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# Influence of occlusal characteristics on temporomandibular joint disorder development –a cross-sectional study

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**Abstract.** Objective: This study aimed at assessing occlusal characteristics and their relation with sign and symptoms of temporomandibular joint disorder in a population group. Material and methods: Two hundred thirteen fourth year dental medicine students (mean age of 23±4.24 years) were evaluated according to Research Diagnostic Criteria for Temporomandibular joint Disorder form, but the examination also included additional procedures. Results: Pain in the oro-facial muscles was more frequent in female patients comparing to males. Articular and muscular pain is more frequent among subjects with interferences during the slide between Centric Relation and Maximum Intercuspation (articular p=0.038, OR 3.089, CI 95%, 1.066-8.954), muscular p=0.045, OR 3.771, CI 95%, 1.031-13.793). They can determine contractions of the masticatory muscles, affecting more often trapezius muscle (p=0,04), lateral pterygoid muscle (p<0.001), SCM (p=0.003) or milohyoid (p<0.001). A higher probability for joint clicks development is encountered in cases with accentuated Wilson curve (p=0.014, OR 17.285, CI 95%, 1.774-168.454). Conclusions: Occlusal characteristics can influence the articular and muscular status in the oro-facial area. These results indicate that clinicians should pay special attention to the temporo-mandibular joint status of patients with abnormal Spee or Wilson curves or presenting interferences during the slide from centric relation to maximum intercuspation.

**Key Words:** temporomandibular joint dysfunction, occlusal features, articular pain, muscular pain.



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## Introduction

Signs of temporomandibular disorders firstly appear in about 60–70% of the general population and yet only about one in four people with signs are actually aware of or report any symptoms (Landi et al 2004; Wang et al 2012).

The most disturbing feature in temporomandibular joint disorder is pain, followed by restricted mandibular movement, which can cause difficulty eating or speaking, and noises from the temporomandibular joint during jaw movement (Landi et al 2004). Temporomandibular joint disorders can detriment quality of life, because the symptoms can become chronic, difficult to support, affecting professional performances and vitality. Their etiology and pathogenesis are poorly understood, so control of temporomandibular joint diseases is difficult and symptomatic treatment is usually recommended. In diagnosed cases invasive surgical therapy has too many risks to become a current treatment solution (Pullinger et al 1993; Sipila et al 2012). Therefore understanding the etiology of temporomandibular joint disorder is extremely important in identifying and avoiding potential pathologic factors.

The occlusal factors and their association or contribution in temporo-mandibular joint disorder were and still are a debate subject in the communities of researchers. Most authors consider occlusal anomalies as a fundamental factor in causing the symptoms, while other studies suggest that occlusal dysfunctions represent only one of the numerous factors associated with temporomandibular joint disorder (Landi et al 2012; Pullinger et al 1993; Sipila et al 2012).

The occlusal factors must be analyzed both static and dynamic. Most of the studies carried out until now evaluated the static occlusal relationships, analyzing the degree of involvement in the etiology of TMD as isolated factor. Pullinger, Seligman and Gornbein realized a multifactorial analysis in order to determinate the degree of influence of each occlusal factor in association with other factors. Eleven occlusal factors were taken into consideration, being compared patients with signs and symptoms of TMD, with a group of healthy subjects. The authors concluded that many occlusal parameters, traditionally considered with increased influence in appearance of TMD, actually have little contribution in developing this disease, dental occlusion therefore cannot be considered the most important etiologic factor in TMD (Pullinger et al 1993).

Several epidemiological studies have identified an association between facial pain and/or TMD and different forms of occlusal dysfunction such as medialized occlusion, cross occlusion,

anterior open bite, deep occlusion, malocclusion class II and III Angle (Celic et al 2002; Schmitter et al 2007).
This study aimed to asses occlusal characteristics within a population group and to analyze their correlation with muscular and articular signs and symptoms in the oro-facial region corresponding to temporo-mandibular joint disorder. The multivariate analysis in this study evaluated parameters of static occlusion and few eccentric movements, representing the traditional approach of examining the occlusal relationships.

# Material and methods

Two hundred thirteen fourth year dental medicine students were included in the study, mean age of 23± 4.24 years, 124 female (58.2%) and 89 male (41.8%).
The examiners, trained according to the specification of Research Diagnostic Criteria for Temporo-Mandibular Joint Disorder, collected the clinical data using measurements and clinical examination charts structured in order to determine occlusal, muscular, and TMJ status of subjects included in the study.
The examination protocol followed the structure RDC/TMD but also included additional procedures, as presented bellow.

**Mandibular movements**

Four mandible movements were analyzed: maximum mouth opening, left laterality movement, right laterality movement, propulsion, evaluating the amplitude (normal, decreased, increased) determined with a ruler. The mouth-opening path was also evaluated and classified as straight, diverted or sinusoidal.

**TMJ examination**

Examiner has placed the index at the TMJ level right and/ or left by asking the patient to make movements of opening and closing the mouth. Information about the presence of pain (on a scale from 0 to 3, 0- no pain, 1-mild pain, 2-moderate pain, 3-severe pain), clicking joints and crepitus were noted.

**Muscle palpation**

Masticatory muscles were palpable under digital pressure. Temporal muscles, masseter muscles, medial pterygoid muscles, lateral pterygoid muscles, milohyoid muscles, trapezius muscles, sternocleidomastoid muscles (SCM), aiming at presence of pain at palpation (scale 0-3, 0- no pain, 1-mild pain, 2-moderate pain, 3-severe pain) and/or of muscle contraction.
Occlusal examination. In the monomaxillary examination the characteristics of Wilson and Spee curves have been evaluated, on the left and right hemiarches (normal, accentuated, reversed, horizontal).
Examination of the occlusion was performed, observing either the coincidence between the maximum intercuspation and centric relation (Point Centric) or the presence of a slide between the two positions (Long Centric).
Dynamic occlusal relationship was evaluated during propulsion, medio and laterotrusion movements, observing the type of guidance, (propulsion- functional, nonfunctional, laterality-group guide, antero-lateral or canine) and the presence of interference or premature contacts. To examine the occlusion, articulating paper was used (200 microns, Bausch articulating paper Inc, Nashua, NH, USA).
The study protocol was analyzed and approved by the Ethics Committee of "Iuliu Haţieganu" University of Medicine and Pharmacy Cluj-Napoca (no. 741/12.04.2013). Written informed consent was provided by all the study individuals.
Statistical analysis was performed using the MedCalc Statistical Software version 15.2.1 (MedCalc Software bvba, Ostend, Belgium). Nominal data was characterized by frequency and percent. Quantitative data was expressed as mean and standard deviation. The following tests were used when appropriate: chi-square test, Student t-test. Binary logistic regression was used for multivariate analysis. The level of significance was considered at $p<0.05$.

# Results

Mean age of the subjects with muscular pain in oro-facial area was 23 years ($p=0.01$) and for joint clicks was 22.9 years, ($p=0.006$). No significant relation between age and TMJ pain could be establish (Table 1).
During mouth opening, most of the subjects (206 (96.7%)) presented normal amplitude of the condylar movement. Pain in the oro-facial muscles was more frequent in females (n=40 (32%)), comparing with 16 males that presented these symptoms ($p=0.03$) (Table 2).
From all subjects, 50 women (40%) presented joint clicks, comparing with 22 (24.7%) men.
No correlation could not be established between patients' gender and presence of joint pain ($p=0.6$), clicks ($p=0.2$), crepitus ($p=0.8$), or bruxism ($p=0.7$).
Bruxism was diagnosed in 39 patients, more common in women (n=22 (56.4%) than men (n=17 (43.6%)).
Among subjects with joint pain, in 3 (15%) cases, the contraction of the masseter muscle was associated, the results being statistically significant ($p=0.03$). TMJ pain was accompanied by the trapezius muscle contracture on the same side, having an intensity between 3 and 5 (on a 0-10 scale, $p=0.01$), medial pterygoid muscle on the same side ($p=0.001$), with the contraction of SCM ipsilateral ($p=0.003$), correlations being statistically significant.
The joint pain was strongly correlated with the presence of TMJ clicks on the same side ($p<0.001$).
For 56 (26.3%) subjects, muscular palpation revealed pain in at least one muscle in oro-facial region.
The decrease in mouth opening is significantly correlated with pterygoid muscle contraction ($p=0.03$).
The quality of mouth opening movements (sinusoidal, diverted or straight path) could not be associated with contractures of the masticatory muscles. The sinusoidal or diverted path during mouth opening was identified more frequently at subjects that also presented joint clicks (sinusoidal at 10 (27%), and deviated at 22 (28%) of the patients with clicks).
Among patients with TMJ crepitus, 2 (5%) also presented sinusoidal mouth opening and in only one case a diverted path was emphasized ($p=0.001$).
Spee curve's analysis revealed that in cases with changes of normal curve anatomy, masticatory muscles contraction was associated. In cases with accentuated Spee curve, the contraction of the masseter muscle ($p=0.03$), milohyoid muscle ($p=0.002$) or trapezius muscle ($p=0.001$) can be encountered. A modified

Table 1. Sex distribution of the sample on TMD and non TMD subjects regarding TMJ pain, Oro-facial muscle pain, joint clicks and joint crepitus

| N (%) subjects | TMJ pain | | Oro-facial muscular pain | | Joint clicks | | Joint crepitus | |
|---|---|---|---|---|---|---|---|---|
| | Women | Men | Women | Men | Women | Men | Women | Men |
| DTM | 13 (10) | 7 (7.9) | 40 (32) | 16 (18) | 50 (40) | 22 (24.7) | 5 (4) | 8 (9) |
| Non DTM | 111 (90) | 82 (92.1) | 116 (68) | 83 (72) | 77 (60) | 64 (75.3) | 120 (96) | 82 (91) |
| P | 0.6 | | 0.03 | | 0.02 | | 0.2 | |

Table 2. The correlation between occlusal characteristics and muscular or articular pain

| Pain | Muscular | | | | Articular | | | |
|---|---|---|---|---|---|---|---|---|
| | P | OR | 95% C.I. for OR | | P | OR | 95% C.I. for OR | |
| | | | Lower | Upper | | | Lower | Upper |
| Long-centric | 0.513 | 1.258 | 0.632 | 2.507 | 0.493 | 0.667 | 0.21 | 2.123 |
| RC/IM interference | 0.038 | 3.089 | 1.066 | 8.954 | 0.045 | 3.771 | 1.031 | 13.793 |
| Propulsive interference | 0.869 | 0.947 | 0.497 | 1.806 | 0.572 | 0.754 | 0.284 | 2.007 |
| Lateral interference | 0.211 | 1.933 | 689 | 5.424 | 0.764 | 0.814 | 0.213 | 3.116 |

Table 3. Characteristics of Wilson curve and masticatory muscles

| N (%) subjects | Wilson Curve | | | | P |
|---|---|---|---|---|---|
| | Normal | Accentuated | Horizontal | Reversed | |
| Medial pterygoid | 2 (1.2) | 1 (4.8) | 1 (5.9) | 0 | 0.05 |
| Lateral pterygoid | 3 (1.8) | 1 (4.8) | 2(11.8) | 0 | 0.05 |
| Sternocleidomastoid | 1 (0.6) | 2 (9.5) | 1 (5.9) | 0 | 0.001 |
| Mylohioid | 1 (0.6) | 1 (5) | 0 | 1 (16) | 0.01 |

Spee curve (horizontal, accentuated or reversed) can also determine SCM contraction (p=0.01).

Patients with joint sounds presented more often a horizontal Spee curve (77 patients (51%)).

Masticatory muscles are influenced by the characteristics of the Wilson curve. Thus changes in the monomaxillary normal occlusal architecture, in the side, in frontal plane (Wilson curve accentuated, reversed or horizontal) can cause significant contractions in medial pterygoid muscles, lateral pretygoid muscles, SCM and milohyoid muscles (Table 3).

The presence of joint sounds was frequently associated with a normal Wilson curve. A horizontal curve was observed in 8 cases, 1 accentuated in 8 cases and 1 reversed in 6 patients with joint clicks.

Most of the examined subjects presented an anterior slide between RC and IM 149 (69,9% patients with long-centric), and 66 (30.9%) presented point-centric.

The type of the rapport between Centric Relation and Maximum Intercuspal position (point centric or long centric) does not influence the presence of the muscular contractures. The patients with long centric present more often joint clicks than those with point-centric (p=0.05).

The interferences on the path between Centric Relation and Maximum Intercuspal position may have as a consequence, contractions of the masticatory muscles, affecting more often trapezius muscle (p=0,04), lateral pterygoid muscle (p<0.001), SCM( p=0.003) or milohyoid (p<0.001).

The laterotrusion movement was supported in most of the cases by canine (canine guidance on the left in 147 (69%) cases and on the right in 142 (66.6%) cases). The type of lateral guidance can determine contractions of the masticatory muscles. Antero-lateral guidance was more often associated with milohyoid contraction (p=0.05). The subjects with canine guidance (left canine guidance 35 subjects (25 %), right canine guidance 31 subjects (21%)) presented more often joint clicks than those with antero-lateral or group guidance.

Premature contacts or interferences in laterotrusion did not influence masticatory muscles, but could be associated with TMJ clicks on the same side (26 patients (29%)) (Table 4).

## Discussion

In the current study we observed that pain, both in TMJ and musculature, was identified more often among females than males. The higher prevalence of joint clicks among women comparing to men, was also noticed. The results are consistent with those obtained by Manfredini, who presented a ratio of 5:1 between women and men for prevalence of symptoms from TMD (Manfredini et al 2010). The differences of perception and tolerance of pain between the two genders are due to the interaction of biological factors (the influence of oestrogen hormones, genetic factors), psychological and sociocultural factors.

Muscular and/or joint pain usually appeared on the same side with the joint click but did not respect the ipsilateral localization of the interference. Similar results were obtained by Fuji who investigated in a study the relationship between the localization of the occlusal interferences and the occurrence of facial pain, concluding that there is not a statistically significant connection between those two (Fuji et al 2003).

Table 4. Multivariate analysis of occlusal characteristics and presence of joint clicks

| Joint clicks | P | OR | 95% C.I. for OR | |
|---|---|---|---|---|
| | | | Lower | Upper |
| **RC/IM interferences** | 0.111 | 0.178 | 0.021 | 1.484 |
| **Accentuated Spee curve** | 0.82 | 0.766 | 0.077 | 7.599 |
| **Horizontal Spee curve** | 0.645 | 0.753 | 0.225 | 2.52 |
| **Reversed Wison Curve** | 0.661 | 1.295 | 0.408 | 4.11 |
| **Horizontal Wilson curve** | 0.986 | 0.987 | 0.232 | 4.192 |
| **Accentuated Wilson curve** | 0.014 | 17.285 | 1.774 | 168.454 |
| **Canine guidance** | 0.2 | | | |
| **Antero-lateral guidance** | 0.62 | 1.309 | 0.452 | 3.79 |
| **Propulsive interferences** | 0.587 | 1.22 | 0.596 | 2.496 |
| **Group guidance** | 0.117 | 2.724 | 0.778 | 9.541 |
| **Interferences during lateral movements** | 0.095 | 1.834 | 0.9 | 3.737 |

The anatomical variations of the Spee curve influenced the appearance of muscles' contractions and of joint clicks. Kanavakis conducted a study on a sample of 100 subjects, in view of analyzing the association between the signs of TMD and the characteristics of Spee and Wilson curves. The results showed there was a highly significant association between the depth of the curve Spee and Wilson (e.g. accentuated) and the presence of the joint clicks (Kanavakis et al 2014).

The results of our study revealed that an accentuated Spee curve favours the contraction of the masticatory muscles with a possible evolution to muscle dysfunction, without influence on the presence of joint sounds. The variations of Wilson curve were significantly associated with the presence of muscle contractions and also with joint sounds.

According to the results obtained in our study, the type of guidance in propulsion or lateral movements cannot be considered a risk factor for the TMD appearance. Interferences during lateral movements of the mandible were associated with joint clicks.

Most of the subjects presented long centric. The statistical analysis revealed a significant association between long centric and joint clicks; interferences during the slide from RC to IM were associated with contractions of the masticatory muscles, muscular and articular pain.

Haralur et al. obtained similar results in a study on a lot of 250 patients. They observed a statistically significant correlation between the signs and symptoms of TMJ and the passive interferences during lateral movements ($p<0.001$), long centric ($p=0.001$), respectively a small number of occlusal contacts ($p=0.033$) (Haralur et al 2014). Kirveskari et al. realized a study on a group of 146 young and teenagers, to who were removed the occlusal static or dynamic interferences in view of TMD prevention. The study was conducted on a period of 4 years and revealed that removing the interferences has highly reduced the incidence of signs and symptoms of TMD in the studied groups (Kirveskari et al 1998).

## Conclusion

Occlusal abnormalities may play a role in temporo-mandibular joint disorder development. They can induce contraction and pain in the oro-facial muscles, but also temporo-mandibular joint pain.

## References


Celic R, Jerolimov V, Panduric J. A study of the influence of occlusal factors and parafunctional habits on the prevalence of signs and symptoms of TMD. Int J Prosthod 2002;15:43-48.

Fuji T. The relationship between the occlusal interference side and the symptomatic side in temporomandibular disorders. J Oral Rehabil 2003;30(3):295-300.

Haralur SB, Addas MK, Othman HI, Shah FK, El-Malki AI, Al-Qahtani MA. Prevalence of malocclusion, its association with occlusal interferences and temporomandibular disorders among the Saudi subpopulation. Oral Health Dent Manag 2014;13(2):164-9.

Kanavakis G, Mehta N. The role of occlusal curvatures and maxillary arch dimensions in patients with signs and symptoms of temporomandibular disorders. Angle Orthod 2014;84(1):96-101.

Kirveskari P, Jamsa T, Alanen P. Occlusal adjustment and the incidence of demand for temporomandibular disorder treatment. J Prosthet Dent 1998;79(4):433-8.

Landi N, Manfredini D, Tognini F, Romagnoli M, Bosco M. Quantification of the relative risk of multiple occlusal variables for muscle disorders of the stomatognathic system. J Prosthet Dent 2004;92(2):190- 5.

Manfredini D, Piccotti F, Ferronato G, Guarda-Nardini L. Age peaks of different RDC/TMD diagnoses in a patient population. J Dent 2010;38:392-9.

Pullinger AG, Seligman DA, Gornbein JA. J Dent Res 1993;72(6):968-79.

Sipilä K, Zitting P, Siira P, Laukkanen P, Järvelin MR, Oikarinen KS, Raustia AM. Temporomandibular disorders, occlusion and neck pain in subjects with facial pain—a case control study. Cranio 2002;20:158-164.

Schmitter M, Balke Z, Hassel A, Ohlmann B, Rammelsberg P. The prevalence of myofacial pain and its associations with occlusal factors in a threshold country non-patient population. Clinical Oral Investigations 2007;11:277-281.

Wang C, Yin X. Occlusal risk factors associated with temporomandibular disorders in young adults with normal occlusions. Oral Surg Oral Med Oral Pathol Oral Radiol 2012 Oct;114(4):419-23.


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