Dr Kostas Karagiannopoulos, *BDS MClinDent, is an experienced specialist prosthodontist, an academic and a researcher. He has been involved in academia since 2008 and is now a Clinical Lecturer at University College London. He leads Bio-Emulation in the UK, an international group of dentists united by the drive to preserve and restore dental tissues using nature as a guide. He co-founded Prosthoworks delivering advanced private prosthodontic education since 2021. His areas of interests are fully guided composites, managing the worn dentition and naturally looking prostheses. He also works in specialist practice limited to Prosthodontics in the London area.*

www.prosthoworks.co.uk
www.drkostas.co.uk

The Dahl concept: Practical aspects through a 5-year follow-up

By **Dr Kostas Karagiannopoulos,** United Kingdom

The Dahl concept in restoring teeth with tooth wear has been extensively used for around 50 years primarily in North Europe. While it may not enjoy global recognition, this approach can serve as a minimally invasive and cost-effective alternative to more extensive dental procedures when applied in an appropriate clinical context. It involves restoring only the affected teeth in localised tooth wear cases, sparing the ones that do not require restorations. It is conceptually an orthodontic modality, firstly described as 'Relative axial tooth movement' by Krogstad and Dahl in 1975.[1-4]

The common denominator in almost all wear cases is lack of restorative space. Dento-alveolar compensation condemns opposing teeth and alveoli to migrate towards each other as the teeth are worn away. This means that worn teeth in occlusion are in the wrong position. For localised tooth wear cases, the options for creating this restorative space and allowing to add the lost volume back on the worn teeth are the following:

- Orthodontic intrusion of the worn teeth followed by additive restorations at the same occlusion
- Increase the occlusal vertical dimension and restore all the teeth in the arch (irrespective of whether they are worn or not)
- Increase the vertical dimension and restore only the worn teeth sparing the ones not affected by wear

Within an average timeframe of 2 to 9 months, a new occlusion is generally established subsequent to the modifications detailed below **(Fig. 1)**:

- Intrusion of the restored teeth
- Supra-eruption of unrestored teeth
- Mandibular repositioning as the anterior composites act as a permanent deprogrammer seating the condyles in centric relation

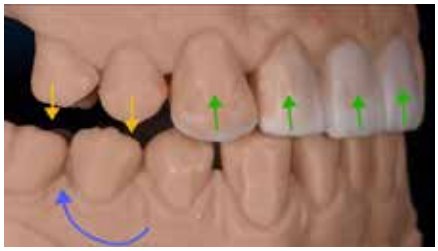

Fig. 1: A diagnostic waxup showing the dynamics of the Dahl concept. The indication for utilising the Dahl concept is localised tooth wear with evidence of dentoalveolar compensation. The contraindications are listed in Table 1.

Contraindications for the Dahl concept and explanations
Generalised tooth wear would require full arch/full mouth restorations
Crowding would benefit from pre-restorative orthodontics
Anterior/posterior open bite shows lack of eruptive potential
Implant prostheses will not exhibit any supra-eruption
Failing posterior restorations lean towards full arch restorations
Periodontal disease, multiple missing teeth, tilted molars and a deep overbite are less predictable to manage with the Dahl concept

Table 1: Contraindications for the Dahl concept

Case report

A 45-year-old man was referred due to significant wear on his anterior teeth. The patient was not interested in comprehensive care (including orthodontics) and was only concerned about the deterioration of his upper anterior teeth. The worn teeth were all in occlusion and there was clear lack of restorative space **(Fig. 2).**

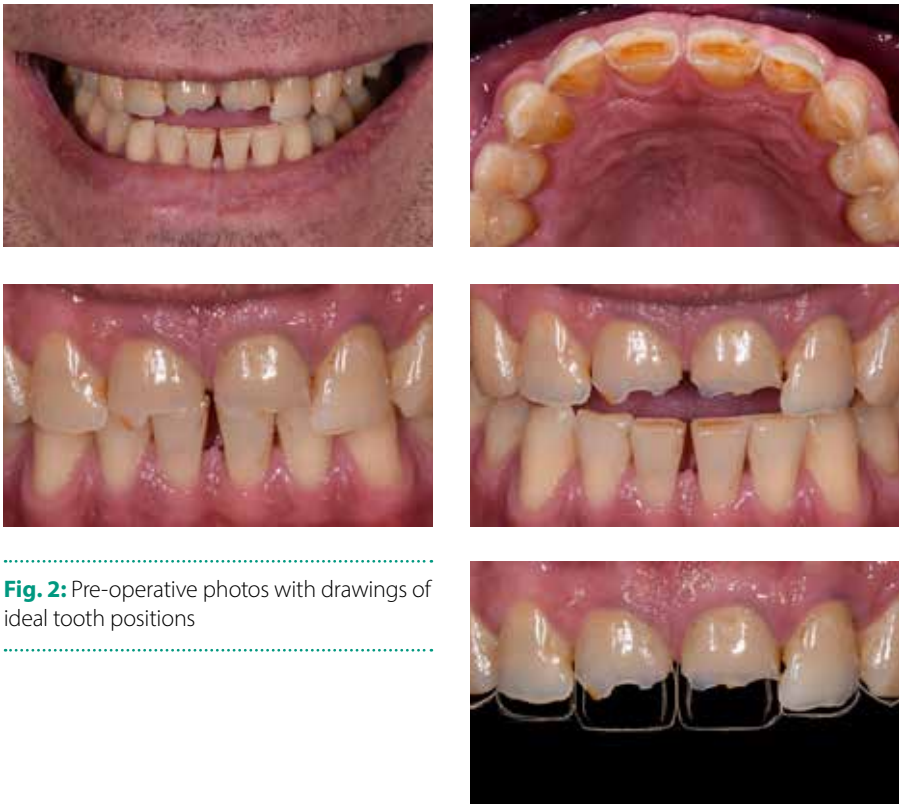

Fig. 2: Pre-operative photos with drawings of ideal tooth positions

The agreed plan was to restore the six upper anterior teeth with bonded additive composite restorations at an increased vertical dimension using the Dahl concept. Intra-oral scans, interocclusal records and clinical photographs were taken to aid the fabrication of an additive diagnostic waxup **(Fig. 3)**.

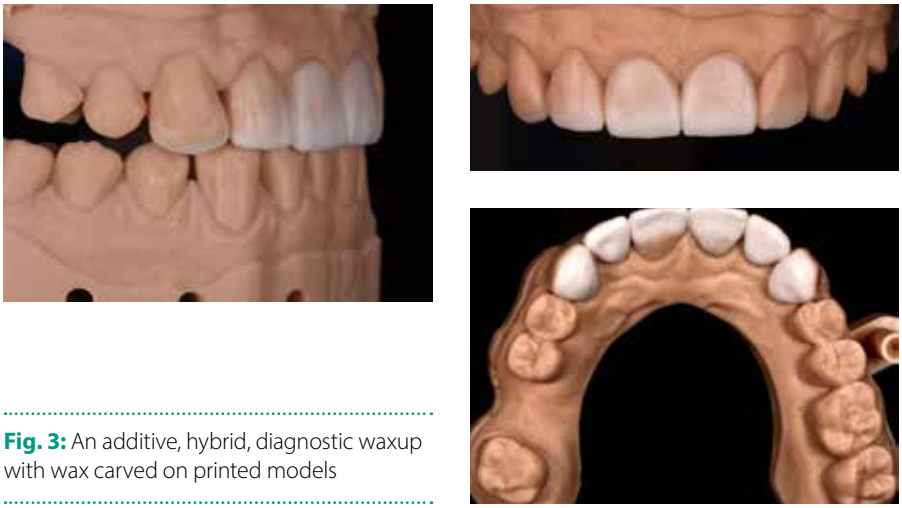

Fig. 3: An additive, hybrid, diagnostic waxup with wax carved on printed models

An additive restorative approach is usually indicated in tooth wear cases and allows for the verification of aesthetics, occlusal changes, patient comfort and phonetics through the process of a mockup intra-orally using a dual-cure composite (TEMPSMART DC, GC) **(Fig. 4).** Moreover, additive dentistry is preferred by patients who sometimes object to tooth preparation required for indirect restorations.

Fig. 4: Diagnostic mockup of teeth 13-23

The injection moulding technique was utilised to restore the six worn anterior teeth thus utilising the advantage of excellent replication of a pre-approved morphology and occlusion. A crystal-clear, pressurised silicone stent (EXACLEAR, GC) was made from the waxup. Rubber dam isolation was applied, air particle abrasion with 29-micron alumina was used followed by placing PTFE tape based on the alternate tooth technique **(Fig. 5)**. The injection moulding technique was applied with a universal, one-bottle adhesive (G-Premio BOND, GC) and a highly filled flowable restorative composite (G-ænial Universal Injectable, Shade A2, GC).

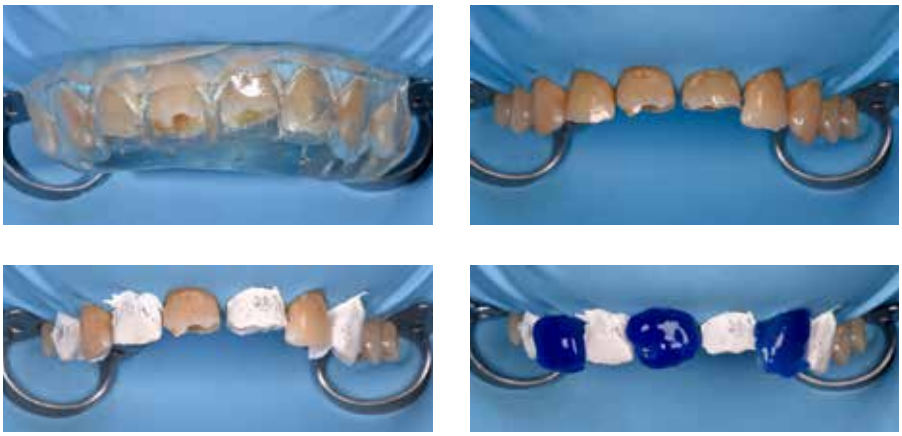

Fig. 5: Preparation for the injection moulding technique

All composite restorations were monoshade and were finished with metal proximal strips (New Metal Strip, GC) and №12 blades. Polishing was completed with silicone spirals. On the day of treatment, the 'opening' of the posterior teeth was observed while all anterior teeth had even occlusal contacts as planned **(Fig. 6)**.

Fig. 6: Immediate post-operative photographs

The patient was reviewed every two months and the occlusion was monitored with articulating paper. After 8 months, the occlusion was fully re-established with all posterior teeth occluding **(Figure 7)**. At this point an occlusal appliance was fitted.

Fig. 7: Re-established occlusal contacts at 8 months

Despite feeling an initially awkward occlusion, the patient reported no pain and he could eat normally again within the first month even though the posterior teeth were not occluding. Occlusal re-establishment typically follows a sequence starting with the second molars, then the first molars, and finally the premolars. The new contacts on the posterior teeth show variation, as some are on cusp inclines, some on cusp tips and some on marginal ridges. Restoration fractures are rarely observed during the Dahl phase, as the anterior composites tend to reduce muscle activity through their deprogramming effect. Moreover, no patient discomfort /pain or tooth mobility/drifting was observed during the Dahl phase. The patient discussion and consenting process is illustrated in Table 2.

The patient was followed up for five years with minimal maintenance **(Figure 8)**. The material properties of G-ænial Universal Injectable – such as high flexural strength and wear resistance – support long-term stability.[5]

Patient discussion and Consent
The worn teeth are restored, separating the ones do not need treatment The treatment will change your bite and on the day of the mockup, the changes are tested The new bite does not hurt and you will get used to it after 3-4 weeks Gradually, the back teeth will drift towards each other over a 2-9 month period In 5% of cases, this movement is not observed, indicating that restoration may be required Once the bite is fully established, a mouth guard will be provided

Table 2: Patient discussion

Fig. 8: 5-year Dahl follow-up

The gold standard for managing a case of anterior localised tooth wear would involve comprehensive orthodontics, followed by additive restorative dentistry on the teeth affected by tooth wear.[6-8] The purpose of this article is to clarify that increasing the occlusal vertical dimension is not synonymous with restoring the entire arch solely for prosthetic convenience. An alternative to a full arch reconstruction is the Dahl concept, an orthodontic modality that spares the unworn teeth from restorative treatment. The use of injectable composite allows for minimally invasive restoration without preparation, preserving healthy tooth structure. While the technique may involve several follow-ups and an uncertain final occlusal outcome, it offers a practical and cost-effective solution for treating localised tooth wear in a general dental setting.

References

1. Magne P, Magne M, Belser UC. Adhesive restorations, centric relation, and the Dahl principle: minimally invasive approaches to localized anterior tooth erosion. Eur J Esthet Dent. 2007 Autumn;2(3):260-73.
2. 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;211(4):E9.
3. Dahl BL, Krogstad O, Karlsen K . An alternative treatment of cases with advanced localised attrition. J Oral Rehabil 1975; 2: 209–214.
4. Dahl BL, Carlsson GE, Ekfeldt A. Occlusal wear of teeth and restorative materials. A review of classification, etiology, mechanisms of wear, and some aspects of restorative procedures. Acta Odontol Scand. 1993;51(5):299-311.
5. Rajabi H, Denny M, Karagiannopoulos K, Petridis H. Comparison of Flexural Strength and Wear of Injectable, Flowable and Paste Composite Resins. Materials (Basel). 2024 Sep 27;17(19):4749.
6. Miraglia B. Pre-Restorative Orthodontics: A Cornerstone of Comprehensive Care. Dent Today. 2015 Oct;34(10):98, 100, 102-3.
7. Vatamanu OEB, Alzyoud Z, Elgarba BM, Fontenele RC, Cristache CM, Jacobs R. Clear aligner therapy for minimally invasive dentistry: A scoping review. J Dent. 2025 Oct;161:105968.
8. Mainjot AKJ, Charavet C. Orthodontic-assisted one step- no prep technique: A straightforward and minimally-invasive approach for localized tooth wear treatment using polymer-infiltrated ceramic network CAD-CAM prostheses. J Esthet Restor Dent. 2020 Oct;32(7):645-661.