



# Prosthodontic management of severely worn dentition: including review of literature related to physiology and pathology of increased vertical dimension of occlusion

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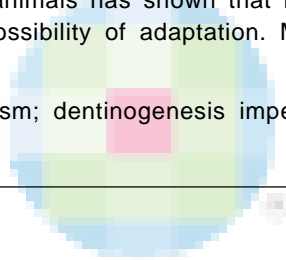
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The factors causing severe wear of natural teeth must be identified and eliminated, or reduced before attempting restorative treatment. This will not only prevent further wear of teeth but also improve the long-term prognosis of restorative treatment. The different clinical situations can be classified in to three types, as described by Turner and Missirlian. While most of the cases can be managed without increasing the vertical dimension of occlusion (VDO), in some cases, the vertical dimension has to be increased. The evaluation and establishment of the occlusal vertical dimension (OVD) is considered particularly important. Before placement of fixed restorations to increase the VDO, a removable splint, and then provisional restorations must be tried to check the suitability of the increase in OVD. A kinematic transverse horizontal axis facebow transfer helps in the accurate transfer of horizontal relation to the articulator. Research with humans and animals has shown that if increases in OVD are not extreme and the occlusion is stable, then there is a good possibility of adaptation. Management of a case of severe teeth wear caused by bruxism is described.

**Key words:** amelogenesis imperfecta; bruxism; dentinogenesis imperfecta; histology; TMJ; vertical dimension of occlusion.



Patients with severe tooth wear may need extensive restorative procedures to achieve appropriate function, esthetics, and comfort. The existing vertical dimension of occlusion (VDO) has to be assessed. Sometimes the vertical dimension has to be restored or increased. The contributing factors for excessive wear of teeth are evaluated and should be removed or reduced if possible.

## ETIOLOGY OF SEVERE WEAR OF TEETH

Occlusal wear is most often attributed to attrition, which is defined as the wearing away of one tooth surface by another tooth surface.<sup>[1]</sup> This gradual wear of teeth is thought to be a normal process during the lifetime of a patient.<sup>[2]</sup> However, excessive occlusal wear can result in pulpal pathology, impaired function, occlusal disharmony, and esthetic disfigurement. The following factors may cause excessive occlusal wear.

### Congenital anomalies

Among the congenital anomalies, amelogenesis

imperfecta, and dentinogenesis imperfecta are important conditions that may cause accelerated wear of teeth because of softness of enamel or dentin.<sup>[3]</sup> Amelogenesis imperfecta is of three types: hypoplastic, hypomaturation, and hypocalcified.<sup>[4]</sup> In the hypoplastic type, the enamel has one-eighth to one-fourth of the normal thickness. The enamel thickness in hypomaturation and hypocalcified type is normal. However, the enamel in hypomaturation type is softer, whereas the enamel in hypocalcified type is very friable.<sup>[2]</sup>

Dentinogenesis imperfecta or hereditary opalescent dentin is a dominant autosomal trait with a high degree of penetrance.<sup>[2]</sup> The dentin is amber colored and translucent. The attachment with the normal enamel is weaker and results in separation of enamel from dentin.<sup>[2]</sup> Thus, the softer dentin is exposed to oral environment and subjected to rapid attrition.

### Bruxism and other parafunctional habits

Both diurnal and nocturnal bruxism have been found to be related to extensive tooth wear.<sup>[5],[6]</sup> Careful



questioning of the patient and the family members will reveal the cause. Bruxism may be triggered by occlusal interferences.<sup>[2]</sup> Occlusal splint therapy and occlusal adjustment may be needed to control bruxism.<sup>[2]</sup>

Other parafunctional habits include chewing tobacco, pipe smoking, pencil or pen biting, and holding objects between the teeth.<sup>[7]</sup> These habits are usually associated with emotional stress. Patient counseling and periodic self-monitoring may help to break away from these destructive habits.

### **Abrasion of teeth**

Abrasion of teeth is the wearing away of tooth tissue by external agents.<sup>[2]</sup> Occlusal abrasion is usually attributed to diet and chewing of abrasives such as tobacco. Environmental factors, such as constant exposure to dust and grit in a farming occupation may cause abrasion of teeth.<sup>[2]</sup> Unglazed porcelain restorations cause abrasion of opposing natural teeth.<sup>[8]</sup> Castable ceramic materials without shading, seem to be less abrasive.<sup>[7]</sup>

### **Erosion**

Erosion is the destruction of hard dental tissues by chemical action. Tooth erosion may be caused by citrus juices, cola drinks, vinegar, and pickled foods.<sup>[9]</sup> Patients who continuously regurgitate stomach contents into the mouth, commonly exhibit perimylolysis on the lingual surfaces of maxillary anterior teeth.<sup>[10],[11]</sup>

### **Loss of posterior support**

Extensive attrition of anterior teeth often occurs when posterior support has been compromised by loss of teeth, malposition of teeth, or occlusal interference that drives the mandible forward and exerts undue force on the anterior teeth.<sup>[2]</sup>

It should be emphasized that most often a combination of factors is responsible for the wear.

## **DIAGNOSIS AND TREATMENT PLANNING**

The first consideration is to identify and try to eliminate or reduce the factors that may contribute to excessive wear of teeth. This is important to preserve the remaining tooth structure and to enhance the long-term prognosis of restorative treatment. Failure to remove the contributing factors may increase the chance of treatment failure.<sup>[7]</sup>

Severe wear, tooth sensitivity, breakage of restorations, multiple missing teeth, and esthetic impairment are indications for active treatment to restore the lost tooth structure.

If tooth wear is moderate, aesthetics is acceptable, and if there is absence of tooth sensitivity, no active intervention may be a reasonable treatment alternative.<sup>[7]</sup> Such patients are periodically monitored, oral hygiene

instructions are given, and fluoride treatment is prescribed to prevent decay of exposed dentine. As a preventive measure, a hard plastic interocclusal device is fabricated and the patient is asked to wear it at night or during the day.<sup>[7]</sup>

## **EVALUATION OF VDO**

It is critical to verify loss of occlusal vertical dimension (OVD) before the restoration of an increased OVD. The different techniques that can be used are: use of phonetics, the use of interocclusal distance, and the evaluation of soft tissue contours.

### **Phonetic evaluation**

Both Pound and Silverman<sup>[12]</sup> have described the reliability of the speaking space as a method to determine OVD for complete denture patients. The normal mandibular position during the 's' sound places the incisal edge of the mandibular incisors about 1 mm inferior and lingual to the incisal edge of the maxillary incisors. Vertical positioning significantly more than 1 mm apart may indicate lost OVD. This may not be true in patients with Angle's classes II and III.<sup>[7]</sup>

### **Interocclusal distance**

Methods of measuring interocclusal distance are diverse, inaccurate, and inconsistent.<sup>[13]</sup> Measurements can be used as supplemental diagnostic aids and they are to be used as mere guidelines. A good clinical judgment must prevail. A patient who demonstrates an interocclusal distance of 6 mm is more capable of tolerating a slight increase in OVD than the patient with an interocclusal distance of 2 mm.<sup>[2]</sup>

### **Facial appearance**

Diminished facial contour, thin lips with narrow vermilion borders, and drooping commissures are associated with over closure.<sup>[14]</sup> However, wrinkling and loss of facial contour are normal ageing processes and one must not attempt to correct these changes by increasing the OVD.<sup>[2]</sup>

None of the above techniques are found to be scientifically as accurate as their proponents claim.<sup>[15]</sup> Use of more than one technique of evaluation of OVD may increase the accuracy and reliability.<sup>[7]</sup>

### **Turner and Missirlian classification<sup>[2]</sup>**

- Category-1: Excessive wear with loss of VDO.
- Category-2: Excessive wear without loss of VDO but with space available.
- Category-3: Excessive wear without loss of VDO but with limited space.

In a typical category-1 patient (loss of VDO), the closest speaking space is more than 1 mm and the interocclusal space is more than 4 mm and has some





loss of facial contour that includes drooping of the corners of the mouth.<sup>[7]</sup> The reliable method to confirm the diagnosis and to determine a physiologic VDO is placement of trial restorations. At first, a removable splint or partial denture is placed and observed periodically for 6–8 weeks. Fixed provisional restorations are placed for another 2–3 months before planning permanent restorations. A removable trial restoration cannot be solely relied because the patient may have removed the prosthesis during periods of stress, fatigue, and soreness associated with excessive OVD. Heat-polymerized acrylic resin is satisfactory for provisional restorations.<sup>[2]</sup> In patients of category-1, all teeth of one arch must be prepared in a single sitting once the final decision is made. This makes the increase in VDO less abrupt and allows better control of esthetics.

Patients in category-2 typically have a long history of gradual wear caused by bruxism, moderate oral habits, or environmental factors.<sup>[2]</sup> In these patients, the OVD is maintained by continuous eruption. Tooth preparation to establish retention and resistance form may be critical because of shorter crown length. Gingivoplasty may be needed to gain clinical crown length. Enameloplasty of opposing posterior teeth may provide some space for the restorative material.

In patients of category-3, there is excessive wear of anterior teeth, which has occurred over a long period, and there is minimal wear of the posterior teeth. Centric relation and centric occlusion are coincidental with a closest speaking space of 1 mm and an interocclusal distance of 2–3 mm.<sup>[2]</sup> In such cases vertical space must be obtained for restorative materials. This can be accomplished by orthodontic movement, restorative repositioning, surgical repositioning of segments, and programmed OVD modification.

Orthodontic movement usually involves anterior–posterior repositioning of the teeth combined with intrusion, although intrusion is considerably more complex. Restorative repositioning of teeth can often achieve space for dental materials, improve esthetics, and develop a more favorable plane of occlusion. Surgical repositioning of a segment of teeth and supporting alveolus may be indicated if a dentofacial deformity exists in conjunction with extreme wear.<sup>[2]</sup> Increasing the OVD to achieve space for restorative materials is seldom advisable; but if deemed necessary, the increase should be minimal and used for restorative needs only.<sup>[2]</sup> Hinge axis location by a kinematic facebow provides greater accuracy in increasing the VDO on the articulator.

### Physiology and pathology of increase in vertical dimension

The VDO is initially determined by the interaction of the genetic growth potential of the craniofacial tissues, environmental factors, and the dynamics of

neuromuscular function during growth. Maintenance of the VDO is related to the interaction of environmental factors and the dynamics of neuromuscular function throughout the ageing process.<sup>[16]</sup>

The masticatory system is capable of successful adaptation to minimal or moderate changes in the VDO.<sup>[15]</sup> However, careless or sudden change in the VDO may be potentially harmful to some patients that may have reduced adaptability relative to their masticatory system.<sup>[7]</sup> Clinical symptoms, such as muscular fatigue or soreness and certain physiologic changes of masticatory muscles, especially of the masseter muscle, caused by increased OVD have been well documented.<sup>[17],[18]</sup>

Several animal studies have been done to find out the effect of increased vertical dimension on the components of the masticatory system.<sup>[19]–[22]</sup> These studies confirmed the histologic and morphologic changes in TMJ, periodontium, and masticatory muscles. Akagawa et al.<sup>[22]</sup> studied histologic changes in various masticatory muscles in Wistar rats from 12 h to 84 days after an experimental increase of the OVD. Only a transient acute inflammation occurred in the deep and superficial masseter muscles in the 1-mm group. A sequence of tissue reaction from acute inflammatory myofiber destruction to myofiber regeneration was observed in the deep masseter muscle of the 2-mm group. Nonetheless, the response is not one of collapse and breakdown but one of general compensation and adaptation.<sup>[2]</sup>

Human studies have been few because ethical concerns limit the type of intervention and the amount of information that can be obtained.<sup>[23]</sup>

Carlsson et al.<sup>[17]</sup> detected low-EMG activity of masticatory muscles after increasing the VDO beyond the rest posture. The decrease in muscle activity has been explained by inhibitory impulses from tendon organs. Christensen<sup>[18]</sup> raised the occlusion only in the molar region and reported more severe clinical findings and subjective symptoms. This has been explained to be caused by occlusal instability rather than by raised VDO. Storey<sup>[24]</sup> concluded that, with increase in VDO, the submaximal closing forces might remain the same or even increase. However, the EMG activity falls, indicating that less number of muscle fibers are contracting. Storey detected a fall of electrical activity in the range of 1–2 mm near the clinical rest position (the suppressed region). The fall in electrical activity was attributed to inhibition of motor neurons by secondary spindle and Golgi tendon organs. Storey<sup>[24]</sup> remarked that the suppressed region might serve as a useful clinical landmark.

### CASE REPORT

A 32-year female patient presented with an advanced



wear of teeth. The patient provided the history of bruxism. On examination, the closest speaking space was found to be 3 mm. All maxillary posterior teeth were missing except 16. In the lower jaw, 33, 31, and 41 were RC treated and 32, 42 were missing. All mandibular posterior teeth were missing except 45. According to Turner and Missirlian classification, this is a class-1 situation (excessive wear with loss of VDO) [Figure 1].

Metal-ceramic complete veneer crowns were planned for 33, 31, and 41. Restoration of vertical dimension was planned, by replacing the posterior teeth with removable partial dentures [Figure 2]. Fixed partial denture treatment was ruled out because of the obvious reasons. Because the increase in vertical dimension was within the rest posture dimension, the patient adapted well to the removable partial dentures. Nevertheless, the patient complained of some discomfort

in the masticatory muscles for 48 h, which then gradually disappeared.

## CONCLUSION

Most patients with severe wear of teeth can be managed by restoring the occlusion and without increasing the vertical dimension. If the VDO has to be increased, such as in Turner and Missirlian class-III situation, it has to be done cautiously. According to literature, a limited increase in vertical height can be tolerated and well adapted. The amount of vertical height to be increased is best judged by placing removable splint/denture and fixed provisional restorations. The final restoration should mimic the OVD, function, and esthetics that have been developed in the fixed provisional restoration.

## REFERENCES

1. Smith BG. Dental erosion, attrition and abrasion. *Practitioner* 1975;347:55
2. Turner KA, Missirlian DM. Restoration of the extremely worn dentition. *J Prosthet Dent* 1985;52:467-74.
3. Schuyler CH. Factors in occlusion applicable to restorative dentistry. *J Prosthet Dent* 1953;3:722.
4. Stewart RE, Prescott GH. *Oral facial defects* (1<sup>st</sup> edn), The CV Mosby Co: St Louis; 1976. p. 151.
5. Carlsson GE, Johansson A, Lundquist S. Occlusal wear: A follow up study of 18 subjects with extensively worn dentitions. *Acta Odontol Scand* 1985;43:83.
6. Clark GT, Beemsterboer PL, Rugh JD. Nocturnal masseter muscle activity and the symptoms of masticatory dysfunction. *J Oral Rehabil* 1981;8:279.
7. Rivera-Morales WC, Mohl ND. Restoration of the vertical dimension of occlusion in the severely worn dentition. *Dent Clin North Am* 1992;36:651-64.
8. Mahalick JA, Knap FJ, Weiter EJ. Occlusal wear in prosthodontics. *J Am Dent Assoc* 1971;82:154.
9. Lewis RJ, Smith BG. The relation of erosion and attrition in extensive tooth tissue loss. *Br Dent J* 1973;135:400.
10. Hellstrom I. Oral complications in anorexia nervosa. *Scand J Dent Res* 85:71.
11. House R, Grisius R, Bliziotis M, Ficht J. Perimyololysis (1981): Unveiling the surreptitious vomiter. *Oral Surg* 1977;51:152.
12. Silverman MM. The speaking method in measuring vertical dimension. *J Prosthet Dent* 1953;3:193.
13. Atwood DA: A cephalometric study of the clinical rest position of the mandible. *J Prosthet Dent* 1956;6:504.
14. Heartwell CN, Rahn AO. *Syllabus of Complete Dentures* (ed 3), Lea & Febiger: Philadelphia; 1980. p. 214.
15. Rivera-Morales WC, Mohl ND. Relationship of occlusal vertical dimension to the health of the masticatory system, *J Prosthet Dent* 1991;65:547.
16. Harper RP. Clinical indications for altering vertical dimension of occlusion. *Quint Int* 2000;31:275-80.
17. Carlsson GE, Ingerval B, Kocak G. Effect of increasing vertical dimension on the masticatory system in subjects with natural teeth, *J Prosthet Dent* 1979;41:284-9.



**Figure 1:** The patient's photograph shows multiple missing posterior teeth and advanced wear of the remaining teeth caused by bruxism. A typical Turner and Missirlian class-1 situation (excessive wear with loss of VDO)



**Figure 2:** Complete veneer metal-ceramic crowns were cemented after root canal treatment of pulpally involved 33, 31, and 41. The VDO was restored by placement of upper and lower removable partial dentures





18. Christensen J. Effects of occlusion raising procedures on the chewing system. *Dent Pract* 1970;20:233-8
19. Waerhaug J, Hansen ER. Periodontal changes incident to prolonged occlusal overload in monkeys. *Acta Odontol Scand* 1966;24:91-104.
20. Ramfjord SP, Blankenship JR. Increased occlusal vertical dimension in adult monkeys. *J Prosthet Dent* 1981;45:75-83.
21. Carlson DS, Schneiderman ED. Cephalometric analysis of adaptations of the masseter muscle after lengthening in adult rhesus monkey. 1983;28:627-37.
22. Akagawa Y, Nikai H, Tsuru H. Histologic changes in rat masticatory muscles subsequent to experimental increase of the occlusal vertical dimension. *J Prosthet Dent* 1983;45:108-14.
23. Rivera-Morales WC, Mohl ND. Relationship of occlusal vertical dimension to the health of the masticatory system. *J Prosthet Dent* 1991;65:547-53.
24. Storey AT. Physiology of a changing vertical dimension, *J Prosthet Dent* 1962;12:912-21.

