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Original Article

What types of occlusal factors play a role in temporomandibular disorders . . .? — A Literature Review —

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Recent studies and literature reviews of temporomandibular disorders (TMD) do not strongly support the role of occlusal etiologic factors. For this paper we collected and classified studies dealing with occlusion as a contributing factor to TMD through reviews, and discussions of these difficulties and possible solutions. Related articles from 275 papers covering nearly the past twenty years were selected from a prosthetic point of view and reviewed.

The validity and reliability of occlusal examinations, however, are questionable since the epidemiological studies dealt with numerous varied subjects. Although occlusal relationships, such as overbite, non-working side interferences, and discrepancy between the intercuspal position and the retruded contact position, have often been considered as contributing factors of TMD, there is no consistency among even those studies that support such an occlusal factor. A project should be initiated to create a revised, precise and practical method to determine the occlusal contact and to categorize an occlusal contact scheme. To detect whether the patients' occlusal scheme works traumatically or not should be an important part of the occlusal examination. That is, the frequency and duration of tooth contact on the occlusal scheme should be studied.

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1. Introduction

Temporomandibular disorders (TMD) or craniomandibular disorders (CMD) are a set of heterogeneous clinical conditions, characterized by pain and dysfunction of the masticatory system. Such pain in the masticatory muscles, in the temporomandibular joint (TMJ), and in associated hard and soft tissues is usually aggravated by chewing or jaw function[1]. Limitation in jaw function and sounds in the TMJ are the common signs and symptoms of TMD[2].

Direct extrinsic trauma to any component of the masticatory system, as well as other contributing anatomic, systemic pathophysiologic, and psychosocial factors are considered to reduce the adaptive capacity of the masticatory system and thus cause TMD[3]. Recent studies and reviews of literature, however, do not strongly support the role of anatomic, especially occlusal, etiologic factors in causing TMD[4–12]. Guidelines for TMD[3] suggest that occlusion is likely to be of secondary importance as a factor that exacerbates symptoms once TMD has become established for other reasons. Once teeth contact together, however, loads will be distributed on the masticatory muscles and TMJs. Thus the role of occlusal factors in TMD may not be a negligible factors although we have found no scientific data to prove this relationship.

The purpose of this review is to collect and classify studies dealing with occlusion as a contributing factor for TMD, and to discuss these difficulties and solutions.

Although there have been large number of reports and reviews concerning occlusion, we gathered related

papers by the following means.

1. Medline search: Search was done for all studies involving a relationship between TMD and occlusion from 1987 to 1998.
2. Hand searching: To gain more specific depth into the composition of the literature, papers from four major journals from 1980 to 1998 were selected; i.e., The Journal of Craniomandibular Practice, The Journal of Orofacial Pain, The Journal of Prosthetic Dentistry, and The Journal of Oral Rehabilitation.

We sometimes went back before 1980 to search for some related major publications. In all, 275 papers were found, and 54 related articles were selected from the prosthetic point of view and reviewed.

Epidemiological findings

Although many studies have investigated the epidemiology of TMD, there are only a few epidemiologic investigations that include occlusion.

Cross-sectional data obtained from 1182 Japanese high school girls aged 12 to 15 years old indicated significant associations between the occurrence of TMD symptoms and occlusal features in all the examined occlusion groups[13].

A total of 522 randomly selected patients with signs and/or symptoms of CMD were classified into one of the following diagnostic subgroups, i.e., CMD with mainly a myogenous component, anterior disk displacement with reduction, anterior disk displacement without reduction, and osteoarthrosis[14]. In conclusion, occlusal interferences were found to the same extent among patients of the four diagnostic groups and with the same incidences as reported in epidemiological studies in nonpatient groups.

One survey[15] involved 600 asymptomatic students of Mosul University (Iraq) divided into groups of 311 men and 289 women (age range from 18 to 22). The study showed that TMDs were prevalent on the chewing sides and were associated with an increased incidence of non-working side contact.

In addition, the presence of horizontal overlap was associated with an increased TMD occurrence. Overbite, the vertical relationship (overlap) of the maxillary anterior teeth to the mandibular anterior teeth, has been implicated as an important factor in the development or maintenance of TMD. The average overbite ranged from 2.65 to 3.82 mm[16,17]. Deep overbite is a vertical overlap of at least 5mm or 50% of the mandibular incisors[18,19]. A number of epidemiological studies have implicated deep overbite as a contributing factor to TMD.

Lieberman et al.[20] found a direct correlation between deep overbite and TMD symptoms in their sample of 369 subjects. Williamson[21] studied 304 college students and found that 35.2% had symptoms of TMD. All of these 107 TMD subjects had a deep overbite.

Helkimo[22] considered occlusal factors to be important in the etiology of CMD, although he found little support for his opinion from the epidemiological literature. A recent epidemiologic study[23] of clinical signs and symptoms of TMD was conducted with a probability sample of adults enrolled in a major health maintenance organization. Clinical cases showed a smaller range of vertical jaw motion, but those cases did not differ from community cases or controls with regard to the extent of lateral, protrusive, or retrusive mandibular movements, the classification of occlusion, or the range of dentally related variables.

The focus of these epidemiologic studies was on the total population rather than the individual, and their purpose was disease classification and prevention[3]. In the future studies, the individual psychologic and biographic information should be included, and classified. Furthermore, the validity and reliability of the reported occlusal examinations are questionable, because these epidemiologic studies dealt with numerous and varied subjects. Consequently, it would be difficult to discuss the relationship between TMD and occlusion from epidemiologic study. Epidemiology is the study of the factors that govern the frequency and distribution of disease or physiologic states in a community.

Clinical findings

It has become routine to state that the etiology of TMD is multifactorial. This statement is true, but not informative, since all diseases are, in principle, multifactorial. It is more useful to ask whether a certain factor is a necessary, sufficient, or nonredundant part of an effective causal complex[24]. The contribution of each factor to a particular profile of symptoms, however, is variable and differs from patient to patient[25].

Ai and Yamashita[26] classified the states of occlusions into three groups; i.e., the abnormal intercuspal position (ICP), abnormal tooth contact in the ICP, and abnormal tooth contact in the eccentric position. The results showed that differences in the frequency of tenderness were observed among the three occlusal groups.

They suggested that this could be caused by differences in muscle function according to the types of occlusal abnormalities. Muscle function programmed by occlusal irritants can cause the mandible to yaw, pitch and/or roll to accommodate to the changing occlusal characteristics. Stress induced in this way on related structures can cause degenerative changes that may aggravate the problem and alter the patients health function, and comfort [27].

Kya and Supruijt[28] showed the dental factors related to TMJ sounds in 179 respondents from the nonpatient population in Amsterdam University. They concluded that TMJ sounds are expected to be accompanied by deviations in these dental factors because of the close relationships between the different components of the craniomandibular system. Some other studies[6,7,29,30] with nonpatient groups, however, reported no significant relationship between sound and dental factors.

Tooth contacts

The relationship between number, distribution, and intensity of occlusal tooth contacts and the craniomandibular functional status was investigated in 56 subjects (aged 16 and 17), using a photoocclusal technique and clinical examination[31]. The results emphasized the importance of occlusal contacts in relation to craniomandibular function. In particular, the posterior occlusion appeared to be related to function, such as the number and load of contacts. The number of teeth appeared to have a significant association with headache, particularly when the number of teeth was decreased.

In one of the latest experimental studies[32], tooth contact sounds during open-close cycles were recorded on tape in 78 subjects, then the mean duration and rise times of each tooth contact sound were calculated. The result showed that the longest and most variable tooth contact sounds were associated with TMJ sounds.

De Laat et al.[4] found that clicking of the TMJ occurred to a higher degree when there were fewer teeth present, when a long centric was found unilaterally or bilaterally, and when there was unilateral contact in the most retruded position.

Tooth loss

Tooth loss has sometimes been considered a predisposing factor to dysfunction. The relationship between missing first molars and symptoms in adult female subjects was studied for 65 subjects with missing first molars and 67 control subjects without missing first molars[33]. The result showed that a population missing three first molars had a significantly higher incidence of headache, sinus pain, and jaw pain and a population missing one or more first molars had a tendency for a higher incidence of earache. Data from this and previous studies[34–38] suggested that the incidence of TMJ sounds among individuals having missing posterior teeth appeared to be higher when compared with that of patients whose posterior teeth were present. Although the interval of time between the loss of posterior teeth and the occurrence of TMJ sounds is not known, Barghi et al.[35] suggested that a reduction in clicking sounds took place in a rather short time after the insertion of removable partial dentures.

One hundred fifty patients with minimal 5 year histories of bilateral and unilateral missing posterior teeth were clinically examined for occurrence, types, and location of TMJ clicking[34]. A higher incidence of TMJ clicking was recorded in these patients in comparison with patients with posterior teeth. The types of clicking were appreciably different in-patients without posterior teeth. Klemetti[39] suggested that for post-menopausal women, clicking noises in the TMJ and tension in the neck were more common complaints among denture wearers than among those who still had natural teeth. Replacing all missing teeth and establishing some types of "ideal" occlusion may be desirable to avoid TMD problems. This may be due to changes in the vertical dimensions and stability of the masticatory system.

Occlusal interferences

Some studies have pointed out that occlusal interference's together with other contributing factors play an important role in the etiology of TMD[40–43]. If it is determined that the patient's occlusal scheme is a contributing factor to their TMD symptoms, the contribution of occlusion is present, making it a condition that cannot be ignored.

De Boever and Adriaens[41] stated after their study of 135 treated patients that the occurrence of prematurities on the non-working side was the only factor in the occlusion which seemed to be of some etiological significance. In fact these prematurities probably cause more changes in the muscular contraction pattern and the mandibular reflex movements than do prematurities in other jaw positions[44].

Experimental 0.5 mm high amalgam fillings were set on the maxillary right first molar and used to study interfering occlusal contacts in each of 11 individuals[45]. They showed an increased postural activity in the anterior

temporal muscle within 48 hours, and this was maintained throughout the one week experimental period. There were no significant changes in the masseter muscle, but most of the subjects developed signs and symptoms of pain and dysfunction.

Magnusson and Enbom[46] used an interesting double blind design. Bilateral balancing side interferences were applied bilaterally in one group, whereas the application was simulated in the other. The results showed that there were no simple relationships between those interferences and the signs and symptoms of dysfunction, yet, in some individuals, the addition of balancing-side interferences was sufficient to create dysfunction. They concluded that the findings underlined the importance of local factors in the etiology of mandibular dysfunction but showed that a relationship is not obligatory.

Kirveskari et al.[24] analyzed the association between occlusal interferences and CMD using a double-blind design throughout a 3-year study in 97 children. The results showed that a cross-sectional analysis in the third year disclosed a significant association between the number of interferences and the signs of CMD. They suggested that the absence of interference-free subjects in nonselected samples could be one explanation for the lack of association reported in most studies.

Tsolka et al.[47] assigned 51 patients with CMD to two groups; i.e., a mock occlusal adjustment group and an occlusal adjustment group to remove significant slides and non-working side interferences. The results showed that there were no significant differences in the improvements on the signs and symptoms obtained by either real or mock adjustment.

In a longitudinal study of 240 children and adolescents, Egermark-Eriksson et al.[48] demonstrated a relationship between sound and lateral sliding of the mandible from the retruded contact position (RCP) to the ICP. In another longitudinal study of 258 adolescents, Wanman[49] established a relationship between sound and restricted lateral jaw mobility. Unfortunately, these results are inconsistent with regard to stability over time of occlusal interferences. In some TMJ patient samples, relationships were found between TMJ sounds and tilted teeth at the contralateral side[50] or between TMJ sound and class II-1 malocclusions and the absence of slide or an asymmetric slide from RCP to ICP[51].

Although the scientific literature has not shown that occlusal problems cause TMD, clinical data do confirm that the two conditions frequently co-exist. There is no consistency, however, even in the studies that support an occlusal factor although occlusal relationships such as overbite, non-working side interferences, and the discrepancy between the ICP and the RCP have often been considered as contributing factors for TMD. This situation may be due to the lack of valid and reliable methods for evaluating occlusion as well as multifactors involving the various signs and symptoms of TMD.

Discussion

According to Clark et al.[12], the studies reviewed concerning the relationship of occlusion to TMD are neither convincing, powerful, nor practical enough to allow any recommendations for making a causal association.

The guidelines of TMD[3] regard the papers with no definite criteria for control groups as worthless, and only the results obtained with strict conditions as reliable; however, it is quite difficult to satisfy such strict conditions in the clinical studies that deal with patients. Therefore, in addition to efforts to clarify comparisons with control groups and conditions as strictly as possible, deduction which searches for truth by collecting and classifying such study results would be required.

Berry and Singh[52] recorded the location and severity of occlusal contacts in the morning and the evening on 3 separate days for 10 women. The findings suggested that occlusion and occlusal contact changed throughout the day and depended on the physical states of the masticatory muscle and the mental state of the patient. Furthermore, Molligoda et al.[53] reported that recording occlusal contacts at intervals during the day seemed to yield a constant finding that the number of occlusal contacts decreased during the day and at the end of the day. These experimental findings have served to strengthen the feeling that the occlusion is far from stable.

Ogawa et al.[54] recommended resolving the following problems in order to describe and classify the patterns of occlusal contact:

1. A clear description regarding nonworking side contact, including a clear and modified definition of balanced occlusion.
2. Consistency of the lateral position when occlusal contact is examined.
3. How to deal with contact patterns, such as single tooth contact on other than canines in a total range of lateral excursion.

Thus, a revised, precise, and practical method to

determine the occlusal contact and categorization of the occlusal contact scheme should be initiated. To detect whether each patient's occlusal scheme works traumatically for themselves should be an important part of the occlusal examination. That is, the frequency and duration of tooth contact on the questionable occlusal scheme should be studied. Knowledge of occlusion, both functionally and individually, may provide a basis for better understanding of occlusion as a factor of TMD.

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