkers? Whenever we come to work, we're in a sense, suiting up and stepping on a playing field with our teammates. Each person in the practice plays an important role in the big picture of what we are trying to achieve for our patients and as a business in our community. Our collective level of unity and connection will have a tremendous

impact on our effectiveness as a team. Connection in the workplace will significantly affect a team's morale, stress, and the level of fulfillment people draw from their role in the practice.

If we call unity the engine of team's potential, then communication would be the fuel. As a practice mastery coach the most common desire I hear from owners, managers, and team members alike is that "we need to be more united ... more connected." It is relationships and communication challenges that seem to be a common recurring theme that people wish to develop within their business. Today people are realizing more and more that to really accelerate the growth of your business you must first grow the people within your business; then together as a more synchronized united team you can take your business anywhere. In my day-to-day coaching practice, my new clients and I go through a discovery consultation where we explore their circumstances, opportunities, and desires for growth and development. Then prior to beginning the implementation process I candidly interview each member of the team to discover what is going on in the hearts and minds of the people who will be at the centre of all positive change initiatives. As soon as I begin the interviews an often hidden world begins to reveal itself. The underlying team dynamics, relationship issues, and communication challenges begin to surface. These discoveries often come as a surprise to people especially to practice leaders and managers. I frequently hear things like ... "I

had no idea this was going on" or "I had no idea they felt this way." Sometimes it's just one person who is bringing down the morale and operational ability of the entire team but more often it's a series of cliques and subgroups that have evolved and are fragmenting the team's effectiveness; the most common one being clinical team versus business team.

The question we must explore is "why do these conflicts occur in the first place? If we know they fragment the team into sub-groups, reducing cooperation and unity; why do we let them happen?" People often say to me "we are all really good caring people who like each other yet we experience these co-worker interpersonal issues." It is important for us to understand that you don't have to be a bad person or have bad intentions to get caught up in a conflict. The dental practice by design is a very intimate setting where people with diverse backgrounds and unique personalities are required to communicate and work together at a very interdependent level. The things we do the things we don't do and the way we do them have a significant impact on our coworkers ability to perform their jobs smoothly and at a high level. The major advantage a team has over an individual is its diversity of knowledge, skills, views, and ideas. Unfortunately with this diversity comes potential for conflict. Conflict arises from our differences. When highly skilled individuals come together at work to play a team game their differences can contribute to the creation of conflict. This conflict immediately begins to emotionally hijack, fragment, and divide the team. However, we must understand that this so called conflict in work teams is not necessarily destructive or a bad thing. It can lead to innovative new ideas and approaches to operational processes and challenges. Conflict, in this sense, can be considered positive, as it facilitates the surfacing of important issues and provides opportunities for people to strengthen their connections while developing their communication and interpersonal skills. Conflict only becomes negative if it is left to fester and escalate to a point where people begin to feel defeated, combative and territorial (my job-your-job).

It is my observation that conflicts usually arise from communication failures which include poor listening skills; insuffi-

cient sharing of information; differences in interpretation and perception; and nonverbal cues being ignored or missed. It is important to understand that regardless of the scenario conflict is not an external set of events that we have the misfortune of being exposed to. It is more of an internal process that is driven by our thoughts and attitude. We "Fuel" conflict. People create conflict based on how they choose to interpret a situation and based on the approach they choose to take when dealing with it. It has been said that "the greatest gap in nature is the gap between one man's thinking and another man's thinking." I think the problem arises when we begin to attach our diverse needs and alternate viewpoints to our emotions and then begin to judge others accordingly. People can do this to a point where they become adversarial towards anyone with viewpoints that deviate from theirs.

It's easy to win or dominate a disagreement at the expense of team unity and connection; especially if you hold a position of authority! All you have to do is not listen and communicate more strongly than the other person and you win. But do you really win in the grander scheme of things? The key to connecting positively with others is rooted in being willing to explore beyond our personal points of view so as to better understand how others are experiencing a particular situation. The question we should all ask ourselves is "do you want to be right or do you want to be happy." If your goal is to be right then your approach will be to shame, blame, label, and prove the other person wrong. If your goal is to be happy then your approach will be to express your needs and viewpoint while sincerely attempting to understand the needs and viewpoint of the person you are dealing with. The problem is that most people, especially when they are stressed; tend to get caught up in their favourite subject (themselves). This personal bias hinders meaningful productive conversation with others and leads to the polarization of hearts and minds. Our personal bias causes us to "judge people by their behaviour; meanwhile we are judging ourselves by the intentions of our behaviour" without fully understanding its actual impact on others. If you really want to solve a difficult situation you must take the time to listen and to acknowledge the other persons intentions and view point.



Be flexible on the road you take to happiness!

When a situation arises with an employee or peer it requires fuel before it can become a conflict. That fuel source is energy, time and attention. Let's look at a simple 10 step process we can follow in order to resolve conflicts quickly thereby preserving our energy, time and attention and for the purpose of doing more positive and productive things.

1. Ask yourself, what meaning have I attached to this ... could this mean something else?
2. Ask the person for their help.
3. Ask the person for permission to discuss your concerns with them.
4. State the situation as you see it without using destructive labels to describe their behaviour. Describe the action you have issues with without labelling the behaviour (i.e., you are lazy/you are inconsiderate).
5. Explain their behaviours' impact on you while showing show respect for their intentions. "This affects me by _____. I understand this is not your intention because I know who you are."
6. Ask them to help you understand and solve this situation.
7. Listen deeply and acknowledge their viewpoint. Even if you don't agree, you are merely acknowledging not agreeing. In most cases the more heard and understood you make them feel the more deeply they will receive and accept your viewpoint.
8. When these steps are followed you create a stage on which to discuss a solution; if a solution is necessary. In the very least you can walk away understanding each other better which usually causes people to behave in ways that are more supportive of each other's needs.
9. If specific resolution is required continue on by making a win-win behaviour modification agreement.
 - a. Define the heart/root of the problem not the surface
 - b. Brainstorm ideas
 - c. Eliminate ideas either party feels won't work
 - d. Clarify remaining ideas
 - e. Iron out details ...



- who/when/what/where/how
- f. Evaluation ... revisit this in the future
10. Thank each other for caring enough to give feedback and to listen and understand each other.

Example/Sample Process

1. **You:** I need your help with something! Can we talk? When you _____ I feel _____. It affects my role _____. I know that is not your intention because I know who you are! Can you help me understand or solve this?
2. **Them:** I'm sorry that is not my intention...I don't mean _____. I do that because _____. I didn't realize _____.
3. **You and Them:** Walk away understanding each other better or discuss and resolve follow up behavioural modifications required to improve things for both parties.
4. **Them:** "Thanks for letting me know."
5. **You:** "Thanks for listening!"

Now let's look at 17 very powerful general guidelines for dealing more positively with a co-worker issue.

1. Speak only to that person and discuss issues privately, not publicly.
2. Address issues as soon as possible.
3. Do not address issues while either

person is in an emotionally charged state.

4. Communicate your concerns openly and honestly without sugar-coating or nursing a silent personal agenda.
5. Avoid being defensive. "LISTEN" to each other and acknowledge each other's views even if you don't agree.
6. Don't get personal. Avoid character labels and name calling ... i.e., "you are lazy," "you don't think," "you don't care." Focus on the behaviour not the person.
7. Speak to one issue at a time. Don't overload the person.
8. Deal only with actions the person can change – asking the impossible only builds frustration into your relationship.
9. Once you've made your point don't keep repeating it.
10. Avoid sarcasm. Sarcasm signals you are angry at people not their actions and may cause them to resent you.
11. Avoid playing "gotcha" type games.
12. Avoid generalizations like "ALWAYS/NEVER." They usually detract from accuracy and make people defensive.
13. Present criticisms as suggestions or questions if possible.
14. Don't forget the complements.
15. Don't apologize for the confrontation-meeting. Doing so detracts from it

and indicates you are not sure you had the right to express your concerns.

16. Be able to forgive! Release yourself and your emotions from the burden of chronic dissatisfaction and frustration by practicing the art of forgiveness on a daily basis.
17. Finally and most importantly; be aware of how you interpret situations. Always ask yourself, "what meaning have I attached to this ... a positive one or a negative one?" "Could this mean something else?" "Do I have all the information?" Be prepared to listen.

Instead of "Conflict Resolution Skills" I prefer to call these "Connection Management Guidelines" since there is no "CONFLICT" until we begin applying the destructive behaviours that reduce important issues to a personal and adversarial level. The ultimate question we must always ask ourselves before a confrontation is "do I want to be right or do I want to be happy." If your goal is to be happy then focus on staying connected. Communicate with a core desire to build cooperation into your relationship by learning more about each other. Connection Management is a proactive way of growing your business by strengthening the teamwork and unity of your people.

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Journal canadien de dentisterie restauratrice et de prosthodontie

Le bureau de l'Académie canadienne de dentisterie restauratrice et de prosthodontie a conclu une entente avec Andrew John Publishing Inc. La nouvelle revue de l'Académie aura un tirage de 2500 exemplaires et sera publiée trois fois par année, soit en mai, en août et en décembre.

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Operating Microscopes and Zero-Defect Dentistry

David J. Clark, DDS

ABSTRACT

Operating microscopes are celebrating their 25th anniversary in dentistry. Initially resisted by endodontists and mainstream dentists, there has been a recent surge of interest in microscope-enhanced dentistry. In endodontics, the microscope is becoming standard equipment. This article discusses a change in the endodontic-restorative protocol and highlights a clinical case that demonstrates the tremendous advantage of advanced magnification when married with other forward-thinking techniques. It concludes with an exploration of the rationale and science of zero-defect restorative dentistry, dentinal caries removal, and finally a review of the science of microscope-enhanced dentistry.

RÉSUMÉ

Les microscopes opératoires célèbrent leur 25^e anniversaire en médecine dentaire. Initialement boudés par les endodontistes et les dentistes, on constate maintenant un intérêt grandissant pour la médecine dentaire de pointe et l'utilisation du microscope. En endodontie, le microscope est maintenant un instrument courant.

Cet article traite d'un changement apporté dans le protocole de l'endodontie et de la médecine dentaire restauratrice et expose un cas clinique qui démontre l'avantage du grossissement combiné à d'autres techniques avant-gardistes. En conclusion, on aborde l'analyse raisonnée et la science de la médecine dentaire zéro-défaut, l'enlèvement des caries de la dentine et finalement on fait une revue de la science de la médecine dentaire de pointe et l'utilisation du microscope.

About the Author

Dr. David Clark, DDS, is the founder of the Academy of Microscope Enhanced Dentistry, an international association formed to advance the science and practice of microendodontics, microperiodontics, micro-prosthodontics, and microdentistry. He is a course director at the Newport Coast Oral Facial Institute in Newport Beach, California. Dr. Clark served Clinical Research Associates in the "Update Series" lectures and as an interim Dentist/Researcher from 2005 to 2007.



Dr. Clark authored the first comprehensive guide to enamel and dentinal cracks based on 16-power magnification in the Journal of Esthetic and Restorative Dentistry. He has written numerous articles relating to minimally invasive dentistry, biomimetic endodontic shaping, and the role of advanced magnification in modern dental practice.

Dr. Clark has developed new techniques and materials, including the endo-restorative casting; a new shape for the class II composite, the "Clark Class II"; and a matrix and interproximal management system, the Bioclear Matrix System, that promises a real advancement for both bonded porcelain and direct composites. He has helped pioneer the concept of biomimetic micro-endodontics, which is a significant departure from Schilderean shaping.

Operating microscopes are celebrating their 25th anniversary in dentistry. Initially resisted by endodontists and mainstream dentists, there has been a recent surge of interest in microscope-enhanced dentistry. In endodontics, the microscope is becoming standard equipment (Figure 1). At a recent opinion leader's forum, the question was posed: "Should microscopes be required for all endodontic treatment?" This incredible swing in endodontic opinion also is being felt in general dentistry. As dental schools begin to integrate the microscope into the curriculum, two new frontiers in dentistry will be realized: minimally traumatic dentistry and zero-defect dentistry.

This brief article discusses a change in the endodontic-restorative protocol and then highlights a clinical case that demonstrates the tremendous advantage of advanced magnification when married with other forward thinking techniques. The article concludes with an exploration of the rationale and science of zero-defect restorative dentistry, dental caries removal and finally a review of the science of microscope-enhanced dentistry.

Modern Decision Making for the Compromised Tooth

Implants have raised the bar to the point where heroic attempts to restore the compromised tooth should generally be accompanied with a conversation that includes the option for implant replacement.

An argument can also be made that the predictability of implants places additional pressure on the restorative dentist; the loss of a restored tooth after a 5-year lifespan may have been acceptable in 1960, but may be unacceptable in 2008.

Microscope-enhanced dentistry is changing the endodontic-restorative protocol, altering the thought process when determining when to save or extract a tooth. Microscopes offer additional methods for caries assessment and endodontic therapy, moving the profession closer to zero-defect restorative dentistry.

The decision to "extract or save" is a constantly evolving art form. In microscope-enhanced dentistry, the thought process in the endodontic-restorative protocol is often inverted. Rather than "endodontics then restorative," it is often "restorative, then endodontics" as clini-



Figure 1. The author at work with his microscope, a G6 Global surgical microscope.

cians can assess the likely outcome and use this information in decision making. Today's finished case should be sealed exquisitely, pleasing esthetically, and accompanied by regenerated papillae. With advanced magnification, the additional visual information afforded to the clinician with the benefit of shadowless, coaxial light combined with infinity corrected optics enhances the clinician's ability to create clean, caries free margins, which, in

turn, can create an optimal restorative seal. Clinicians also can assess the actual invasion of the biologic width and potential for healthy and esthetic soft-tissue contours.¹ For example, in the case presented, caries removal, margin identification, and the potential for papilla regeneration could be verified by restorative investigation. "Restorative investigation" is an important concept that is defined as "The clinical practice of prosthodontic disassembly,



Figure 2. Preoperative view of deep caries on mesial aspect of upper right central incisor.

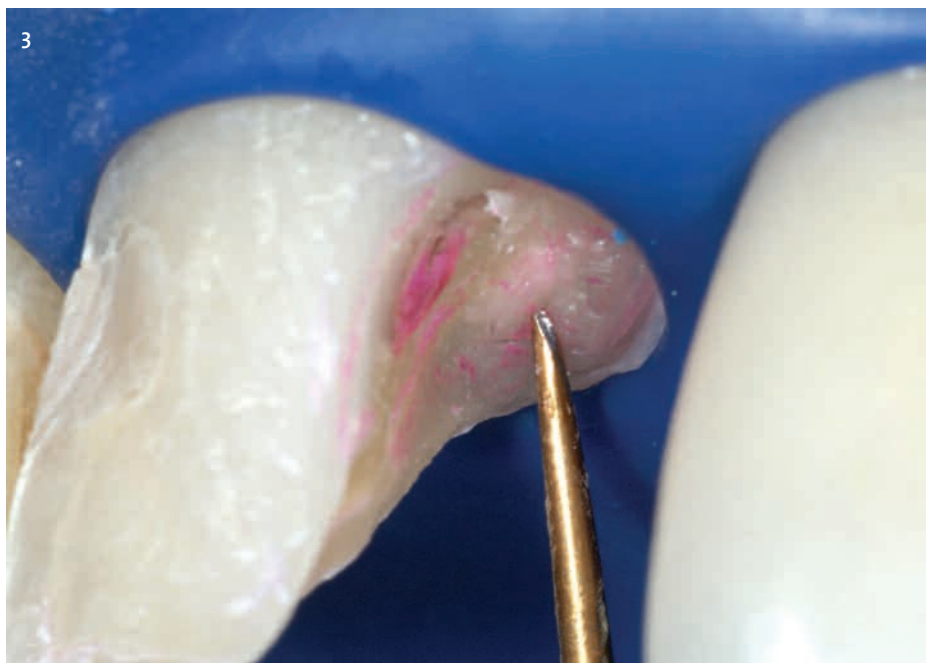


Figure 3. Initial caries removal. Application of caries-indicator solution did not stain the dentin. Extremely soft dentin often does not allow penetration of the dye, creating a false negative caries assessment (original magnification 8x).

restoration removal, caries excavation, microsurgical access, and tissue retraction; the goal of which is to assess the true extent of dental pathology combined concurrent with the long term restorative potential of the tooth.”² After these issues

are deemed satisfactory, then, and only then, is the pulp chamber re-accessed and endodontic therapy initiated. This evolution in triage has the potential to become the standard of care in the modern era of dentistry.

Case Summary

The patient, a 56-year-old woman, was vacillating between treatment plans for her upper arch: a full immediate upper denture or restorative reconstruction. While the treatment for the lower arch was proceeding, she began to experience pain with the upper right central incisor (Figure 2). She had a class reunion that was a week away. She desperately wanted to attend this important function without pain and with a smile that did not embarrass her.

Implants were not an option for the upper arch for financial reasons. She was faced with a decision of either removing the tooth and receiving a temporary partial denture, or initiating restorative treatment combined with endodontic therapy. The patient chose the latter because it allowed for retention of the tooth as an interim treatment until a final decision was reached for the maxillary arch.

Figure 3 demonstrates the tooth after caries removal was thought to be complete. Although the dentin did not stain with caries-indicator solution, in the author’s experience the use of high magnification to evaluate hardness is the ultimate test of sound dentin. Magnification (16x) revealed that gross caries was still present. Figure 4 demonstrates exploration of the deepest layer of “noodle dentin.” Final evaluation of the nuances of sound dentin is demonstrated in Figure 5. A coarse diamond can be used to assess dentin because at 20–24x magnification the scratches can be used as clues to assess dentin hardness.³ Carr has shown that the unaided eye cannot distinguish between two lines that are closer together than 200 microns. With the microscope, 20 micron assessment is possible.

To create an ideal embrasure form, a Bioclear matrix (Tacoma, WA) was used (Figure 6 and Figure 7). This anatomically shaped matrix encourages the papilla to regenerate.⁴

The composite was cured, then shaped and polished. Modern porcelain polishers, such as the D♦Fine™ (Clinician’s Choice, New Milford, CT) or Jazz™ series (SS White Burs, Inc, Lakewood, NJ), yield a finish that is absolutely breathtaking (Figure 8).

After the patient and clinician were confident that the tooth was a good investment, delicate endodontic access (Figure 9) was created and endodontic therapy was completed in a more sterile environment.^{5,6}

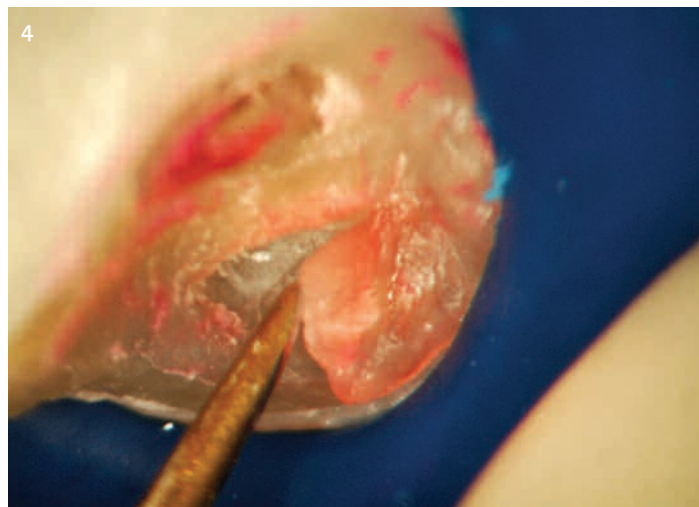


Figure 4. Soft dentin being teased with an explorer (original magnification 16x).

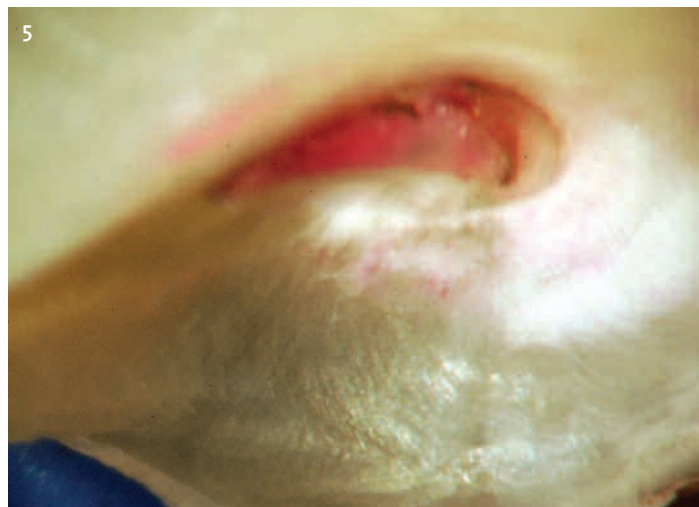


Figure 5. Complete caries removal confirmed by scratch marks from a coarse diamond bur. Softer, infected dentin does not exhibit this type of surface texture (original magnification 24x).



Figure 6 and Figure 7. The anatomically shaped Bioclear matrix in position. The aggressive cervical curvature encourages the static pressure and scaffold needed to stimulate the regeneration of the papilla.

In the traditional approach, endodontics is performed first with either no restorative seal in the interproximal area of caries or a marginally sealed temporary restoration. Bacterial strains such as *Enterococcus faecalis* that are commonly cultured from the root canal systems of endodontic failures are rarely cultured from the pulp spaces of cases of irreversible pulpitis (no radiographic lesion, partially or fully vital pulp) such as the featured case.⁷ The logical conclusion discussed by the endodontic community is that these problematic bacteria can only gain access into the canals and periapical areas through coronal leakage *after* endodontic therapy, *in between* endodontic appointments, or *during* endodontic therapy from inadequate isolation and improper asepsis.

Introduction of untoward bacteria into the canal systems both during and after endodontic therapy⁸⁻¹² has been shown in multiple studies to contribute to endodontic failure.¹³⁻¹⁶ Additionally, there are reports of failing endodontic therapy with multiple failed endodontic re-treatments that were ineffective until a well sealed coronal restoration was placed.¹⁷ Other cross sectional studies have shown that a good coronal seal is at least as important as a good root filling.¹⁸

The patient was so impressed with the result (Figure 10) that this one event created the excitement and optimism to retain rather than extract her upper natural dentition. Accompanying this decision is a vic-

tory for minimally traumatic dentistry, and for the patient, an elevated commitment to lifestyle changes and improved home care. This case also highlights a key factor in many restorative cases, the emotional state of patients that influences decision making and how one small success can turn the tide of decision making.

Zero-Defect Restorative Dentistry

Caries removal is a fundamental task of traditional dentistry. Unfortunately, the commercially driven focus of bleaching, veneers, lasers, and implants has distracted some away from the topic of caries removal. The basic preparation tool (carbide and diamond burs) of dentistry is very similar to what it was generations ago.



Figure 8. A, Preoperative view of deep caries on mesial aspect of upper right central incisor. B, Immediate postoperative view. The long, infinity-edge margin allowed an ideal esthetic result – a heroic composite restoration that is as smooth as the contralateral tooth that has a porcelain crown. This exceeds all expectations of what we can do with composite.

Traditional burs can in no way differentiate between healthy and unhealthy tooth structures. The only known selective hardness cutting instruments are Smartburs™ (SS White Burs, Inc.), which are not readily available. The tactile differences between decayed dentin (soft) and healthy dentin (hard) is the single most common tool that is employed by practitioners in the determination on of which structures to remove.¹⁹ Although there are many ways in which a clinician can assess carious dentin, today's most common approaches include radiographs, caries-indicator dye, spoon excavator or explorer tip (tactile hardness) tests, and laser fluorescence detection^{20–22} (Table 1).

Table 1. Traditional clinical dental caries assessment

• Radiographs
• Dentine color
• Dentine hardness (spoon excavator or explorer)
• Uptake of caries-indicator dye
• Laser Fluorescence (Diagnodent)

The presumption that healthy dentin is “harder” is supported by extensive research.²³ The most predictable clinical indicator of sound versus unsound dentin is hardness.²⁴ The Knoop hardness scale of infected dentin ranges from 0 to 30, affected dentin from 30 to 70, and healthy dentin from 70 to 90. Ideally, dentin

removal should be terminated once the affected dentin has been reached, in the 40 to 50 Knoop hardness range.

Microscopic evaluation at extreme levels of magnification provides additional visual information to assess the texture and hardness of dentin that can augment the traditional tactile approach to dentin hardness (Table 2).

Maintaining areas of affected dentin that may be discoloured will not compromise the tooth-restoration complex.²⁵ However, some studies have shown a compromised long term resin bond to discoloured, affected, and amalgam contaminated dentin.²⁶ In these cases, the use of a glass ionomer sandwich technique is an option,

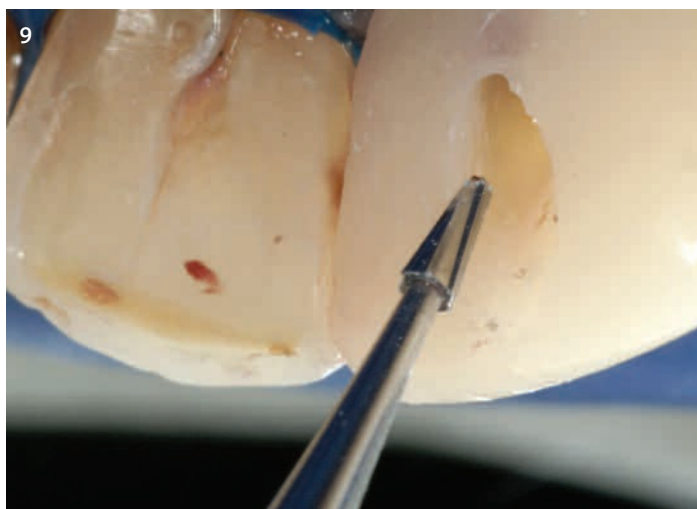


Figure 9. Endodontic access with a conical carbide is less traumatic than with fissure burs or round burs. Pictured is a prototype CK endodontic access bur from SS White Burs, Inc. (original magnification 4x).



Figure 10. At 4 weeks, there was partial papilla regeneration. The patient had very little postoperative discomfort and was ecstatic about the esthetic result.

Table 2. Visual clues of tooth hardness observed by the author under the microscope

1. "Wet sponge" reaction to explorer pressure	8x magnification
2. Dentin-enamel microgapping at dentino-enamel junction	16x magnification
3. Diamond bur scratching	20–24x magnification

which can have a more stable long term bond (glass ionomer-dentin interface) to compromised dentin.²⁷ Alternatively an enhancement of other more predictable surfaces (i.e., creating longer enamel margins or dentinal undercuts) could be utilized in lieu of a glass ionomer sandwich. Dentin colour is one of the least predictable indicators of sound dentin, i.e., black, brown, and green dentin in previously restored teeth is often non-carious and should not be removed.²⁸ Conversely, normal coloured dentin can be soft and grossly infected but appear normal at low magnification. In these cases, caries-indicator dye often can give a "false negative" to stain uptake. In other words, the dentin can have a normal colour, and yet be so soft that no absorption of caries-indicator solution occurs. A study comparing differ-

ent diagnostic approaches to occlusal caries assessment found that visual techniques without advanced magnification were only correct 53% of the time and caries disclosing dyes were only accurate 43% of the time.²⁹ While laser fluorescence can be very accurate,³⁰ its use in most practices is for initial diagnosis. Use of instruments such as a Diagnodent for on-the-fly diagnosis during cutting of the tooth is both impractical and non specific (a positive reading of 20 or above indicates that caries are present but not precisely where the carious and non carious tooth structures are). In the case presented, the dentin in Figure 2 was treated with caries-indicator dye and had no stain uptake. It is my opinion that without the microscope I could have easily been lulled into a false sense of security that caries removal was

complete. Leaving gross residual caries at the margin areas contradicts many restorative principles could doom this case to premature failure.

Clinical Microscopes: Luxury or Necessity?

The operating microscope is not just simply higher magnification than oculars (loupes). It is *better* magnification. Oculars have been very helpful and may always have a role in dentistry, but the optics are crude when compared to the Infinity Corrected Optics of a stereoscopic microscope (Figures 11–14). When combined with the shadowless coaxial light source, they transform the clinician's potential for accuracy of nearly every aspect in the different disciplines in dentistry.

Increasing levels of magnification produce a squared, not linear relationship to visual acuity. In other words, a clinician working at 3.5× sees **10 times** more visual information, 10× magnification allows the human retina to acquire **100 times** more information, and 20× allows **400 times** the visual information³¹ (Table 3).

Improved Outcomes?

Improved outcomes from the use of magnification have been well documented in the medical literature, and scientific validation in dentistry is beginning to emerge.^{32–40} There are no legal requirements in Canada or the United States mandating that dentists use magnification. However, most dental schools today either recommend or require the use of magnifying loupes for both pre-clinical and clinical training. In 1999 the American Association of Endodontists mandated that microscopes be implemented into all US graduate endodontic residency programs. There are scant studies conducted at the highest level as randomized, controlled, and double blind in *any* field of dentistry to prove or disprove most of what we do in private practice. To prove without question that magnification or microscopic magnification provides better clinical outcomes will be as difficult and pointless, in my opinion, as proving that using a bright operatory light is better than a dim light. In spite of this, the "magnification escalation" continues in most nations around the world as even third world countries such as Chile now boast Societies of Microscope

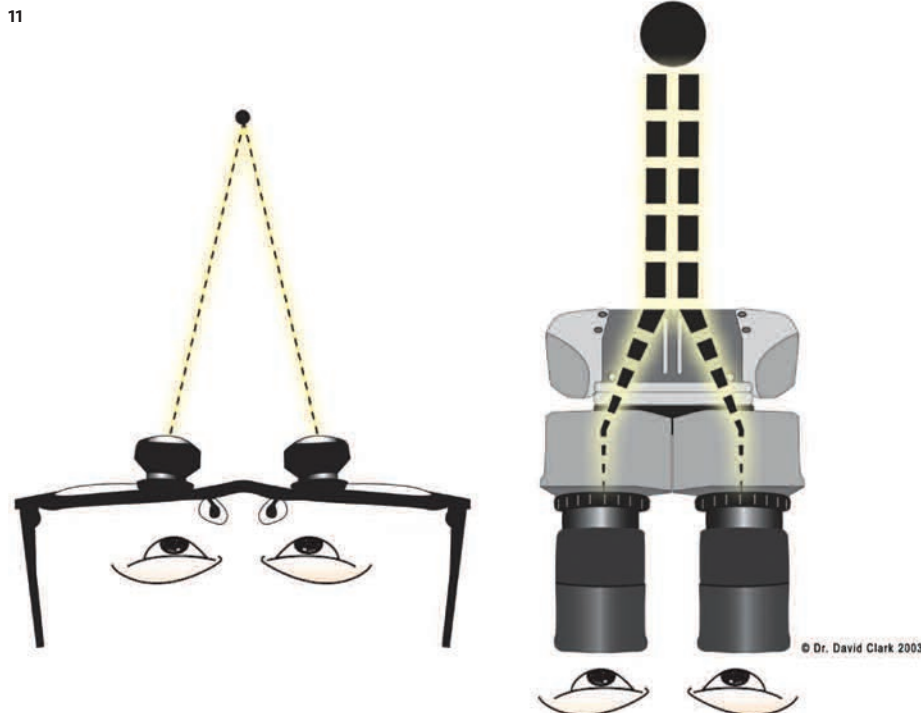


Figure 11. Oculars (loupes) rely on convergent vision that essentially requires an overlap of two images. This form of magnification creates increasing problems and eye strain as magnification power increases. The clinical microscope utilizes a more refined optical system (original magnification 16x).



Figure 12. The figure features 8x convergent magnification with loupes and a representation of the two images that the brain receives as the eyes begin to focus.

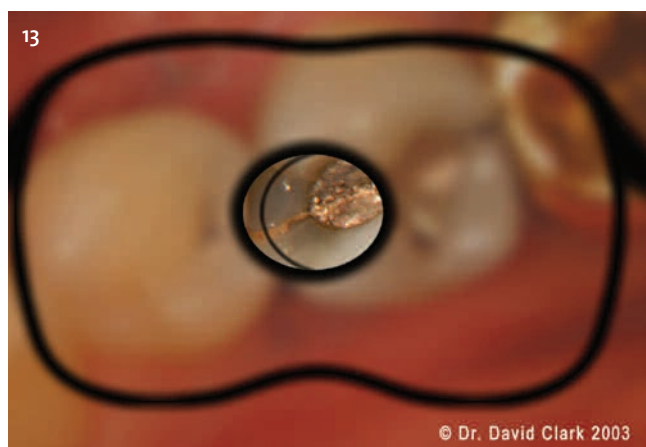


Figure 13. The figure shows a common occurrence of the incomplete merging of the images seen through a pair of loupes. Both Figure 12 and Figure 13 demonstrate the visual noise (blurry periphery) of loupes optics.

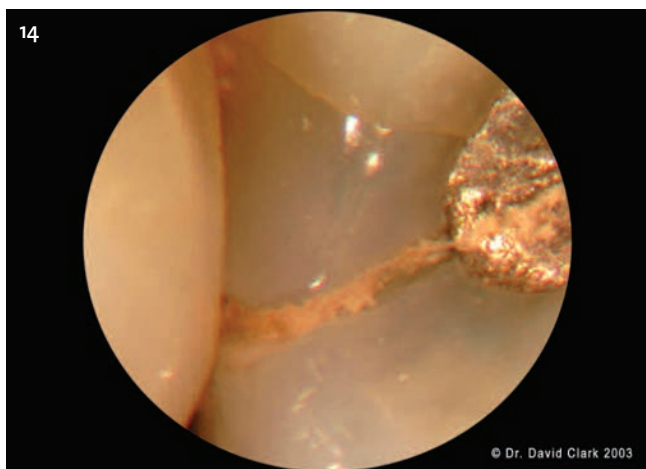


Figure 14. The figure represents the same case seen with a clinical microscope at 24x original magnification featuring infinity corrected optics. There is no eye strain and no visual noise. Loupes magnification at 8x (original magnification) and beyond becomes excruciating for most clinicians. For advanced magnification, the microscope is a superior and healthier choice.

Table 3. Magnification and visual information

Magnification	1x	2x	4x	10x	16x	25x
Information content	1x	4x	16x	100x	256x	625x
Picture element	660	2,640	10,560	66,000	168,960	412,500

Dentistry. Once the bar is raised to allow a new level of diagnostic sensitivity, it is unlikely that a regression toward a lesser capability will occur.

There are many studies that have shown that magnification plays an important role in clinical accuracy, such as the ability to access and shape complex root canal anatomy. In a compelling study, the use of a microscope enabled the author, an endodontist, to improve his ability to find a fourth canal system from 73 to 93% in maxillary first molars.^{41,42} Sadly, most general dentists and endodontists who do not use microscopes rarely report finding four canal systems in maxillary first molars. There are studies showing that use of an operating microscope *can* lead to less postoperative discomfort.⁴³ In periodontics, the microscope enhances the surgeon's visual acuity⁴⁴ allowing better manipulation and more accurate suturing of the soft tissues.⁴⁵ Low tissue trauma, excellent flap control, and a micro-suturing technique that allows primary wound closure may be responsible for improved clinical success.^{46,47} Reduced operator mistakes in endodontics have been reported as a benefit of clinical microscopes.⁴⁸ The ergonomics of the microscope clinician's proper posture have shown a remarkable reduction in back pain and disability, a priceless benefit to the practitioner for a pervasive and serious problem that can destroy our health and diminish the daily enjoyment of our craft.⁴⁹⁻⁵¹

Conclusion

Owning and using a microscope does not make one dentist better than another. Experience, training, commitment, and ability are the key traits that distinguish the *good* from the *great*. Excellence in dentistry is both a choice and a journey, and magnification can be a powerful asset for those who seek absolute clinical accuracy. The testimony of doctors who use the microscope daily in their practices confirms its value; an overwhelming majority affirms that it has improved their clinical skills. The microscope, with instantaneous magnification from 2.5x to 24x, no visual noise, and shadowless coaxial light, offers the best means for achieving complete visual information in dentistry. It can nurture great confidence, healthier posture, and better and surer hands for the clinician. And in the end, the excellent visual information it offers can help the doctor to create more precise, more healthful, and more esthetically pleasing dentistry.

Disclosure

Dr. Clark has no financial interest in any microscope company. Dr. Clark has a financial interest in the Bioclear Matrix System. He is also the co-developer of the CK endodontic access burs.

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