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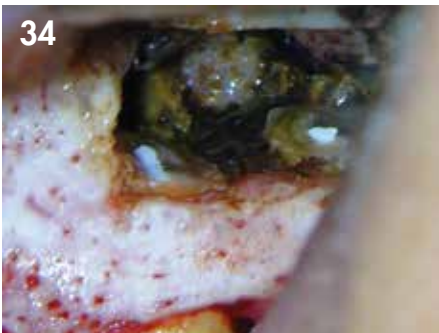
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Henry Schein team members around the world band together for bushfire relief



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An efficient approach to the restoration of worn incisors

Florian Klumpp¹

The injection moulding technique with resin composite is a semidirect restorative procedure that enables a predictable translation of the diagnostic wax-up into composite restorations¹. While this technique requires a more elaborate preparation, this time can be recovered again in the finishing phase. Moreover, more attention can be given to the functional aspects of the restorations, which are crucial for the long-term result.

Case report

A 28-year-old male patient visited the dental clinic because he was dissatisfied with the appearance of his upper front teeth (Fig. 1). Clinical examination revealed the presence of an old composite restoration on tooth 11 and excessive incisal wear of all maxillary incisors and the canines, with dentine exposure on the incisal edges (Fig. 2).

Labioversion of tooth 41 caused a premature contact, triggering deflective interferences (Fig. 3). This was first corrected with a removable aligner.

First, the teeth were whitened according to a home bleaching protocol with 6% hydrogen peroxide gel during 2-3 weeks to improve the shade and shade uniformity (Fig. 4).

When the diagnostic wax-up (Fig. 5) was created, the canines were shaped first and the canine guidance^{2,3} was verified in the articulator. Owing to the disclusion during lateral and protrusive movements in this articulation pattern, the wear of the teeth is minimised, thus preventing recurrence of the excessive wear on the incisal edges.

The diagnostic wax-up was copied using a clear vinyl polysiloxane (EXACLEAR, GC) in an unperforated, sectional impression tray (Fig. 6) to create a transparent mould. After setting, the silicone was removed from the tray and holes ending at the incisal edges of the incisors and canines were drilled. On both central incisors, an extra hole was drilled as an escape vent.

¹ Dr. Florian Klumpp, Germany
Dr. med. dent. Florian Klumpp graduated in Dentistry at the Eberhard Karls Universität in Tübingen (Germany) in 2008. In 2010, he obtained his PhD "magna cum laude" with his dissertation, entitled "Comparison of BMP-4 versus BMP-2 for the osteogenic differentiation of periosteal cells". After having worked in different dental offices around Stuttgart, he now runs his own dental office in Metzingen (Germany).



Fig. 1: Extraoral view of the initial situation. a) en face; b) oblique view. Note the excessive incisal wear



Fig. 2: Intraoral view of the initial situation



Fig. 3: Occlusal view of the mandible before treatment. Note the labioversion of tooth 41, which was triggering deflective interferences



Fig. 4: Tooth shade after bleaching

Before starting the procedure, the enamel and dentine shade of the teeth were determined with composite buttons

(Essentia, GC) on the incisal and cervical third of the tooth, respectively, and with cross-polarised filtered images to



Fig. 5: Diagnostic wax-up. a) vestibular view; b) palatal view



Fig. 6: a) A sectional nonperforated tray was filled with a clear vinyl polysiloxane (EXACLEAR). b) Creation of the transparent mould based on the wax-up

remove the influence of the reflection (Fig. 7). This was done because it was planned to restore the incisal edge with a layering approach to give a very realistic appearance.

The old composite restoration on tooth 11 was removed. The teeth were etched and the adhesive was applied and cured in accordance with the manufacturer's instructions. The



Fig. 7: Shade selection (Essentia) with the button technique and cross-polarising filter



Fig. 8: Injection of G-aenial Universal Injectable, shade A2

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Fig. 9: Light-curing of the composite through the EXACLEAR mould

mould was seated and the composite (G-aenial Universal Injectable, shade A2) was injected (Fig. 8), tooth per tooth, and light-cured through the mould (Fig. 9). Sprue and excess

were removed. It was not necessary to separate the teeth from each other, as the proximal surfaces were not involved and the transparent silicone key was fitting precisely, so overflow of the composite was avoided.

For the central incisors, the incisal part was cut back (Fig. 10) to embed various degrees of translucency and opacity in the incisal layer. A more distinct expression of the mamelons in those teeth fits the facial features of this patient and give a natural, young and vivid appearance. The adhesive procedure (etching and bonding)

(Fig. 11) was repeated on the cut back part and the composite in the dentine shade that was initially selected

(Essentia, shade MD) was used to create the mamelons (Fig. 12). Attention should be paid to obtain the correct thickness; a too thick dentine layer will make the result opaque and less natural, so make sure there is space left to place the enamel layer on top. On the other hand, if



Fig. 10: The vestibular incisal part of the central incisors was cut back for the layering technique



Fig. 11: The bonding procedure was repeated on the cut back surface



Fig. 12: The mamelons of the central incisors were shaped (Essentia, shade MD) to mimic the natural anatomy of the tooth



Fig. 13: Restored vestibular surface of the central incisors (Essentia, shade LE)



Fig. 14: Intraoral view after rehydration



Fig. 15: The palatal surface show sufficient concavity not to interfere with the anterior closing path

this layer is too thin, the effect will not be very visible and the restoration might look somewhat greyish. Thereafter, the selected enamel shade (Essentia, shade LE) was used to complete the vestibular surface (Fig. 13) and the restorations were finished. After rehydration, the teeth showed a good colour integration and surface gloss (Fig. 14). The palatal surfaces have an adequate morphology and sufficient concavity, without interference with the anterior closure path (Fig. 15). The extraoral view shows a natural and aesthetic overall appearance (Fig. 16) that satisfied the patient.

In conclusion, this technique can be used as a minimally invasive and simplified treatment alternative. In this case, injection moulding was combined with a cut-back technique to obtain a young, lively appearance of the teeth, aesthetically fitting the patient in an optimal way. The reliable reproduction of the wax-up enables us to obtain an

end result with a correct occlusion and guidance pattern in a relatively easy way.

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Fig. 16: Extraoral view of the final restorations. a) en face; b) oblique view

Evidence-based treatment planning for the restoration of endodontically treated single teeth: importance of coronal seal, post vs no post, and indirect vs direct restoration

Alan Atlas,¹ Simone Grandini², Marco Martignoni³

Abstract

Every orthograde endodontic procedure requires restoration of the coronal (access) cavity. The specific type of treatment used in individual cases greatly depends on the amount and configuration of the residual coronal tooth structure. In practice there are Class I access cavities as well as coronally severely damaged, even decapitated, teeth and all conceivable manifestations in between. The latest attempts to review results from clinical trials to answer the question of whether post placement or crowning can be recommended for the restoration of endodontically treated teeth or not are inconclusive. For dental practitioners, this is not a satisfactory result. This appraisal evaluates available evidence and trends for coronal restoration of single endodontically treated teeth with a focus on clinical investigations, where available. It provides specific recommendations for their coronal restoration to assist clinicians in their decision making and treatment planning. (*Quintessence Int* 2019;50: 772–781; doi: 10.3290/j.qi.a43235)

Key words: coronal restoration, direct restoration, endodontically treated teeth (ETT), endodontics, fiber post, indirect restoration, seal

¹ Alan Atlas
Clinical Professor, Departments of Endodontics, Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, USA; Private Practice, Philadelphia, Pennsylvania, USA

² Simone Grandini
Professor and Chair, Department of Medical Biotechnologies, Division of Restorative Dentistry and Endodontics, University of Siena, Siena, Italy

³ Marco Martignoni
Clinical Assistant Professor, Department of Medical Biotechnologies, Division of Restorative Dentistry and Endodontics, University of Siena, Siena, Italy; Private Practice, Rome, Italy

Correspondence:
Dr Alan Atlas, Departments of Endodontics and Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, University of Pennsylvania, 240 S 40th St, Philadelphia, PA 19104, USA.
Email: amatlas@upenn.edu

The importance of coronal restoration for endodontic treatment outcome

Leaking coronal restorations dramatically reduce the chance of endodontic treatment success. Numerous studies by renowned authors provide appropriate evidence, concluding that the coronal restoration is at least as important for apical periodontal health as the quality of the endodontic treatment itself.¹⁻⁴

An early study on the influence of the marginal integrity of coronal restorations on endodontic treatment outcome assessed more than 1,000 teeth radiologically that had undergone endodontic treatment.¹ It was apparent that the absence of apical periodontitis was significantly dependent on the marginal integrity of the coronal

restoration; 90% of endodontically sufficiently treated teeth were free of apical foci, assuming these were also restored coronally and a marginal seal achieved. The success rate dropped to 44% for coronal restorations that appeared to have marginal leakage (Fig 1).

The importance of coronal restoration is also verified by a large epidemiologic study of survival data on close to 1.5 million ETT, provided by a US dental health insurer.² From approximately 42,000 teeth extracted during the observation period, 85% had no proper coronal coverage and were removed at a rate six times greater than teeth that had coronal coverage. Further retrospective research is in line with this finding.³

A comprehensive meta-analysis of data available on the subject concluded that when either the quality of the coronal restoration or the quality of the root canal filling is completed inadequately, it is equally contributive to an unsuccessful outcome.⁴ Placement of a sufficient restoration over a poorly obturated root canal, or vice versa, does not render the high degree of success associated with performing both procedures adequately.

Hence, for the best possible, meaning long-term successful, endodontic treatment, both adequate endodontic and restorative treatments are indispensable. The question remains how state-of-the-art coronal restoration can be accomplished in an endodontic context.

To post or not to post, that is the question

ETT are more susceptible to fracture than vital teeth.⁵ It appears that particularly the loss of marginal ridges reduces fracture-resistance.^{6,7} In the case of a three-surface Class II mesio-occluso-distal (MOD) access cavity configuration, that is involving loss of both marginal ridges, coronal stiffness reduction is on average 63%.⁷ To compensate for this loss of stability, it is still customary to crown ETT. A central procedure in this context is frequently placement of a post.

A root post is traditionally used primarily for improving retention of the build-up material to the residual tooth structure. Whether posts improve the time in situ of the coronal restoration or tooth, however, is a controversially discussed subject. Current reviews assess the data available on the issue.^{8,9} As the authors of these reviews criticize the lack of methodic quality of the investigations under review, they are unable to provide a general recommendation for or against the use of posts. However, it is noted that there appears to be an emerging trend toward the superiority of fiber-reinforced posts.⁹

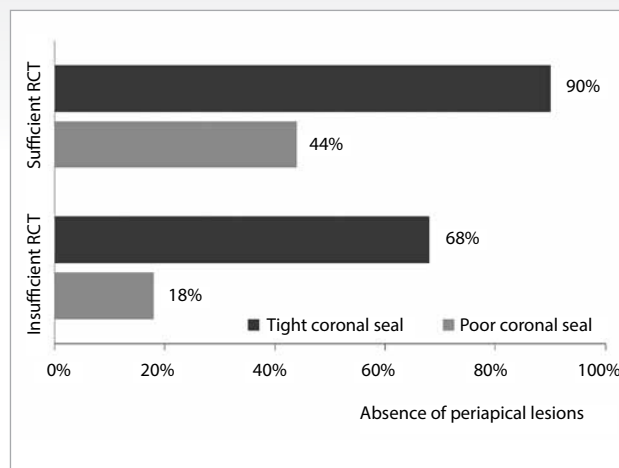


Figure 1: Endodontic success, ie the absence of periapical lesions, depending on coronal restoration seal (tight or poor) and the quality of the root canal treatment (RCT, sufficient or insufficient). Modified from Ray and Trope.¹

Post type

Within the scope of this appraisal, a selection of the clinical trials available on the subject shall therefore be made according to the following rationale: fiber posts are based on state-of-the-art technology and the accepted standard of care. Studies and reviews confirm that:

- fiber posts exhibit relatively uniform stress distribution to the root¹⁰
- fiber posts have elastic moduli similar to dentin¹⁰
- fiber posts are easy to place, cost effective, and esthetic¹⁰
- glass fiber posts are associated with low catastrophic failure rates compared to other post types¹¹
- glass fiber posts exhibit lower and thus superior stress peaks in finite element analysis.¹²

Based on this rationale, the appraisal at hand only takes clinical trials into consideration, which:

- deal with a “composite core with fiber post vs composite core without fiber post” scenario
- are included in the “Level I Evidence” category (that is, randomized controlled trial [RCT]) as set forth by the US Preventive Services Task Force (USPSTF).¹³

Premolars

According to the recent review of trials on the topic,⁸ there are three published RCTs that match the above criteria.¹⁴⁻¹⁶ Conclusions from these trials can be summarized as follows:

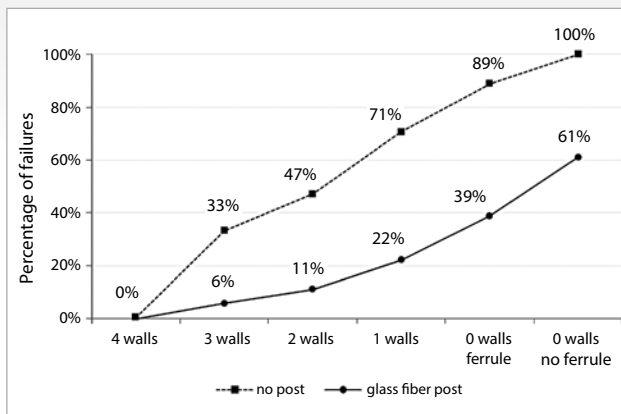


Figure 2: Overall failures of ETT as a function of residual coronal walls, with and without glass fiber post. Modified from Ferrari et al.¹⁵

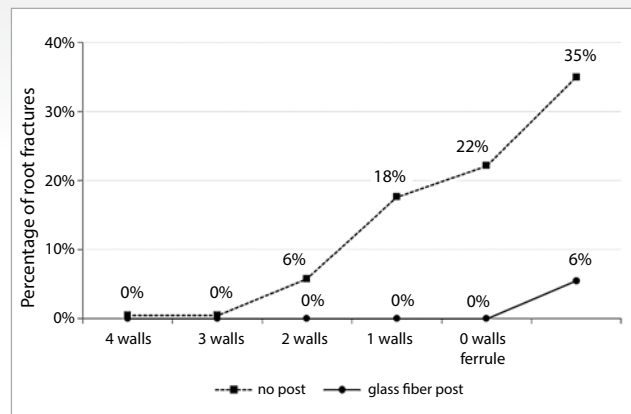


Figure 3: Root fractures of ETT as a function of residual coronal walls, with and without glass fiber post. Modified from Ferrari et al.¹⁵

- in premolars, the amount of residual coronal tooth structure generally influences survival, ie the more coronal walls, the fewer failures (Fig 2)^{14,15}
- in premolars, glass fiber posts reduce failure risk (Fig 2)^{14,15}
- in premolars, glass fiber posts protect against root fracture (Fig 3)^{14,15}
- in premolars, the previous two effects are more pronounced the more coronal cavity walls remain^{14,15}
- in decoronated teeth, quartz fiber posts significantly extend the time to restoration failure.¹⁶

Based on these findings it can be concluded that post placement is still a legitimate approach to restoration of ETT, especially for cases with extensive coronal structure loss (Fig 4). The more structure is lost, the more useful fiber post placement becomes. However, it needs to be taken into consideration that the above-mentioned clinical trials mostly focus on crowned premolars.

Molars and incisors

There is only one RCT that matches the criteria and which also considers molars and incisors.¹⁶ The trial followed a non-inferiority design with an assumed margin of equivalence of 15%. Its objective was to show that placement of quartz fiber posts makes no difference to clinical failure for any reason. Based on the results and in line with its non-inferiority design, the authors conclude that placement of a post provides no added clinical value except for the "no-wall" scenario, that is decoronated teeth. In this group, post retention exhibited a 7% failure rate compared to 31% for teeth without post retention. The authors conclude that quartz



Figure 4: For severely destroyed teeth, adhesive placement of a glass fiber post with subsequent core buildup and conventional crowning is recommended. Reprinted from Naumann⁵³ with permission.

fiber post placement is efficacious in reducing failures of post-endodontic restoration of teeth exhibiting no coronal wall. The same study recommends that post insertion for teeth with minor structure loss should be critically reconsidered to avoid overuse. One circumstance limiting the validity of the trial is the lack of totally standardized conditions, as the authors themselves admit. Beyond pooling of various types of teeth, crowns of the teeth observed were, depending on the extent of the defect, restored using either metal, porcelain-fused-to-metal, or all-ceramic full crowns, metal or all-ceramic partial crowns, or composite restorations. Also, it should be taken into consideration that the cores were built up using a combination of conventional self-curing adhesive and

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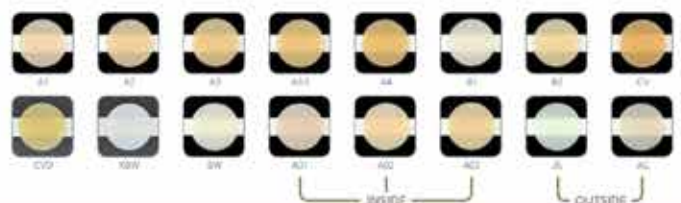
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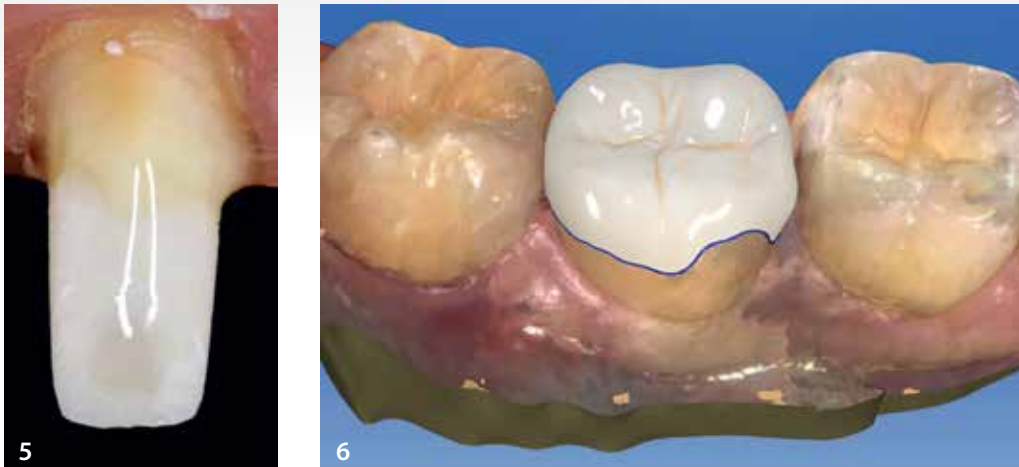


Figure 5: In cases where placement of a conventional crown is planned, preparation of a ferrule is advised. Reprinted from Naumann⁵³ with permission.

Figure 6: CAD/CAM construction of an all-ceramic overlay. For posterior teeth presenting with few or undermined walls, cuspal coverage with a partial crown or an adhesively placed onlay is advised. (Courtesy of Dr Andreas Bindl, Switzerland.)

core build-up composite – material classes characterized by moderate bond strengths and considerable shrinkage stress development.

In similar form, a comprehensive literature review recommends restoration of root filled molars (and premolars) exhibiting limited tissue loss, that is, with 50% or more of the coronal structure preserved, without post placement, especially when cusp protection is planned.¹⁷ One of the rare in vitro investigations on the effects of post placement in molars also found fiber posts ineffective in increasing the fracture-resistance of teeth with cuspal coverage.¹⁸

In addition, data for anterior teeth are scant. Biomechanical considerations suggest that, due to different load directions, anterior teeth behave differently from premolars and molars. Which effect these load patterns ultimately have on restorative success and survival of ETT is the subject of scientific discussion. Some consider the maxillary anterior region a particularly high-risk area for mechanical failure after endodontic treatment owing to the oblique loading pattern,⁸ while others argue that lateral, horizontal, or oblique forces generated at angles less than 90 degrees, as they occur in posterior teeth, are more destructive than vertical loads and can lead to greater failure of restorations.¹⁹ Deep overbites, a horizontal envelope of function, and extreme parafunctional forces also may increase the possibility of fracture and loss of anterior teeth. It seems that in maxillary central incisors, tooth stability decreases starting with preparation of the endodontic access cavity, with further

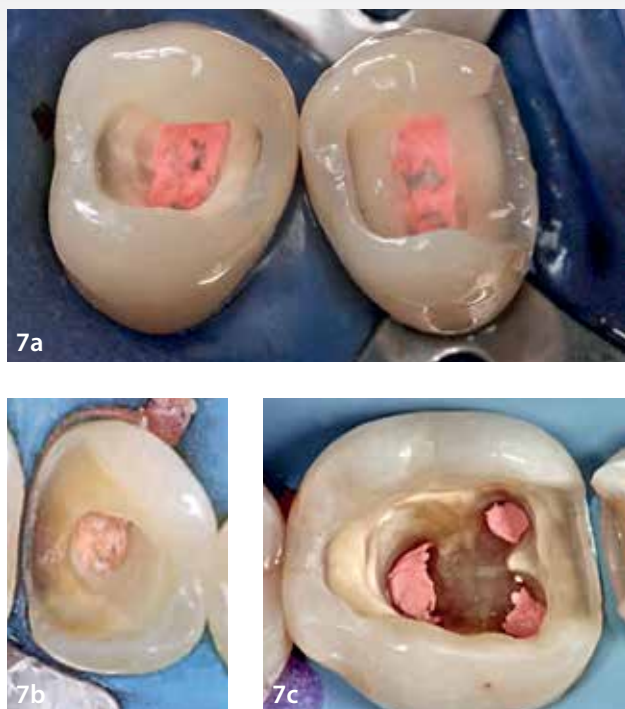
significant destabilization occurring after post space preparation.¹⁹ In the mandible, the anatomy of incisors is generally daintier compared to other teeth. Some authors recommend coronal reconstruction of root-filled incisors with limited tissue loss using composite only.¹⁷ Notwithstanding, a trend to achieve additional retention through post placement to compensate load patterns or anatomical limitations in anterior teeth, such as small pulp chambers and thin residual walls, is recognized.²⁰ Because it appears, however, that preservation of natural tooth structure is a decisive factor for successful restoration of ETT, post space preparation should be kept to a minimum in all cases.²¹

Coronal restoration of ETT

Crowning and cuspal coverage

Crowns are proven to function well as a long-term restorative measure for ETT. With an average annual failure rate of 1.9%, their longevity corresponds to those of various indirect restorations in vital teeth, which range between 1.4% and 1.9%.^{22,23} The preparation of a ferrule (Fig 5) is deemed a decisive success factor in that context.²⁴

With classic crowning, however, a significant amount of residual tooth structure is sacrificed in the preparation. Moreover, crowning often involves creating a subgingival preparation margin and therefore a significantly less hygienic margin region. For those reasons and in the light of recent research results, the almost habitual, reflex-like decision in favor of crowning single teeth regardless of the coronal



Figs 7a to 7c: Endodontically treated posterior teeth with four and three coronal walls, respectively. In such Class I and two-surface, Class II type (access) cavities with barely undermined residual tooth structure, the decision to treatment plan direct adhesive composite restorations is possible if risk factors discussed in the article and listed in Table 1 are favorable. (Courtesy of Dr Marcus Holzmeier, Germany, and Prof Simone Grandini, Italy.)

cavity configuration must be considered questionable.

The epidemiologic investigation referred to earlier in this appraisal advises cuspal coverage for ETT lacking three or more coronal surfaces.² However, the call for cuspal coverage does not make crowning compulsory if coronal stabilization can be achieved by other means.

A recent retrospective clinical evaluation comparing 3-year survival of post-retained porcelain-fused-to-metal crowns and cast ceramic onlays without posts in mildly and severely destroyed premolars found no statistically significant differences in outcome across the various scenarios.²⁵ The authors concluded that onlays are a reliable method of restoring endodontically treated premolars.

On an ex vivo level, it has been demonstrated that in endodontically treated premolars with Class II MOD configuration, cuspal coverage can enhance fracture-resistance by a factor of 2.3 versus composite Class II MOD



Figure 8: Micro-computed tomography view of a flowable, bulk-fill composite (SDR, Dentsply Sirona, light blue portion) applied to an endodontic access cavity. Note the high degree of adaptation to the pulp cavity despite its complex geometry. (Courtesy of Dr Frank Paqué, Switzerland.)

restorations without cuspal replacement. In fact, for the former, fracture-resistance was increased to a level close to the value determined for the sound teeth in the control group.²⁶

Cuspal replacement is typically carried out in indirect procedures (Fig 6). However, this approach appears to be noncompulsory as direct resin-based cuspal replacement was shown to be equally effective.²⁷

Direct restoration

With a two-surface Class II configuration, the increase in fracture-resistance through cuspal replacement, though statistically significant, seems to be much less pronounced.²⁸ Here again the stabilizing effect of the remaining ridge becomes apparent. Access cavities with four intact walls are even more stable.²⁹

A Cochrane review on the matter concluded that insufficient data are available for deciding whether preference should

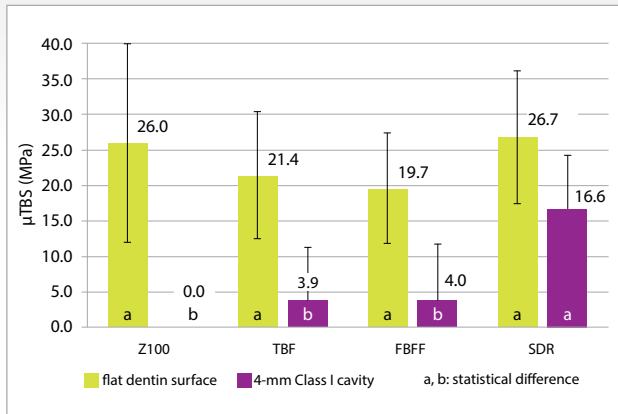


Figure 9: Microtensile bond strength (μ TBS [MPa]) of various (bulk-fill) composites achieved on flat dentin surfaces and in Class I, that is, the highest C-factor cavities. All composites were applied in 4-mm increments. It appears that commercially available materials are not equally performant. Z100, 3M; TBF, Tetric EvoCeram Bulk Fill, Ivoclar Vivadent; FBFF Filtek Bulk Fill Flowable, 3M; SDR, Dentsply Sirona. Modified from Van Ende et al.^{42,43}

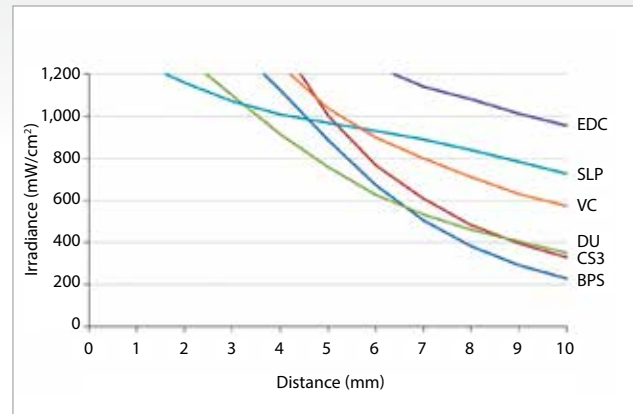


Figure 10: Irradiance of LED curing units decreases over clinically relevant distances. BPS, Bluephase Style 20i, Ivoclar Vivadent; CS3, Coltene SPEC 3, Coltene; DU, Demi Ultra, Kerr; EDC, Elipar DeepCure, 3M; SLP, SmartLite Pro, Dentsply Sirona; VC, Valo Cordless, Ultradent. Data provided by Bluelight Analytics, Halifax, Canada.

be given to direct restorations or crowns for restoring ETT.³⁰ The review identified one single acceptable study, in which survival of porcelain-fused-to-metal crowns and fiber-post-retained composite restorations in Class II cavities with preserved cusps were compared.³¹ The reviewed investigation itself, however, established that clinical success rates of both restorative approaches are equivalent. Another recent RCT in largely destroyed ETT found a statistically significant and yet only slightly more frequent need for intervention for the composite group versus crowns. There was, however, no statistically significant difference between crowns and composites in terms of survival. The authors concluded that both composite restorations and porcelain-fused-to-metal crowns are acceptable approaches for achieving good survival and success rates.³² In another retrospective clinical investigation, the authors concluded that ETT with coronal defects lacking up to three surfaces can be restored with adhesive composite fillings.³³ A similar view is supported by a systematic review which suggested that in teeth with limited coronal hard structure loss, composite resin restorations and crowns do not present significantly different longevity.³⁴ A recent retrospective study demonstrated that long-term (6 to 13 years) durability of Class II posterior composites with 2.5- to 3-mm cusp thickness in ETT was clinically comparable to that of vital teeth.³⁵ Placement of composite fillings in ETT should therefore be considered, depending on the amount and configuration of residual

coronal tooth structure following endodontic treatment (Fig 7).

The use of a low-stress, flowable bulk-fill composite is a natural choice when restoring ETT directly. Such materials are deemed effective from both an in vitro³³⁻³⁹ and clinical^{40,41} point of view, and equally, or even more, reliable than conventional composites. Even in high C-factor cavities, such as in ETT with little coronal structure loss, flowable bulk-fill composites are proven to achieve high adhesion.^{42,43} Likely reasons are their low shrinkage stresses as well as self-adaptational properties (Fig 8). However, at least in this particular indication, commercially available materials do not appear to be equally performant (Fig 9). Hence, careful consideration should be given to the choice of material. The choice of light-curing unit also influences the quality of clinical treatment. One important factor is the amount of light that arrives at the resin subject to curing.⁴⁴⁻⁴⁶ This value is referred to as irradiance. Endodontic access cavities can easily exhibit depths of 10 mm or more, and the irradiance decreases according to the distance (Fig 10). The use of a curing device that delivers sufficient irradiance also across clinically relevant distances is advised.

Risk factors

An important prerequisite for direct restoration is that the individual tooth does not present with undermined and thus weakened residual coronal walls.⁴⁷ In posterior teeth, large

Table 1. Minimally invasive treatment recommendation for incisors, premolars, and molars

Teeth	Treatment	Cavity configuration					Risk factors
		Access cavity	One ridge lost	Both ridges lost	One wall remaining	No walls remaining	
Premolars and incisors	Glass fiber post	No	No	Yes	Yes	Yes	Parafunctional patterns, dietary habits, periodontal status, tooth location, number of adjacent teeth, gender, or patient age may necessitate crowning
	Coronal restoration: incisors	Composite filling	Composite filling	Ferrule and crown	Ferrule and crown	Ferrule and crown	
Coronal restoration: premolars	Composite filling	Composite filling	Cusp coverage	Cusp coverage	Ferrule and crown		
Molars	Glass fiber post	No	No	No	No	Yes	
	Coronal restoration	Composite filling	Composite filling	Cusp coverage	Cusp coverage	Ferrule and crown	

Cuspal coverage is typically carried out indirectly (adhesive composite or all-ceramic onlay, partial crown). In context with a crown preparation, creation of a ferrule is deemed beneficial. Use of the smallest post size available is advised.

cuspal heights and group function may generate greater lateral forces compared to canine-protected occlusions.⁴⁸ With respect to molars, factors such as occlusal patterns and parafunctional habits play a pivotal role. In the treatment planning sequence, periodontal status,⁴⁹⁻⁵¹ tooth location, number of adjacent teeth, requirement as a survey crown for a removable partial denture, parafunctional habits, gender, and the age of the patient are important diagnostic criteria for evaluating the requirement for a full coverage crown. Another important risk assessment during the treatment planning process is the patient's dietary habits. Harder type foods such as nuts and hard candies place enormous stress on teeth, especially those with restorations. Consumption of large quantities of these specific foods will cause a tooth with a large filling to flex, thus increasing the likelihood of fracture. Chewing gum and ice weaken the adhesive interface significantly and may cause the tooth to break even when eating something softer in consistency. Parafunctional habits such as nocturnal bruxism will significantly lower the lifespan of fillings and crowns.^{35,52}

Summary and clinical recommendations

Importance of coronal seal

There is a strong link between endodontic treatment of the root and restoration of the crown. The quality of the coronal restoration is at least equal to or even more important for the endodontic treatment outcome than the quality of the actual root canal treatment. Hence, endodontic treatment cannot be considered completed unless the crown is adequately restored.

Post versus no post

Post placement remains a viable approach to restoration of ETT with extensive coronal structure loss. Owing to their mechanical and clinical properties, adhesively luted glass fiber posts can be considered the gold standard of care. For endodontically treated premolars with substantial coronal defects there is sound scientific evidence from prospective randomized controlled clinical trials that glass fiber post placement enhances clinical outcome. In the same trials, the use of fiber posts is shown to protect against root fractures. This correlation becomes clearer the more coronal tooth structure has been lost. Based on those trials, it is recommended to place a fiber post in premolars if three or more coronal surfaces, including the occlusal surface, have been lost.

There is a lack of clinical data regarding adequate treatment of root filled incisors and molars. For anterior teeth with limited tissue loss, reconstruction with composite without a post is recommended. There seems to be a trend, however, towards providing additional retention through fiber post placement due to the anatomical limitations and biomechanical load patterns. Therefore, the same approach to fiber post placement is advised for incisors and premolars. Molars may be unaffected by the use of a post if they present with significant residual amounts of coronal hard tissue or if cuspal coverage is planned. Results from a RCT in which molars were also considered suggest that fiber post placement significantly prolongs the time to clinical failure of the restoration only in cases where no coronal walls remain at all. On those grounds, fiber post placement in molars is

only recommended if the tooth is decoronated.

It should be noted that placement of fiber posts according to the present studies does not seem beneficial under certain circumstances, but is also not detrimental. If the preference is for placement of a fiber post, a conservative approach for preparing the post space is recommended to ensure long-term success of the residual tooth structure. In other words, preference should be given to posts with a small diameter as opposed to posts with a large diameter.

Posts are traditionally used to increase retention of the core. Self-adapting, low shrinkage stress, bulk-fill composite technology used in conjunction with modern light-curing adhesive agents for core buildup may become a viable alternative for post placement, even in largely destroyed posterior teeth. More research in this area would be desirable.

It is not clearly established to what extent fiber posts are beneficial in scenarios where no crown is placed. Some of the investigations dealing with such scenarios look into post retained restorations while others do not. Prospective investigations comparing onlays as well as direct composite restorations in Class II cavities, both with and without a post, do not exist at the moment.

Indirect versus direct restoration

As to the question of whether the crown should be restored in direct or indirect fashion, the same approach is recommended for all types of teeth. In ETT with three or four coronal walls left, that is, at least one marginal ridge remaining, and no undermined cavity walls, direct adhesive restoration may be considered as an alternative to cuspal coverage. For posterior teeth with few or undermined coronal walls, cuspal coverage with an adhesively placed onlay, a partial crown, or a conventional crown is advised. Risk factors such as parafunctional patterns, dietary habits, periodontal status, tooth location, and more should be included in the evaluation as to whether a specific ETT can be restored with a direct composite filling, or requires full cuspal coverage or even a crown. In cases where crowning is intended, preparation of a ferrule is required.

An overview of the clinical treatment recommendation given above is provided in Table 1.

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A simple and cost-effective makeover using the Dahl technique and composite edge bonding

Tif Qureshi¹

The Dahl principle is a method for treating localised anterior tooth wear, before posterior wear begins (Poyser et al, 2005).

It opens the vertical dimension of occlusion (VDO), without having to treat the back teeth. The technique can be thought of as a non-invasive, preventive treatment and, for the right case, can stop a patient from developing full-mouth wear or needing oral rehabilitation. I also use it as a way of protecting anterior guidance and function.

Dahl is often viewed as an unconventional way of treating wear, but many of the traditional restorative options have expensive final outcomes, which can be a barrier for the patient. I use the Dahl technique nearly every day in my practice and have been doing so for more than 25 years.

Arguing for one type of approach over another is difficult. Few dentists have tried all the techniques extensively. However, I found that, in cases where the combined anterior wear in both arches is 6mm or less, and there is still some enamel coverage on posterior teeth, it is my preferred mode of treatment. Teeth and guidance can be restored, and within a few months, posterior contacts regained.

I usually employ traditional techniques in more severe cases. There are important caveats for using Dahl; for example, patients should have a reasonably well-aligned posterior arch, and care should be taken not to generate off-axial forces.

The Dahl principle

Modified Lucia jigs have been used as anterior deprogrammers to help the mandible find centric relation (CR). Direct composites can also be used as an anterior deprogrammer. Because of their resilience and ease of manipulation, even in small thicknesses, resin composites represent an ideal material to restore the palatal surface (Cardoso et al, 2000) and the worn lower anterior incisal and canine edges.

Dahl and Krogstad (1975) suggested creating space to treat localised anterior tooth wear by separating posterior teeth, using an anterior bite plane for four to six months.

A combination of passive eruption of the posterior teeth, and intrusion of the anterior teeth, allows the re-establishment of posterior occlusion, while holding the anterior space (Dahl and Krogstad, 1982). Dahl used a metal appliance to separate the posterior teeth, but the same result can be achieved with adhesive anterior direct composites.

¹ Dr Tif Qureshi BDS
Private Practice, Dental Elegance,
Sidcup, UK.

Email: tif@iasortho.com
Website: www.iasortho.com



Figure 1: The patient wanted the aesthetics of her smile improved



Figure 2-4: The patient was reluctant to show her worn teeth and was experiencing increased sensitivity



By identifying the difference between maximum intercuspal position and CR, using pressure to gently guide the mandible, the position of the direct composite can be set slightly posterior to maximum intercuspal position (Magne et al, 2007). This will create anterior contact on the incisal edge build-ups and possibly create premature contacts on the posterior teeth. These can be improved through minor equilibration, but the residual space will eventually close through passive compensation and settling over a few months.

The following case shows how Venus Diamond composite

can be used to place balanced and axial-force generating Dahl build-ups. Lower-edge direct build-ups and an upper 'Dahled' retainer are used as an interceptive method to stop a teenager developing full-mouth wear.

The Dahl principle allows such cases to be treated early to help avoid more extensive work. Why should treatment only commence once the patient has developed further wear? Is it necessary for the whole occlusal vertical dimension (OVD) to be increased with full arch restorations, to treat anterior wear only?



Figure 5: She presented with a significant amount of anterior tooth surface loss, and dentine exposure on the lower and some upper edges



Figure 6: The patient was losing anterior guidance and starting to develop posterior interferences



Figure 7: Direct build-ups were placed on the lower 4-4 worn teeth and the upper teeth were edge bonded

Teenage tooth wear

An 18-year-old female came to see me at Dental Elegance because she wanted the aesthetics of her smile improved (Figure 1). Due to anterior wear, she was reluctant to show her worn teeth and she was experiencing increased sensitivity (Figures 2 to 4).

The patient was medically fit and healthy, with good oral hygiene. She presented after orthodontic treatment with a significant amount of anterior tooth surface loss, and dentine exposure on the lower and some upper edges (Figure 5). Parafunction was the likely cause.

There was no posterior wear, but she was losing anterior guidance and starting to develop posterior interferences (Figure 6). She had no temporomandibular disorder symptoms.

Minimally invasive treatment

Treatment choices to improve her smile included providing the patient with a splint, which would prevent tooth wear caused by night-time grinding. However, this method would offer no protection during the day and it was important to preserve the dentine from further erosion. Ceramic veneers were possible, but irreversible and expensive. They would require tooth structure preparation and would begin an ongoing restorative cycle.

Direct composite veneers using the Dahl technique were an option. It was explained that the surfaces of the teeth would need complete coverage, making alterations difficult and increasing the maintenance costs.

Instead, the patient opted for composite edge bonding with the Dahl technique, and tooth whitening. She preferred the minimally invasive nature of the composite edge-bonding treatment and the lower cost. She also understood that the material was easy to adjust, add to and repair.

Tooth whitening was undertaken with super-sealed home trays and Philips Zoom! Daywhite. This whitening system contains 6% hydrogen peroxide, and the patient bleached for just 35 minutes a day, over a three to four week period.

Composite build-up

The teeth were prepared using water-based air abrasion and etched with 35% phosphoric acid. Kulzer Ibond Universal was applied and light cured, in accordance with the manufacturer's instructions.

Direct build-ups were placed on the lower 4-4 worn teeth using a freehand composite technique. Adding to the lowers increases the vertical dimension. When doing this with the Dahl principle, my aim is to prop the anteriors open, loading

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Figure 8-10: Three to four millimetres of composite were added to the anterior region

primarily on the canines. This was balanced and checked with articulating paper. A light contact was then generated on the incisors and checked with articulating paper.

Two weeks later, the upper teeth were edge bonded (Figure 7). The teeth were lengthened for functional and aesthetic reasons. During the same appointment, the upper anterior and canine guidance was adjusted and improved.

Three to four millimetres of composite were added to the anterior region (Figures 8 to 10). This separated the back teeth by 1.5mm to 2mm. During the first two weeks, some condylar seating was expected, as the anterior bonding would have a deprogramming effect.

Each tooth was restored using Kulzer Venus Diamond in layers of the Opaque Light (OL) and B1 shades (Figure 11). The composite was laid freehand in a reverse triangle technique, which blocks out the light transmission on the join (Figure 12).

I have used Venus composite for 10 years and it is the

perfect material for edge bonding because of its high strength in thin sections.

It has a great colour match, which adapts and blends in well to the surrounding teeth. This is particularly useful when applying the reverse triangle technique. The dentine material has a natural opacity and helps to block out and mask transitions effectively (Figure 13). The matching enamel shades also blend well and have great polishing qualities.

Polishing and finishing

The patient's teeth were given a light polish immediately after edge bonding. The patient was recalled after a month, to ensure no posterior interferences developed.

To counteract any risk of hygroscopic expansion, the teeth were polished again with the high-gloss Kulzer Venus Supra kit. This simple-to-use system does not cut or damage the composite, and the rubberised polishers are the correct shapes to create a high lustre. The final shine was achieved



Figure 11: Each tooth was restored using Kulzer Venus Diamond in layers of the opaque light and B1 shades



Figure 12: The composite was laid freehand in a reverse triangle technique which blocks out the light transmission on the join



Figure 13: The dentine material has a natural opacity, and helps block out and mask transitions effectively



Figure 14 and 15: After one month, her posterior contacts were starting to settle and at the two-month review the contacts were completely closed



with a flexible felt and mylar disc, and polishing paste.

After one month, the posterior contacts were starting to settle and at the two-month review, the contacts were completely closed (Figures 14 and 15). This process appeared a little faster than usual, but younger patients do seem to 'Dahl' more quickly. Once the bite had settled down, an impression was taken using Kulzer Xantasil to fabricate a clear permanent Essix retainer for the patient to wear at night.

Ultimate preventative dentistry

The Dahl principle can offer dentists another way of approaching wear and occlusal issues, especially in mild and moderate cases. When used correctly, this interceptive method can stop patients from going on to develop full-mouth wear.

Directly bonded composite can act as a fixed Dahl appliance and is reversible. The clinical ease with which

composite restorations can be modified and altered offers better control over the outcome of the treatment. I believe this is the ultimate preventative dentistry.

The patient was thrilled with her teeth. The treatment was simple, cost effective and can last for five to 10 years, preventing any further anterior wear (Figure 16). If ceramic alternatives can be avoided, many patients who simply don't have the budget can have wear issues treated and reversed at more realistic prices.

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Bonding of ceramic veneers

Olivier Étienne¹ and Bérangère Cournault²

In recent years, the use of aesthetic bonded ceramic restorations has been favoured because of the aesthetic demand of our patients as well as our profession's concern to promote minimally invasive procedures¹. Among these restorations, veneers are mostly associated to the aesthetic improvement of the smile and the techniques of tissue preservations².

The fragility and detachment of these fine pieces of ceramics remain the main sources of apprehension of practitioners despite excellent results reported in the many clinical studies published to date^{3,4}. Admittedly, a low rate of failure is still relevant, but the understanding of the phenomena and the clinical criteria influencing the result either positively or negatively enabled to systematise the entire procedure in a better way. Among the criteria reported as determinants, the respect of an exclusive enamel bonding is essential. Indeed, the enamel can be easily etched and its composition, mainly mineral, does not make adhesion difficult as hydrated dentine can do. Hence, when the bonding system is wisely selected, the ceramic-enamel bond can reach adhesion values greater than the natural dentinoenamel junction.

In order to preserve the enamel tissue of the vestibular surfaces, several authors have proposed clinical procedures based on the analysis and preliminary composed aesthetic treatment plan. The use of silicone keys to control the reduction⁵ to the transfer the treatment plan through a mock-up^{6,7} are approaches that limit the preparation to the bare minimum. Then, the respect of a strict bonding protocol ensures the durability of the final result.

Clinical evaluation and aesthetic project

The initial consultation enables to take note of the patient's wishes and to confront them with the clinical and radiographic criteria. The aesthetic therapeutic decision may depend on desires such as shape modification, colour alteration, restoration of a large caries or correction of malpositions. The clinical case described below relates to a patient with oligodontia and microdontia, eager to improve her smile and to overcome the lack of permanent posterior teeth. The initial analysis (Figure 1) shows a "childlike" appearance of the smile, characterised by small anterior upper teeth associated with the presence of several diastemas.

¹ Prof. Olivier Étienne is Assistant Professor and Head of the Prosthetics Unit of the Faculty of Dental Medicine in Strasbourg (France). He is Doctor of Odontological Sciences (PhD) and devotes his research to surface characteristics and their interaction with biological tissues.

² Dr. Bérangère Cournault is a dentistry student in the 6th year at the Faculty of Dental Medicine in Strasbourg (France).



Figure 1: The 45-year-old patient presented with oligodontia and microdontia, characterised by the presence of many diastemas in the smile. The distribution of the teeth on the arch has been optimised by the previous orthodontic treatment which enables to envision the realisation of ceramic facets. Front view of the smile (a), intraoral view of the smile (b) and occlusal view (c).



Fig. 2: (a) The aesthetic analysis associated with an aesthetic project (smile design) enables the efficient guidance of the dental technician towards the construction of the desired wax-up. (b) The future gingival contour was drawn on the plaster (c) Then, it was covered by the modeling wax.

The aesthetic treatment plan resulting from the preceding analysis must allow effective communication with the patient as well as the dental technician. We found the use of a virtual project from a Photoshop Smile Design (PSD) approach ideal to fulfil both the communication to the patient

and the technician (Fig. 2a). This way, the technician was able to carry out a preparatory wax-up (Fig. 2b, 2c), which was then transferred to the mouth through a mock-up of bis-acryl temporary resin. In this case, the PSD project made it possible to present the two treatment options to the patient:

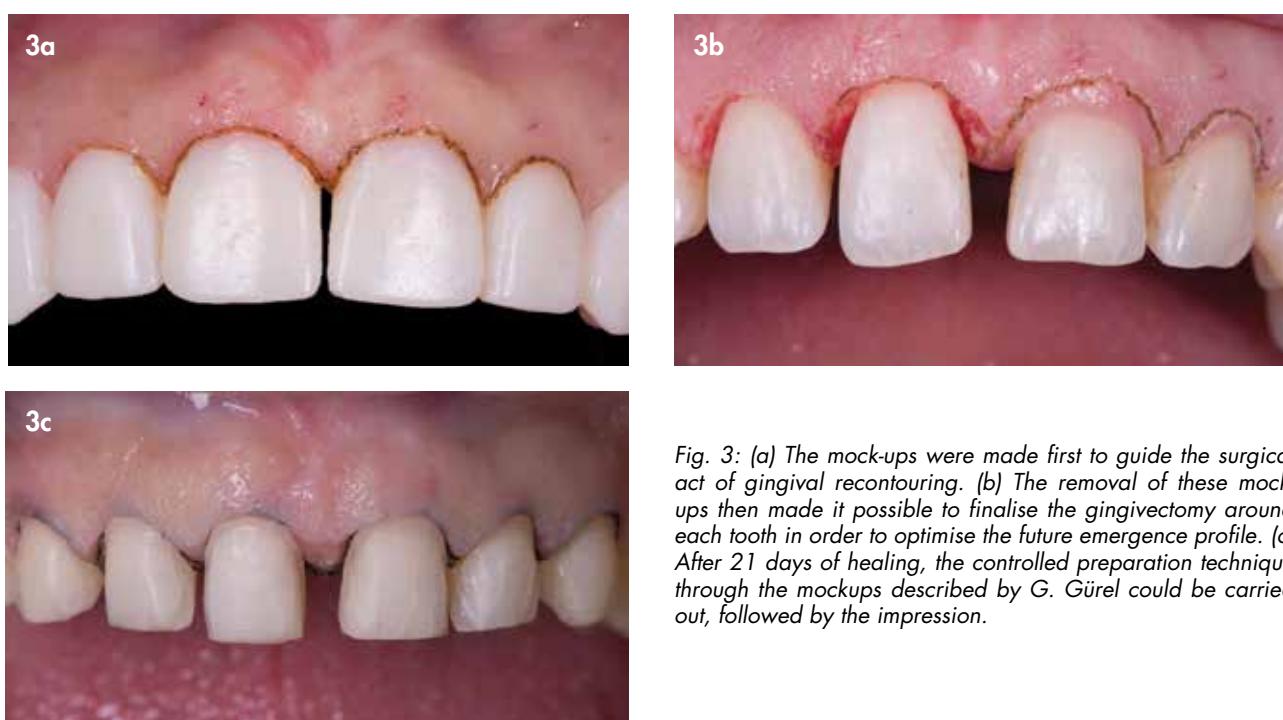


Fig. 3: (a) The mock-ups were made first to guide the surgical act of gingival recontouring. (b) The removal of these mock-ups then made it possible to finalise the gingivectomy around each tooth in order to optimise the future emergence profile. (c) After 21 days of healing, the controlled preparation technique through the mockups described by G. Gürel could be carried out, followed by the impression.



Fig. 4: (a) After removal of the provisional veneers, the dental surfaces were cleaned before trying all veneers with G-CEM Try-in Paste. When veneers are thin (<0.6mm), the colour of the bonding resin can influence the aesthetic result. (b) It is interesting to do several glycerine fitting trials to judge the final result. Here, 11 was tried with a try-in paste "A2" while 21 was tried with a try-in paste "Bleach". The brightness of 21 was preferred and therefore chosen.

partial preservation of the central diastema or complete closure of the diastema. Our common preference was to partially preserve the central diastema.

Enamel preparation

Once the mock-up was made, it served as a guide for the necessary gingivo-plasty (Fig. 3a, 3b). After gingival healing, the preparation could be started. The use of techniques to guide the preparation depth is essential. To do this, specific burs allow the practitioner to maintain enamel for the bonding, as long as a depth of 0.4 to 0.8 mm is respected. Horizontal, vertical and cervical depth marks were prepared on the buccal surface of the teeth, before starting the preparation.

The cervical limit was placed juxta-gingivally to facilitate the placement of the rubber dam during the luting later on. The proximal limits connected below the contact point to position the dento-restorative joint in a non-visible area, regardless of the angle of view. The contact point was

preserved at first and then faded by an abrasive matrix tape. Finally, the free edge was reduced when it was worn, altered or dyed.

The preparation was rounded and finished with a fine-grit bur (yellow coded), or even using sonic or ultrasonic instruments, to ensure a more reliable reproduction during the impression (Fig. 3c).

Try-in and luting

The aesthetic validation was done in the chair using the dedicated try-in pastes (G-CEM Try-In Pastes), allowing the practitioner to evaluate the possible impact of the colour of the cement on the final colour of the veneer (Fig. 4a, 4b). This criterium is particularly essential when the veneer is thin and/or made of feldspar ceramic without reinforcement⁸. When all the aesthetic criteria initially desired were respected, the restorations could be luted. Firstly, the intaglio surfaces of the glass ceramic veneers (reinforced lithium disilicate) were etched with hydrofluoric acid for 20 seconds, then rinsed

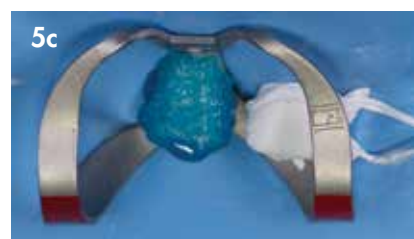


Fig. 5: (a) After rubber dam placement, the enamel of the prepared tooth was rinsed with water, to eliminate the water-soluble fitting paste. (b) Next it was sandblasted with alumina. (c) The surface was etched for 30 s with orthophosphoric acid, rinsed and dried.

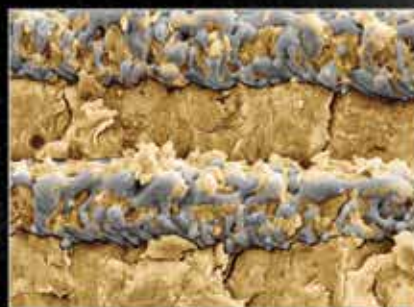
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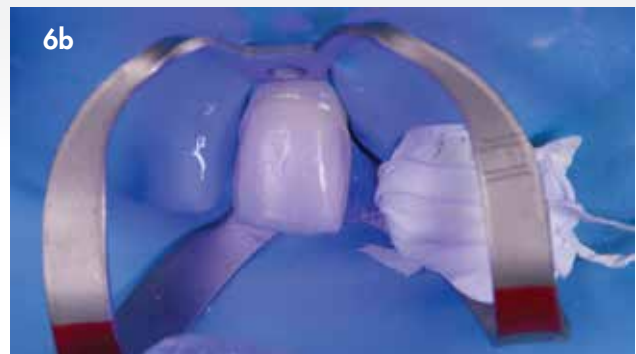
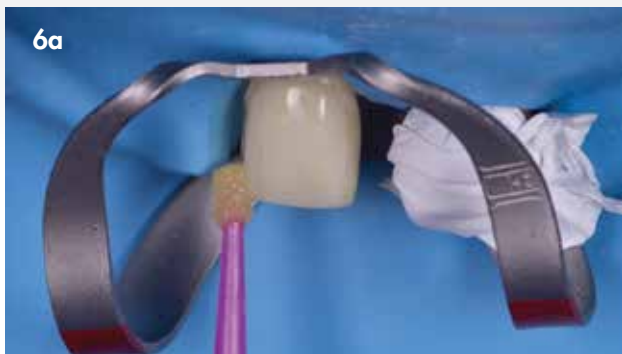


Fig. 6: (a) The universal adhesive G-Premio BOND was applied vigorously over the entire enamel surface, before being spread with oil-free air. (b) The adhesive was then immediately light-cured. Its low thickness (no more than 10 µm) does not pose any risk of difficulty to insert and seat the veneer.

and dried before being covered with a primer (G-Multi PRIMER) and left one minute minimum until evaporation.

The placement of a rubber dam guaranteed isolation from ambient humidity and sulcular fluid. The dam was supplemented by a Teflon tape which ensured the protection of neighbouring preparations on which the different products

could be deposited (Fig. 5a).

After rinsing the try-in paste away with water, an alumina micro-blasting guaranteed a cleaned surface and generated a macro-roughness, enhancing the adhesion (Fig. 5b).

The choice of the adhesive approach was based on scientific evidence concluding that the best adhesion values



Fig. 7: (a) Each veneer was pretreated with hydrofluoric acid (20 s) and rinsed and dried before applying a coat of G-Multi PRIMER. After one minute, the veneer was dried and then coated with G-CEM Veneer light-cure resin cement in the selected colour. (b) It was positioned on the preparation before (c) removing the resin excess by wiping. This option made it possible to obtain an adhesive joint without microleakage unlike the tack-cure technique. The veneer was firmly held onto the tooth during the entire light-curing procedure. (d) When the six anterior teeth are involved in the treatment, the recommended sequence is to bond first 11 and 21, then 13 and 23, ending with 12 and 22.



Fig. 8: After a week of healing, the periodontium refound its position. The redesigned gingival contours gave the illusion of a natural emergence profile.



Fig. 9: Result after 6 months.

between enamel and ceramic are observed when the protocol includes enamel etching⁹ (Fig. 5c).

The adhesive was scrubbed vigorously onto the enamel surface (Fig. 6a) before being spread by a strong dry air blow as recommended by the manufacturer. This step also contributes to the evaporation of the solvents contained in the adhesive. Finally, immediate light-curing of the hybrid layer obtained at this stage is strongly recommended (Figure 6b).

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The cortical window

Naheed Mohamed¹, Yosi Nahmias² and Ken Serota³

Introduction

Techniques, materials and innovations in the micro-armamentarium of endodontic microsurgery are seminal to enhanced predictable outcomes by comparison with historical microsurgical procedures.

The superior magnification and illumination of surgical operating microscopes improves the identification of root peripheries, ensures a lesser degree of root reduction and diminishes the size of osteotomies; thus retaining greater residual bone.

Smaller resection angles (perpendicular to the long axis of the root) reduce the number of tubuli exposed. Lateral canals, canal deltas, isthmus connections and micro-cracks can be identified prior to root resection, retro-preparation and retro-sealing (Weller et al, 1995)

Studies of positive treatment outcomes for conventional endodontic surgical therapy show a diverse range of success dependent upon an array of predictors (Garcia-Guerrero et al, 2017; De Chevigny C et al, 2008).

A study by Wang et al reported an overall healed rate of 74% of assessed teeth; root filling length and size of preoperative lesions proved to be important predictors of treatment outcomes (Wang et al, 2004).

Positive treatment outcomes (94%) were demonstrated by microsurgical techniques (Tsesis et al, 2013)

Retreatment of failing endodontic procedures demonstrate statistically less positive treatment outcomes than those done by microsurgical techniques (86%); fewer failures ensue (Setzer et al, 2012). These conditions are more readily addressed with microsurgical techniques (Floratos and Kim, 2017)

The computer-guided cortical window approach

A cortical window (bone lid) access to the apical region is less invasive, minimises bone loss and is less traumatic in comparison to alternative techniques.

The perimeter of the window is determined from radiographs of the area. Radiographs are essential to all aspects of endodontics; however, flat films are two-dimensional images of three-dimensional structures and so data interpretation is subjective.

Cone beam computed technology (CBCT) enables the clinician to visualise structures in sagittal, axial and coronal planes. Three-dimensional imaging provides

¹ Dr Naheed Mohamed DMD, MSD, PERIO, FRCD(C)
Private practice, Mississauga and Oakville, Canada.
Contact: naheedm@gmail.com.

² Dr Yosi Nahmias DDS, MSC
Private Practice, Oakville, Canada.
Contact: yosi@allianceds.com.

³ Dr Ken Serota DDS, MMSC
Clinical instructor in the University of Toronto, Canada postdoctoral endodontics department.



Figure 1: A variety of piezotomes are commercially available; saw-toothed tips of 8mm to 10mm are essential. Piezotomes ensure precise and safe cutting of mineralized tissues and preserve soft tissues (blood vessels, nerves, and mucosa)



Figure 2: The porcelain-fused-to-metal (PFM) crown appeared to fit appropriately. The root filling demonstrated incomplete sealing and there was no evidence of the expected MB2 canal



Figure 3: The post-operative radiograph showed four treated canals



Figure 4: Eighteen-months post-endodontic retreatment therapy. Apical pathology appeared to be present

more substantial data for diagnosis, pre-treatment planning, post-treatment assessment and reassessment evaluations (Ahlowalia et al, 2013; Venskutonis et al, 2014).

A printed stereolithographic surgical template can guide the osteotomies during the surgery; minimising deviation from the digital surgical plan. Surgical templates printed from three-dimensional imaging optimise site preparation, the perimeter of the osteotomy, depth of cortical bone, extent of pathology and volume of bone graft required (Kuhl et al, 2015; D'haese et al, 2012; Pinsky et al, 2007; Strbac et al, 2017).

Piezotome osteotomy

Traditional osteotomies use large, round burs which remove significant cortical bone. Delayed healing, increased post-operative pain and other complications may ensue.

With microscopes, piezotomes and ultrasonic tips, a smaller osteotomy is created, thus minimising the aforementioned sequelae.

Piezo surgery enables micrometric saw cuts which preserve cortical bone loss and facilitates preservation of root length by lower resection angles and enhanced visibility.

In deep spaces, ultrasonic vibrations break down irrigants

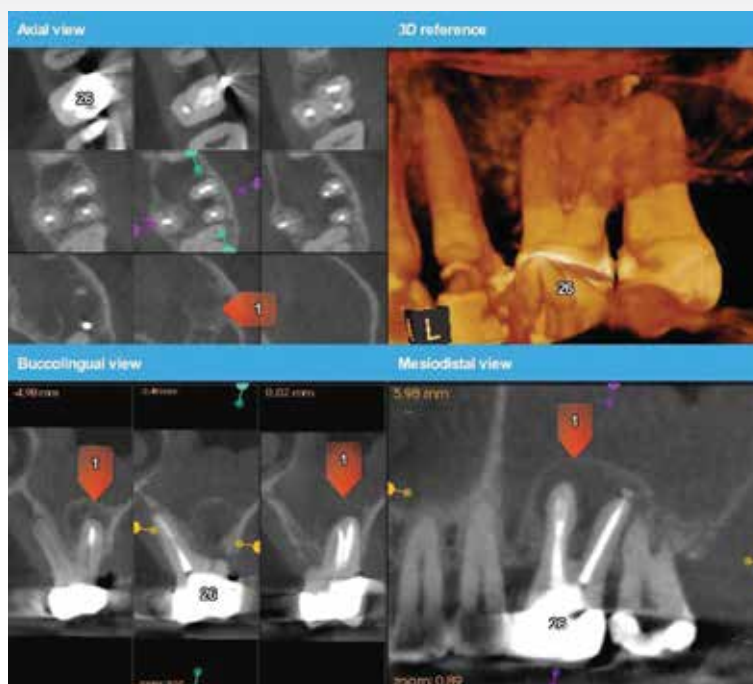


Figure 5: The cone beam computed tomography (CBCT) scan results showed rarefying osteitis and sinus cortical floor elevation along the mesiobuccal and distobuccal roots

into small particles readily washed from the crypt.

Less vascular presence in the crypt minimises use of hemostatic agents (Viscostat) and interference with retro-seal setting time. The use of a piezo surgical devices (Figure 1) enables accurate shaping of the cortical window and diminished osseous removal, in contrast to traditional crypt creations which are freehand guided (Abella et al, 2014).

Case report

The patient presented to our surgery with a history of 'sporadic discomfort in the gum' overlying tooth LR2.

A two-dimensional intraoral radiograph revealed a prior history of root canal therapy and a porcelain-fused-to-metal (PFM) crown (both completed approximately 10 years ago) (Figure 2)

Swelling began the evening prior to the appointment; the patient reported that the throbbing necessitated analgesics for relief of the pain. No sensitivity to pressure nor reaction to temperature were noted; the patient could not localise the tooth causing the distress. Treatment options were discussed with the patient; retreatment through the PFM crown was chosen.

Anaesthesia was administered (posterior superior alveolar nerve block - 2% xylocaine with epinephrine 1:

100,00 and infiltration facially and palatally 2% xylocaine with epinephrine 1 :50,000). A conservative access preparation was made; decay was identified proximal to the palatal canal and no fractures or cracks were noted.

Cavil was present beneath the composite core and the untreated MB2 canal (Stropko, 1999) was discovered.

A reservoir was made in the gutta percha (Proultra ultrasonic tip). Endosolv E was used to soften the gutta percha (Hwang et al, 2015)

After debridement and shaping, Ca(OH)₂ (Ultracal XS) was placed in the root canal space to further enhance disinfection.

Prior to obturation, drainage was noted coming from the MB2 canal; drainage was arrested and the canals root was filled with vertical condensation of warm gutta percha (VCWG) and AH-Plus sealer (Figure 3).

The patient returned in six months for reassessment. Tooth LR2 was within normal limits to percussion, bite, palpation, mobility and probing.

Eighteen months later, the patient returned for a second reassessment appointment (Figure 4). Tooth LR2 was slightly sensitive to percussion and the overlying gingival tissues were inflamed.

The patient was referred for a CBCT; the scan (Figure 5)



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Figure 6: The digital rendering of the surgical stent used to guide the cortical bone window osteotomies



Figure 7: The 3D-printed model and surgical stent used to guide our cortical bone window access



Figure 8: The surgical stent was put in place against the bone to guide the piezosurgical saw osteotomies



Figure 10: The clinical view of the surgical site once the cortical window had been removed and the roots resected



Figure 11: The microsurgical view of the root apical retro-preparation and apical seal

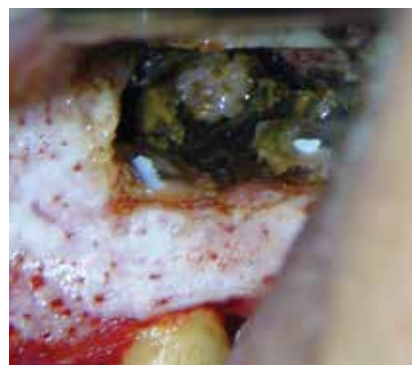


Figure 12: The defect was grafted with allograft cortical bone chips (Straumann Allograft)



Figure 13: The cortical bone window was replaced and fixated in place with gentle pressure



Figure 14: The flap was replaced and sutured with prolene monofilament sutures



Figure 15: The immediate post-operative radiograph

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Figure 16: The nine-month post-operative radiograph showed excellent bone regeneration

revealed a common area of rarefying osteitis surrounding the mesial buccal and distal buccal roots which had caused elevation of the sinus floor. As the endodontic pathology had not resolved, treatment options were proposed. The patient chose to have microsurgical therapy performed.

A 3D-printed stereolithographic template was created by combining the CBCT scan data with an intraoral scan's (3Shape Trios intraoral scanner) digital data. The data was then imported into Codiagnostix software in order to plan our approach and design our cortical window dimensions for optimal access to the roots (Figure 6).

The guided microsurgical approach would facilitate an osteotomy design to minimise the potential for sinus membrane perforation. The JD-printed guide for the cortical window would guide the length and angle of the osteotomies using the piezosurgical saw (Figure 7).

Cervical recession and decay were in evidence about teeth LU and LRI in addition to exposure of the crown margin of tooth LR2.

The cervical area of tooth LR3 was severely abraded. An intra-sulcular full-thickness muco-periosteal flap was raised; a vertical releasing incision was positioned mesial to tooth LRI.

The surgical stent was placed over the maxillary teeth (Figure 8) and a piezotome-guided surgical window was developed using the margins of the stent (Figure 9).

A chisel was used to elevate the cortical plate and root resection performed with Lindemann burs (Figure 10).

The cortical window was placed in sterile saline while the endodontic microsurgery was completed. After resection

using Lindemann burs, the root periphery was stained with methylene blue and examined for anomalies and the root canal space was retro-prepared with ultrasonic tips to a depth of three millimetres, creating a reservoir for the retro-sealing materials.

The retro-preparation was rinsed with ethylenediaminetetraacetic acid (EDTA) and dried with paper points.

Bosworth Super-EBA was placed (Figure 11) and the root end burnished with a multi-fluted carbide bur. Radiographs were taken at the retro-preparation stage and the retro-sealing stage to ensure accuracy of direction and material placement. The defect thoroughly debrided and was grafted with allograft (Straumann Allograft) (Figure 12). The cortical bone window was replaced and ensured to have no mobility (Figure 13)

The flap was closed with Ethicon 5-0 Prolene monofilament sutures (Figure 14) and a post-operative radiograph was taken (Figure 15).

The patient was directed to use 800 mg of ibuprofen and 1000 mg of acetaminophen for pain and to rinse with chlorhexidine.

Sutures were removed in seven days and the patient reappointed for reassessment. The re-evaluation radiograph taken at nine months showed substantial osseous regeneration (Figure 16) and a post-operative CBCT scan was taken after one year, showing complete bone regeneration and continuity of the buccal plate. (Figure 17).

Conclusions

Along with surgical operating microscopes and piezotomes, integration of optical scanners and CBCT Dicom files to JD-printed stereolithographic surgical guides is yet another iteration in the advancement of endodontic microsurgery

This novel, digitally-guided approach used in this case report, along with the intraoperative use of a JD-printed osteotomy guide, allows for greater efficiency and accuracy for creation of the access window to the roots.

The technique gives the advantage of bone preservation by allowing the cortical plate to be replaced, yet still provides adequate access for the apical root preparation.

The JD-printed guide provides a control for the osteotomies without risking damage to vital structures. This digitally-guided microsurgical approach provides accuracy, access, control and bone preservation to the endodontic apical surgery procedure.

As we come upon the dawn of a new age of digital dentistry, we can see the future applications to be endless.

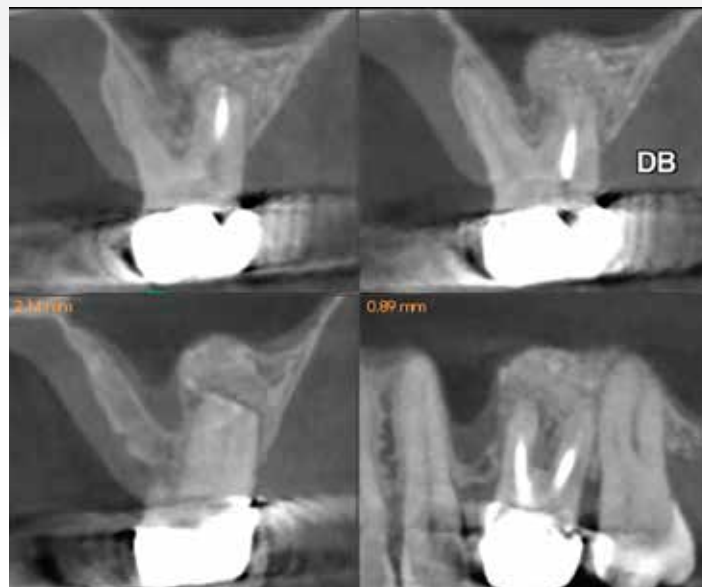


Figure 17: The one-year post-operative cone beam computed tomography (CBCT) scan showed complete regeneration of the defect and buccal plate

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Antibiotic stewardship in dentistry – review of evidence-based clinical recommendations on appropriate antibiotic prescribing in dental practice

Part 2: Clinical guidelines and recommendations for antibiotic prescribing in dental practice

Johan Hartshorne¹

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Executive summary

Rational

- Antibiotic stewardship efforts in dental practice are an opportunity to improve antibiotic prescribing practices and to curb antibiotic resistance.

Key Points

- Antibiotic prophylaxis is used routinely in high-risk groups of patients to reduce bacteraemia and the risk of developing infective endocarditis.
- Endocarditis prophylaxis is required in all dental procedures that involve manipulation of gingival tissue, the periapical region of teeth, or perforation of the oral mucosa
- In general, for patients with prosthetic joint implants, prophylactic antibiotics are NOT recommended prior to dental procedures to prevent prosthetic joint infection. In cases where antibiotics are deemed necessary, it is appropriate that the orthopaedic surgeon recommend the antibiotic regimen and when reasonable write the prescription.
- A single dose 2gm of amoxicillin given orally 1 hour preoperatively is effective and efficacious and significantly reduce failures of dental implants placed in ordinary conditions.
- There is no conclusive evidence to suggest the routine use of antibiotic as prophylaxis for third molar extraction surgery in healthy young adults.
- The primary care for odontogenic infections is by local intervention through drainage and or removal of the cause of infection by means of endodontic or surgical therapy.
- In patients with clearly established oral and dental infections, antibiotic therapy should be reserved for those patients who have regional or systemic body manifestations.
- Patients with infection spreading to the eye (orbital cellulitis) or throat (Ludwig's angina) or presenting with life threatening symptoms should be referred to an Oral Maxillo-

¹ Dr Johan Hartshorne
B.Sc, B.Ch.D., M.Ch.D., M.P.A.,
PhD. (Stell), FFPH. RCP. (UK)
Intercare Dental Clinical Advisory
Committee and General Dentist
Intercare Tyger Valley Medical and
Dental Centre, 43 Old Oak Rd.,
Tyger Valley, Bellville
Email: johan.laptop@intercare.co.za
Mobile No: 082 5512 993

Facial Surgeon for immediate intravenous antibiotics and appropriate surgical intervention.

- Prescribe narrow-spectrum antibiotics for the shortest duration possible until the clinical cure of the patient is obtained. This will also minimize disturbance of the normal gut flora.
- Amoxicillin is the preferred first line antibiotic because it is more effective against various Gram-negative anaerobes and has a lower incidence of gastro-intestinal adverse effects.
- A review point two to three days after drainage of an acute dental infection is a key element of the guidance. Those patients whose infections have resolved, and body temperature returned to normal, should be instructed to stop taking the antibiotics.
- Antibiotics may be used in conjunction with, but not as an alternative to other appropriate interventions, such as endodontic therapy, periodontal debridement, or surgical extraction of a tooth.
- Dentists should curb the use of Clindamycin due to high frequency of side effects, and specifically because it increases the risk of *Clostridiosis* (formerly *Clostridium difficile* pseudomembranous colitis 4 x
- Any antibiotic prescribing recommendations should be integrated with the practitioner's professional judgement in consultation with the patients' physician, and the patient's needs and preferences.
- The benefits of giving an antibiotic should always outweigh the risks of antibiotic-related allergy, toxicity, super infection and the development of drug-resistant strains.

Practical implications

- Local intervention (endodontic therapy, periodontal debridement, extraction and surgical drainage) are always first line primary care, with antibiotics serving as adjunctive therapy in indicated cases.
- First line antibiotics used in dentistry are penicillin's, amoxicillin, clindamycin and azithromycin. The use of Clindamycin should be reviewed and used with caution.
- Topical or local administration of 10% Doxycycline as an adjunctive to deep scaling and root planning (SRP) for treatment of periodontitis, can reduce or avoid the need for systemic therapy and subsequent gut microbiome exposure.
- Amoxicillin is the most commonly recommended antibiotic for children, with metronidazole or azithromycin being the alternative antibiotic in penicillin-sensitive patients.
- Safety and product cost should always be taken in consideration when selecting an appropriate antibiotic.

Introduction

Avoiding unnecessarily and inappropriate prescribing of antibiotics is the key to reducing the number of adverse drug reactions and curbing antibiotic resistance.

Various international (World Health Organization), Governmental Organizations (Centers for Disease Control and Health Prevention, USA, Department of Health and Human Services, USA, National Health Service, UK, British National Formulary, UK), Health Related Associations (American Heart Association, American Dental Association, Faculty of General Dental Practitioners, UK), Research Organizations (Cochrane Database) and Independent research collaborative efforts, publish and regularly update evidence-based clinical guidelines, recommendations and systematic reviews and meta-analysis for prescribing antibiotics. These clinical recommendations and guidelines are a key element of antibiotic stewardship and therefore fundamental for appropriate antibiotics prescribing in the dental setting.

- **Infective endocarditis prophylaxis recommendations¹**
- **Indications**

Antibiotic prophylaxis is used routinely in high-risk groups of patients to reduce bacteraemia, and the risk of developing infective endocarditis.² Patients at increased risk of developing infective carditis (IE) are:

- Prosthetic cardiac valves, including trans catheter-implanted prostheses and homografts
- Prosthetic material used for cardiac valve repair, such as annuloplasty rings and cords
- Previous IE
- Unrepaired cyanotic congenital heart disease or repaired congenital heart disease, with residual shunts or valvular regurgitation at the site of or adjacent to the site of a prosthetic patch or prosthetic device.
- Cardiac transplant with valve regurgitation due to structurally abnormal valve.

Endocarditis prophylaxis is required in all dental procedures that involve manipulation of gingival tissue, the periapical region of teeth, or perforation of the oral mucosa, including prophylactic cleaning, dental extractions, periodontal procedures, endodontic instrumentation, placement of orthodontic bands, placement of implants or any oral surgical procedure.

- **Antibiotic regimen**

The AHA guidelines state that an antibiotic for prophylaxis should be administered in a single dose 1 hour before the procedure^{3,4} (Table 3)

Table 3: Prophylactic regimen to prevent infective endocarditis ¹

Situation	Regimen: Single dose 30-60 minutes before procedure		
	Antibiotic	Adults	Children
Oral	Amoxicillin	2g	50mg/kg
Unable to take oral medication	Ampicillin OR Cefazolin or Ceftriaxone	2g IM or IV	50mg/kg IM or IV
		1g IM or IV	50mg IM or IV
Allergic to penicillin or ampicillin – oral	Cephalexin	2g	50mg/kg
	OR Clindamycin	600mg	20mg/kg
	OR Azithromycin or clarithromycin	500mg	15mg/kg
Allergic to penicillin or ampicillin and unable to take oral medication	Cefazolin or Ceftriaxone	1g IM or IV	50mg/kg IM or IV
	OR Clindamycin	600mg IM or IV	20mg/kg IM or IV

However, in the event that the dosage of antibiotic is inadvertently not administered before the procedure, it may be administered up to two hours after the procedure.

For patients already receiving an antibiotic that is also recommended for IE prophylaxis, then a drug should be selected from a different class; for example, a patient already taking oral penicillin for other purposes may likely have in their oral cavity *Streptococcus viridans* that are relatively resistant to beta-lactams. In these situations, clindamycin, azithromycin or clarithromycin would be recommended for antibiotic prophylaxis.^{3,4} Alternatively if possible, treatment should be delayed until at least 10 days after completion of the antibiotic to allow reestablishment of usual oral flora.

A recent systematic review ² made the following recommendations based of the available evidence-based literature:

Antibiotic prophylaxis should be limited to patients at high risk of developing infective endocarditis, according to the recommendations and protocol of the American Heart Association as summarized above.

- Oral amoxicillin is still the antibiotic of choice to reduce bacteraemia.
- IV amoxicillin-clavulanic acid could be used for patients at high risk of developing IE who require invasive dental procedures and are treated under general anaesthesia.
- In patients with penicillin allergies, oral azithromycin showed higher efficacy for the reduction of bacteraemia.
- The use of clindamycin should be reviewed.

• *Prophylactic antibiotics prior to dental procedures in patients with prosthetic joints*

Based on the updated systematic review and the 2015 ADA clinical practice guidelines state: "In general for patients with prosthetic joint implants, prophylactic antibiotics are NOT recommended prior to dental procedures to prevent prosthetic joint infection"⁵

However, a commentary published in February 2017 issue of JADA written by American Dental Association appointed experts, calls for appropriate decision-making criteria and to encourage dentists to continue using the 2015 guidelines.⁶ It is recommended that dentists, patients and orthopedic surgeons should discuss and weigh the potential risks and benefits before making a decision. It is also recommended that the dentists consult the appropriate use criteria as needed and respect the patients' specific needs and preferences when considering antibiotic prophylaxis before dental treatment.⁵

In cases where antibiotics are deemed necessary, it is most appropriate that the orthopaedic surgeon recommend the appropriate antibiotic regimen and when reasonable write the prescription.⁷

• *Prophylaxis for preventing implant failures*

The use of antibiotics in implant dentistry is controversial. The evidence-based data suggests that a single dose 2gm of amoxicillin given orally 1 hour preoperatively is effective and efficacious and significantly reduce failures of dental

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implants placed in ordinary conditions.^{8,9,10} It is still unknown whether postoperative antibiotics are beneficial, and which is the most effective antibiotic.

- **Prophylaxis for preventing infection in third molar extractions**

There is evidence that prophylactic antibiotics reduce the risk of infection, dry socket and pain following third molar extractions and result in mild and transient adverse effects. It is unclear whether the evidence is generalizable to individuals with concomitant illnesses or immune-deficiencies, or those undergoing the extraction of teeth due to severe caries or periodontitis.¹¹ In a recent systematic review and meta-analysis it was concluded that there is little conclusive evidence to suggest the routine use of antibiotic as prophylaxis for third molar extraction surgery in healthy young adults.¹²

- **Oral and Dento-Facial infections**

As a general guideline antibiotic therapy should be reserved for those patients with clearly established infections who have regional or systemic body manifestations e.g., presence of pronounced oedema (cellulitis), limited mouth opening (trismus), increased heart rate (tachycardia), difficulty swallowing (dysphagia), general malaise, fever and should be used as an aid to fight infection.¹³ Such patients should be treated surgically as early as possible. Adjunctive treatment should include endodontic therapy, or extraction of the causative tooth and surgical drainage of any areas of pus accumulation.

- **Life threatening sepsis:**

Patients with infection spreading to the eye (orbital cellulitis), or throat (Ludwig's angina), or presenting with symptoms indicating a life threatening sepsis such as an altered mental state, decreasing respiration rate, oxygen saturation below 92%, and increased heart rate >130bpm, systolic BP <90mmHg, should be referred to an Oral Maxillo-Facial Surgeon for immediate treatment with intravenous antibiotics and appropriate surgical intervention.¹⁴

- **Abscess:** acute dentoalveolar cellulitis and abscess usually require antibiotic therapy. Chronic dental abscesses need no antibiotic therapy.

- **Pericoronitis:**

The bacteria responsible for pericoronitis are all Gram-negative anaerobic bacteria. Debridement by irrigation

and possible extraction of the offending tooth usually are sufficient without requirement for antibiotic therapy.¹⁵ However if the patient presents with temperature elevation and trismus preventing adequate surgical therapy, then the use of antibiotics may be necessary for several days before surgery can be performed. Penicillin is the drug of choice.¹⁵

- **Osteomyelitis:**

Osteomyelitis usually requires surgical and antibiotic therapy for successful treatment. Special care must be taken to identify the causative organisms using anaerobic and aerobic culture of tissue removed at surgery for appropriate antibiotic therapy. Osteomyelitis must be treated with antibiotics for much longer period than soft tissue infections.¹⁵

- **Management of maxillo-facial fractures:**

Administration of antibiotics should begin as early as possible after diagnosis to diminish the chance of clinical infection.

Dento-facial infections can be treated with less extensive and aggressive surgical and antibiotic therapy, reduced hospitalization costs and fewer complications if approached earlier when diagnosed during premature clinical manifestations.¹⁶

- **Odontogenic infections**

Current clinical guidelines for the rational use of antibiotics in the United Kingdom on treating acute dental infections is provided by the Faculty of General Dental Practice (FGDP)¹⁷, British National Formulary¹⁸, and Scottish Dental Clinical Effectiveness Programme.¹⁹

The primary care for odontogenic infections is by local intervention through drainage and or removal of the cause of infection by means of endodontic or surgical therapy. It is suggested that the correct diagnosis and local intervention should be given the greatest attention by the dentist, whilst the choice of antibiotic playing a secondary role, provided that the antibiotic used fits in with the spectrum that has been proved effective in the treatment of odontogenic infections.¹³ The safety and cost of antibiotic should be taken into account.

Management of odontogenic infections includes diagnosis of causative organisms, clinical management including appropriate antibiotic selection, and referral to a specialist where indicated.^{20,21,22}

- **Endodontic (pulpal-and periapical-related) infections**

Studies have shown that adjunctive antibiotics are not

effective in preventing or ameliorating signs and symptoms in cases of irreversible pulpitis, symptomatic apical periodontitis, or localized acute apical abscess, when adequate local debridement, medication and incision for drainage, if indicated, have been achieved.²³⁻²⁸

A clinical practice guideline just released by an expert panel of the American Dental Association made the following recommendations on antibiotic use for the urgent management of pulpal- and periapical-related conditions in immunocompetent adult patients.²⁹

- Antibiotics should not be prescribed for immunocompetent adult patients with pulpal or periapical-related conditions where definitive conservative dental treatment is available, including pulpotomy, pulpectomy, or incision drainage of an abscess.
- Prescribing antibiotics in immunocompetent adults are not recommended owing to potentially negligible benefits and likely large harms associated with their use.
- Antibiotics should be prescribed for immunocompetent adult patients with pulp necrosis and localized acute apical abscess, in settings where no definitive conservative dental treatment is available.
- It is suggested good practice to prescribe oral amoxicillin (500mg, 3 times per d, 3-7d) or oral penicillin V potassium (500mg, 4 times per d, 3-7d) for immunocompetent adults with pulp necrosis and acute apical abscess with systemic

involvement.

Antibiotics should only be used as adjuvant therapies in cases with evidence of systemic involvement.²⁹ In addition patients who are immune-compromised or having predisposing conditions such as previous endocarditis should receive prophylactic antibiotics. When using adjunctive antibiotics in addition to adequate debridement and surgical drainage, such as in cases with spreading infections, the practitioner should use the shortest effective course of antibiotics, minimize the use of broad spectrum antibiotics and monitor the patient closely.³⁰ Penicillin VK and amoxicillin are the first line of antibiotics used for urgent management of pulpal- and periapical- related pain and intra-oral swelling.³⁰ However, amoxicillin is the preferred antibiotic because it is more effective against various Gram-negative anaerobes and has a lower incidence of gastrointestinal adverse effects.²⁹

As an alternative for patients with a history of penicillin allergy, but without a history of anaphylaxis, angioedema, or hives with penicillin, ampicillin or amoxicillin, oral cephalexin (500mg, 4 times per d, 3-7 d) is recommended.

As an alternative for patients with a history of penicillin allergy, and a history of anaphylaxis, angioedema, or hives with penicillin, ampicillin or amoxicillin, oral azithromycin (loading dose of 500mg on day 1, followed by 250mg for

Table 4: Recommended antibiotic regimens for orofacial infections in children^{34,35}

Infection	Recommended antibiotic regimen	Infection	Recommended antibiotic regimen for penicillin-allergic patient
Cellulitis, Necrotizing ulcerative gingivitis or pericoronitis	Amoxicillin (2-3 days, max 5 days) Children >3 mths and <40kg: 20-40mgs/kg/day in divided doses 8 hourly Children >40 kg 250-500mg 8 hourly Or 500-875mg 12 hourly	Cellulitis Necrotizing ulcerative gingivitis pericoronitis	Metronidazole (3 days): Children: 30mg/kg/day in divided doses 6 hourly (max 4gm/24 hr) Adolescents: 7.5mg/kg/ 6 hourly (max 4g/24hrs) OR Azithromycin (3 days): Children < 6mths – 16 yrs: 5-12mg/kg/daily for 3 days (max 500mg/day) OR Clarithromycin (7 days) 7.5mg/kg 12 hourly 13-18yrs: 250mg 12 hourly
Aggressive periodontitis	Amoxicillin 50mg/kg/day AND Metronidazole 30mg/kg/day 8 hourly for 7 days	Aggressive periodontitis	Azithromycin (3 days) 10mg/kg daily OR Metronidazole 30mg/kg/day 8 hourly for 7 days

(Adapted from: Geller, Lovegrove, Shehab et al, 2018)⁴⁹

an additional 4 days, or oral clindamycin (300mg 4 times per d , 3-7 d). Bacterial resistance rates for azithromycin are higher than for other antibiotics and clindamycin substantially increases the risk of developing Clostridiosis difficile infection after a single dose.^{29, 30}

The recommended dose regimen for amoxicillin is 500mg tds, with or without a loading dose of 1000mg.

• **Periodontal infections**

Antibiotics are not needed for most cases of periodontal infections. Non-surgical mechanical debridement by deep scaling and root planning (SRP) resolves a considerable amount of infection on its own. Antibiotics adjunctive to SRP should be assessed on an individual risk basis against the necessity for further therapy.³² Specific indications for prescribing antibiotics as an adjunct to mechanical debridement are multiple deep pockets, especially in the molar area, severe periodontitis with a rapid rate of progression and ANUG.³² So far, no antibiotic or combination of antibiotics, has shown clinical or microbiological superiority to amoxicillin 500mg tds and metronidazole 400mg tds in any appropriately conducted randomized clinical trial.³² Poor quality mechanical

debridement and poor oral hygiene is a contraindication for prescribing antibiotics.³² Administration of antibiotics has been identified as a risk for the development of periodontal abscesses if subgingival debridement in the apical portion of a lesion is incomplete.³³ It is also suggested that the use of topical or local administration of antibiotics (e.g., 10% Doxycycline) can reduce or avoid the need for systemic therapy and subsequent gut microbiome exposure.³⁴

• **Pediatrics – Treatment of acute dental infections**

A systematic review of the literature revealed that the main indication for use of antibiotics in children were for cellulitis, aggressive periodontitis, ulcerative gingivitis and pericoronitis. Amoxicillin was found to be the most commonly recommended antibiotic for short durations of 3-5 days, with metronidazole or azithromycin being the alternative antibiotic in penicillin-sensitive patients.³⁵

Children should be followed up for a few days to evaluate response to treatment, and the development of unwanted side effects.³⁵

The recommended antibiotic prescribing clinical guidelines by the Faculty of General Dental Practitioners (UK)¹⁷ for acute dental infections in children are as follows:

Table 5: Alternative recommended antibiotic prescribing clinical guidelines for children¹⁷

Amoxicillin dosing	
1mth- 1 yr	125mg every 8 hrs, increased if necessary up to 30mg/kg every 8 hrs
1-5 yrs	250 mg every 8 hrs, increased if necessary up to 30mg/kg every 8 hrs
5-12 yrs	500 mg every 8 hrs (max 1gm every 8 hrs)
12-18 yrs	500 mg every 8 hrs, in sever infections 1 gm every 8 hrs
Metronidazole dosing	
1 - 3 yrs	100mg tds for up to 5 days- review after 2-3 days and discontinue if resolved
3-7 yrs	200mg bd for up to 5 days- review after 2-3 days and discontinue if resolved
7-10 yrs	200mg tds for up to 5 days - review after 2-3 days and discontinue if resolved

A review point two to three days after drainage of an acute dental infection is a key element of the guidance. Those patients whose infections have resolved, and body temperature returned to normal, should be instructed to stop taking the antibiotics.³⁷

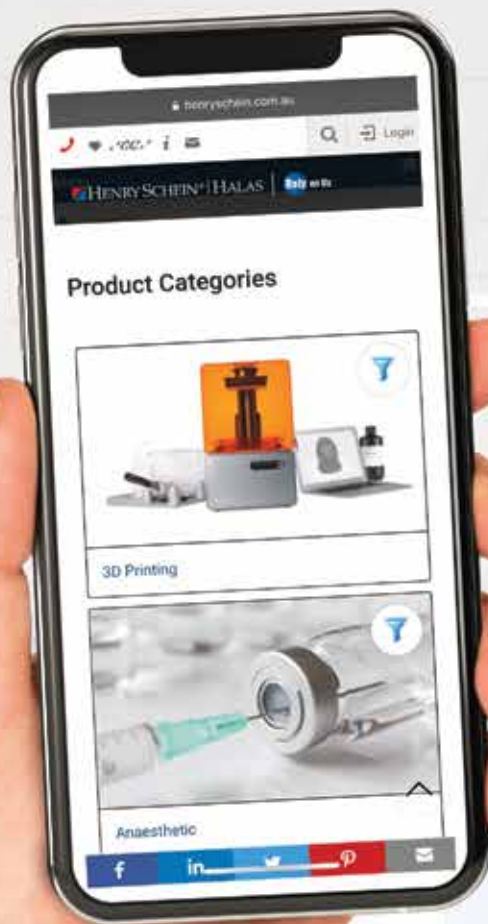
Fundamental clinical guidelines for pediatric antibiotic

stewardship, embrace the following principles^{17,38}:

- Avoid prescribing antibiotics for conditions where antibiotics are not indicated.
- Reduce macrolides.
- Increase first-line guideline concordant.
- Review after 2-3 days and discontinue if infection has resolved.



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Ethical considerations and medical risk

Patients have the right to expect that clinicians will examine them thoroughly, diagnose their needs correctly, provide a clear treatment plan and treat them accordingly. Dentists must be prepared to decline requests for a particular treatment if they judge it would not benefit the patient's health, such as when a patient requests antibiotics without any real indication for a prescription.³⁹ The dentist has an obligation to explain the consequences and/or risks of not continuing the treatment and ensure the patient knows that they are responsible for any future problems which arise as a result of not following or completing the treatment.

The practitioner should in consultation with the patient consider if there are possible clinical circumstances that may suggest the presence of a significant medical risk in providing dental care without antibiotic prescribing. Any antibiotic prescribing recommendations should be integrated with the practitioner's professional judgement in consultation with the patients' physician, and the patient's needs and preferences. All communications between the dentist and the patient in this regard must be recorded in the patients' notes.

Due to the increasing prevalence of bacteria, which are resistant to treatment by currently available antibiotics, clinicians should consider carefully treating all patients' with antibiotics. This is likely to do more harm than good.¹¹ Ultimately dentists must weigh the benefits and risks of antibiotics and make an informed decision with their patients on the appropriateness of using antibiotics. The benefits of giving antibiotics should always outweigh the risks of antibiotic-related allergy, toxicity, super infection and the development of drug-resistant strains.¹⁵

It is the duty of every dentist to arrive at a correct diagnosis in order to avoid inappropriate use of antibiotics. When selecting an antibiotic that fits in with the action spectrum that has been proved effective for treatment, safety of antibiotic use and product cost should always be taken in consideration.¹³

Conclusion

Primary indications for using antibiotics to prevent and fight bacterial infections in the dental setting are: prophylaxis to prevent infective endocarditis, when there is systemic body response to infection, and in patients that are immune-suppressed or immune-compromised. Antibiotic prescribing in the dental setting should always be based on the narrowest spectrum antibiotic for the shortest duration possible. In addition, effective plaque control must also be prioritised.

As a society we need to recognize that antibiotics are fundamental to how we practice modern dentistry, and therefore use and value antibiotics prudently and cautiously. It is essential to understand that antibiotic therapy will fail if the source of infection is not removed. Primary dental care, including periodontal debridement, endodontic therapy, extractions, drainage and/or surgical intervention should always be the first line of care, with antibiotics serving as adjunctive therapy in indicated cases. Antibiotics are not a replacement for surgical drainage or debridement.

Any antibiotic prescribing should be based on the practitioner's professional judgement, in consultation with the patients' physician, and the patient's needs and preferences. The benefits of giving antibiotics should always outweigh the risks of antibiotic-related allergy, toxicity, super infection and the development of drug-resistant strains.

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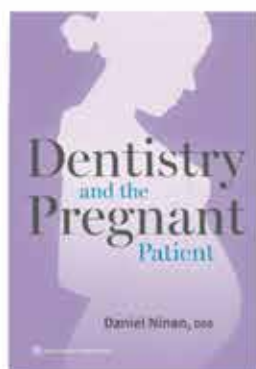
Dentistry and the Pregnant Patient

Daniel Ninan

To err on the side of caution, some dentists may hesitate to perform necessary procedures on pregnant patients. However, good oral health is essential to a healthy pregnancy and can help reduce prenatal complications, including preterm delivery and fetal loss. This book serves as an easy-to-use guide to help dentists of all specialties provide safe, effective care for their patients during pregnancy. The book is broken down into chapters on general treatment guidelines, pregnancy-related conditions in each organ system that may impact care, and the safety of the use of common dental drugs, including anesthetics, during pregnancy.

With over 50 quick-reference charts and tables and a breakdown of treatment recommendations by trimester, this book is a must-have for any dental office.

Q-5120853 | 160pp | **\$83.90**



Short and Ultra-Short Implants

2D AND 3D

Douglas Deporter

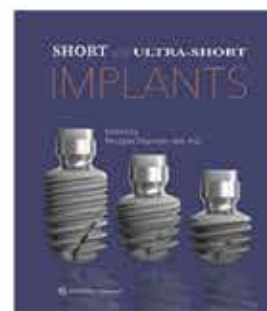
Research has shown that short implants are not only a viable option but oftentimes a superior one that carries fewer risks for the patient and dentist, especially in resorbed jaw sites.

As clinical trials continue to underscore the safety and efficacy of short implants, more dentists are considering their use with real interest, and this book provides the information clinicians need to incorporate short implants into their own practice.

The book reviews the clinical effectiveness of short implants and then describes treatment protocols for the various types of short implants and their placement in different areas of the mouth.

Case presentations demonstrate the recommended techniques and showcase the results.

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Botulinum Toxin for Facial Harmony

Altamiro Flávio

The mastery of dentistry brings esthetic knowledge of the face that is applicable to more than just the teeth. In the process of performing a complete facial analysis, the practitioner can identify asymmetries and concerns localized to an area—such as the forehead, eyebrows, nose, or lower face—and offer Botox therapy to increase facial harmony. This book outlines the many clinical uses for Botox, with detailed illustrations and case presentations to support each procedure.

The first part of the book covers systematic facial analysis, photographic documentation, and how to plan treatment. Special attention is paid to the anatomy and physiology of the face and the identification of injection points. Detailed treatment instructions for dosage, syringe type, and needle size are included for each procedure, as well as guidelines on how to evaluate results anthropometrically to determine whether esthetic treatment goals have been met. This stunning book will change the way you approach facial analysis and widen your esthetic treatment options for patients.

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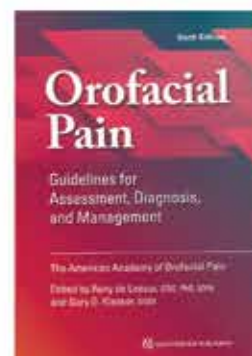


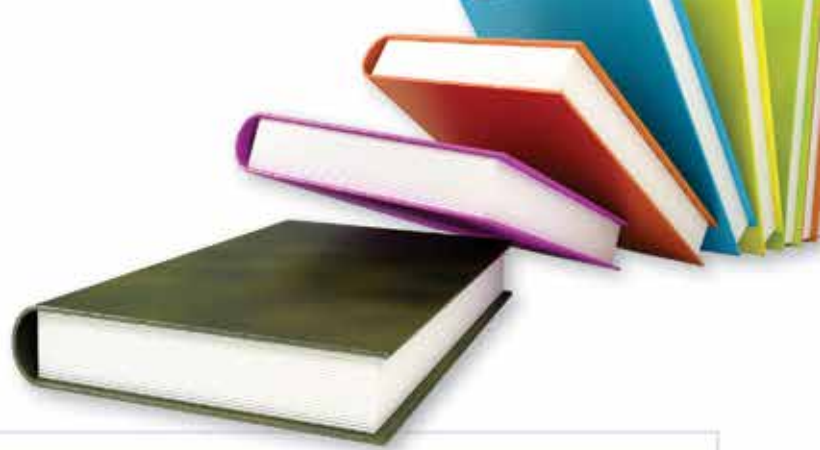
Orofacial Pain: Guidelines for Assessment, Diagnosis and Management

SIXTH Edition Reny de Leeuw & Garry Klasser

Following in the tradition of the previous editions, this book offers the latest research and most up-to-date information on orofacial pain, including a concise overview of each condition as well as its symptoms, comorbidities, differential diagnosis, and treatment options. Every chapter has undergone critical updates to reflect the developments in the expanding field of orofacial pain, including the glossary. These updates include the addition of new diseases such as first-bite syndrome, revised information on genetic factors to reflect new insights gleaned from the OPPERA studies, expanded information on management strategies for certain conditions, and revisions to screening tools for biobehavioral factors. In addition, the classification system used in the fifth edition has been replaced and extended and includes DSM-5 codes where applicable. This book remains an essential tool for any health care provider who treats patients with orofacial pain.

Q-5120852 | 336pp 9 illus | **\$97.85**





Ceramics in Dentistry: Principles and Practice

Robert J. Kelly

The use of ceramics in dentistry holds enormous potential for restoring dentitions, but ceramics can be difficult to master because of the common problems of chipping and fracture.

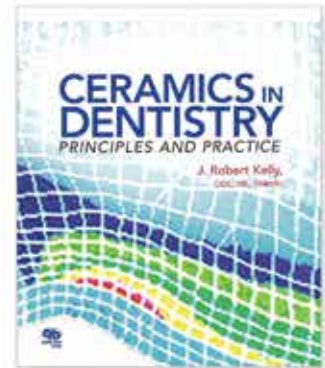
This book unlocks the mystery behind successful use of dental ceramics and lays bare the science behind this high technology.

The author shows how and why fracture occurs and explains why choosing the right material, design and processing method are vital to the success of any ceramic restoration and why certain ceramic systems are most suitable for certain clinical situations.

The author also details how to achieve esthetic excellence without compromising strength.

The book concludes with a chapter on the use of ceramics in implant dentistry and how CAD/CAM technology can be used to revolutionize this field. Thumbnails featured throughout point to extra online content.

Q-5120806 128 pp; (softcover); 176 illus; ~~WAS \$76~~ NOW \$38



Inspiration: People, Teeth, and Restorations

Luiz Narciso Baratieri

Natural tooth behaves much as a collection of mosaics that change color according to the type of light and media in which they are viewed, and it is this beauty of tooth composition and form that is the inspiration to those who seek to mimic tooth in dental restorations.

This stunning atlas is the culmination of more than 25 years of dedicated study into the optical behavior of teeth and restorative materials. Although the author wows readers with dazzling photography throughout, this book moves beyond a mere clinical art book that only shows what is possible.

The practical purpose of this book is also to outline the clinical sequences of how to use composite resins and dental ceramics to achieve the optical characteristics observed so exquisitely in natural teeth.

By blending art and dental science, the author has created an ultimate textbook on dental anatomy and restorative dentistry that explores the underlying make-up of the layered structures of the teeth and reveals the techniques of how to meet the challenge of mimicking natural tooth.

Q-5120720 482 pp; 1,672 color illus; ~~WAS \$454.60~~ NOW \$227.30

Advances in Oral Tissue Engineering

Masaru Murata & In-Woong Um

For many decades, researchers have tried to develop materials that could be used just like autogenous bone. The editors of this book have assembled experts to showcase recent developments in tissue engineering and to demonstrate the basic biologic phenomena of bone repair using dentin grafts, growth factors, stimulating factors, inductive factors, and other factors in clinical applications.

The research gathered in this book underscores the excellent outcomes based on sound science and pioneering clinical applications. New techniques using the tooth materials provide realistic and practical regenerative treatments for all patients.

Q-5120774

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Direct and indirect composite

Gregory Camaleonte¹

The treatment

For any aesthetic treatment, the practitioner should encourage patients to express their motivations and desires. The dentist must devote time to listen, understand and offer support to the patient. After a thorough analysis of the existing problem, including clinical examination, X-rays and photos, a treatment plan should be proposed to the patient, who then may accept it or not. In case of refusal, it is important to understand the reasons and, if possible, to make another proposal in accordance with the patient's expectations as long as they are realistic; the patient has to understand and accept the limits of the second proposal. When agreement is reached, study models are needed and through the production of a diagnostic wax-up, the dentist and laboratory can show the expected outcome to the patient.

The case



Figure 1: A young female patient visited the practice to improve her smile. She asked for a fast treatment because she was getting married four months later. Her desire was to have white and aligned front teeth.

¹ Gregory Camaleonte
Private Practice, Marseille, France



Figure 2: X-rays of the deciduous teeth showed important root resorption. At this point, the patient was informed that, in order to obtain a long-lasting result, teeth URc and ULc should be extracted, space would be created between the canines and central incisors using orthodontic treatment and then implants would be used to replace UR2 and UL2 after bleaching. The patient refused this proposal and reminded us of the need for a fast solution. At this point there is the option to either stop the treatment or to find an alternative solution. It was decided to propose rebuilding the teeth with indirect composite crowns on URc and ULc and to make direct restorations to transform the canines in lateral incisors. It was explained to the patient that this treatment could accelerate the root resorption of the deciduous teeth and the patient accepted this risk.

Figure 3: First we made study models and send them to the laboratory (DT Gilles Philip laboratory). Digital design was used to guide the production of the wax-up.

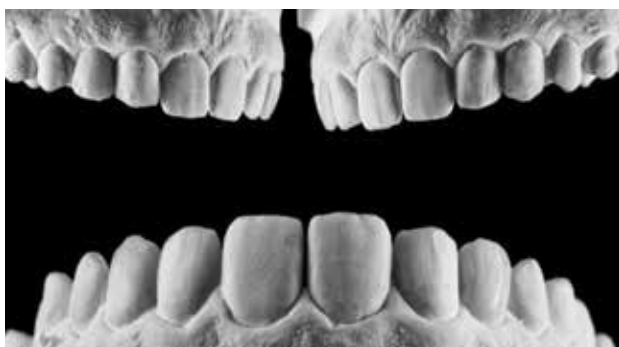


Figure 4: The lab closed the spaces between canines and central incisors and transformed the deciduous teeth into permanent canines. Notice in this case that the gum level of the UR3 and UL3 is lower than the gum level of the teeth UL1 and UR1, this can be resolved in the final integration of the new smile.



Figure 5: Before any intervention, the patient has to validate the proposal made in the laboratory. To precisely transfer the sculpture into the mouth of the patient we used silicone materials (Honigum Putty and Light). With a #15 blade, the unwanted parts of the silicone stent were removed to obtain a very clean and precise mock up. At this point the patient can appreciate the final outcome and validates the treatment plan.



Figure 6: The first step of the treatment is bleaching with White Dental Beauty - 6% hydrogen peroxide for 14 days. This picture shows the initial colour of the teeth and the strong saturation of the canines.



Figure 7: After one-week of treatment (left) and final colour (right). After bleaching, a silicone impression is made and the laboratory builds composite crowns on the deciduous teeth. The patient is reminded that because of the occlusion (even if we are able to avoid occlusal contacts in static occlusion), the root resorption of the URc and ULc will certainly be accelerated. The patient is still motivated and tells us she understands the risks.



Figure 8: The composite crowns (Gilles Philip lab) were cemented with individual rubber dam. After excesses removal, rubber dam is used again from teeth UR4 to UL4 to transform UR3 and UL3 into lateral incisors using direct composites.



Figure 9: Final result after polishing procedure, before rubber dam removal



Figure 10: Direct post-op situation, immediately after rubber dam removal



Figure 11: The outcome one month later is satisfactory



Figure 12: Six months later, the patient is happy and the deciduous teeth show no mobility.

In conclusion

Before starting any treatment it is important to listen carefully to the patient's expectations. If we have to make realistic compromises, the patient has to understand and accept the

limits of the new treatment plan. In the case presented here, the patient is aware the outcome won't last for many years. Despite this, the patient is grateful and returns to the clinic every six months for the situation to be assessed.

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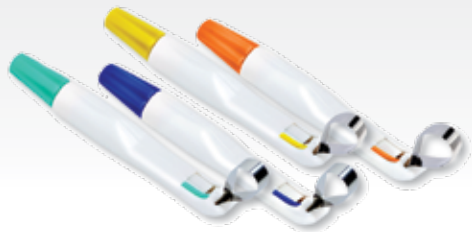
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IDEM 2020 postponed until 19 - 21 June 2020

28 February 2020 – SINGAPORE - Following guidance from Singapore's Ministry of Health and to address the concerns of all stakeholders about holding IDEM in April 2020, Koelnmesse and the Singapore Dental Association, the co-organisers of IDEM 2020, will postpone the event to Friday – Sunday, 19 – 21 June 2020.

"The health of all IDEM participants is of great importance to us and we are putting their wellbeing first by delaying the event," said Mathias Kuepper, Managing Director of Koelnmesse Pte. Ltd.

"We have much gratitude for the understanding and ongoing commitment from our partners, sponsors, exhibitors and conference speakers, not to mention the participants and attendees that have enabled us to postpone IDEM," he added.

"In light of the current situation, it is important for us to make decisions in the best interests of our attendees, and we will continue to listen to and work closely with our partners to create a successful event," said Dr Lim Lii, President of the Singapore Dental Association.

"We are optimistic that the current Covid-19 virus outbreak will be temporary and we believe that it is in the interests of the dental industry to resume businesses as quickly as possible after the present crisis has been addressed," shared Dr. Lim Lii.

"We are committed to standing by our MICE industry to provide the support required, and we believe that Singapore's reputation as a preferred destination for MICE events remains strong. The health and safety of locals, visitors and industry partners remain a priority and we are working closely with Koelnmesse Pte. Ltd to support the continued success of IDEM 2020," said Mr Andrew Phua, Director, Exhibitions and Conferences, Singapore Tourism Board.

The 11th edition of IDEM, the International Dental Exhibition and Meeting, was originally scheduled to take place from 24-26 April 2020. IDEM is Asia Pacific's leading exhibition and scientific conference for dentistry.

About IDEM Singapore

IDEM Singapore, a specialised dental trade fair accompanied by a professional congress, has developed since its premiere in 2000 into the No. 1 dental event in the Asia-Pacific region. At IDEM 2020, participants will meet key decision-makers, strengthen valuable contacts with customers and partners, and explore the potential of an exciting growth market.

For full updated information, please visit: www.idem-singapore.com



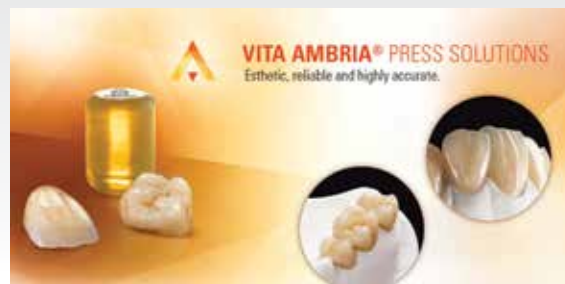
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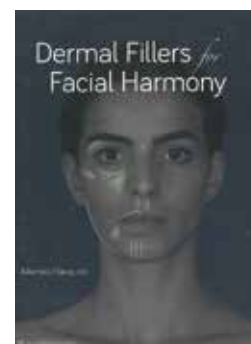
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