OCCLUSION IN PATIENTS WITH TEMPOROMANDIBULAR JOINT ANTERIOR DISK DISPLACEMENT

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SUMMARY – The aim of this study was to determine the correlation between the static and dynamic occlusal factors in patients with anterior disk displacement (DD) and to compare it with occlusion in asymptomatic individuals. The study included a group of 40 patients with DD (median age 35.5) and a control group of 25 students of dental medicine (median age 23.4). In all subjects, the position, i.e. DD was determined by magnetic resonance imaging of temporomandibular joints. The study was focused on data gathered by direct analysis of occlusion: relationship between the molars (Angle class), horizontal and vertical overlap, preservation of occlusal contacts between the molars (Eichner classification), difference between contact points in maximal intercuspidation and centric position, and contact points on the laterotrusive and mediotrusive side. There was a statistically significant difference in tooth contact in maximal intercuspidation and centric positions between patients and asymptomatic subjects ($p<0.0001$). There was also a difference between occlusal contact points on the mediotrusive side ($p<0.05$) since the hyperbalanced contacts were only determined in asymptomatic subjects. Study results support the fact that a number of occlusal factors are related to DD. The fact that hyperbalanced contacts were only determined in asymptomatic subjects suggests that their mutual etiopathogenetic correlation is not quite clear.

Key words: *Temporomandibular joint disorders – etiology; Temporomandibular joint disorders – diagnosis; Dental occlusion; Magnetic resonance imaging*

Introduction

Temporomandibular disorders (TMDs) include a number of clinical conditions of arthrogenic and myogenic disorders in the orofacial region. Anterior disk displacement (DD) is one of the TMDs the study of which has considerably expanded by use of magnetic resonance imaging (MRI). Since the interarticular soft tissues can be clearly seen, it is possible to evaluate the correlation between clinical symptoms and radiological signs of DD[1,2].

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Received July 15, 2008, accepted August 18, 2008

The concept of occlusion and occlusal treatment is an essential part of dental treatment, and specific correlation between occlusion and temporomandibular joints (TMJs) is indisputable. Current approaches to defining occlusion in etiopathogenetic models of TMD development are compatible. DeBoever and Carlsson[3] classify etiologic factors into three groups: anatomic (occlusion and TMJ), neuromuscular and psychosomatic. In a similar way, American Academy of Orofacial Pain[4] defines the following factors as traumatic, anatomic, pathophysiological and psychosocial. The multifactorial etiology includes a large number of etiological factors which can have different relative significance in each individual case, so that risk factors are more often mentioned. Either anatomic or structural factors belong to a group of predisposing factors such as either compromised occlusal relations or inappropriate prosthodontic treatment[5,6].

In clinical practice, the correlation between occlusal factors and signs and/or symptoms of TMDs, in particular tooth loss or insufficient restorations of anterior teeth, has been widely accepted[7-10]. Results of the studies on the basis of which the causal role of occlusal factors in the development of TMDs, DD in particular, has been postulated, are controversial[11-25].

The aim of the present study was to determine the correlation between occlusal factors in patients with clinically and MRI confirmed DD, and to compare it with asymptomatic subjects.

Subjects and Methods

The study was carried out in a group of 40 patients with DD (median age 35.5, range 15-71) and a control group of 25 dental medicine students (median age 23.4, range 21-27) that presented to Department of Prosthodontics, School of Dental Medicine, University of Zagreb in Zagreb, during the 2001-2004 period.

The diagnosis of arthrogenic TMD was based on patient medical history and clinical examination using standardized methods contained in the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and supplemented by manual functional analysis. The need of initial therapy was also indicated[26,27]. The need of active TMD treatment was assessed according to clinical symptoms and signs of the disorder: arthrogenic pain or arthrogenic and myogenic temporomandibular pain, restricted irregular and painful mobility of the mandible, and presence of pathologic sounds in the TMJ. Definitive evaluation to confirm DD (diagnosis of DD either with or without reduction) was made by MRI at Clinical Department of Diagnostic and Interventional Radiology, Sestre milosrdnice University Hospital.

In the control group, clinical symptoms and signs of TMDs were excluded by both patient history and clinical examination, thus excluding the need of active or passive treatment[26,28].

Occlusion analysis

Clinical examination included direct analysis of dental status along with static and dynamic occlusal relations. Partial edentulousness by Eichner classification was determined based on dental status and subsequently modified by inclusion of the teeth replaced by prosthetic appliance. The sum of lost teeth and/or posterior upper and lower teeth replaced by prosthetic appliance (premolars and molars apart from third molars) was particularly noted. Prosthetic appliances, if there were any, were included into dental status, for each jaw accordingly: minor fixed prosthetic appliance (in one quadrant), major fixed prosthetic appliance (in two quadrants of teeth alignment), partial denture, a combination of fixed prosthetic appliance, and partial denture as well as complete denture.

Static occlusal factors in anteroposterior plane indicated Angle class, which was based on occlusal relation of permanent first molars. Horizontal overlap of central incisors was measured. Relation of anterior teeth was evaluated as normal overlap of upper incisors over lower incisors, tête-à-tête occlusion and reverse overlap. Adequacy of the medial line of dental arches was measured in transverse dimension. Vertical dimension was determined by vertical overlap of central incisors along with the presence of posterior or anterior open bite. Measurements were expressed in millimeters. Occlusal vertical dimension (OVD) was evaluated as existing or reduced according to the number of natural teeth and the condition of prosthetic appliances.

Dynamic occlusal factors included investigation of difference between tooth contacts in maximal intercuspidation as well as in centric (or retruded intercuspal) position of the mandible. Occlusal relation at laterotrusive movements of the mandible was analyzed as follows: bilaterally by the canine and/or anterior teeth, bilateral group guidance, mixed guidance by the canine and/or anterior teeth and group guidance on the other side, unilateral guidance on posterior teeth without contact with the canine and/or anterior teeth, bilateral guidance on the posterior teeth without the canine and/or anterior teeth and the absence of laterotrusive contacts due to hyperbalanced contacts on mediotrusive sides. The following contacts were determined on the mediotrusive side of the movement: bilateral contacts, unilateral contacts, without any balanced contacts, unilaterally and bilaterally present hyperbalanced contact which impedes contacts on laterotrusive sides.

Statistical analysis

Statistical data analysis was made by the Statistica and SAS programs. Frequencies were graphically presented. The frequency of analyzed variables was shown in tables with minimal and maximal values, mean value and standard deviation. The measured metric analysis values were shown by whisker plot presentation. Box was defined by the first and third quartiles, median is the horizontal line in the box, and all measured values apart from those in non-outlier range were defined by whiskers. The outliers were placed beyond the limits. Different non-parametric analytical procedures were used (Kruskal-Wallis test, Fisher exact test). A significant difference on statistical analysis was 5% and 1%.

Results

There was no statistically significant difference in the frequency of Angle class I in the anteroposterior plane between the group of asymptomatic subjects and DD patients (Fisher exact test, p=0.095) (Fig. 1). Normal overlap of upper incisors was found in all asymptomatic subjects, whereas three (7.5%) DD patients had incisal occlusion. Six (15%) DD patients and two (8%) asymptomatic subjects had unilateral posterior crossbite, and only one DD patient had bilateral crossbite.

There was no statistically significant difference in the values of horizontal overlap of central incisors (Kruskal-Wallis test KW(1.65)=0.146; p=0.703) (Fig. 2a), vertical overlap of central incisors (Kruskal-Wallis test KW(1.65)=0.335; p=0.563) (Fig. 2b) and lack of concordance of dental arch medial line (Kruskal-Wallis test KW(1.65)=1.733; p=0.188) (Fig. 3) between asymptomatic subjects and DD patients.

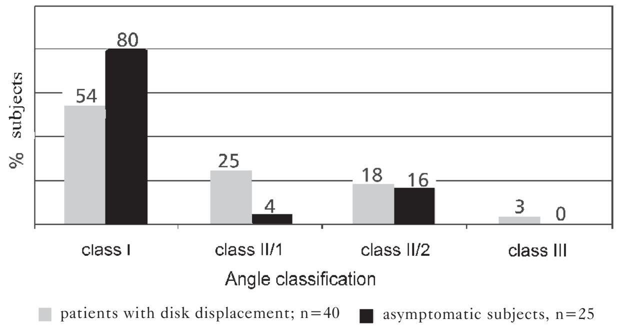

Fig. 1. Distribution of patients with disk displacement and asymptomatic subjects with Angle classification of anteroposterior tooth relations.

Only one (2.5%) DD patient had anterior and posterior open bite each, whereas one (4%) asymptomatic subject had anterior open bite.

OVD was preserved in 12 (30%) patients with DD. Reduced vertical dimension was recorded in elderly patients and none of patients from the youngest age group, which was statistically significant (Fisher exact test, $p=7x10^{-5}$) (Fig. 4). There was no statistically significant difference according to any single diagnosis of DD (Fisher exact test, p=0.216).

The distribution of patients with DD according to modified Eichner classification by which the condition

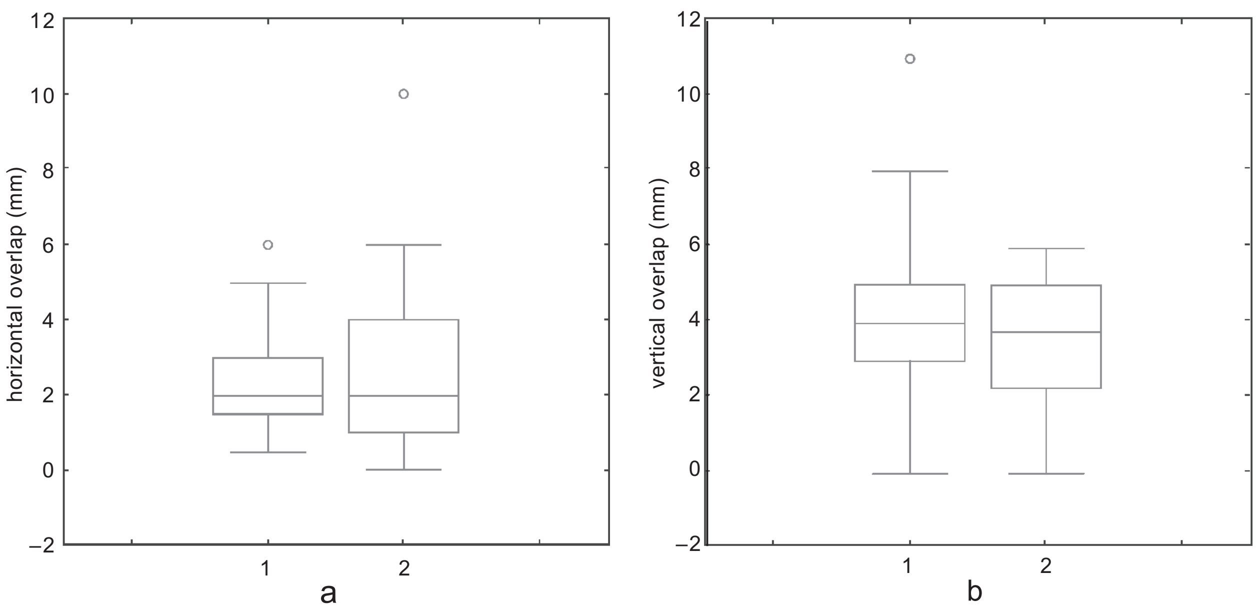

Fig. 2. Comparison of the incisor horizontal overlap (a) *and vertical overlap* (b) *in asymptomatic subjects (1) and patients with disk displacement (2).*

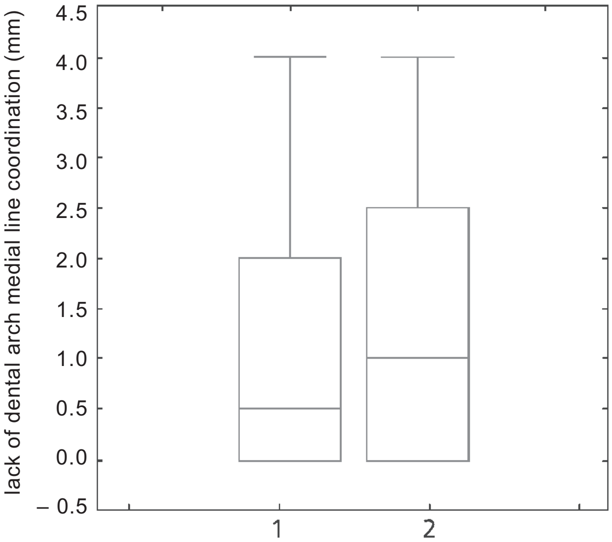

Fig. 3. Comparison of the lack of dental arch medial line coordination in asymptomatic patients (1) and patients with disk displacement (2).

of occlusion with the existing prosthetic appliances of any kind was taken into consideration was as follows: class I, 27 (67%) patients; class II, 12 (30%) patients; and class III, 1 (3%) patient. The majority of patients had preserved antagonistic occlusal contacts. All asymptomatic subjects belonged to Eichner class I and had preserved OVD.

Comparing patients with discopathy classified by Eichner and vertical occlusal dimension yielded a higher prevalence of class II patients with reduced OVD, which was statistically significant (Fisher exact test, $p=1.8 \times 10^{-5}$) (Fig. 5).

There was a statistically significant difference (Kruskal-Wallis test $KW(1.65)=23.486$; $p<0.0001$) (Fig. 6) in tooth contacts in habitual (maximal intercuspidation) and centric position (centric relation) between asymptomatic subjects and patients with DD. Twelve (30%) DD patients and one (4%) asymptomatic subject had uneven, i.e. unilateral occlusal contacts between antagonistic teeth in maximal intercuspal position.

In both groups, the highest frequency of canine guidance/anterior teeth was recorded on the laterotrusive side (Fig. 7a), whereas a statistically significant difference between the two groups of subjects was found on the mediotrusive side (Fisher exact test, $p=0.0036$) (Fig. 7b).

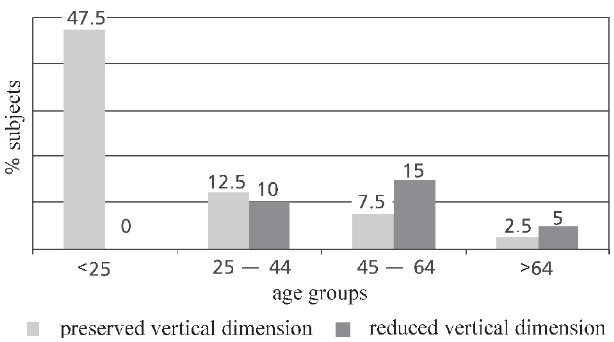

Fig. 4. Distribution of patients with disk displacement according to age groups and preservation of occlusal vertical dimension.

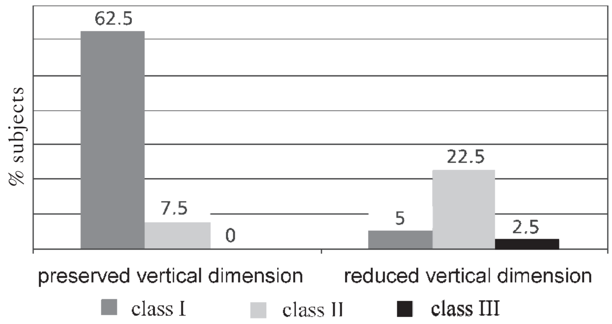

Fig. 5. Distribution of patients with disk displacement according to Eichner classification and preservation of occlusal vertical dimension.

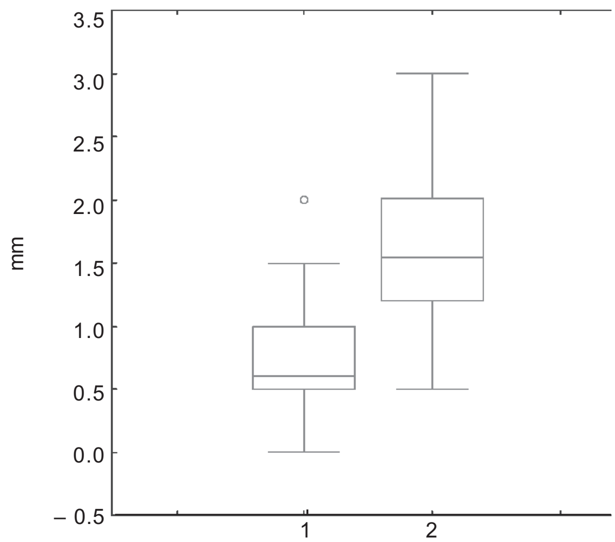

Fig. 6. Difference in tooth contacts between intercuspal (habitual) and centric position in asymptomatic patients (1) and patients with disk displacement (2).

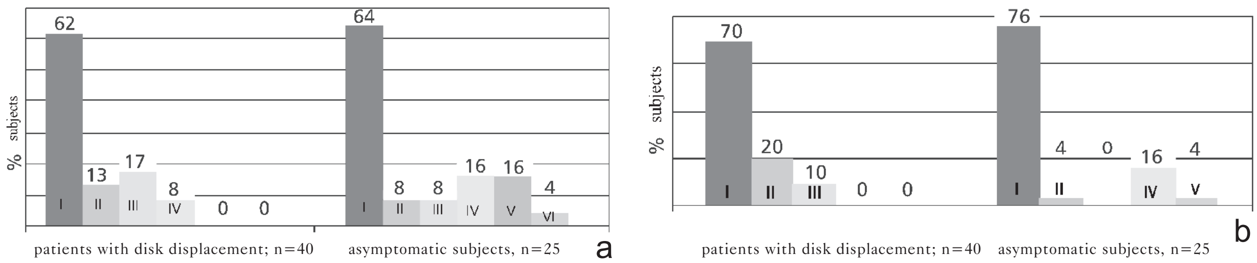

Fig. 7. (a) Distribution of dynamic occlusal tooth contacts (types of guidance) on the laterotrusive side in patients with disk displacement (DD) and asymptomatic subjects (I, bilaterally by canine/anterior teeth; II, bilateral group guidance; III, mixed guidance by canine/anterior teeth; IV, guidance by posterior teeth; V, hyperbalance unilaterally; and VI, hyperbalance bilaterally); (b) distribution of dynamic occlusal tooth contacts (types of guidance) on the mediotrusive side in patients with DD and asymptomatic subjects (I, without any balanced contacts; II, unilaterally balanced contact; III, bilaterally balanced contact; IV, hyperbalance unilaterally; and V, hyperbalance bilaterally).

Discussion

Epidemiological studies show the prevalence of TMD signs or symptoms in adolescence to be between 35% and 62%; however, the most common symptoms are clinically mild and usually without pain in the TMJ area, thus obviating any treatment modalities[29]. The incidence of TMDs is highest at the age between 18 and 40. The prevalence is also higher in female population (80% of cases)[30]. Both of these tendencies were confirmed in our study population. Also, a number of studies in adult asymptomatic subjects confirmed the relatively higher prevalence of asymptomatic DD, ranging between 18% and 45%[31]. In our control group that included young subjects with good oral health, the prevalence of DD involved TMJ was 20%.

Occlusion ensures orthopedic stability of TMJ, while occlusal stability is ensured by mutual antagonistic contacts in maximal intercuspal position[6]. Almost half of interviewed Swedish dentists believed it was necessary to replace molars due to the risk of developing TMD and masticatory function compromise[7].

In their clinical studies, Tallents *et al*.[8] found evidence for the loss of molars to affect DD. Rammelsberg[9] found inappropriate restorations on posterior teeth to be a risk factor for the development of DD. Peroz[10] found close relationship between Eichner classification and clinical diagnosis of TMJ discopathy. Sarita *et al*.[11] could not find any correlation between the loss of posterior teeth and occurrence of clinical signs and symptoms of TMD. In the present study, there was no significant frequency of inappropriate prosthetic care and Eichner classification in the patient group.

Occlusion classified by Angle is considered to be insufficiently specific to correlate malocclusion with the pathophysiology of TMD[12]. The results of this study showed no statistical significance of Angle classes between patients with discopathy and asymptomatic subjects. Nevertheless, Fushima *et al*.[13] found a higher prevalence of Angle class II in symptomatic subjects. Matsumoto *et al*.[14] found no difference between patients with normal occlusion and those with malocclusion. Malocclusion implied Angle class II, horizontal overlap larger than 3 mm, deep vertical overlap and anterior or posterior crossbite. Gesch *et al*.[32] found that only bilateral open bite up to 3 mm appeared to be associated with TMD and it occurred in only 0.3% of study subjects. In the present study, only two patients and one asymptomatic subject had anterior or posterior open bite.

This study pointed to the importance of statistical difference in intercuspal position and centric relation between DD patients and asymptomatic subjects. This aspect of occlusal relations is considered to be a very important dynamic factor related to TMD[15-17]. Ciancaglini *et al*.[18,19] found no explicit correlation between unilateral and asymmetric occlusal contacts and TMD. Pullinger and Seligman[33] found large discrepancy between intercuspal position and centric relation as a potential risk factor for the development of TMD symptoms. Kahn *et al*.[20] found a horizontal overlap greater than 4 mm to be more common in DD patients. Although the results of the present study were confirmed by MRI, there were no differences between patients and asymptomatic subjects. In their epidemiologic study, Ćelić *et al*.[21,22] found no statistical difference between patients with vertical and horizontal overlap greater than 5 mm and control subjects.

The importance of occlusal interferences has been differently understood regarding the etiopathogenesis of TMD. LeBell *et al.*[23,24] found that artificial interferences did not stimulate the development of dysfunctional symptoms in asymptomatic subjects. The fact is that asymptomatic subjects successfully adapt to dysfunctional symptoms. By contrast, interferences stimulated a large number of recurrent symptoms in patients with TMD. These studies support the idea that interferences are not an etiologic factor for TMD development. This explains why in the present study there was a significantly higher prevalence of hyperbalance and interference contacts in asymptomatic subjects as compared with DD patients.

Specific changes in observing peripheral stimuli in the central nervous system can reduce tolerance threshold to altered or unfavorable occlusal relations. Hypervigilance is related to fibromyalgia and hypersensitivity to sensory stimuli[34,35].

Statistical correlation with the development of TMDs was determined by unifying static and dynamic occlusal factors. Anterior open bite, Angle class III, crossbite and contacts on the nonworking side cannot be considered as apparent causes of TMDs[25] due to a low correlation coefficient, which has been confirmed by reviewing most recent literature data on occlusion and TMDs[36-38]. A synchronous development of both TMJs and occlusion in the stomatognathic system is unclear in relation to the development of occlusal prematurities that cause TMD. Occlusion has a possible impact on TMD only in individual cases[39].

It is very difficult to determine what occlusion is related to because of a large number of factors of static and dynamic occlusion, which can be considered a mutually independent factor and due to the fact that certain symptoms are used instead of actual diagnoses of TMDs[40]. In the present study, the diagnosis of DD was made in each individual patient and confirmed by MRI as the diagnostic gold standard[41].

It is difficult to confirm the individual causal relationship between the potential etiopathogenetic factors because each of them can have different significance in different patients, which is the main problem in TMD diagnosis. Certain factors can have different relative significance in an individual case, therefore risk factors are more commonly mentioned[6,42].

Conclusion

In conclusion, occlusion is considered to be the possible etiopathogenetic factor of TMDs but the relationship among factors is complex and their mutual correspondence has not been completely clarified. An unexpected statistically significant difference between the maximal intercuspal position and centric position as well as the frequency of hyperbalanced occlusal contacts on the mediotrusive side between patients and asymptomatic subjects were recorded. There was a greater difference in tooth contacts between maximal intercuspal position and centric position in patients than in asymptomatic subjects ($p<0.0001$). A statistically significant difference was also found for occlusal contacts on the mediotrusive side ($p<0.05$) because hyperbalance was only found in asymptomatic subjects.

Acknowledgment. This paper is part of the scientific projects 065-0650445-0441 and 065-0650448-0438 supported by the Ministry of Science, Education and Sports, Republic of Croatia.

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Sažetak

OKLUZIJA U BOLESNIKA S PREDNJIM POMAKOM PLOČE TEMPOROMANDIBULARNOG ZGLOBA

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Cilj studije bio je utvrditi korelaciju između statičnih i dinamičnih okluzivnih čimbenika u bolesnika s prednjim pomakom ploče temporomandibularnog zgloba te ih usporediti s okluzijom kod asimptomatskih osoba. Istraživanje je provedeno u skupini od 40 bolesnika s prednjim pomakom ploče (medijan dobi 35,5 godina) i kontrolnoj skupini od 25 studenata stomatologije (medijan dobi 23,4 godine). Kod svih ispitanika je položaj, tj. pomak ploče određen magnetskom rezonancom temporomandibularnih zglobova. Studija je bila usredotočena na podatke prikupljene izravnom analizom okluzije, koja je obuhvaćala slijedeće: odnos između molara (Angleova klasa), vodoravno i okomito preklapanje, očuvanje okluzivnih kontakata između molara (Eichnerova klasifikacija), razliku između kontaktnih točaka kod maksimalne interkuspidacije i centrične pozicije, te kontaktne točke na laterotruzivnoj i mediotruzivnoj strani. Zabilježena je statistički značajna razlika u zubnom kontaktu između maksimalne interkuspidacije i centričnih pozicija između bolesnika i asimptomatskih ispitanika ($p<0,0001$). Razlika je isto tako zabilježena između točaka okluzivnog kontakta na mediotruzivnoj strani ($p<0,05$), jer su hiperbalansirani kontakti utvrđeni samo kod asimptomatskih ispitanika. Rezultati ove studije govore u prilog tome da su mnogi okluzivni čimbenici povezani s pomakom ploče. Činjenica da su hiperbalansirani kontakti utvrđeni samo kod asimptomatskih ispitanika ukazuje na to da njihova uzajamna etiopatogenetska korelacija nije sasvim jasna.

Ključne riječi: *Bolesti temporomandibularnog zgloba – etiologija; Bolesti temporomandibularnog zgloba – dijagnostika; Zubna okluzija; Prikaz magnetskom rezonancom*