

The Dahl principle: Creating space and improving the biomechanical prognosis of anterior crowns

Basil Mizrahi, BDS, MSc, Med¹

There is an increased demand for restoration of anterior teeth based on esthetic requirements. Oftentimes, the teeth restored are compromised and have minimal remaining dentin after undergoing root canal treatment. Reduction of nonaxial forces by controlling incisal guidance is essential in improving the long-term prognosis of such situations. Another common complication when crowning anterior teeth is the lack of palatal space for restorative material. This is often evident in patients with anterior tooth wear and deep overbite. This article describes the Dahl principle, a conservative method for controlling incisal guidance and gaining palatal space for restorative material. A case presentation is used to illustrate the concepts discussed. (*Quintessence Int* 2006;37:245–251)

Key words: anterior teeth, biomechanical forces, Dahl principle, incisal guidance

In the treatment of complex anterior restorative cases, combining esthetic and biomechanical principles is a challenging task. Good biomechanical principles usually improve the potential longevity of restorations and should not be compromised in esthetics-directed treatment.

In deep bite situations requiring full-coverage crowns, there is often a lack of space for restorative material on the palatal aspect, especially if all-ceramic crowns are being considered. In addition, the steep incisal guidance angle associated with a deep bite may generate excessive nonaxial forces on anterior teeth^{1,2} (Fig 1). This may not be an issue in natural unrestored dentition, but in extensively restored, structurally compro-

mised teeth, excessive nonaxial forces may lead to catastrophic failure.

Nonaxial forces are a risk for fatigue fracture of teeth, cement, and restorative material. By lending the prosthesis a favorable occlusal design, the nonaxial forces may be markedly reduced, thereby improving the prognosis of structurally compromised teeth.^{3,4} Favorable occlusal design on compromised anterior teeth therefore requires the shallowest incisal guidance capable of discluding the posterior teeth.⁵

Methods to reduce steep incisal guidance angles include:

- Shortening of incisal edges: This has esthetic implications and may create posterior interferences.
- Increase of the vertical dimension of occlusion (VDO): This may require otherwise unnecessary restoration of healthy teeth.

Methods of gaining additional palatal space include⁶:

¹Private practice in prosthodontics and restorative dentistry; Clinical lecturer, Eastman Dental Institute, London, England.

Reprint requests: Dr Basil Mizrahi, 39 Harley Street, London W1G 8QH, England. Fax: +44 (0) 207 323-1679. E-mail: info@basilmizrahi.co.uk

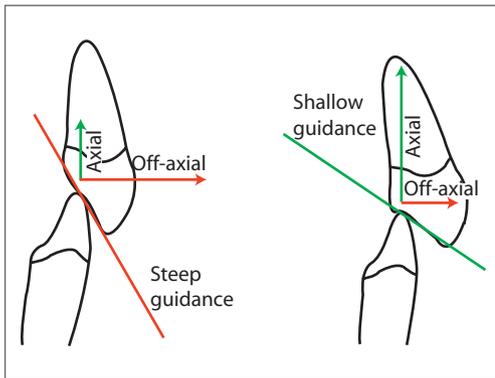


Fig 1 Relationship between incisal guidance and potentially dangerous nonaxial forces. Steep guidance leads to increased nonaxial forces; shallow guidance creates reduced nonaxial forces.

- Excessive tooth preparation: This results in thin, fragile preparations with a lack of resistance and retention form.⁷ In extreme cases elective endodontics may be necessary.
- Minor reduction of opposing teeth: This should be preplanned and carried out with the patient's consent prior to making final impressions.
- Orthodontic repositioning of anterior teeth: Patient consent to lengthy treatment time in fixed appliances may be difficult to obtain.
- Increase of the VDO.

As is evident from above, increasing the VDO addresses the problem of both steep incisal guidance and inadequate palatal space. The conventional restorative approach to increasing the VDO requires buildup and restoration of teeth that would otherwise not be needed. An alternate and more conservative technique to increase VDO is the Dahl concept.

THE DAHL PRINCIPLE

The concept was originally proposed by Dahl in 1975 to create space in the treatment of anterior localized tooth wear.⁸ It involved the wearing of a removable chrome-cobalt appli-



Fig 2 Cast metal removable Dahl appliance.

ance with an anterior bite plate that separated the posterior teeth (Fig 2). Initially the posterior teeth were discluded, but rather than use restorative means to reestablish the posterior occlusion, it was allowed to reestablish by itself over time. Dahl stated that this reestablishment of posterior occlusion was due to a combination of both intrusion of anterior teeth and eruption of posterior teeth, which usually occurred over a period of about 4 to 6 months.⁹

Over time, with the availability of newer techniques and materials, the technique has been adapted to become a useful adjunct for restorative dentistry.¹⁰ In addition, by increasing the VDO, the incisal guidance angle is reduced, providing a favorable biomechanical situation. The palatal surfaces of the anterior teeth can be built up using any of the following materials: a removable or cemented cast metal appliance, resin composite buildup,¹¹ or specifically designed provisional crowns.

The amount of initial buildup needed on the palatal surfaces is determined by a combination of the palatal space required and the perceived patient tolerance. Modifications and adjustments are possible over time, however. Once the posterior occlusion has reestablished, the palatal space created on the palatal surfaces of the maxillary anterior teeth is utilized for restorative material of the definitive crowns.



Figs 3a and 3b Preoperative smile and retracted view.

CASE PRESENTATION

Following is a presentation of a case illustrating use of the Dahl concept to gain additional palatal space and to reduce the incisal guidance angle on compromised anterior teeth requiring crowns.

The patient presented complaining about the appearance of her existing crowns (Figs 3a and 3b). Pretreatment esthetic analysis showed that the incisal edges needed to be lengthened slightly and the labial surfaces needed to be built out. The maxillary right central and both maxillary lateral incisors had received root canal treatment (Fig 4). There was marginal exposure and discoloration of the existing metal-ceramic crowns on the maxillary right central and left lateral incisors, and the maxillary right lateral incisor had a large defective resin composite restoration.

The treatment plan was as follows:

- Redo endodontic treatment and place a crown on the maxillary right lateral incisor.
- Replace the existing crowns on the maxillary right central and left lateral incisors.
- Place a porcelain veneer on the maxillary left central incisor.

Increasing the incisal length would steepen the anterior guidance, and this together with the combined effect of the minimal remaining dentin would compromise the bio-

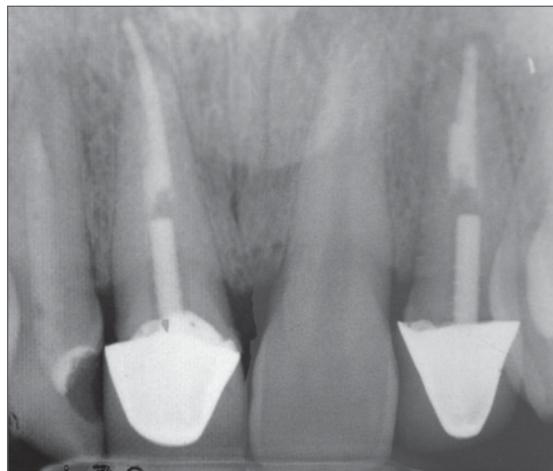


Fig 4 Radiographs showing compromised teeth.

mechanical prognosis of the restorations. As such, it was decided to use the Dahl principle to preserve palatal tooth substance and reduce the existing incisal guidance angle despite increasing the tooth length.

A diagnostic waxup of the anterior teeth was made at an increased VDO. The cingulum areas of the anterior teeth were built up to provide a horizontal shelf onto which the mandibular incisal edges occluded. This ensured that the forces were applied in a vertical direction as opposed to a labial direction, thereby preventing unwanted labial tooth movement (Fig 5). The waxup was



Fig 5 Preoperative waxup at increased VDO with bulky gingulum areas.

used to fabricate the provisional crowns and veneer as well as a silicone matrix to direct composite buildup on the palatal surfaces of the maxillary right canine, left central incisor, and left canine.

The right central and left lateral incisors had metal prefabricated posts with composite cores and minimal coronal tooth structure remaining (Figs 6a and 6b). Various options such as implants, orthodontic extrusion, and periodontal crown lengthening were considered and discussed with the patient. A decision was made to retain the teeth and restore them with cast metal posts and cores and crowns. Because of the guarded structural prognosis of these teeth, it was decided not to redo the endodontic treatment on these two teeth.

The right central incisor and both lateral incisors were prepared for full-coverage crowns, with cast gold posts and cores placed in the right central and left lateral incisors. Long-term acrylic resin crowns were placed on these three teeth and a provisional composite veneer was placed on the left central incisor (Fig 7). To distribute the forces evenly over the six anterior teeth, resin composite was bonded directly onto the palatal surfaces of the remaining anterior teeth (left central incisor and both canines). The gingulum areas of these teeth were built up to match those of the provisional restorations on the adjacent three teeth. The anterior

guidance was adjusted for simultaneous contact in protrusion and canine guidance in lateral excursions (Fig 8). There was no posterior occlusion, and the second molars were separated by about 1 mm (Figs 9a and 9b).

The patient remained in the provisional restorations for 6 months until the posterior occlusion had reestablished. At this stage, fabrication of the definitive restorations was begun. The definitive restorations consisted of three Procera AllCeram crowns (Nobel Biocare) and a feldspathic porcelain veneer for the left central incisor (Noritake EX3) (Figs 10 and 11).

The crowns were cemented into place with a resin-modified glass ionomer (Fuji Plus, GC), and the veneer was bonded into place with a resin cement (Rely X Veneer cement, 3M Espe). The completed result shows both an esthetic improvement and a biomechanical and esthetic improvement (Figs 12 and 13). When comparing the preoperative and postoperative casts (Fig 14), it is possible to see the changes made: longer central incisors, flatter gingulum rest to direct forces up the long axis of the teeth, and shallower incisal guidance to reduce nonaxial forces.

DISCUSSION

When designing anterior crowns, the labial aspects should follow esthetic dictates and mimic natural teeth as closely as possible. However, in some situations, it may be biomechanically beneficial to alter the palatal forms of crowns so that they differ from those of natural teeth. These morphologic changes are carried out on areas not visible in day-to-day conversation, ie, palatal surfaces of maxillary anterior teeth.

Increasing the VDO on the anterior teeth effectively creates an anterior bite plate. This has been shown to be therapeutic and to reduce muscle activity, which may be a result of removing any possible posterior interferences.¹² As such, patients find the anterior occlusion and slight increase in VDO comfortable and easy to adapt to. The slight bulkiness of the gingulum areas is initially a mild



Figs 6a and 6b Existing posts and cores in place and removed, showing minimal remaining dentin.



Fig 7 Provisional restorations at increased VDO with posterior open bite.



Fig 8 Control of incisal guidance using provisional restorations and resin composite.



Figs 9a and 9b Posterior open bite.

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Fig 10 Final tooth preparations ready for final impressions.



Fig 11 Definitive all-ceramic restorations.



Figs 12a and 12b Definitive restorations in place.



Figs 13a and 13b Reestablished posterior occlusion.



hindrance to speech and comfort, but this is overcome within 1 to 2 weeks.

Before commencing treatment, informed consent must be obtained from the patient and the following aspects must be discussed:

- When the provisional restorations are placed, the anterior teeth will feel bulky palatally, and speech may be slightly affected. Speech usually returns to normal within 1 to 2 weeks. If adaptation does not occur within a week, the palatal bulk can be reduced.
- The posterior teeth will no longer meet in occlusion. This will not significantly affect eating. Posterior occlusion will gradually reestablish over 6 to 9 months.

The potential shortcoming of this technique is the failure of all or some of the posterior teeth to reestablish occlusion. However, Gough and Setchell showed a 96% success rate.¹³ This is corroborated by the clinical experience of this author as well as colleagues at the Eastman Dental Institute, from where much of the development of the Dahl principle has been forming and where the technique is widely used. The case presented here has now had 3 years of follow-up, and to date all restorations are holding up well and the occlusion appears to be stable. If the posterior occlusion fails to reestablish while the provisional restorations are in use, other more traditional means, as described earlier in the article, may need to be used to obtain palatal space. If the clinician is reluctant to place provisional restorations for an extended period of time, or wants to proceed cautiously, the palatal surfaces of the anterior teeth can be built up temporarily and reversibly using one of the other methods described earlier.

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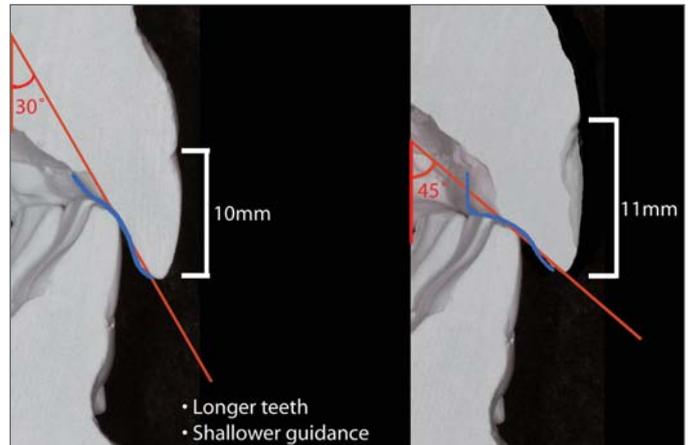


Fig 14 Cross-sectional comparison of pre- and postoperative casts. Longer central incisors and shallower incisal guidance have been established.

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