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CAD/CAM

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Basic instincts and the dental metamorphosis

Michael L. Young, DDS

The world of dentistry has undergone profound change during the last 30 years and is steadily evolving toward a digital world.

As dental practitioners, our major concerns are dental anatomy and physiology, materials science and perfecting our preparation and dental operative techniques. It was challenging enough to master the techniques of achieving the perfect margin while simultaneously learning to become physicians of the oral cavity, as well as being small business owners.

Today, however, dentistry has undergone a rapid revolution as it incorporates technology at a dizzying pace. Not only are dentists physicians of the oral cavity, master technicians, materials scientists and business people, they are finding themselves in the position of needing to understand and master advanced aspects of computer engineering and a vast array of available digital technologies.

Digital impressions change the traditional methods and workflow completely. These digital technologies, however, give us complete control over results, with improvements in patient comfort and convenience and the quality of restorative results. Techniques and processes have matured and advanced to the point that they can provide same-day results, predictably and in an extremely cost-effective fashion, and with great acceptance by our patients.

I was an early adopter of digital technology. The integration of the Romexis software with the patient's soft-tissue scans and CBCT image provides valuable information for exceptional treatment planning. The flexibility of the open platform is the core of Planmeca's systems. The modularity and support that I receive allows me to practice better dentistry.

Digital transition doesn't have to mean major upheaval – as a matter of fact, the digital transition simply puts a new spin on what you already know and is often all you need to make huge strides in improving your practice and providing a better patient experience. After all, the basics are the foundation of change.

– Michael L. Young, DDS


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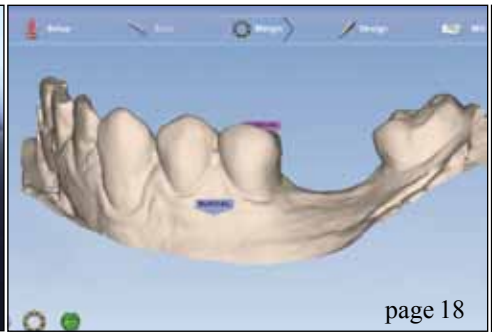
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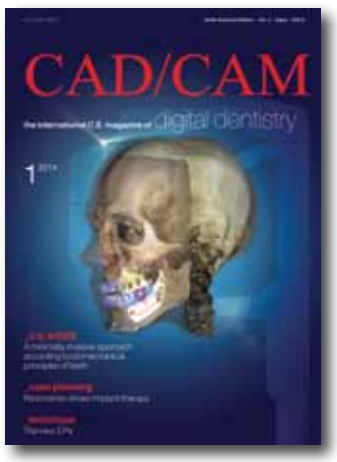

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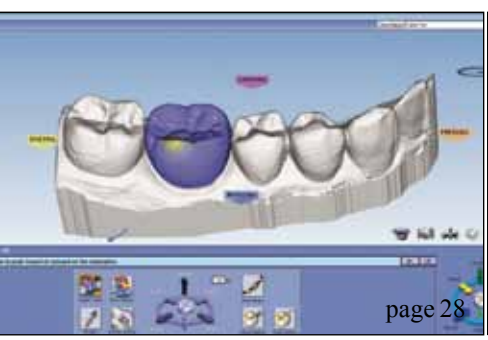
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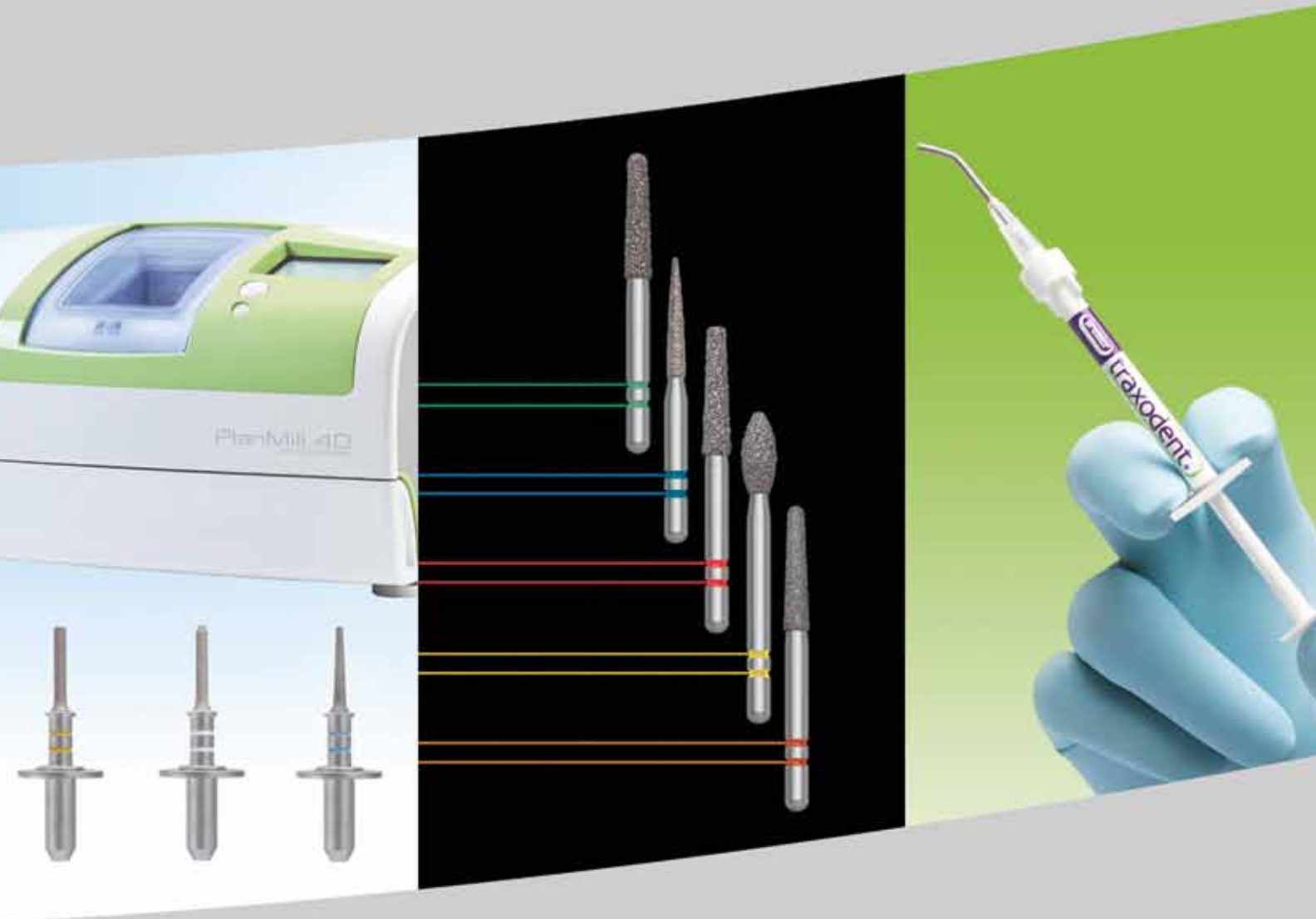

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A minimally invasive approach according to biomechanical principles of teeth

Author_Michael L Young, DDS

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_Introduction

Traditionally, the practice of dentistry has been a reparative model. We have waited for disease to express itself, and then repaired it. What if we could predict who would express a disease and prevent it from happening in the first place? How would this approach affect the long-term oral and overall health of the dental patient?

Many of our patients tell us, "If it's not broken, don't fix it." Patients are often unaware of the conditions in their mouths because there isn't an associated disability, and they won't accept a solution to a problem they don't have. Thus teeth at risk may remain untreated until a quality of life issue has occurred, such as pain, infection or a fractured tooth.

According to Geurtsen, Schwarze, & Gunay (2003), root fractures are the third leading cause of tooth loss.

Tooth loss is a quality of life issue. Loss of a tooth ideally requires replacement, which necessitates further expenditures and procedures.

Failure to replace the tooth has consequences, which may lead to further cost and need for treatment or loss of additional teeth. The consequence of the reactive approach to dental care is, at best, a lesser prognosis for the tooth and, at worst, loss of the tooth.

This may be avoidable with a paradigm shift to a wellness model of practice. A wellness model is proactive and preventative. If we can identify a dental condition that increases risk to the tooth and patient, and treat the condition prior to its consequence, we're effectively reducing risk. The effect is an improved prognosis. Subsequently, health-care costs will be reduced and quality of life improved.

We can do better.

_Biomechanical principles

Tidmarsh said in 1979 that teeth are like prestressed laminates. They flex but can return to their natural state. However, under prolonged loading, teeth can permanently deform.

Grimaldi said in 1979 that there is a relationship between how much tooth structure has been lost and deformation.

Cavity preparation or endodontic access destroys the pre-stress state. Teeth can then deform greater and are more susceptible to fracture. Too much flexing makes them crack.

Larson, Douglas and Geistfield (1981) showed that a restoration that takes up just one-third of the intercuspal distance is less than one-half of the strength of an unrestored tooth. The load required to fracture a tooth was the same if the restoration

involved only the occlusal surface or included the mesial and distal surfaces as well.

Geurtsen, Schwarze and Gunay (2003) agreed that the risk of cuspal fracture increases considerably when the isthmus width of a restoration is 50 percent of the intercuspal distance. They stated that amalgam or resin composite restorations should not exceed one-fourth to one-third of the intercuspal distance. The more tooth structure that is removed in cavity preparations, the more the tooth flexes under increasing loads.[1]

Teeth with cuspal fractures may still be restored; however, the prognosis will be lower and less than ideal because there is less remaining natural structure to retain a crown and withstand the flexing from functional and non-functional forces. These teeth may last for years. However, they may eventually fracture at the gingival crest or below, because of further cracks and propagation of those cracks.

Teeth with history of endodontic treatment are at an increased risk of subgingival fracture, rendering the tooth non-restorable or with a poor prognosis.[2] Therefore, it's important to prevent these cracks from forming at all.

How do we prevent too much flexing in these teeth and prevent cracking? Some have wondered whether a bonded inlay restoration would strengthen the tooth and prevent cuspal fracture.

A study of bonded inlay restorations under static load testing in maxillary premolars with large MOD preparations concluded that bonding ceramic or composite will not strengthen the tooth.[3] A bonded resin or ceramic inlay will not prevent cuspal deformation and fracture. However, bonded ceramic onlays have been shown to be an effective answer in restoring posterior teeth.[4,5]

Bakeman and Kois (2009) stated that all-porcelain, adhesively retained restorations offered the possibility of limited or no removal of tooth structure on the axial wall, while covering the cusps. The result is a tooth with more remaining original structure, less flexure under force and thus less risk of permanent deformation and fracture.

It is important to preserve as much enamel as possible, as failure rates of adhesively retained restorations increase the more the tooth preparation involves the dentin.[6] In addition, the size of the remaining enamel ring after occlusal reduction is an important determinant between an adhesively or cohesively retained approach in tooth preparation.

Increased occlusal reduction, or occlusal reduction on a worn tooth, results in a preparation with a reduced enamel ring width. A decrease in the size of the enamel ring thickness from 1.5 mm to 1 mm increased the failure rate dramatically. An enamel ring of less than 1 mm in width would be a contraindication for an adhesively retained restoration, and a cohesively retained restoration would then be required.[7]

A restoration bonded to enamel also provides a margin with reduced or no microleakage.[8]

_Summary

Aminian and Brunton (2003) stated: "The removal of sound tooth structure is an unfortunate biological compromise. The conservation of sound tooth structure, therefore, represents an appropriate strategy to minimize biologic risk."

Adhesively retained restorations offer the possibility to be more minimally invasive while restoring a tooth to natural appearance and function. More conservative removal of tooth structure also means there is less risk to the pulp.

The converse is true in that cohesively retained restorations are more invasive. Removal of more structure increases pulpal risk, decreases strength and increases tooth flexure, which may lead to fracture.

Tooth preparation is also more important as retention and resistance form is essential to retain the crown.

A laboratory can fabricate minimally invasive, adhesively retained restorations. However, chairside CAD/CAM technology can fabricate excellent restorations of the same quality in the same visit. This means the challenge of fabricating a provisional for a tooth preparation that lacks retention and resistance form is eliminated.

In addition, it has been shown that patients prefer a digital impression technique in lieu of the traditional impression method.[9–13]

Yuzbasioglu, et al (2014), also determined that the digital impression method was faster than the traditional method. This finding was also verified by Patzelt, Lamprinos, Stampft and Att (2014), who indicated that workflow efficiency was improved using a digital impression technique.

_Case report

This patient presented for restorations of teeth #3 and #4 (Fig. 1a). Because of the size of the existing restorations, these teeth were diagnosed as structurally compromised (Figs. 1b, c). The prognosis without treatment was fair.

The restorations were to be completed with PlanScan chairside CAD/CAM technology in the same visit.

Local anesthesia was achieved with 1.7 cc 2 percent Lidocaine with 1:100,000 epi, buffered with Onset sodium bicarbonate inj., 8.4 percent, USP neutralizing additive solution.

Depth guide cuts were made using a 330 bur,


Fig. 1a


Fig. 1b


Fig. 1c


Fig. 2a


Fig. 2b


Fig. 2c


Fig. 3a


Fig. 3b


Fig. 4


Fig. 5


Fig. 6


Fig. 7


Fig. 8a


Fig. 8b

Fig. 1a_Pre-operative photo: Diagnosis of structurally compromised teeth. (Photos/Provided by Michael L. Young, DDS)
Fig. 1b_Pre-op: Measuring intercuspal distance of filling #3.
Fig. 1c_Pre-op: Measuring intercuspal distance of filling #4.
Figs. 2a–c_Depth cut bur #3.
Fig. 3a_Final depth cuts.
Fig. 3b_Final depth cuts, occlusal view.
Figs. 4, **5**_Gross occlusal reduction with KS7 #3.
Figs. 6, **7**_Gross occlusal reduction with KS7 #4.
Fig. 8a_Final occlusal reduction frontal view.
Fig. 8b_Final occlusal reduction occlusal view.

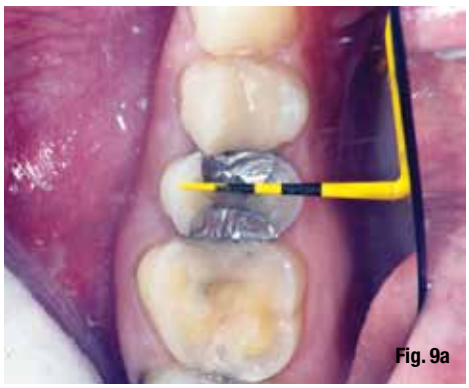
Fig. 9a


Fig. 9b


Fig. 9c


Fig. 10


Fig. 11


Fig. 12


Fig. 13


Fig. 14a


Fig. 14b


Fig. 15a


Fig. 15b


Fig. 15c

which has a 2 mm cutting surface (Figs. 2a–3b). This ensures 2 mm of occlusal reduction to accommodate 2 mm of material thickness on the occlusal surface of the restoration.

Gross occlusal reduction was completed using a KS7 bur to the depth cuts (Figs. 4–8b, 9c). Adequate clearance was verified with a 2 mm prep check from Common Sense Dental Products.

After gross occlusal reduction was completed, the remaining enamel ring was measured (Figs. 9a, b). The enamel rings were noted to be 1.5 mm, and the teeth were prepared for adhesively retained restorations. If the enamel rings were less than 1 mm, the teeth would have been prepared on the axial walls to create retention for cohesively retained crowns.

The remainder of the existing composite resin in #3 and the amalgam in #4 were removed. The occlusal surfaces of the preparations were blended into the interproximal areas using a KS2 bur to create smooth preparations (Figs. 10–15c). There was no retention or resistance form prepared to retain the restorations.

Tissue management was obtained with ViscoStat Clear, gingival hemostatic gel, 25 percent (m/m) aluminum chloride (Figs. 16, 17). Gingival retraction was obtained using a two-cord system. First, a #00 size cord from Ultradent was placed on the mesial and distal of both preparations (Figs. 18, 19).

Additional hemostatic gel was used prior to the second cord. The second cord was #2 size cord from

Fig. 9a_Measuring remaining enamel ring after occlusal reduction #4.
Fig. 9b_Measuring remaining enamel ring after occlusal reduction #3.
Fig. 9c_Occlusal reduction lateral view.
Figs. 10–12_Breaking contacts and removing remainder of existing filling.
Fig. 13_Blending occlusal and interproximal #4.
Figs. 14a, b_Blending occlusal and interproximal #3.
Figs. 15a, b_Final preparations occlusal views.
Fig. 15c_Final preparations lateral view.