



Let's make happiness a clinical outcome.

Dentists tell us more than 50 percent of restorative procedures involve direct restorations, so getting them right is critical. Discover how we can help.



More predictable outcomes.

Postoperative sensitivity. All dentists worry about it. No patient wants it. With Single Bond Universal Adhesive, you can virtually eliminate it whether you prefer a total-etch, self-etch or selective-etch technique.

And for strength and esthetics anywhere in the mouth, use Filtek™ Z350 XT Universal Restorative.

Then complete the restoration with Sof-Lex™ Spiral Finishing and Polishing Wheels, which adapt to all tooth surfaces.

It's one simple system that's as versatile as it is effective.

More efficient procedures.

You want a day that runs smoothly, thanks to procedures that go efficiently. Because these products are designed to work together regardless of the direct restorative procedure you're performing, they streamline inventory and your tray. And that saves you steps and time.

At 3M, we simplify outcomes. Especially happiness. For you and your patients.



A minimally invasive approach for the treatment of localised anterior tooth wear: Dahl technique

Udatta Kher, MDS¹/Priya Bijlani, MDS²

INTRODUCTION

The term 'tooth wear' (TW), also known as tooth surface loss (TSL) is a general term that can be used to describe the surface loss of dental hard tissues from causes other than dental caries, trauma or as a result of developmental disorders.^{1,2} Evidence suggests that pathological tooth wear is an increasing problem.^{3,4} This can be attributed to changing dietary and lifestyle habits and also because of elderly patients retaining more of their teeth into later years. The process of tooth wear has a cumulative, multifactorial aetiology. Individual aetiological factors include erosion, abrasion, abfraction and attrition.^{2,5}

Tooth wear results in loss of mineralized tooth substance and affects tooth anatomy. Several complications may arise if it is left untreated. These include a higher risk of tooth sensitivity, pulpal complications, discoloration, poor esthetics and loss of function.⁶

A contemporary approach to the treatment of tooth wear is to focus on prevention and adopt the most minimally invasive approach. Diagnostic tools such as study casts, photographs and indices which aid in early diagnosis and monitoring wear must be used routinely.⁷

Prevention would mandate comprehensive etiological investigations including diet analysis, identification of general/medical risks or disorders (Bulimia, gastric reflux, medications), identification of local risk factors like bruxism, abnormal occlusal conditions, carious activity, periodontal disease, insufficient salivary flow or compositional changes.⁸

While for many cases of pathological tooth wear, passive management and monitoring may suffice, some may require active restorative intervention. These would be situations where there is sensitivity or pain, aesthetic concerns functional difficulties, or unstable

occlusion. Cases where the rate of tooth surface loss may be of concern due to the possibility of future pulpal involvement also require intervention.⁹

It is prudent to implement a preventive regime and follow up the patient for a period of 6-12 months in order to ensure that the cause of tooth wear is eliminated or reduced.⁹

This article describes the active restorative intervention for management of localized anterior tooth wear based on the Dahl principle.

THE UNIQUE CHALLENGES OF LOCALISED ANTERIOR WEAR

In a large number of patients, tooth wear is accompanied by dento-alveolar compensation which allows occlusal contacts to be maintained, in order to preserve the efficacy of the masticatory system. This results in lack of interocclusal space and poses a major dilemma for the restorative dentist.¹⁰

One option would be to follow traditional prosthodontic protocols and to create space for the restorative materials by tooth reduction while conforming to the existing occlusion.

In other cases, the required interocclusal clearance may be available in centric relation (CR). This reorganized approach may result in several teeth (often unaffected teeth) being in need of restorations in order to maintain occlusal stability. This increases complexity of treatment, adds to procedural and biological expenses.

Conventional restorations may be associated with a high risk of pulpal injury and the copious loss of critical tooth tissue. Saunders and Saunders¹¹ reported that 19% of teeth prepared to receive full coverage crowns in adult Scottish population, had radiographic evidence of periradicular disease necessitating endodontic treatment. Furthermore, iatrogenic pulp exposure is more likely among teeth which have been affected by the process of wear, by virtue of the pulp chamber being closer to the occlusal surface of the affected tooth. The resistance and retention form of worn down

¹????

²????



Fig 1 Erosive Tooth surface loss seen in a 22 year old male: (a) Frontal view displaying marked wear of the incisal edges (b) Occlusal view depicting tooth surface loss on the palatal aspect of the maxillary incisors.

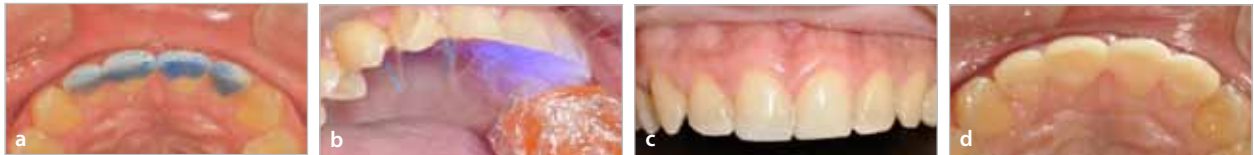


Fig 2a to d (a) Etching of the maxillary anterior teeth (b) Use of Mylar strips during bonding with Single bond Universal (Adhesive 3M ESPE) (c) Frontal view post free hand composite restorations (d) Occlusal view post free hand composite restorations

teeth prepared for conventional restorations may be compromised. Edelhoff and Sorensen¹² reported that approximately 63% to 72% of the coronal tooth structure was removed when anterior teeth were prepared for all-ceramic and metal-ceramic crowns.

With the advances made in adhesive dentistry, it is feasible to manage cases of localized anterior wear using additive composite restorations.

This approach is biologically based and conservative vis a vis the conventional full prosthetic rehabilitation needing further aggressive tooth preparation.

THE DAHL APPROACH

In 1975, Bjorn Dahl et al¹³ described the use of a removable metal anterior bite platform, to create inter-occlusal space in a patient with tooth wear localised to the maxillary anterior teeth. The appliance covered the cingulum areas of the affected teeth and increased the occlusal vertical dimension by 2-3 mm. Occlusal contacts were only present between the mandibular anterior teeth and the bite platform. This resulted in posterior disclusion.

The appliance was prescribed for continual wear for several months until the posterior teeth re-established inter-occlusal contact. This was due to a combination of eruption of the posterior teeth and intrusion of the anterior teeth. Removal of the appliance resulted in an inter-occlusal space between the anterior maxillary and mandibular teeth which was utilised to restore the worn surfaces without the need for further tooth reduction.

As material science has progressed, this principle has been utilised using a variety of materials.¹⁴⁻¹⁷

APPLICATION OF THE DAHL PRINCIPLE IN MODERN DENTISTRY

The authors advocate using the Dahl Principle utilising Composite resin palatal 'veneers' for management of cases with localized anterior tooth wear. Once a diagnosis has been made and the causes of wear established, this method is recommended in cases where the posterior tooth surfaces are largely intact.

Figure 1a & 1b illustrates the tooth surface loss restricted to the maxillary anterior teeth seen in a 22 year old male. The patient complained of sensitivity of teeth localized to the maxillary anterior region. A detailed history disclosed high consumption of aerated drinks elucidating erosion as the causative factor for tooth surface loss.

The patient was educated about his oral condition. Treating the cause of TSL was emphasized. The patient was explained all the treatment options. The patient gave an informed consent for the Dahl approach. Contingency planning was done.

This was followed by use of free hand direct composite restorations (Filtek Z350 XT, 3M ESPE) to recreate the tooth anatomy and improve esthetics (Figure 2a-d). Tooth preparation for the composite restoration merely involved freshening the surface, providing a bevel on the labial surface in order to mask the composite and enamel junction. The rim of enamel on the palatal aspect was scrupulously preserved to aid in bonding. Utmost care was taken to provide good inter-dental contours and contacts so that the patient could continue with good inter-dental hygiene procedures after restorations.

Fig 3 (a) Posterior disclusion right side (b) Posterior disclusion left side

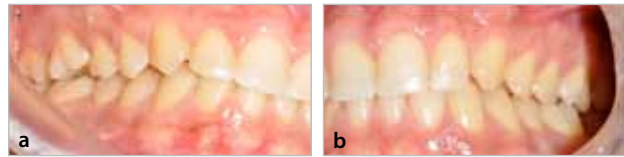


Fig 4 (a) Posterior contacts right side at 6 weeks (b) Posterior contacts left side at 6 weeks



Fig 5 (a) Frontal view showing erosive tooth surface loss in a 28 year old male (b) Occlusal view of the maxillary incisors (c) Study models clearly showing tooth surface loss from palatal aspect



Fig 6 (a) Wax up of the ideal palatal contours (b) Posterior disclusion with the anterior wax up

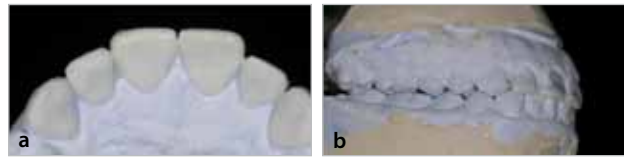


Fig 7 Putty index made from wax up used to carry composite provisional material chair-side.



Fig 8 Occlusal view post bonding and finishing of composite provisional material

The aim was to have simultaneous 'centric' contacts on all six anteriors at the new vertical dimension of occlusion, canine guidance in lateral excursions and incisal guidance in protrusive excursions.

This resulted in posterior disclusion (Figures 3a & 3b). The patient was advised regular follow up.

Figures 4a & 4b show the establishment of posterior contacts as early as 6 weeks.

Free hand composite build ups require considerable operator skill. An alternative method to simplify the contouring would be an indirect method. This would involve making study models, mounting them in maximum intercuspation on an articulator and making a wax up of ideal anatomy with laboratory support. The pin on the articulator would have to be raised resulting in the posterior teeth being out of contact. A putty index made on this wax up could be used to build ideal

contours chairside with composite provisional material (Protemp 4, 3M ESPE). This could serve as a long term provisional restoration bonded to the tooth surface. It could be replaced with porcelain veneers in due course of time. Figures 5 -8 depict the use of the indirect method.

DISCUSSION

The use of additive composite restorations for the management of localized anterior tooth wear based on the Dahl principle is ultra conservative and biologically based.

It results in immediate improved aesthetics of the affected teeth without any treatment of the posterior dentition, which returns to full occlusal contact within few months. The resin composite acts as a direct fixed

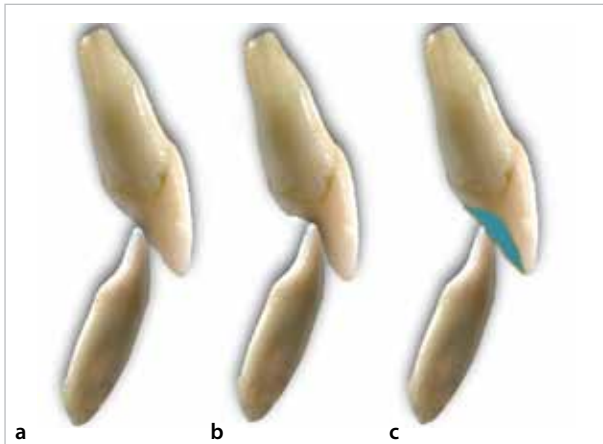


Fig 9a to c (a) Normal incisal relationship (b) Tooth Surface Loss in Maxillary incisor (c) Palatal Composite resin restoration

orthodontic device and the teeth are protected by proprioception in the periodontal ligaments while the patient adapts (Fig 9).

Patients being treated with the Dahl approach should expect some difficulties in chewing and speech that is transient.

The Dahl concept refers to the relative axial tooth movement that is observed to occur when a localised appliance or localised restorations are placed in supra-occlusion and the occlusion re-establishes full arch contacts over a period of time.⁹ The inter-occlusal space created using the Dahl principle occurs through a process of combined intrusion (40%) and extrusion (60%).¹⁸

Dahl and Krungstad¹⁸ reported that in most cases re-establishment of occlusal contacts occurred within 4-6 months. Poyser et al¹⁹ reported that it might take up to a period of 18-24 months in some cases. In some cases the time taken for tooth movement to occur is faster than that which could be achieved with orthodontic tooth movement. It has been suggested that a degree of mandibular repositioning involving the condyles might be occurring in these situations.

This principle has been used by various clinicians using different materials over the years with success rates of 93% to 100% regardless of age or gender.^{14,15,19-21}

The successful use of composite resin restorations placed at an increased occlusal vertical dimension as 'Dahl' type appliances has been demonstrated over the short- to medium term.^{14,15,20-23}

Composite restorations are well tolerated by pulpal tissues, minimally abrasive to the antagonistic surfaces, easy to repair or adjust and economical.²⁴ Conventional restorations may offer superior levels of longevity when compared to adhesive restorations.²⁵ However failures in the longer term tend to be catastrophic and often not amenable to repair. In contrast, failures associated with adhesive restorations used to treat wear are often readily addressed, without further biological damage to tooth structure.

In 2011, Gulamalli et al²² reported that with some degree of maintenance, repeated use of composite resin restorations to treat localised anterior tooth wear at an increased occlusal vertical dimension is a viable treatment option over a ten-year period. The restorations commonly failed due to wear, marginal discolouration and fracture, frequently occurring in combination. The failure modes expose the limited mechanical and physical properties of composite resin used in this way.

The mean survival time of 5 years and 9 months was comparable to the previous study by Redman et al¹⁶, who noted a MST of 4 years and 9 months over a six-year period when all types of failure were considered. The biological complications associated with this treatment regime were very low. Only 2% of all the restorations that had major failures were replaced as a result of secondary caries.²² This compares favorably to conventional crowns where endodontic complications develop in 19% of the restored teeth.¹¹

The patient satisfaction remained high despite long-term failures and maintenance involved.

Willems et al²⁶ have demonstrated modern composite resin restorations to have similar wear rates to human enamel in contrast to porcelain, supporting its use in the management of tooth wear. Several studies have shown the marked abrasive nature of porcelain compared to other restorative materials such as gold alloy and composite resin.²⁷⁻²⁸

When correcting anatomy and replacing missing tissue at the same time, using a strong and wear-resistant material is imperative; hybrid composites are preferred.^{14,15}

Dahl approach must not be undertaken in cases where they may be lack of eruptive potential due to bony ankylosis, dental implants, conventional fixed bridgework and anterior open bites.⁹

Hemmings et al¹⁴ have reported failures of the Dahl approach to occur in patients with gross class III malocclusions and in cases with mandibular facial asymmetry that had a lack of stable occlusal contacts in either CO or CR.

The application of the Dahl concept should also be undertaken with great caution among patients who may have active/a past history of periodontal disease, temporomandibular joint problems, where endodontically teeth may be involved, in cases post-orthodontic treatment (as stability may become compromised) and among patients who may be taking oral or IV bisphosphonate drugs.⁹

CONCLUSION

The concept of Minimally invasive dentistry focuses on respect for the original tissue, diagnosis, risk assessment, preventive treatment, and minimal tissue removal. This article highlights the use of minimally invasive, additive composite resin restorations for the management of localized anterior tooth wear based on the Dahl principle. This approach is viable in the short-to-medium term. Although these restorations are susceptible to failures and require a degree of maintenance, they are biologically based, preserve what remains of the dental tissues and patient satisfaction is very high.

REFERENCES

- Hattab F, Yassin O. Etiology and diagnosis of tooth wear: A literature review and presentation of selected cases. *Int J Prosthodont* 2000;13:101-107.
- Eccles J. Tooth surface loss from abrasion, attrition and erosion. *Dent Update* 1982;9:373-381.
- Van't Spijker A, Kreulen C, Bartlett D. Prevalence of tooth wear in adults. *Int J Prosthodont* 2009;22:35-42.
- Kreulen CM, Spijker A, Rodriguez JM, Bronkhorst EM, Creugers NH, Bartlett DW. Systematic review of the prevalence of tooth wear in children and adolescents. *Caries Res* 2010;44:151-9.
- Watson IB, Tulloch EN. Clinical assessment of cases of tooth surface loss. *Br Dent J* 1985;159:144-148.
- Muts EJ, van Pelt H, Edelhoff D, Krejci I, Cune M. Tooth wear: A systematic review of treatment options. *J Prosthet Dent* 2014 Oct;112(4):752-9.
- Mehta SB, Banerji S, Millar BJ, Suarez-Feito JM. Current concepts on the management of tooth wear. Part 1: assessment, treatment planning and strategies for the prevention and the passive management of tooth wear. *Br Dent J* 2012;212:17-27.
- Dietschi D, Argente A. A comprehensive and conservative approach for the restoration of abrasion and erosion. Part I: concepts and clinical rationale for early intervention using adhesive techniques. *Eur J Esthet Dent*. 2011 Spring; 6(1):20-33.
- Mehta SB, Banerji S, Millar BJ, Suarez-Feito J-M. Current concepts on the management of tooth wear. Part 2. Active restorative care 1: the management of localised tooth wear. *Br Dent J* 2012; 212: 73-82.
- Berry D, Poole D. Attrition: possible mechanisms of compensation. *J Oral Rehabil* 1976;30:201-206.
- Saunders W, Saunders E. Prevalence of peri-radicular periodontitis associated with crowned teeth in an adult Scottish subpopulation. *Br Dent J* 1998; 185: 137-140.
- Edlehoff D, Sorensen J. Tooth structure removal associated with various preparation designs for anterior teeth. *J Prosthet Dent* 2002;87:503-509.
- Dahl B, Krungstad O, Karlsen K. An alternative treatment of cases with advanced localised attrition. *J Oral Rehabil* 1975;2:209-214.
- Hemmings K W, Darbar U R, Vaughan S. Tooth wear treated with direct composite restorations at an increased vertical dimension: results at 30 months. *J Prosthet Dent* 2000; 83:287-293.
- Gow AM, Hemmings KW. The treatment of localised anterior tooth wear with indirect Artglass restorations at an increased occlusal vertical dimension. Results after two years. *Eur J Prosthodont Rest Dent* 2002;10:101-105.
- Redman CDJ, Hemming KW, Good JA. The survival and clinical performance of resin-based composite restorations used to treat localised anterior tooth wear. *Br Dent J* 2003;194:566-572.
- Magne P, Magne M, Belsler UC. Adhesive restorations, centric relation, and the Dahl principle: minimally invasive approaches to localized anterior tooth erosion. *Eur J Dent* 2007 Autmn;2(3):260-73.
- Dahl B, Krungstad O. Long term observations of an increased occlusal face height obtained by a combined orthodontic/prosthetic approach. *J Oral Rehabil* 1985;12:173-176.
- Poyser N, Porter R, Briggs P, Chana H, Kelleher M. The Dahl concept: past, present and future. *Br Dent J* 2005;198: 669-676.
- Gough MB, Setchell DJ. A retrospective study of 50 treatments using an appliance to produce localised occlusal space by relative axial tooth movement. *Br Dent J* 1999;187:134-139.
- Poyser NJ, Porter RW, Briggs PF, Chana HS, Kelleher MG, Patel MM. The evaluation of direct composite restorations for the worn mandibular anterior dentition-clinical performance and patient satisfaction. *J Oral Rehabil* 2007; 34:361-376.
- Gulamali AB, Hemmings KW, Tredwin CJ, Petrie A. Survival analysis of composite Dahl restorations provided to manage localised anterior tooth wear (ten year follow-up). *Br Dent J* 2011 Aug 26;211(4):1-8.
- Al-Khayatt AS, Ray-Chaudhuri A, Poyser NJ, Briggs PF, Porter RW, Kelleher MG, Eliyas S. Direct composite restorations for the worn mandibular anterior dentition: a 7-year follow-up of a prospective randomised controlled split-mouth clinical trial. *J Oral Rehabil* 2013 May;40(5):389-401.
- Mehta SB, Banerji S, Millar BJ, Suarez-Feito JM. Current concepts on the management of tooth wear: Part 4. An overview of the restorative techniques and dental materials commonly applied for the management of tooth wear. *Br Dent J* 2012;212:169-177.
- Smales RJ, Berekally TL. Long-term survival of direct and indirect restorations placed for the treatment of advanced tooth wear. *Eur J Prosthodont Restor Dent* 2007;15:2-6.
- Willems G, Lambrechts M, Braem M, Vanherle G. Three-year follow-up of five posterior composites: in vivo wear. *J Dent* 1993;21:74-78.
- Mahalick JA, Knap FJ, Weiter EJ. Occlusal wear in prosthodontics. *J Am Dent Assoc* 1971;82:154-159.
- Hudson JD, Goldstein GR, Georgescu M. Enamel wear caused by three different restorative materials. *J Prosthet Dent* 1995;74:647-654.