#### IN BRIEF

- Correct diagnosis and treatment planning is crucial.
- A diagnostic wax up is essential to allow conservative preparation and prototype fabrication and thus verifying any change in the occlusal scheme.
- A thorough understanding of occlusion is essential for any rehabilitation case be it functional or aesthetic.
- Changes in vertical dimension can allow for more conservative dental rehabilitations.
- All porcelain resin bonded restorations can be a conservative treatment modality for increasing vertical dimension.

# Increasing occlusal vertical dimension - Why, when and how

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Cosmetic dentistry has evolved with the advent of more robust porcelain materials and ever-stronger bonding agents. This series of three articles aims to provide a practical overview of what is now possible both functionally and cosmetically from the preparation of a small number of teeth, through a whole smile, to full mouth rehabilitation. A complete diagnosis is the starting point to planning any cosmetic or functional changes. Guidance is given on the techniques used but adequate training must be considered essential before embarking upon modification in occlusal schemes or even minor adjustments in smile design. Understanding vertical dimension and how and when it can be changed has always been a challenging prospect for the general dental practitioner. This article aims to discuss the rationale behind changes in vertical dimension and demonstrate how it can be achieved in general practice assuming adequate hands-on postgraduate training has been completed.

#### **AESTHETICS AND COSMETICS**

- 1. Aesthetic changes with four anterior units
- 2. Smile lifts a functional and aesthetic perspective
- Increasing occlusal verti-3. cal dimension - why, when and how

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#### INTRODUCTION

Vertical dimension (VD) can be defined as the distance between any two points measured in the maxilla and the mandible when the teeth are in maximum intercuspation.<sup>1</sup>

Anterior teeth are the dominant factor in determining vertical dimension.<sup>2</sup> VD is unrelated to temporomandibular disease (TMD) and there is no evidence to suggest that by changing VD one can treat TMD. However, VD can be increased or decreased for the best functional and aesthetic anterior contact in centric relation.3

The vertical dimension of occlusion (VDO) is determined by the repetitive contracted length of the closing muscles, hence increases in VDO cannot be maintained as the jaw to jaw relationship will always return to the original dimension ie the muscles always win.4

Wear does not result in loss of VD, as the alveolar process lengthens to make up for this. But the position of the condyles does affect muscle length and hence the VDO. When looking at changes in VD it is paramount to mount

Table 1 Treatment options
1. Equilibrate
2. Reposition
3. Restore
4. Surgical osteotomy
5. Orthognathic surgery

the study casts in centric relation (CR) (when the heads of the condyles are in their most superior position within their sockets, with the discs properly aligned and full neuromuscular release).<sup>5</sup> From here it is possible to see the options for treatment choices (Table 1).

#### VERTICAL DETERMINANTS

There are four philosophies for condylar position when determining VD. All work on the basis of a canine protected occlusion.

#### 1. Gnathological

Involves use of fully adjustable articulators to determine condylar path from the hinge axis and setting this path for a 5 degree increase to ensure no posterior interferences.6

#### 2. Bioaesthetics

Works via a fixed numerical value based on incisal relationship. Distance between gingival margins of 18-20 mm in an unworn class one occlusion, with upper incisal length of 12 mm, lower incisal length 10 mm, 4 mm overbite and 1 mm overjet.

#### 3. Centric relation based

Following the principles of P. Dawson whereby CR is defined as 'when the heads of the condyles are in their most superior position within their sockets, lateral pterygoid muscle is relaxed and the elevator muscles are contracted with the disc properly aligned'.



#### 4. Neuromuscular

Based on the principles of muscle activity determined by electromyography.<sup>7</sup>

#### POSSIBLE CLINICAL CONCERNS BEHIND CHANGING VD

#### Joint or muscle pain

This is not a problem, as altering VD does not produce pain of more than one to two weeks' duration; any pain is a result of increased temporary muscle awareness.<sup>8</sup>

#### Stability

When closing VD there is very little relapse; it may open by up to 1 mm within the first year and will then remain stable. Such a small amount is not detectable by the clinician or the patient.<sup>9</sup> When opening the VD some patients can remain stable, others can relapse a little, and others a lot, but again this may go unnoticed dentally.

#### Muscle activity

VD increases electromyographic activity of the elevator muscles when clenching. This is short lived, as if readings are taken two to three months later they will have returned to base line values. The postural muscle tone (ie the rest position) reduces when VD is increased but is also back to normal within three months.<sup>10</sup>

#### Phonetics

This can sometimes be a problem for the 'S' sounds.<sup>11</sup> Initially wait for one month to see if the patient can adapt (this will usually be the case) before considering any changes. If not then this will need to be corrected by creating space. Generally this will be by shortening the lower incisors as shortening the upper incisors will have aesthetic implications - how depends on the lower incisor position when the 'S' sound is created:



- If 'S' is generated with the lower incisors in the cingulum area of the upper incisors (ie behind and above the upper incisal tip), shortening the lower incisors will leave them out of contact when the teeth are in occlusion. For this reason the VD will then need to be reduced.
- 2. If 'S' is generated by the incisors being more edge-to edge the lower incisors can be reduced and the linguals of the upper incisors built out to maintain contact.

#### RATIONALE FOR ALTERING VD

- 1. Aesthetics.
- 2. Alter the occlusal relationship.
- 3. For prosthetic convenience to allow space for restorations.

## ANTERIOR DETERMINANTS OF VERTICAL DIMENSION (Fig. 1)

When changing incisal position restoratively, it is paramount to do this in provisional restorations first. Provisional restorations can be modified in the mouth until all guidelines have been precisely followed and the patient completely happy. As ever a diagnostic wax-up will aid in such treatment planning.

- 1. Stable CR contacts.
- 2. Upper half of the labial surface. After CR the second most important determination is upper incisal edge position. However, this will not be precise until the upper half of the labial contour has been determined. There is no bulge in nature from the alveolus to upper labial surface ie the upper half of the labial surface is continuous with the labial surface of the alveolar process.
- Lower half of labial surface. This is in two planes - for incisal position and to allow the lip closure path to slide along the labial surface hence the need to roll in the incisal tip.
- 4. Incisal edge. This should rest along the inner vermillion border of the lower lip and is best determined by observing the patient to counting from 50 to 55 ie 'F' sound. This needs to be in harmony with the neutral zone, lip closure path, phonetics, envelope of function and aesthetics.
- 5. Anterior guidance. This is determined by the protrusive path but should include a 'long centric' that allows a little freedom before this path is engaged and so the lower incisors are not bound in.
- 6. Contour of the lingual surface from the centric stop to the gingival margin. There should be no interferences with the 'T', 'D' or 'S' sounds.

Finally check for the absence of fremitus as this is indicative of a premature contact.

#### **CRITERIA FOR SUCCESS**

1. Load testing is negative - no sign of tension or tenderness in either joint when it is vertically loaded.

Fig. 1 Anterior determinants of vertical dimension



- 2. Clench testing is negative no sign of tension or tenderness in either joint, or teeth.
- 3. Grinding test is negative no posterior interferences.
- 4. Fremitus is negative.
- 5. Stability test no sign of instability ie wear or chipping.
- 6. Comfort test complete comfort of lips, face and teeth with no speech concerns.
- 7. Aesthetic test patient and dentist completely happy with the overall appearance.

#### TECHNIQUE

In the example used to illustrate this article, a full comprehensive examination with appropriate radiographs and photographs (Figs 2-7) was conducted and a hygiene programme was initiated to ensure periodontal health. All treatment modalities were discussed. The patient was given the options:

- 1. No treatment of wear.
- 2. Restore worn teeth only with an equilibration.
- 3. Surgical orthodontics to reduce the overjet orthodontically would have required osteotomy along with two years of orthodontic treatment.
- 4. Full mouth rehabilitation at an increased vertical dimension to treat wear

Figs 2–7 Pre-op

BUT also to improve his facial aesthetics and smile.

The dentistry was performed to treat the pathological wear of the patient's dentition and not primarily to change his occlusal scheme. He also wanted to change the appearance of his smile.

If these changes are to be made then they need to be completed in a logical, reproducible and organised manner. When reorganising the occlusion, rather than conforming to the original occlusion, using a recognised occlusal scheme is essential.<sup>5</sup>

Several posterior teeth had existing crowns, and along with the change in his vertical dimension and the use of adhesive restorations (as apposed to conventional porcelain fused to metal) this would mean relatively conservative preparations.<sup>12</sup>

This would involve his lower incisors being out of contact with his palate and since they were contacting before treatment some splinting device would be required to prevent them over-erupting. By increasing the patient's buccal corridor it would be possible to make the 14 mm overjet less apparent.

The patient was scheduled for full mouth preparation over a whole day. An anterior acrylic jig13 made at the new vertical prior to

### PRACTICE

Fig. 8 Anterior jig to give amount of opening (left) Fig. 9 Lateral view (right)

Fig. 10 Lateral view, lower preparations (left) Fig. 11 Lateral view, lower temporaries (right)

Fig. 12 Lateral view, upper and lower temporaries (left) Fig. 13 Lateral view, jig removed (right)

Fig. 14 Detailed view of temporaries equilibrated (left) Fig. 15 Temporaries RHS *in situ*, other teeth prepared (right)

Fig. 16 Occlusal registration LHS (left) Fig. 17 Occlusal registration LHS and anterior (right)











full mouth wax up was used both as an anterior deprogrammer and as a guide to the extent of the occlusal preparation required (Figs 8-9). Upper and lower right hand side sextants were prepared, temporaries made at the increased vertical and equilibrated (Figs 10-12). The jig was removed and the left hand











side sextant prepared, temporaries made and equilibrated. This then allowed the anterior sextants to be similarly prepared (Figs 13-15) and temporaries made. Anterior guidance was checked – all temporaries were made via putty matrices made from the diagnostic wax ups.



Fig. 18 Full mouth ccclusal registration at new vertical (left) Fig. 19 Temporaries (right)

Fig. 20 Temporaries (left)

Equilibrating the temporaries can involve addition of flowable composite as well as removal of material.

All temporaries except right hand side upper and lower sextants were removed and a CR bite recorded (Fig. 16); then once set this was left in situ, the remaining temporaries removed and the CR bite registration completed (Fig. 17). The laboratory was given two of these bites to allow for cross checking. Impressions of the prepared teeth were taken in two-stage technique. A denar facebow record and stick bite was taken. The lower arch temporaries were then cemented and the bite of upper preps against lower temporaries recorded (Fig. 18) in a similar fashion to allow for cross mounting of model of temporaries against model of preps - this is a major help to the ceramist in deciding where to build the teeth.

The patient wore the temporaries for one month to confirm his adaptation to his new vertical dimension, (Figs 19-21) before the final restorations were cemented. The occlusion was checked and refinements made as appropriate.

As the lower incisors were now out of contact with his palate, the decision was made to splint these teeth together with fibre-reinforced composite (the temporaries were all linked and so acted as a splint) (Figs 22-29).

#### DISCUSSION

It is rarely necessary to increase VD by greater than 2 mm for a stable result. In the case we used to illustrate this article, all teeth were prepared due to the pre-existing wear of the lower teeth, however, this need not be the case. In fact care should be taken with occlusal philosophies that apply strict dogma that always necessitates full mouth preparations of

28 teeth. Thus, make the teeth fit the jaw-tojaw relationship, not vice versa, and always do the least amount of dentistry to achieve a stable result.

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## PRACTICE

