

Occlusion, prosthodontic treatment, and temporomandibular disorders: A Review

Ghada Hagag, Keiichi Yoshida and Hiroyuki Miura

Department of Prosthodontics II, Faculty of Dentistry, Tokyo Medical and Dental University

The purpose of this article is to review the literature on the relationship between occlusal discrepancies and temporomandibular disorders (TMD) and to summarize the guidelines of treating TMD by prosthetic rehabilitation.

To date, the relationship between occlusal condition and TMD has not been confirmed, although there is a current trend toward making a weak correlation between occlusal interference and TMD. Furthermore, several types of occlusal discrepancies have been considered as variable features of the norm. But unstable occlusion in the intercuspal position may cause TMD.

In cases of restored dentition, the problem is probably different and iatrogenic TMD are not rare. Namely, malformed occlusal surfaces, defects in anterior guidance, occlusal curvature, and vertical dimension may lead to some TMD trouble.

According to these recent concepts the treatment modalities of TMD have been changed. Conservative treatments such as counseling, behavioral modification, physical therapy, pharmacotherapy, and interocclusal appliances should be the first choice, and treatments that lead to drastic changes of occlusion are not recommended.

Key words: Temporomandibular disorders, occlusal discrepancy, prosthodontic treatment

Introduction

Temporomandibular disorders (TMD) is a collective term embracing a number of clinical problems that involve the masticatory musculature, the temporomandibular joint (TMJ) or both, and associated structures. TMD is characterized by pain in the preauricular area, the TMJ, and/or the muscles of mastication, restricted range of mandibular motion and/or deviations in jaw opening, and joint sounds such as clicking, popping or crepitation¹. The etiology of TMD is generally agreed to be multifactorial. In addition to the known factors, such as anatomic factors including the occlusion and the joint itself, neuromuscular factors, and psychogenic factors², recently the iatrogenic factors resulting from dental practice have also been claimed to be contributing factors in TMD^{3,4,5}.

The prosthodontist has always played a major role in TMD treatment by providing many different treatments mostly oriented toward prosthetic reconstruction⁶. But the recent concepts in the field regarding the nature of both the pathology and the physiology of TMD have affected their treatment modalities.

In this article, we review the literature on the relationship among occlusal discrepancies, TMD, and prosthetic treatment in regard to the following questions. What occlusal conditions interfere with TMD? How does restored dentition interfere with TMD? What treatment philosophies are currently applied in managing TMD by prosthetic rehabilitation?

1. TMD and Occlusal Discrepancies

Many studies have discussed extensively the role of dentition and of various occlusal features in TMD pathogenesis, with special emphasis on occlusal

Corresponding Author: Hiroyuki Miura

Department of Prosthodontics II, Faculty of Dentistry, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo-ku, Tokyo 113-8549 Japan.

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interference (prematurities) and the loss of molar support.

(1) TMD and Occlusal interference (prematurities)

Although the occlusal interference (OI) factor had been considered as a major contributor in characterizing TMD, lately this has been questioned on the basis of epidemiological and experimental studies, and there is a current trend toward making a weak correlation between OI and TMD.

Epidemiological studies

The results of epidemiological studies remain inconclusive. Agerberg and Sandstorm reported that 85-90 percent of the population exhibited some form of OI⁶. Other studies conducted in different population groups with different ages and gender⁷⁻¹⁰ have shown that various types of OI were significant but often weakly correlated with the signs and symptoms of TMD. Seligmann and Pullinger reported that balancing, working occlusal contact, and asymmetric contact in retruded position are too common and variable to offer sensitivity and specificity for distinguishing asymptomatic from symptomatic patient groups¹¹.

Experimental studies

Experimental studies employing artificial OI have also reached controversial results. Some studies have failed to demonstrate any electromyographic response to the artificial OI^{12,13}. Others showed that artificial OI were significantly associated with consistent clinical changes in the myoelectric contraction pattern of the jaw muscles (EMG changes)¹⁴⁻²⁴, translatory mandibular motion pattern^{17,22,25}, and common clinical symptoms such as headache, clicking, and muscle fatigue. Most of these experiments were short time studies. In a double-blind study²¹ involving two healthy groups of subjects, balancing-side interferences were applied bilaterally by adding composite resin after acid etching on the maxillary first molars in one group, whereas in the other group the application was simulated (placebo prematurities). Namely, instead of acid-etch, sterile water was used, and the composite resin was never applied to the tooth surface. Various subjective symptoms and clinical signs of dysfunction in many but not all subjects during the experiment resulted after a 2-week period. Interestingly, three out of 12 participants in the control group reported subjective symptoms, and three had clinical signs of dysfunction. In another experimental study²⁵, Karlsson has showed that occlusal interferences

in a short-term perspective might have a varied influence on different individuals, and in even those who were affected, adaptation was frequently observed. The results in the literature indicate that whether or not OI has negative effects on masticatory system components depends on how each individual adapts and reacts to them. These results may help to interpret and support the heterogeneous and multifactorial nature of TMD, and, subsequently, reinforce the currently emerging principles that affect TMD, such as physiologic occlusion, patient's adaptability, and functional equilibrium.

(2) TMD and loss of molar support

Loss of posterior molar support has been linked to anterior dislocation of the disk resulting in clicking²⁶⁻²⁸, disk derangement, and osteoarthritis²⁹. In the past, it was concluded that because of the loss of molar support, the joints were subjected to increased joint loading with negative impact of functioning on the anterior teeth.

In two recent studies^{30,31}, however, Witter and his colleagues found that there was no evidence of increased risk of TMD or a tendency to more signs and symptoms over the years in individuals with shortened dental arch (SDA) consisting of 3-5 occlusal units (provided the bicuspid were present). They have also showed that restoration of SDA by free end removable partial denture (RPD) in the lower arch seemed to neither contribute to occlusal stability and improve oral function nor prevent TMD³⁰. Conversely, Witter reported that chewing with the anterior teeth in cases of extreme SDA may lead to fatigue of the muscles and, hence, TMD³¹.

(3) TMD and unstable occlusion in intercuspal position

The conflict of opinions regarding the role of OI in TMD etiology mentioned above are mostly focused on prematurities of occlusion, such as balancing interference, and the IP-RP (Intercuspal Position—Retruded Position) relationship.

In contrast, there are some reports that showed an intimate relationship between occlusal stability and function of the masticatory system, particularly in the intercuspal position (ICP) where most of the primary masticatory functions usually take place. The occlusal instability may lead to neuromuscular disturbances and TMJ dysfunction^{32,33}.

The experimentally introduced unilateral intercuspal prematurities have shown, in general, that the postural

activity of the anterior/posterior temporal muscle was significantly increased ipsilateral to the interference and decreased on the side opposite to it. It was predicted that the asymmetry of action in all muscles under study lead to frontal plane rotation of the mandible^{14,15,16,18,19,24}. Symmetric distribution of tooth contact in ICP is desirable for optimum distribution of the closing forces and maximum tooth, jaw, and joint stability. The above-mentioned report that extreme SDA may lead to fatigue of the muscles and TMD³¹ may also give some indication of these possibilities.

2. TMD and restored dentition

Occlusal principles rule the successful prosthodontic treatment outcome, and most of these treatments affect the shape of the dental units thus interfering morphologically and functionally with the harmony of the masticatory system and its components, especially the occlusal condition.⁵ Therefore, the emergence of TMD signs and symptoms after restorative treatment is not rare.

It seems that the acute morphological alteration of the occlusal conditions as a result of restorative or prosthodontic restoration may interfere with the established functional equilibrium, disturbing the coordinated pattern and timing of jaw muscle contraction.

(1) Occlusal surface

Most restorative procedures affect the shape of the occlusal surface; however, the iatrogenic effect of dental restoration in TMD etiology had rarely been studied. A recent 15-year controlled longitudinal clinical study⁴, has examined the possible etiological significance of dental filling therapy in causing TMD. It showed that the subjects with restored dentition were likely to have more signs and symptoms of TMD, such as muscle tenderness, pain during mandibular movement, and muscular hyperactivity, than do subjects with intact dentition. This might be due to the fact that fillings were high or not contoured to the anatomical form of the tooth leading to occlusal instability. Klinberge³⁴ reported that overcontoured anterior crowns without adequate lingual concavity will direct the jaw along a retruded closing path, forcing the condyle onto a vascular innervation area that is not designed to resist pressure. In this way the condyles become more distally placed producing hyperactivity and fatigue in muscles retruding the jaw and predisposing it to inter-articular disc displacement.

(2) Anterior Guidance

Kohno and Nakano³⁵ described the relation between flat anterior guidance and the resulting jerky condylar movement. His conclusion was confirmed by Ferrario et al³⁶ who found that flat anterior guidance was significantly associated with lateral deviation of the mandible at maximum opening, with the usual development of more restricted ipsilateral working side border movement and more balancing side molar contacts. He suggested that flatter working side guidance produces unnatural stress to the joint and periarticular structures, such as the lateral pterygoid muscle. This may provoke initially a protective response leading to pathologic modification and impaired TMJ mobility. A similar correlation was also observed in another study³⁷.

(3) Occlusal Curvature

Occlusal curvature is one of the morphologically important factors in occlusion and occlusal reconstruction. It has a direct influence on cusp height and position, and their relationship to the harmony of the masticatory system. Clinically, excessive occlusal curvatures are found in some TMD patients. In a study³⁸ evaluating the functional significance of the occlusal curvature, it was found that "clicking and locking" groups had significantly greater anteroposterior and lateral curvatures than did healthy subjects.

(4) Vertical Dimension of occlusion

Increasing or decreasing of the vertical dimension of occlusion (VDO) is thought to interfere with TMD. The loss of occlusal vertical dimension, which results for instance from undercontoured posterior restoration or from restorations with different wear rates, may guide the mandible apically along the lingual concavity of the maxillary anterior teeth creating unfavorable TMJ loading on retrodiscal tissue. On the other hand, when, for example, constructing porcelain fused to metal crowns for short clinical crowns or with complete dentures, increasing VDO beyond the clinical rest position produces difficulty in mastication, speech, headache, clenching, grinding, and muscle pain (myalgia)³⁹. It seems that when increasing VDO, a moderate equal bilateral posterior vertical support and an appropriate angle of anterior guidance are very important for successful results⁴⁰.

Such physical features may apparently develop progressively as a result of dental treatment that has been inadequately performed. Minor irregularities are

accommodated by soft-tissue resiliency (periodontal and articular tissue) and are of no consequence. On the contrary, discrepancies with sufficient magnitude may produce muscle hyperactivity often accompanied by pain leading to fatigue. Articular remodeling occurs continually under these circumstances leading to deviations in the form of the condyle, disc, and eminence and may lead to further articular sounds and other symptoms. Therefore, an evaluation of possible detrimental long-term effects of all occlusal restorations is urgently needed⁴¹.

3. Prosthetic rehabilitation in patients with TMD

As a general rule, TMD is treated by a multi-disciplinary approach, and more conservative therapies are being applied such as counseling, behavioral modification, physical therapy, pharmacotherapy, and intraoral occlusal appliances. Some studies^{42,43} demonstrated that patients with a myogenous type of TMD would respond favorably to conservative methods.

But the evaluation of the effect of occlusal appliances has been changing, especially with respect to repositioning appliances.

Prosthetic rehabilitation should be performed after these conservative procedures, if needed.

(1) Prosthetic rehabilitation of an occlusal problem caused by previous treatment for TMD

Intraoral occlusal appliances are considered as crutches in the treatment of TMD. It must be kept in mind, however, that the long term use of certain partial coverage interocclusal splints, e.g., pivot splint, and anterior repositioning splint (ARS), may result in drastic occlusal changes that need to be corrected by full mouth reconstruction, fixed or removable appliances, or orthodontic treatment. There had been a commonly held clinical belief that the use of such an appliance for repositioning the mandible anteriorly would result in recapturing the disc in a therapeutic position, eliminating joint noise, and preventing any clinical dysfunction or degenerative disease. Furthermore, the resulting protrusive position of the mandible following ARS therapy should be maintained with reconstructive procedures to stabilize the recaptured disc⁴⁴.

Recently, the effectiveness of ARS in recapturing the disc has been questioned. In 1986, Manco and Messing⁴⁵ evaluated disc position using direct sagittal computed topography. They found that 41.8% of the discs evaluated were not repositioned. In an MRI

study, Kirk⁴⁶ treated 18 patients with 30 clicking joints by using a Sved-type splint that covered only the anterior segment. He reported that disc repositioning occurred in only 3 joints. In a 3-year follow up study after using ARS for the treatment of disc displacement that considered the elimination of joint sounds as criteria for a successful treatment outcome, Moloney and Howard⁴⁷ found a 70% success rate after 1 year, 53% after 2 years, and 36% after 3 years. They also reported that cases where major occlusal changes were necessary in order to maintain the protrusive therapeutic position by prosthodontic reconstruction showed 43% of recurrent joint sounds. In another study⁴⁸, disc displacement was recorded again after 6 months in 33% of the patients with mandibular repositioning onlays.

These data suggest that neither disc recapturing nor elimination of joint sounds are valuable measures for successful treatment outcome, and that they are not responsible for improving patients' symptoms. Current knowledge about the natural course of untreated symptomatic disc displacement with and without reduction has indicated that these conditions have a favorable natural prognosis^{49,50}. Other studies demonstrated favorable outcomes following treatment with simple methods⁵¹, stabilization splint therapy, or no treatment at all⁵². In cases where ARS is applied, the patient should be fully informed of all possible consequences.

(2) Prosthetic rehabilitation need for patients with recurrent TMD

Providing prosthetic rehabilitation for a patient with a history of, or recurrent TMD is not an easy task. The clinician should realize that the TMD patient does not fit the prosthetic routine and that the long-term prognosis of prosthetic treatment in such cases is unpredictable due to the possibility of recurrent symptoms⁵³. In fact, the severity of the existing TMD symptomatology is likely to influence our decision to initiate either a permanent or temporary restoration, or, alternatively, wait until the TMD problems have been controlled.

Unfortunately there are only a few published guidelines on how to proceed in these cases. Recently, in the report of the Committee on Temporomandibular Disorders, the American College of Prosthodontists⁵⁴ provided guidelines for the process of decision-making in treating patients with a history of or a present TMD condition who need prosthetic rehabilitation. The following points are given special attention:

1. It is imperative to evaluate existing articulator con-

ditions before, during, and after prosthetic therapy by an imaging technique.

2. The adjunctive therapy should be continued during or after prosthetic therapy, such as physical, pharmacotherapy, and behavioral therapy.

3. Care must be taken not to alter the treatment position. Considering fixed reconstruction, it is best accomplished with provisional restoration completed in a segmental approach to evaluate the patient's response.

4. Final fixed restoration should be cemented temporarily for an adequate period of time for reevaluation.

The decision regarding the timing of any prosthetic intervention should be subject to clinical decision making. The instability of the bite and the severity of the clinical presentation need to be considered as possible contradictions for any restorative procedure⁵⁵.

4. Conclusion

Despite the fact that there is no confirmed relation between occlusal condition and TMD, it is important to notice the role of iatrogenic factors in TMD pathogenesis. Furthermore, we should notice the importance of stable occlusion in the intercuspal position. More longitudinal controlled studies are needed for a better understanding of the relationship between dental treatments and TMD. Moreover, treatment of TMD patients should rely on evidence-based medicine, and one treatment for one disease is no longer a valid paradigm.

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