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Review Article

Effect of change in occlusal vertical dimension on the masticatory muscles and TMDS: A review of literature

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ABSTRACT:

Increasing the occlusal vertical dimension for gaining sufficient restoration space in the management of severely worn dentition is being practiced. Bite raising can be done to rehabilitate an extremely worn dentition with lack of space for restoration and as a temporary symptom reliever in intra-capsular TMJ problems. Any modification of dental status, saliva flow or neuromuscular apparatus can affect mastication and nutrition. Oral incapacities affect mastication for solid and semi-solid foods. There is no indication that permanent alteration in the OVD will produce long-lasting TMD symptoms. Permanent occlusal changes should only be attempted after the patient has demonstrated adaptability at the new vertical dimension.

Key words:vertical dimension, temporomandibular joint disorders, dental occlusion, masticatory muscles.

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INTRODUCTION

Changing the occlusal vertical dimension (OVD) is a dental procedure causing problems such as muscle pain, temporomandibular joint pain, headaches, tooth grinding and clenching. Initially some authors expressed their concerns about the 'dangers' of altering the OVD. They hypothesised that changing the OVD caused physical suffering due to muscle strain. These authors believed that shortening of the lower third of facial (a decrease in the OVD) was a product of natural adaptation. Therefore, restoring this vertical dimension (e.g. edentulous patients) was an extreme dental treatment that went against the delicate balance of the stomatognathic system. Additionally, some decades later, several authors reported that creating an inadequate OVD by either increasing or decreasing it could create serious problems. They believed the OVD was a specific and fixed value that cannot be changed and that this value should be carefully and accurately calculated so that it will not be altered when treating patients.¹⁻⁵

Changing the occlusal vertical dimension is a common procedure in restorative dentistry, during treatment of patients with cranio-mandibular disorders, and during orthodontic and orthognathic treatment. Early occlusal force studies employed bulky instruments that required wide separation of the teeth and jaws. There has been speculation that the extent of vertical separation of the teeth and jaws and especially opening beyond the freeway space may have an effect on the magnitude of occlusal forces. This viewpoint has been supported theoretically by length tension curves for a single muscle fiber. As a muscle fiber is stretched beyond its resting length, more force is generated up to a point; then further stretch results in reduced force generation. If the elevator muscles of the mandible behaved like an ideal single fiber, small increases in vertical opening past rest position should increase occlusal forces, whereas larger openings should cause a reduction in occlusal force. Traditional length-tension curves may not be adequate to represent forces generated by the muscles of mastication in occlusal force studies, since in vivo forces are produced by a combination of whole muscles.

In some animals, maximum force is generated at or very near maximum opening. Vertical occlusal forces in humans need to be measured over a complete range of vertical openings to determine whether the degree of vertical opening has an effect.⁵⁻⁹

The functional provisional restoration should contain the occlusal scheme intended for the final restoration. Permanent occlusal changes should only be attempted after the patient has demonstrated adaptability at the new vertical dimension.

REVIEW OF LITERATURE

Moreno-Hay I et al presented a comprehensive review of the scientific evidence available in the literature regarding the effect of altering the occlusal vertical dimens-ion (OVD) on producing temporomandibular disorders. The authors conducted a PubMed search with the following search terms 'temporoman-dibular 'occlusal vertical dimension'. disorders', 'stomatognatic system', 'masticatory muscles' and 'skeletal muscle'. Bibliographies of all retrieved articles were consulted for additional publications. Hand-searched publications from 1938 were included. The literature review revealed a lack of well-designed studies. Traditional beliefs have been based on case reports and anecdotal opinions rather than on wellcontrolled clinical trials. The available evidence is weak and seems to indicate that the stomatognathic system has the ability to adapt rapidly to moderate changes in occlusal vertical dimension (OVD). Nevertheless, it should be taken into consideration that in some patients mild transient symptoms may occur, but they are most often self-limiting and without major consequence. In conclusion, there is no indication that permanent alteration in the OVD will produce long-lasting TMD symptoms.⁵

Guguvcevski L et al evaluated the value of decreased occlusal vertical dimension in cases with temporomandibular disorder and to follow up the influence of corrective treatment with occlusal splints and definitive prosthetic construction upon the elimination of clinical symptoms. Eight cases with decreased occlusal vertical dimension accompanied with temporomandibular disorders were treated with an occlusal splint, as part of reversible occlusal treatment. After reducing, or complete elimination of the symptoms related to problems of decreased occlusal vertical dimension, the definitive prosthetic therapy was performed. The mean value of decreased occlusal vertical dimension in our patients is 8.5 mm, and the mean value of therapy time with an occlusal splint in these patients was 3.5 months. Occlusal splint is a part of reversible occlusal therapy in cases with decreased occlusal vertical dimension. After reducing the symptoms related to decreased occlusal vertical dimension definitive prosthetic therapy can be done.10

T Sierpinska et al investigated how changes in vertical dimension during denture exchange affect muscular activity and hyoid bone position. Twenty-five edentulous, otherwise healthy patients (14 females, 11 males) aged 70.5 +/- 9 years, wearing their dentures over 5 years but no longer than 15 years (mean 9.8 +/-5.2), were studied. New dentures were fabricated and the occlusal vertical dimension was recorded on

cephalometric radiographs. Cephalograms were analyzed according to Ricketts. The relation of the hyoid bone position to the mandible was estimated. An evaluation of muscular activity was performed using the Biopak Electromyography Recording System synchronized with the T-Scan II Occlusal Analysis System. The occlusal vertical dimension was higher with the new dentures compared with the old dentures. The transition to new dentures was accompanied by a change of the vertical position of the hyoid bone. Digastric muscle activity was lower with the new dentures in comparison with the old dentures. Increase of the occlusal vertical dimension in complete denture wearers affects the hyoid bone position and masticatory muscle activity.¹¹

Ribeiro AB et al investigated the effect of increased OVD on the electrical activity of masticatory muscles and the pressure-to-pain threshold (PPT) in asymptomatic participants. Twenty asymptomatic participants (22.7 ±2.39 years of age; 10 men, 10 women) were submitted to an increase in OVD by using interocclusal devices of different thicknesses (3and 6-mm) for 24 hours. Masticatory muscle activity assessed with electromyography was (EMG), expressed in microvolts (μ V), while the participants masticated 2 pieces of latex of different consistency (latex S and H) with and without the device. The change of OVD did not significantly affect the electrical activity of the muscles. The latex of hard consistency (latex H) showed higher electrical activity values than the soft texture (latex S). For the working side anterior temporal muscle, a change in the PPT was detected on the day the 6-mm-device was inserted, but for the other muscles, device thickness and latex mastication did not change the PPT. For a short time, an increase in occlusal vertical dimension did not affect the electrical activity in the masticatory muscles or pressure-to-pain threshold in asymptomatic participants.¹²

A Manns et al studied the influence of vertical dimension in the etiology of bruxism and MPD syndrome. The vertical dimension of least EMG activity was determined for each of 75 patients who were randomly divided into three groups according to the vertical dimension at which the occlusal splint was constructed. Group I occlusal splints were constructed at 1 mm from the occlusal vertical dimension, group II splints at 4.42 mm, and group III splints at 8.15 mm. Results showed a faster and more complete reduction in clinical symptoms for groups II and III than for group I. The temporary use of occlusal splints with a vertical height exceeding the physiologic rest position did not encourage a greater muscular tonus or hyperactivity of jaw muscles. It can be concluded that elongation of elevator muscles to or near the vertical dimension of least EMG activity by means of occlusal splints is more effective in producing neuromuscular relaxation.7

EFFECTS OF INCREASING VERTICAL DIMENSION

When OVD is increased within or equal to the preexisting VDR position, muscle activity/tonus is kept to minimal levels and hence there is no muscular tendency to rebound. If OVD is increased above VDR, muscles tend to re-establish the original dimension by compressing tooth into the socket results in tooth mobility, bone resorption, tooth intrusion, strain or fatigue of muscles and bruxing tendency. Previous authors documented that increase in OVD leads to encroachment of freeway space causing exaggerated respiratory problems. The inference that can be arrived by studying the effects of altering OVD is that any attempt to restore OVD in excessively worn dentition results in increasing the OVD. This increase will ultimately lead to adaptive recoil of muscles resulting in tooth intrusion and OVD will return to pre-treatment level.¹³⁻¹⁵

INDICATIONS FOR INCREASING OVD

From the literature appraisal, it is understood that OVD should not be increased in a few specific conditions like full occlusal rehabilitation situations where space for restoration can be achieved by crown lengthening and foundation restorations, to reduce face wrinkles, muscle dysfunction, extracapsular TMJ disorders, and upper respiratory tract distress syndrome. The indications for bite raising are:

- Inadequate space for the restoration
- For temporarily relieving the symptoms in intra-capsular TMJ disorders¹⁶⁻¹⁸

EFFECT OF DECREASING OCCLUSAL VERTICAL DIMENSIONS OVD ON TEMPOROMANDIBULAR DISEASES TMD

Similar to increasing the OVD, there are conflicting reports in the literature regarding the effects of decreasing the OVD. Some authors have suggested that the stomatognathic system naturally adapts to decreases in OVD

It has been reported that severely worn dentitions resulting in a decrease in OVD are usually due to parafunctional habits or an abrasive diet. However, patients with significant tooth wear do not regularly present signs or symptoms of TMD

Interestingly, Pullingeret al.¹⁴ studied the correlation between the presence of severe dental attrition and TMD. They did not find any statistically significant correlation between the degree of dental attrition and TMD symptoms.

Pullinger and Seligman published that TMD risk factors included the following: anterior open bite, cross-bite, overjet more than 6 mm, discrepancy between centric relation and intercuspal position more than 2 mm and loss of posterior teeth. As abovementioned, the loss of posterior teeth often results in occlusal instability that is considered as a possible aggravating, perpetuating or predisposing factor for TMD.¹⁴

It is interesting to note that when complete dentures are placed patients immediately adapt to a wide range of variation in OVD which is a different OVD from not having the dentures in place. This seems to once again demonstrate the adaptability of the masticatory system.

To summarise, decrease in OVD may occur with the loss of posterior teeth but, because other risk factors such as occlusal instability are involved, the relationship between decreased in OVD and TMD cannot be determined.

DISCUSSION

Temporomandibular disorders is a collective term embracing all the problems relating to the TMJ and related musculoskeletal structures. Many therapies have been advocated for treating TMD. A therapy that is commonly provided is an occlusal orthotic, also called a dental or occlusal appliance or a splint. splint/occlusal device/orthotics: "Any Occlusal removable artificial occlusal surface used for diagnosis or therapy affecting the relationship of the mandible to the maxillae. It may be used for occlusal stabilization, for treatment of TMJ disorders, or to prevent wear of dentition." The appliance can be made to cover the occlusal surfaces of maxillary or mandibular teeth and can be fabricated from many different materials, giving it a hard, soft, or intermediate feel. Occlusal orthotics is beneficial for masticatory muscle pain, TMJ pain, TMJ noises, restricted jaw mobility, and TMJ dislocation.14-16

Splint therapy is considered an adjunct to pharmacologic therapy and most appropriate when nocturnal parafunctional activities can be identified. Typically, a flat-plane maxillary occlusal splint designed for bilateral contact of all teeth is fabricated. Such splints are thought to unload the joint by disarticulating the dentition and increasing the vertical dimension of occlusion. By unloading the joint, there will be a reduction in both Synovitis and masticatory muscle activity. Therefore, the result is a reduction in symptoms. These appliances may also change condylar position and the existing occlusal relationship, thereby reducing abnormal muscle activity and spasm. Most occlusal splints have one primary function that is to alter an occlusion so they do not interfere with complete seating of the condyles in centric relation.¹⁷⁻¹⁹

ADAPTATION OF STOMATOGNATHIC SYSTEM TO CHANGES IN OCCLUSAL VERTICAL DIMENSIONS OVD

Mannset al.²⁰demonstrated that an increase in OVD in patients with muscle TMD reduced the painful symptoms. These findings suggest that a change in the working length of a painful muscle may actually reduce painful symptoms. This is certainly clinically verified when muscles that are tight and painful are passively stretched or lengthened. This, however, does not suggest that if this particular length is maintained, it will keep the patient muscle pain free indefinitely. This concept is not well appreciated in dentistry. In fact, when a patient reports a reduction in pain with an increased OVD, the dentist often assumes that this is the correct vertical dimension and if it were permanently established, the patient would be permanently free of pain. In fact, muscles seem to be more pain free when they are allowed to change their length during normal function.

The stomatognathic system can adapt and does so routinely when OVD is altered, ether naturally or by dental procedures. Adaptation may be the results of muscle or joint responses, or both.

SUMMARY:

Mild transient TMD symptoms may appear after moderate increases of OVD and these symptoms routinely resolve and the stomatognathic system has great ability to adapt to increases in OVD without any major clinical consequences.

CONCLUSION

Changes in OVD are closely related to TMD symptoms, and the stomatognathic system has the ability to adapt rapidly to moderate changes in OVD. Clinicians may increase the OVD with an oral splint as a treatment for TMD symptoms. This produces symptomatic relief, and most patients' muscles appear to adapt well to this approach.

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