THE RANGE OF MAXIMUM MOUTH OPENING IN PARTIALLY EDENTULOUS PATIENTS WITH SYMTPOMS OF TEMPOROMANDIBULAR JOINT DYSFUNCTION

Strujić-Porović S.[*1], Ajanović M.[1], Kazazić L.[1], Berhamović L.[1], Đonlagić A.[1], Kamber-Ćesir A.[1]

[1] Department of Prosthodontics, Faculty of Dentistry, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

***Corresponding author**

Sanela Strujić - Porović, Ph.D
Department of Prosthodontics
Faculty of Dentistry
University of Sarajevo
Bolnička 4a
71 000 Sarajevo
Bosnia and Herzegovina
Phone: + 387 (61) 144 350
e-mail: sanelastrujic@yahoo.com

ABSTRACT

Objective: The objective of this research was to determine the range of active maximum mouth opening and the condylar position in partially edentulous patients with and without symptoms of temporomandibular joint dysfunction.

Subjects and Methods: The sample consists of partially edentulous patients with (30) and partially edentulous patients without symptoms of temporomandibular joint dysfunction (30). In all patients involved in the research a case history was taken accompanied by a detailed clinical intro-oral and extra-oral examination. The range of active maximum mouth opening was measured as a maximum distance between the incisal edges of the upper and lower central incisors at mid-line. Radio-graphs of the right and left temporomandibular joint in the position of the maximally opened mouth were taken using the Ortopantomograph OP 100, program 6. On the obtained radio-graphs the analysis of condylar position in relation to the top of articular eminence and the linear measurements were performed.

Results: Partially edentulous patients with symptoms of temporomandibular joint dysfunction had a higher range of maximum mouth opening ($p<0.008$) and the condyles significantly more in front of the top of articular eminence in the sagittal plane ($p<0.001$) compared to the partially edentulous patients without symptoms of temporomandibular joint dysfunction.

Conclusion: Partially edentulous patients with symptoms of temporomandibular joint dysfunction had a higher range of maximum mouth opening and temporomandibular joint hypermobility in comparison to partially edentulous patients without symptoms of temporomandibular joint dysfunction.

Key words : range of maximum mouth opening, temporomandibular joint hypermobility, condyle position.

Introduction

The range of maximum mouth opening is considered as one of the parameters to evaluate the function of temporomandibular joint (TMJ) and the status of masticatory musculature [1]. The maximum mouth opening (MMO) shows a great variability because it is related to age, gender, antropometric characteristics, height, weight, race, size of mandible, but also the size of the cranial base [2,3,4]. Both excessive and reduced mandibular movement can show the signs and symptoms of the muscular and TMJ dysfunction. Maximum mouth opening in patients with myogenous problems is reduced but in patients with anterior disc discplacement with reduction is similar to those without symptoms and signs of temporomandibular disorders (TMD) [1,5].

Patients with the condylar hypermobility showed wide range of mouth opening with an greater interincisal distance [5]. Previous studies have shown that a higher condylar translation may be related to the disc displacement with reduction and symptoms of TMJ dysfunction [6,7]. The findings of magnetic resonance have shown that in patients with the symptoms of clicking and pain in the area of TMJ, and also with the pain at palpitation of masticatory muscles and the condyle position considerably in front of the articular eminence, there exist structural and pathological changes in the lateral pterygoid muscle. These changes play an important role in the occurrence of clinical symptoms [8]. Because of great variability in the range of active maximum mouth opening (MMO) in asymptomatic patients, the diagnostic value of this parameter in patients with the symptoms of TMJ dysfunction is questionable [9]. Therefore, the objective of this research was to determine the range of active maximum mouth opening and the condyle position in partially edentulous patients with and without symptoms of TMJ dysfunction.

Subjects and methods

The research included the patients who came to the Department of Prosthodontics at the Faculty of Dentistry University of Sarajevo. The research was approved by the Ethical Committee of the Faculty of Dentistry. Partially edentulous patients (60) of either gender, aging from 40 to 60, with the eugnathic jaw relationship were included in the study. Patients without upper and lower anterior teeth, prosthetic rehabilitated patients with crowns on the anterior teeth, patients with abrasion of teeth, tumors in the facial area have been excluded from the research. A medical history of each patient was taken, clinical examination was carried out as well as TMJ radiographs at the maximum mouth opening.

The patients in this study were divided according to the presence of clinical symptoms and signs of TMJ dysfunction: pain in the TMJ area, painful reciprocal clicking, painful terminal clicking, deviation and deflection of the mandible, headache, ringing and tinnitus into the experimental group – partially edentulous patients with the symptoms of TMJ dysfunction (30) and the control group – partially edentulous patients without symptoms of TMJ dysfunction (30). The measurements were taken with patients in the upright position who were given instructions to maximally open their mouth three times as much as possible.

The biggest interincisal distance was recorded as a referential value. The range of active maximum mouth opening was measured as a maximum distance between the incisal edges of the upper and lower central incisors at mid-line without the overbite by using a millimeter ruler. The TMJ radio-graphs in the position of maximum mouth opening were taken by using Ortopantomograph® OP100, Instrumentarium Imaging (Finland), program 6. The lead apron, covering the back, shoulders and the upper thorax, were used as a protection of patients against irradiation.

The patient's head was positioned by light lines so that his mediosaggital plane was directed to the floor while its Frankfurt plane was parallel to the floor. In the medial line an appropriate nasal support was placed. A temporomandibular pointer placed in line with the external auditory canal was used to adjust the direction of focal beam to TMJ. At this the patient's head was fixed in cephalostat by a semi ring holder in the area of the forehead. On the obtained radio-graphs of both TMJs at the maximum mouth opening linear measurements of the range of articular surfaces in the sagittal and vertical planes were carried out.

The range was measured between the two marked points, ie. point A on the top of the articular eminence as an anterior border of the upper articular surface of mandibular fossa and point C on the top of the lower articular surface (**Figure1.**). The results of all measu-

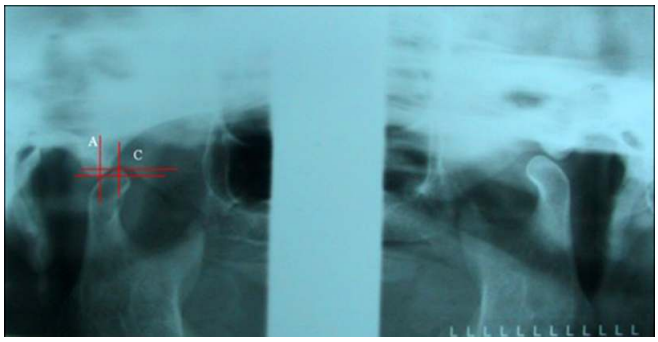

Figure 1.
X –ray of TMJ at maximum mouth opening.
A – Top of the articular eminence
C – Top of the lower articular surface.

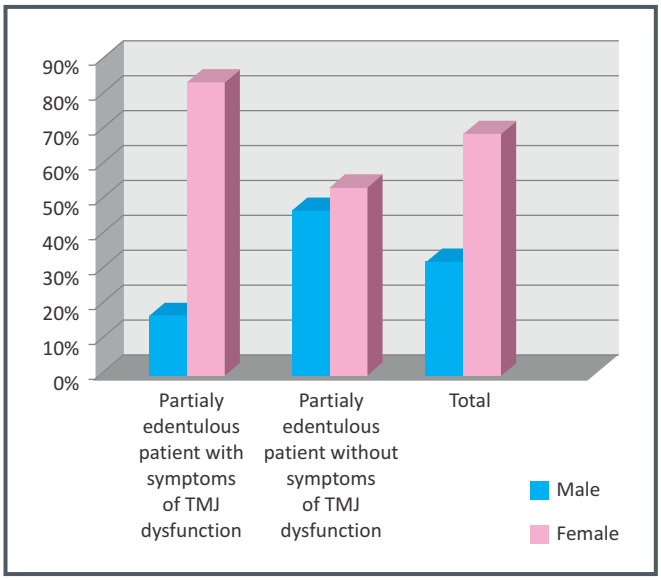

Figure 2. Percentage of partially edentulous patients by gender.

	Range of maximum mouth opening (mm)	
	Experimental group	Control group
Interval	40-60	40-50
N	30	30
Mean	48.700	45.667
SD	5.730	2.758
SE	1.046	0.504
Median	50	45
Mann-Whitney Rank Sum Test	**p = 0.008**	

N – number ; SD- standard deviation; SE- standard error

Table 1. Range of maximum mouth opening in partially edentulous patients with and without symptoms of TMJ dysfunction.

rements were statistically analyzed by using the standard methods of descriptive statistics. Statistically significant differences between the two groups were evaluated by using *Mann-Whitney Rank Sum test, t-test and Chi-square test*. The significance level was $p < 0.05$.

Results

Out of the total of 60 partially edentulous patients 19 (32%) were males, while 41 (68%) were females. In the group of partially edentulous patients with the symptoms of TMJ dysfunction females were prevalent (83%) compared to males (17%). In the control group there were 53% of female subjects and 47% of male subjects (**Figure 2.**).

The difference with regards to gender between the examined groups was statistically significant ($p<0.05$). In partially edentulous patients with the symptoms of TMJ dysfunction the mean of maximum mouth opening was 48.700 mm (± 5.730) with minimum and maximum mouth opening 40 and 60 mm, while in partially edentulous patients without symptoms of TMJ dysfunction it amounted to 45.667 mm (± 2.758).

By statistical analysis it was established that there is a statistically significant difference between the examined groups at the level of probability $p = 0.008$ (**Table 1.**).

At the maximum mouth opening the difference in the condyle position between the right and left TMJ in the sagittal and vertical planes is neither statistically significant in the experimental group ($p=0.252$ and $p=0.308$) nor in the control group ($p=0.535$ and $p=0.250$). At the maximum mouth opening in partially edentulous patients with the symptoms of TMJ dysfunction, the lower articular surface was on average 6.400 mm (± 4.029) in front of the top of articular eminence in the sagittal plane, while in partially edentulous patients without symptoms of TMJ dysfunction it amounted to 3.933 mm (± 2.883). By analysis, it was established that there is a highly significant difference in values ($p<0.001$) (**Table 2.**). The difference in the position of the lower articular surface superior to the top of articular eminence in the vertical plane between the experimental group (3.107 mm ± 1.720) and the control group (2.511 mm ±1.237) was not statistically significant ($p=0.127$) (**Table 3.**) (**Figure 3.**).

	Maximum open mouth	
	Right and left TMJ Sagital plane Experimental group	Right and left TMJ Sagital plane Control group
Interval	1-18	0.5-12
N	60	60
Mean	6.400	3.933
SD	4.029	2.883
SE	0.520	0.372
Median	6	3
Mann-Whitney Rank Sum Test	**p < 0.001**	

N – number ; SD- standard deviation; SE- standard error

Table 2. The position of the lower articular surface in front of the top of articular eminence in partially edentulous patients with and without symptoms of TMJ dysfunction.

	Maximum open mouth	
	Right and left TMJ Vertical plane Experimental group	Right and left TMJ Vertical plane Control group
Interval	0.5-3	1-4
N	42	44
Mean	3.107	2.511
SD	1.720	1.237
SE	0.265	0.186
Median	3	2.5
Mann-Whitney Rank Sum Test	**p = 0.127**	

N – number ; SD- standard deviation; SE- standard error

Table 3. The position of the lower articular surface superior f rom the top of articular eminence in partially edentulous patients with and without symptoms of TMJ dysfunction.

Discussion

Maximum mouth opening is an important diagnostic parameter in the evaluation of patients with temporomandibular disorders (TMD). Limited mouth opening can be a result of extracapsular or intracapsular disorders [1,10] while increased maximum mouth opening is commonly an argument in diagnosing TMJ hypermobility [11,12], namely, subluxation. The previous research has shown a wide range of MMO values in asymptomatic subjects, from 40-60 mm, and depending on many factors, age, gender, race, ethnic origin, differences in body size, facial morphology, size of mandible, position of head [2,13-15]. The average of MMO value in Americans amounts to 48.8 mm [13], in Chinese 49.10 mm [14], in Croats 49.89 mm [16], in Irish 42.2 mm [3], in French 50.77 mm [17]. In this study, patients without symptoms of TMJ dysfunction had MMO value ranging from 40-50 mm, the average being 45.66 mm.

Patients with the symptoms and signs of TMJ dysfunction and condylar hypermobility showed wide range of mouth opening with an interincisal distance greater than 4 cm [5]. The findings of this research have shown that partially edentulous patients with the symptoms of TMJ dysfunction and condylar hypermobility had a significant higher range of maximum mouth opening in relation to partially edentulous patients without symptoms (p=0.008) (**Table 1. and 2.**). In comparison to our findings Kitsoulis et al. (2011) found a statistically significant difference

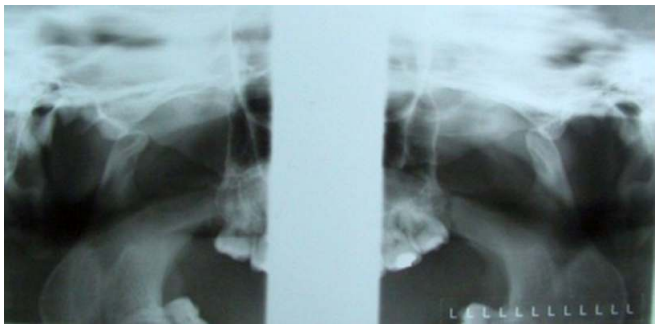

Figure 3. X- Ray of patient with symptoms of TMJ dysfunction.

(p<0.05) in the average value of MMO between those with symptoms (44.45 mm, SD 6.11) and asymptomatic ones (46.45 mm, SD 7.16) [18].

Also, Čelić et al. found a higher value of MMO in asymptomatic persons (50.8 mm) in relation to those with TMD (48.4 mm), but the difference was statistically significant only between asymptomatic persons and the persons with symptoms of muscular disorders and disc displacement with reduction. The authors concluded that this data did not have a clinical significance because they were in the range of "normal" MMO values [19]. In our research the average MMO values in both groups of individuals are also in the range of ''normal'' values. These differences in MMO values in asymptomatic persons and those with symptoms in our research and the previous ones could be accounted for by the age difference of persons, gender influence, condylar hypermobility, great inter-individual variation, antropometric characteristics, overbite of incisors included in the MMO values along with a different methodology of measurement.

Contrary to our findings, Casanova et al. (2012) did not find a statistically significant difference in the average value of MMO between asymptomatic persons and those with symptoms such as miofacial pain and dislocation of the articular disc [2]. Gallagher et al. found that there were no apparent differences in mean maximum opening between the group with symptoms (TMJ "abnormal") and group without symptoms of TMJ dysfunction (TMJ "nor-mal") [3].

Sawair et al. (2010) found that there was a weak but significant negative correlation between the active maximum mouth opening and the number of lost teeth [20]. Sarita et al. state that a statistically significant correlation between shortened dental arch and symptoms and signs of TMD does not exist. Only the complete absence of posterior occlusal support increases a risk of TMD development [21].

The range of maximum mouth opening is used as an indirect assessment of TMJ mobility while a more direct measurement is determined by the evaluation of condylar translation and the condyle position in relation to the top of articular eminence both clinically and radiographically [22]. The results of this research have shown that in partially edentulous patients with symptoms of TMJ dysfunction at the maximum mouth opening, in the sagittal plane, the condyles are found considerably higher in front of the articular eminence in relation to asymptomatic patients ($p<0.001$) (Table 2.). In the vertical plane, the difference in the condyle position between the examined groups was not statistically significant (**Table 3.**). Patients with symptoms of TMJ dysfunction who had condyles considerably higher in front of the top of articular eminence had a statistically significant higher values of the range of the MMO in relation to patients without symptoms, which is in accordance with the findings of Juce et al. and Stegenge et al. [12,22].

Gallagher et al. did not find a correlation between the reduced mouth opening and TMJ dysfunction which corresponds to our findings [3]. Muto et al. have found a significant correlation between the MMO range and the condyle position in front of the top of articular eminence in the sagittal plane, while the correlation was not significant in the vertical plane [23]. Obwegeser et al. showed that this correlation did not exist [24]. Kalaykovom et al. indicate that the condylar position itself is not an indicator of symptomatic hypermobility of condyle [25]. In the absence of symptoms subluxation of TMJ is to be considered as variation of the normal [26] as it is a case with the individuals in the control group. Nevertheless, condyle hypermobility causes acute and chronic trauma of the joint structure and associated muscles and ligaments, and it is one of the etiological factors of TMJ disorder and the occurrence of clinical symptoms [27].

Females show a higher degree of TMJ hypermobility and TMD symptoms in relation to males [28], which can be explained by a higher degree of TMJ hypermobility in the experimental group with the prevalent presence of females compared to the control group. The relationship between the symptoms of TMJ dysfunction and condylar hypermobility was also confirmed by Şener et al. [29], Katzberg et al. [6], Kavucun et al. [30]. The loss of teeth, accompanied by chronic subluxation can later develop into a recurrent TMJ dislocation [31].

Conclusion

Partially edentulous patients with symptoms of temporomandibular joint dysfunction had a higher range of maximum mouth opening and temporomandibular joint hypermobility in comparison to partially edentulous patients without symptoms of temporomandibular joint dysfunction.

References

1. Miller VJ, Bookhan V, Brummer D, Singh JC. A mouth opening index for patients with temporomandibular disorders. J Oral Rehabil. 1999; 26:534-538.
2. Casanova –Rosado JF, Medina Solis CE, Casanova –Rosado AJ, Vallejos- Sánchez AA, Patiño- Marín, Maupome G, Gomez-Gomez V. Clinical characterization of mouth opening among Mexican adolescents and yang adults. J Dent Sci. 2012;7:81-4
3. Gallagher C, Gallagher V, Whelton H, Cronin M. The normal range of mouth opening in an Irish population. J Oral Rehabil. 2004; 31(2) : 110-116.
4. Dijekstra PU, de Bond LG, Stegenga B, Boering G. Angle of mouth opening measurement: reliability of a technique for temporomandibular joint mobility assessment. J Oral Rehabil. 1995; 22:268-8.
5. Eberhard D,Bantleon HP, Steger W. Functional magnetic resonance imaging of temporomandibular joint disorders. European Journal of Orthodontics. 2000;22(5):489-97.
6. Katzberg RW, Keith DA, Guralnick WC, Ten Eric WR. Correlation of condilar mobility and arthrotomography in patients with internal derange-

ments of the temporomandibular joint. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1982; 54(6):622-7.
7. Holmlund AB, Gynther GW, Kardel R, Axelsson SE. Surgical treatment of temporomandibular joint luxation. Swed Dent J.1999;23(4):127-32.
8. Yang X, Pernu H, Phytien J. et al. MRI Findings Concerning the Lateral Pterygoid Muscle in Patients with Symptomatic TMJ Hypermobility. J Craniomand Pract. 2001;19(4):261-8.
9. Hochstedler JL, Allen JD, Follmar MA. Temporomandibular joint range of motion: a ratio of interincisal opening to excursive movement in a healthy population. Cranio. 1996;14(4): 296 -300.
10. Dworkin SF, LeResche L, DeRouen T, Von Korff M. Assessing clinical signs of temporomandibular disorders: reliability of clinical examiners. J Prosthet Dent. 1990; 63(5):574-9.
11. Maruyama T, Kotani M, Ozaki H, Sumida N, Akanishi M, Kuroda T. A study on the condylar position of temporomandibular joint in the dysfunction of the stomatognathic system using tomography. J Osaka Univ Dent Sch. 1984; 24:89-96.
12. Juca FK, Suazo Galdames IC, Guimarães AS. Mandybular condyle position in maximum mouth opening. A magnetic resonance imaging evaluation. Int J Morphol. 2009;27(3):867-71.
13. Zawawi KH, Al-Badawi EA, LoboSL et al. A index for measurement of normal maximum mouth opening. J Can Dent Assoc. 2003;69(11):737-41.
14. Yao KT, Lin CC, Hung CH. Maximum mouth opening of ethnic Chinese in Taiwan. J Dent Sci. 2009; 4(1):40-44.
15. Visscher CM, Huddleston Slater JJ, Lobbezoo F, Naeije M. Kinematics of the human mandible for different head postures. J Oral Rehabil. 2000;27: 299-305.
16. Celic R, Jerolimov V, Knezovic D: Relationship of slightly limited mandibular movements to temporomandibular disorders. Braz Dent J. 2004; 15(2):151-154.
17. Placko G, Bellot-Samson V, Brunet S, Guyot L, Richard O, Cheynet F, Chossegros C, Ouaknine M: Normal mouth opening in the adult French polulation. Rev Stomatol Chir Maxillofac. 2005; 106:267-71.
18. Kitsoulis P, Marini A, Iiiou K, Galani V, Zimps A, Kanavaros P, Paraskevas G. Signs and symptoms of temporomandibular joint disorders related to the degree of mouth opening and hearing loss. Ear, Nose nd Throat Disorders. 2011; 11:5.
19. Čelić R, Jerolomov V, Knezović Zlatarić D, Klaić B. Measurements of mandibular movements in patients with temporomandibular disorders and asymptomatic subjects. Coll.Antropol. 2003; 27 Suppl 2:43-49.
20. Sawair FA, Hassoneh YM, Al-Zawawi BM, Baqain ZH. Maximum mouth opening. Associated factors and dental significance. Saudi Med J. 2010; 31(4): 369-73.
21. Sarita PTN, Kreulen CM,Witter DJ, Creugers NHJ. Signs and Symptoms Associated with TMD in Adults with Shortened Dental Arches. Int J Prosthodont. 2003;16(3): 265.
22. Stegenga B, de Bont L.G.M, de Leeuw R, Boering G. Assesment of mandibular function impairmant associated with temporomandibular joint osteoarthrosis and internal derangement. J Orofac Pain. 1993; 7:183.
23. Muto T, Kohara M, Kanazawa M, Kawakami J.The position of the mandibular condyle at maximal mouth opening in normal subjects. J Oral Maxillofac Surg. 1994; 52(12):1269-72.
24. Obwegeser HL, Farmand M, Al-Majali F, Engelke W. Findings of mandibular movement and position of the mandibular condyles during maximal mouth opening.Oral Surg OralMed Oral Pathol 1987; 63 (5):517-25.
25. Kalaykova S, Naeije M, Huddleston Slater JJ, Lobbezoo F. Is condylar position a predictor for functional signs of TMJ hypermobility? J Oral Rehabil. 2006;33(5): 349-55.
26. Caminiti MF, Weinberg S. Chronic Mandibular Dislocation: The role of Non-Surgical and Surgical Treatment. J Canad Dent Assoc.1998; 64(7): 483-91.
27. Hong L, Zhou J, Hong M. The use of panoramic radiograph to observe abnormal movement of condyle. Zhonghua Kou Qiang Yi Xue Za Zhi. 1997;32(2):92-4.
28. Barrera-Mora JM, Espinar Escalona E, Abalos Labruzzi C, Llamas Carrera JM, Ballesteros EJ, Solano Reina E, Rocabado M.The relationship between malocclusion, benign joint hypermobility syndrome, condylar position and TMD symptoms. Cranio. 2012 Apr;30(2):121-30.
29. Sener S, Akgüniü F. Correlation of Diffeent MRI Characteristics of Anterior Disc Dispacement With Reduction and Without Reduction. J Contem Dent Pract. 2005;6(1):26- 36.
30. Kavucun V, Sahin S, Kamanli A,Karan A, Aksov C. The role of systemic hypermobility and condylar hypermobility in the temporomandibular joint dysfunction syndrome. Reumato Int. 2006; 26(3): 257-60.
31. Shorey CW, Campbell JH. Dislocation of the temporomandibular joint. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000; 89:662-8.