Vertical Dimension in Restorative Dentistry

- I would like to introduce you to a group of slides with references that allowed me to make sense of both the importance and flexibility of vertical in Restorative Dentistry and Prosthodontics for the dentate and partially dentate patient.
- Hopefully it will help you too.
It became clear in the late 80s and 90s that dentate patients with tooth wear did not lose face height with tooth wear – nature maintains natural tooth contact with alveolar compensation.
Vertical Dimension comparison between a young patient group without tooth wear and older patients with tooth wear

Crothers and Sandham (1993)

Compared the face heights of young dentate patients in Newcastle Dental Hospital without TSL to middle aged patients with significant TSL.

Conclusion: They found no significant difference between the two groups. why?
So dentate patients with tooth wear and natural tooth ‘stops’ do not lose face height – their teeth shorten!

Crothers and Sandham (1993)
So can we ‘open up’ and increase VD? If yes, what will be tolerated?
What is the first thing that we all think of doing for patients with TMJ dysfunction?

Constructing a splint and increasing the inter-incisal VD by approx 4-6mm
What historical studies guided us on this?
Carlsson, Ingervall & Kocak

In all cases the increase of VD exceeded the freeway space

‘The fitted splints brought about a reduction in postural activity. No sign of increased muscle activity to restore the original VD were observed. No clinically demonstrable symptoms were found at the end of the 7 day experiment’.
found no signs of either symptoms or muscle dysfunction until the VD had been increased (by a Michigan splint) by more than 11-12mm!
Freeway Space

The re-establishment of freeway space in dentate patients - they put in splints of differing thickness and got them to bite together once and assessed adaptability of patient to learn freeway space

Hellsing (1984)
Hellsing G.
Functional adaptation to changes in vertical dimension. J Prosthet Dent 1984 Dec;52(6):867-70

The traditional concept of PP stability defies neurophysiologic explanation. Conversely, the hypothesis presented to explain the rapid adaptation of jaw elevator postural tonus to sudden change of vertical dimension is in accordance with research of automatized motor behavior. Furthermore, there is no logical reason to believe that maladaptive reactions develop after prolonged procedures that increase the vertical dimension of occlusion. Rather, Goldspink reports that within a few weeks complete normalization probably occurs. Jaw muscle motor behavior is more dynamic and adaptable to environmental changes than has been believed.
So - it seems that we have a fair bit of space and vertical height to ‘play with’
The next bit of the puzzle came from the work of Bjorn Dahl in the 80s / 90s – the placement of a flat anterior bite plane in a ‘non-growing’ adult patients
The 'Dahl' Appliance

The evidence using a cobalt chrome anterior removable bite plane to create interocclusal room


What he did - the ‘Dahl Appliance’

- He inserted a removable anterior palatal bite platform in 22 non-growing adults with localised TSL.
- They wore them full time for 6 months.
- At completion of the study the posterior occlusion had re-established.
- He found no evidence of associated TMJ symptoms, pulpal pain, root resorption or function problems.
Space was created by Intrusion & over-eruption. The younger the patient the greater the over-eruption and opposite with older patients. The initial increase in VD returned to pre-op values at 5 years. No change in inter-incisal angulation, no TMD or root resorption. Some cases took longer than others (3-16 weeks). 4% non-responder.

This clinical study involved Clinical examination and Cephalometric assessment with Tantilum balls inserted in the A & B points prior to the study – couldn’t be done now!
Development of what we now know as the ‘Fixed Dahl Concept’

Clinical teams within the UK have described and evaluated fixed evolution techniques of the original ‘Dahl Appliance’. It is interesting that Prof Bjorn Dahl did not drive these developments.
UK teams initially described the use of fixed techniques as an alternative to the original removable ‘Dahl Appliance’. It is interesting that Prof Bjorn Dahl himself did not drive these developments.
UK teams then published the results of clinical evaluation of both fixed and removable modifications to the original removable ‘Dahl Appliance’ – mostly level 3 evidence


**Darbar UR, Hemmings KW.** Treatment of localized anterior tooth wear with composite restorations at an increased occlusal vertical dimension. Dent Update (1997) 25 166-170

**Gough, M. B. Setchell D. J.** Br Dent J (1999); 187: 134-139

A retrospective study of 50 treatments using an appliance to produce localised occlusal space by relative axial tooth movement

**Hemmings KW. Darbar UR. Vaughan S.** J Prosthet Dent (2000); 83:287-93 Tooth wear treated with direct composite restorations at an increased vertical dimension: Results at 30 months

**Chana H. Kelleher MGD. Briggs PFA. Hooper R.** J Prosthet Dent (2000);83:294-300 Clinical evaluation of resin bonded gold alloy veneers
What was their conclusions?

• They also worked
• No evidence of resorption
• No evidence of significant TMD problems
• Could ‘Dahl’ individual teeth
• Around a 4% non-responder rate – but reduced with time
• Composite predictable on anterior teeth
Survival analysis of composite Dahl restorations provided to manage localised anterior tooth wear (ten year follow-up).

Gulamali A1, Hemmings KW, Treloar CJ, Petrie A.

Abstract

OBJECTIVE: To evaluate ten-year survival and clinical performance of resin-based composite restorations placed at increased vertical dimension as a 'Dahl' type appliance to manage localised anterior tooth wear. Design: A prospective survival analysis of restorations provided at a single centre. Setting: UK NHS hospital and postgraduate institute.

METHODS: The clinical performance of 283 composite resin restorations on 26 patients with localised anterior tooth wear was reviewed after a ten year follow-up period. The study used modified United States Public Health Service (USPHS) criteria for assessing the restorations. Survival of the restorations was analysed using Kaplan-Meier survival curves, the log-rank test, and the Cox proportional hazards regression analysis.

RESULTS: The results indicated that the median survival time for composite resin restorations was 5.8 years and 4.75 years for replacement restorations when all types of failure were considered. The restorations commonly failed as a result of wear, fracture and marginal discoloration. The factors that significantly influenced the survival of these restorations were the incisal relationship, etiology, material used, and the nature of opposing dentition. The biological complications associated with this treatment regime were rare. Patient satisfaction remained high despite the long term deterioration of the restorations.

CONCLUSION: 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.
Al-Khayatt et al 2013
level III evidence

Direct composite restorations for the worn mandibular anterior dentition: a 7-year follow-up of a prospective randomised controlled split-mouth clinical trial.

Al-Khayatt AS¹, Ray-Chaudhuri A, Poyser NJ, Briggs PF, Porter RW, Kelleher MG, Eliyas S.

Abstract
The purpose of this study was to report on the 7-year follow-up of 15 patients who took part in a prospective randomised controlled split-mouth trial to evaluate the performance and patient satisfaction of 107 direct composite restorations bonded to their worn anterior mandibular dentition. This is the continuation of a study by Poyser et al., which investigated the performance of the same direct composite restorations on this cohort of patients at 2.5 years. The results of the present study suggest that direct composite restorations bonded to the worn anterior mandibular dentition to have an approximate survival of 85% at the 7-year follow-up. Approximately 53% of patients experienced survival of all of their restorations. Pre-operative circumferential preparation did not influence restoration survival, patient satisfaction or other clinical variables (restoration staining, marginal discoloration, shade match, surface roughness and marginal adaptation). The time taken to initially build-up the restorations was shown to be statistically significant with a longer procedural time meaning less chance of the restoration being present at 7 years. This treatment modality exhibited no biological complications for the teeth, supporting periodontium or TMJ apparatus. The placement of these restorations provided an improvement in the aesthetics of the teeth, a reduction in the concern over the longevity of the worn lower anterior teeth, and improvements with regard to sensitivity experienced with hot or cold foods or drinks. Marginal breakdown was the most frequently recorded clinical complication. Thus, for the majority of patients, the restorations offered a high degree of patient satisfaction and required an acceptable level of maintenance in the 7-year follow-up period.

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Major conclusions

• Direct composite build-ups on top and bottom anterior teeth – work!
• De-novo survival of 5.8 years and re-do restorations 4.75 years
• No difference with preparation or non-preparation
• High patient cosmetic and functional satisfaction – even when repair needed
• The thicker the composite the better
The *Dahl Concept* allows the best to be made of the mechanical properties of composite resin

The restorations can be placed in some bulk
Long-term survival of direct and indirect restorations placed for the treatment of advanced teeth wear. Smales and Berekally

Eur J Prosthodont Restor Dent 2007 15:2-6

• Advanced TSL restored with direct resin-based composites (DRBCs) in 17 patients
• Indirect ceramo-metal crowns (CMCs) and full gold crowns in 8 other patients
• Mean age 64.9 years
• Each patient had a mean of 13.8 restorations
• Retrospective assessment
Findings over 10 years  
(cumulative survival estimates)

• 62% for direct restorations
• 74.5 % for indirect
• Direct Anterior RBCs = 58.9%
• Anterior Indirect CMCs = 70%
• Composites mostly failed due to fracture and indirect CMC from complete loss

Long-term survival of direct and indirect restorations placed for the treatment of advanced teeth wear  
Smales and Berekally Eur J Prosthodont Restor Dent 2007 15:2-6
The palatal / incisal use of ‘Dahl’d’ composite for maxillary anterior teeth can be very predictable.
Gold standard = Acid Etched Enamel
(for optimum bond strength & control of leakage)

Anterior Erosion: tailor-made for composite resin - we must get over message of diagnostic etching prior to planning adhesive restorations

‘Rings of confidence’
I know there are alternative views on the restorative management of erosive TSL & I don’t want to start an argument here but surely...........

If further damage occurs isn’t the repair straightforward?