Differences between Subjective Balanced Occlusion and Measurements Reported With T-Scan III

Zana Lila-Krasniqi1, Kujtim Shala1, Teuta Pustina Krasniqi1, Teuta Bicaj1, Enis Ahmed2, Linda Dula1, Arlinda Tmava Dragusha1, Ljuben Guguvcevski3

1University Clinical Center Prishtina - QKSUK, Prosthodontics, Prishtina, Kosovo; 2Med Uni Graz, Dental School, Prosthodontics, Graz, Austria; 3Department of Prosthetics, Faculty of Dentistry, SS Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia

Abstract

BACKGROUND: The aetiology of Temporomandibular disorder is multifactorial, and numerous studies have addressed that occlusion may be of great importance in the pathogenesis of Temporomandibular disorder.

AIM: The aim of this study is to determine if any direct relationship exists between balanced occlusion and Temporomandibular disorder and to evaluate the differences between subjective balanced occlusion and measurements reported with T-scan III electronic system.

MATERIAL AND METHODS: A total of 54 subjects were divided into three groups, selection based on anamnesis-responded to a Fonseca questionnaire and clinical measurements analysed with electronic system T-scan III. In the I study group were participants with fixed dentures with prosthetic ceramic restorations. In the II study group were symptomatic participants with TMD. In the III control group were healthy participants with full arch dentition that completed a subjective questionnaire that documented the absence of jaw pain, joint noise, locking and subjects without a history of TMD. The occlusal balance was reported subjectively through Fonseca questionnaire and compared with occlusion analysed with electronic system T-scan III.

RESULTS: For attributive data were used percentage of the structure. Differences in P < 0.05 were considered significant. After distributing attributive data of occlusal balance subjectively reported and compared with measurements analysed with electronic system T-scan III were found significant difference P < 0.001 in all three groups.

CONCLUSION: In our study, it was concluded that there were statistically significant differences of balanced occlusion in all three groups. Also it was concluded that subjective data are not exact with measurements reported with electronic device T-scan III.

Introduction

Temporomandibular disorder (TMD) occurs with a dysfunction associated with pain in the muscles of mastication [1]. Accordingly, the symptoms of patients with TMD are musculoskeletal in essence and mostly derive from long-lasting muscle hyperactivity [2]. Several electronic instruments and radiological techniques have been proposed over the years in the attempt to integrate clinical evaluation of TMD patients [3]. Some studies have evaluated and reported the important role of occlusal alteration and strong correlation between occlusal interferences and TMD [3-6].

Nevertheless, currently, the role of occlusion in TMD is increasingly recognized as a controversial issue between clinicians and researchers, [7] there are multiple recognized occlusal disorders (traumatic occlusal interferences, phantom bites, attrition, unstable intercuspal position, and severe morphologic malocclusions [8].

TMD symptoms were evaluated by a structured questionnaire, and clinical signs/symptoms were evaluated during clinical examination [9].

Careful analysis of occlusal contacts should be performed in every fixed restoration in order to avoid the creation of iatrogenic interferences that can produce the signs and symptoms of TMD [10, 11] and not to conduct a disharmonic relation between the arches [12-17].

The traditional procedure based on subjective interpretation of the articulating paper marks is an
ineffective clinical method for determining the relative occlusal forces of tooth contacts, and thus a poor guideline for performing occlusal balance [18].

Studies repeatedly show that it can be very difficult for a clinician to predictably identify which occlusal contact has more force than the others nearby when using articulating paper alone [19-21].

The aim of this study is to determine if any direct relationship exists between balanced occlusion and TMD and to evaluate the differences between subjective balanced occlusion and measurements reported with electronic system T-scan III (Tekscan Inc., South Boston, MA, USA).

Material and Methods

This research has been realized in: Faculty of Medicine, School of Dentistry, Pristina, Kosovo and in Faculty of Dentistry, Skopje, Republic of Macedonia.

The study population consisted of total 54 participants.

The study population was divided into three groups:

- In the first study group (SG I) were participants with fixed dentures with prosthetic ceramic restorations
- In the SG II were symptomatic participants with TMD. Participants also underwent clinical and dental examination for signs and symptoms commonly associated with TMD or internal derangements. In this group were excluded patients with orthodontic problems or pretreated with the orthodontic device.
- In the third SG III-CG were healthy participants with full arch dentition that completed a subjective questionnaire that documented the absence of jaw pain, joint noise, locking and subjects without a history of TMD.

In order to obtain clinical study, the selection was based on anamnesis—responded to a Fonseca questionnaire on the self-perception of the balanced occlusion of the patients and clinical measurements analysed and compared with electronic system T-scan III.

The study has been initiated after the subjects had signed informed consent forms, and the research program had been approved by the Ethical Committee. All the subjects are examined clinically by the same trained dentist and answered the questionnaire for TMD—the anamnesis index proposed by the Fonseca [22-25].

Using a simplified questionnaire, they were able to recognize unnoticed symptoms that could lead to wear or a greater disorder of the stomatognathic system [23]. The Fonseca’s questionnaire follows the characteristics of a multidimensional evaluation. It is composed of 10 questions, which include checking for the presence of pain in temporomandibular joint, head, back, and while chewing, parafunctional habits, movement limitations, joint clicking, the perception of malocclusion and sensation of emotional stress [24-28].

With this questionnaire, an even non-patient population that was unaware can be identified that they had TMD (Fig. 1).

In this study, focus was in one of the questions about subjective feelings of the participants about balanced occlusion. On the other hand is used The T-Scan III - Computerized Occlusal Analysis System to measure the occlusion from maximum habitual intercuspation (MHI). Sensitive sensors that are used senses and analyses occlusal contact forces using pressure and those are shaped to fit the dental arch [29, 30].

The following aspects were recorded for the
evaluation of balanced occlusion: number of teeth present, the number of occlusal interferences [31] all starting from MHI. T-Scan system readily identifies the very first contact point (Fig. 2, 3) that precedes numerous other contact points that transitorily occur during maxilla-mandibular functional movements.

For data were used Statistical Package Statistica 7.1 for Windows (StatSoft, Inc., Tulsa, OK 74104, USA). Data were presented with Fisher exact test, Kruskal-Wallis ANOVA by Ranks (H), t-test, independent by groups (t) and Mann-Whitney U Test (Z), also the percentage of the structure were used for attributive data.

Differences in P<0.05 were considered significant. All data are presented in Table 1.

Results

The study population consisted of total 54 participants. The study population was divided into three groups.

The first study group (SG I) analysed according to gender and age consisted of 17 participants, 8 (47.06%) men, and 9 (52.94%) females with age range from 22 to 65, mean age 56.35. Second study group (SG II) consisted of 14 participants, 5 (35.71%) men, and 9 (64.29%) females with age range from 23 to 58, mean age 33.93, and CR consisted of 23 participants, 6 (26.09%) men and 17 (73.91%) females with age range from 20 to 35 years mean age 25.43.

After descriptive analysis of the three SGs for the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-Scan III, the value of P<0.001 (P = 5.2E-0.6) for distribution data was found significant (Table 1).

Table 1: Subjective feeling of occlusal balance compared with T–scan III measurements at three groups

| Subjective feeling | T-scan III measurements |
|--------------------|-------------------------|
| Count | Count |
| Unbalanced | 9 | 52.94 | 17 | 100.00 |
| Balanced | 8 | 47.06 | 0 | 0.00 |
| Group II (n = 14) | | | | |
| Unbalanced | 9 | 64.29 | 7 | 50.00 |
| Balanced | 5 | 35.71 | 7 | 50.00 |
| Group III (n = 23) | | | | |
| Unbalanced | 1 | 4.35 | 8 | 34.78 |
| Balanced | 22 | 95.65 | 15 | 65.22 |

There were significant differences between Fixed bridges and group with TMD (P=6.8E-05). There were significant differences between Fixed bridges and Control group (P=8.2E-05). There were significant differences between groups with TMD and Control group (P=0.02).

Results of 8 (14.81%) patients from the SGI with fixed dentures had subjective feelings for balanced occlusion and the same patients analysed with T-Scan III had unbalanced occlusion. 9 (16.67%) patients had subjective feelings for unbalanced occlusion and the same patients analysed with T-Scan III had unbalanced occlusion. Results of this distribution data for P > 0.05 (P = 1.00) was not significant (Table 1).

Five (5) (9.26%) patients from the SG II with

**Data analysis**
TMD had subjective feelings for balanced occlusion, and the same patients analysed with T-scan III had balanced occlusion too. Nine (9) (16.67 %) patients had subjective feelings for unbalanced occlusion from which 2 (3.70%) had balanced occlusion analysed with T-scan III, and 7 (12.96%) had unbalanced occlusion. Results of this distribution data for P<0.05 (P = 0.02) was significant (Tabel 1).

At the SG III control group, 22 (40.74 %) healthy participants had subjective feelings for balanced occlusion from which 14 (25.93%) healthy participants analysed with T-scan III had balanced occlusion too, but 8 (14.81%) healthy participants analysed with T-scan III had unbalanced occlusion. One (1) (1.85%) healthy participant had a subjective feeling for unbalanced occlusion, and the same one had balanced occlusion analysed with T-scan III. Nine (9) (16.67 %) patients had subjective feelings for unbalanced occlusion from which 2 (3.70%) had balanced occlusion analysed with T-scan III. Results of this distribution data for P > 0.05 (P = 1.00) was not significant (Tabel 1).

Descriptive analysis of the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-scan III in the relation between the group with Fixed bridges and group with TMD. Value of P < 0.001 (P = 6.8E-05) for distribution data was found significant (Tabel 1).

Descriptive analysis of the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-scan III between groups with Fixed bridges and Control group for the value of P<0.001 (P=8.2E-05) of distribution data was found significant (Tabel 1).

Also, descriptive analysis of the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-scan III between groups with TMD and Control group for the value of P < 0.05 (P = 0.02) of distribution data was found significant (Tabel 1).

Discussion

From the information gathered, it was evident that occlusal interferences can lead to the development of or to an increase in the severity of TMD.

Considering that many etiologic factors, such as parafunctional and postural habits, but also psychological and occlusal factors, are usually attributed to the onset of TMD and also to the perpetuation of the muscular-related disturbances [2], it is necessary to understand the anatomy and morphology of the Temporomandibular Joint (TMJ) in order not to misinterpret a normal situation as an abnormality [39].

Clinicians are interested that new restorations are fabricated in harmonious contact relative to the opposing teeth. Sometimes, however, the patient has tooth pain, and one of the possible reasons for tooth pain is excessive occlusal loading. In this context, it is necessary to evaluate the tooth for the presence of a super contact [7].

In order to obtain and compare results from different clinical studies, there was a need for using reliable and valid instruments to measure TMD severity within the sample, which also consisted of nonpatient volunteers who could present TMD symptoms [28, 35].

The T-scan III system is a quantitative and reliable method for occlusal evaluation and represents a potential substitute for occlusal indexes [40].

In this study was found that subjective data are not exact with measurements reported with electronic device T-scan III, also after distributing attributive data of occlusal balance subjectively reported and compared with measurements analysed with electronic system T-scan III were found significant difference P < 0.001 in all three groups. TMD subjects had a significantly higher frequency of premature contacts and greater bilateral asymmetry in the occlusal force.

One surprising result in one of the studies was that occlusal asymmetry it was associated with contra lateral muscular asymmetry and the balancing of muscular activity is a more challenging goal than Centering the Occlusal Force which, on the other hand, is an immediate result [2]. These side-related discrepancies have been reported previously in several of Kerstein’s studies [41, 42].

The T-scan III helps us to measurably adjust and create a balanced force distribution between the left and right arch halves. When comparing T-Scan III data with the paper markings, we can see the accidental force determination errors caused by observing paper mark shapes that appear to indicate teeth which are receiving more force, but in reality, when forces are measured with the T-Scan III, we find that another region is receiving more force.

The possibility that occlusal interference results in TMD have been investigated in one study in humans using a double-blind, randomized design. It was found that subjects without a history of TMD show fairly good adaptation to interferences. In contrast, subjects with a history of TMD develop a significant increase in clinical signs and self-report stronger symptoms (occlusal discomfort and chewing difficulties) in response to interferences [1].

Numerous etiological and therapeutic theories are based on this presumed association and have
been applied to justify the use of several therapeutic approaches, such as occlusal appliance and anterior repositioning appliance therapies, occlusal adjustment, restorative procedures and orthodontic and orthognathic treatments [43]. Conversely, many TMD experts hold opposing views [1], and various types of dental interventions, including routine orthodontic treatment, have been reported as causes of TMD [15]. In fact, these interferences can be formed by uneven tooth wear, but also by restorative procedures performed incorrectly, which can lead to a disharmony between the articulation of the teeth and the centric relation position of the TMJ [44]. The TMD group presented higher means regarding: age, time of chewing, the number of chewing strokes and TMD severity. Chewing time and type were positively correlated with TMD severity and negatively correlated with a number of occlusal interferences [45].

According to previous studies conducted on subjects with adequate occlusion and no dysfunction, the process occurs with symmetrical activity between the left and right masseter and anterior temporal muscles [32, 46]. However, in subjects with occlusal balancing side interferences and with unilateral crossbite, an altered and symmetrical pattern of muscle contraction has been observed by electromyography and by palpation during mastication [33, 46].

Also in one study, was tested that the condylar path and the lateral anterior guidance angles did not differ between the symptomatic and nonsymptomatic side among individuals with chronic unilateral TMD [47].

In our study, it was concluded that there were statistically significant differences of balanced occlusion in all three groups with predominance of the disharmonic relation between the arches with an overload of the occlusal force on the one side at the groups with TMD and fixed dentures. Also, it was concluded that subjective data are not exact with measurements reported with electronic device T-scan III.

References
1. Xie Q, Lie X, Xu X. The difficult relationship between occlusal interferences and temporomandibular disorder – insights from animal and human experimental studies. J of Oral Rehabilitation. 2013;40:279-95. https://doi.org/10.1111/joor.12034
2. Abraham D, Javier M, José-Miguel S, Antonio LV. Electromyographic and patient-reported outcomes of a computer-guided occlusal adjustment performed on patients suffering from chronic myofascial pain. Med Oral Patol Oral Cir Bucal. 2015;20(2):135–43.
3. Kahn J, Tallents RH, Katzung RW, Ross ME, Murphy WC. Prevalence of dental occlusal variables and intraarticular temporomandibular disorders: Molar relationship, lateral guidance, and nonworking side contacts. J Prosthet Dent. 1999;82:410-5. https://doi.org/10.1016/S0022-3913(99)70027-2
4. Haralur SB. Digital Evaluation of Functional Occlusion Parameters and their Association with Temporomandibular Disorders. J Clin Diagn Res. 2013;7:1772–5. https://doi.org/10.7860/JCDR/2013/56023.3307
5. Troeltzsch M, Troeltzsch M, Cronin RJ, Brodine AH, Frankenberger R, Messlinger K. Prevalence and association of headaches, temporomandibular joint disorders, and occlusal interferences. J Prosthet Dent. 2011;105:410–7. https://doi.org/10.1016/j.prosdent.2011.03.039
6. 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;114:419–23. https://doi.org/10.1016/j.ooeo.2011.03.039
7. Manfredini D, Lobbezoo F. Relationship between bruxism and temporomandibular disorders: a systematic review of literature from 1998 to 2008. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;109:26-50. https://doi.org/10.1016/j.tripleo.2010.02.013
8. Baba Y, Tsukiyama Y, Clark G T. Reliability, validity, and utility of various occlusal measurement methods and techniques. J Prosthet Dent. 2000;85:1. https://doi.org/10.1067/mpr.2000-3913(00)70092-8
9. Pizolato RA, Gavião MDB, Berretin-Felix G, Sampaio ACM, Trindade Junior AS. Maximal bite force in young adults with temporomandibular disorders and bruxism. Braz Oral Res. 2007;21:1. https://doi.org/10.1590/S1518-08242007000300015
10. Lima AF, Cavalcanti AN, Martins LR, Marchi. Occlusal Interferences: How Can This Concept Influence The Clinical Practice? Eur J Dent. 2010;4:487–9. PMid:20922171
11. Seligman DA, Pullinger AG. The role of intercuspal occlusal relationships in temporomandibular disorders: A review. J Craniofacial Syndromes. 1991;5:96-106.
12. Le Bell Y, Niemi PM, Jamsa T, Kymlama M, Alanen P. Subjective reactions to intervention with artificial interferences in subjects with and without a history of temporomandibular disorders. Acta Odontol Scand. 2006;64:59-63.
13. Niemi PM, Le Bell Y, Kymlama M, Jamsa T, Alanen P. Psychological factors and responses to artificial interferences in subjects with and without a history of temporomandibular disorders. Acta Odontol Scand. 2006;64:300-5. https://doi.org/10.1080/00016350100417287
14. Barbosa GAS, Badaró Filho CR, Fonseca RB, Soares CJ, Neves FD, Fernandes Neto AJ. The role of occlusion and occlusal adjustment on temporomandibular dysfunction. Braz J Oral Sci. 2004;3:589-94.
15. Le Bell Y, Jamsa T, Korri S, Niemi PM, Alanen P. Effect of artificial occlusal interferences depends on previous experience of temporomandibular disorders. Acta Odontol Scand. 2002;60:219-22. https://doi.org/10.1080/00016350100417287
16. Tsukiyama Y, Baba K, Clark GT. An evidence-based assessment of occlusal adjustment as a treatment for temporomandibular disorders. J Prosthet Dent. 2001;86:57-66. https://doi.org/10.1067/j.mpr.2001.115399
17. Kirveskari P, Alanen P. Occlusal variables are only moderately useful in the diagnosis of temporomandibular disorder. J Prosthet Dent. 2000;84(1):114-5. https://doi.org/10.1067/mpd.2000.108688
18. Haralur SB. Digital Evaluation of Functional Occlusion Parameters and their Association with Temporomandibular Disorders. J Clin Diagn Res. 2013;7:1772–5. https://doi.org/10.7860/JCDR/2013/56023.3307
19. Lila-Krasniqi ZD, Shala KSh, Pustina L, Krasniqi et al. Differences between Subjective Balanced Occlusion and Measurements Reported With T-scan III.
maximum intercusption as possible cause for development of temporomandibular disorder analyzed with T-scan III. Eur J Dent. 2015;9(4):573–79. https://doi.org/10.4103/1305-7456.172627 PMid:26929698 PMCid:PMC4735241

20. Kerstein RB. Articulating paper mark misconceptions and computerized occlusal analysis technology. Dent Implantol Update. 2008;19:41-6. PMid:18686885

21. Kerstein RB, Wilkerson DW. Locating the centric relation prematurity with a computerized occlusal analysis system. Compend Contin Educ Dent. 2001;22:525-32. PMid:11913303

22. Campos JADB, Gonçalves DAG, Camparris CM, Speciali JG. Reliability of a questionnaire for diagnosing the severity of temporomandibular disorder. Rev Bras Fisiol Dent. 2009;13(1):38-43. https://doi.org/10.1590/S1413-35522009000500007

23. Nomura K, Vitti M, Oliveira AS, Chaves TC, Semprini M, Siessere S, Hallak JE, Regalo SC. Use of the Fonseca’s Comparison of Occlusal Analyses to Assess the Prevalence and Severity of Temporomandibular Disorders in Brazilian Dental Undergraduates. Braz Dent J. 2007;18(2):163-7. https://doi.org/10.1590/S0103-64402007000200015 PMid:17982559

24. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniofacial Disord. 1992;6(4):301-55. PMid:12987676

25. Da Fonseca DM, Bonfante G, Valle AL, de Freitas SFT. Analysis of anamnestic and clinical and signs and symptoms of TMD. J Craniofacial Prosthodont. 2006;24(2):112-6. https://doi.org/10.1179/crm.2006.016 PMid:16711273

26. Helkimo M. Studies on function and dysfunction of the masticatory system. II – Index for anamnestic and clinical dysfunction and occlusal state. Sven Tadiak Tidskr. 1974;67(2):165-81. PMid:4526188

27. Helkimo M. Studies on function and dysfunction of the masticatory system. III – Analyses of anamnestic and clinical recordings of dysfunction with the aid of indices. Sven Tadiak Tidskr. 1974;67(3):165-81. PMid:4526188

28. Bevilaqua-Grossi D, Chaves TC, Oliveira AS, Monteiro-Pedro V. Anamnestic Index severity and signs and symptoms of TMD. J Craniofacial Prosthodont. 2006;24(2):112-6. https://doi.org/10.1179/crm.2006.016 PMid:16711273

29. Mathiowetz V, Hillier SC, Kishore V. Masticatory performance in adults related to temporomandibular disorder and dental occlusion. Pró-Fono Revista de Atualização Científica. 2007;19:2.

30. Majithia IP, Arora V, Anil Kumar S, Saxena V, Mittal M. Comparison of articulating paper markings and T Scan III recordings to evaluate occlusal force in normal and rehabilitated maxillofacial trauma patients, Med J Armed Forces India. 2015;71(2):382-88. https://doi.org/10.1016/j.mjafi.2014.09.014 PMid:26843754 PMCid:PMC4705179

31. Cheng HJ, Geng Y, Zhang FQ. The evaluation of intercuspal occlusion of healthy people with T-Scan II system. Shanghai Kou Qiang Yi Xue. 2012;21:62-5. PMid:22431060

32. Garcia VCG, Cartagena AG, Sequeiros OF. Evaluation of occlusal contacts in maximum intercusption using the T-Scan system. J Oral Rehabil. 1997;24:899-903. https://doi.org/10.1046/j.1365-2842.1997.00586.x

33. Kerstein RB. Current Applications of Computerized Occlusal Analysis in Dental Medicine. USA Gen Dent. 2001;49:521-30. PMid:12017798

34. Harvey WL, Osborne JW, Hatch RA. A preliminary test of the replicability of a computerized occlusal analysis system. J Prosthet Dent. 1992;72:697-700. https://doi.org/10.1016/0022-3913(92)90174-9

35. Liu CW, Chang YM, Shen YF, Hong HH. Using the T-scan III system to analyze occlusal function in mandibular reconstruction patients: A pilot study. Biomed J. 2015;38:52-7. https://doi.org/10.4103/2319-4170.128722 PMid:25163500

36. Cooper BC, Kleinberg I. Examination of a large patient population for the presence of symptoms and signs of temporomandibular disorders. Cranio. 2007;25(2):114–126. https://doi.org/10.17193/cm.2007.018 PMid:17506832

37. Imarnimoghadam M, Madani AS, Mahdavi P, Bagherpour A, Darijani M, Ebrahimejhad H. Evaluation of condylar positions in patients with temporomandibular disorders: A cone-beam computed tomographic study. Imaging Sci Dent. 2016;46(2):127–31. https://doi.org/10.6624/isd.2016.46.2.127 PMid:27358820 PMCid:PMC4925649

38. Lee Sang-Min, Lee Jin-Woo. Computerized occlusal analysis: correlation with occlusal indexes to assess the outcome of orthodontic treatment or the severity of malocclusion. Korean J Orthod. 2016;46(1):27-35. https://doi.org/10.4041/kiod.2016.46.1.27 PMid:26877980 PMCid:PMC4751298

39. Kerstein RB, Radke J. Masseter and temporalis excursion hyperactivitydecreased by measured anterior guidance development. Cranio. 2012;30:243–54. https://doi.org/10.17193/cm.2012.038 PMid:23156965

40. Kerstein RB, Wright NR. Electromyographic and computer analyses of patients suffering from chronic myofascial pain-dysfunction syndrome: before and after treatment with immediate complete anterior guidance development. J Prosthet Dent. 1991;66:677–86. https://doi.org/10.1016/0022-3913(91)90453-4

41. Nishigawa K, Nakano M, Bando E. Study of jaw movement and masticatory muscle activity during unilateral chewing with and without balancing side molar contacts. J Oral Rehabil. 1997;24(9):691-8. https://doi.org/10.1046/j.1365-2842.1997.00583.x PMid:9367750

42. Ikeda T, Nakano M, Bando E, Suzuki A. The effect of light occlusion on masticatory function. Acta Odontol Scand. 1988;46(5):423-30. https://doi.org/10.3109/00016358609041309

43. Imanimoghadam M, Madani AS, Mahdavi P, Bagherpour A, Darijani M, Ebrahimejhad H. Evaluation of condylar positions in patients with temporomandibular disorders: A cone-beam computed tomographic study. Imaging Sci Dent. 2016;46(2):127–31. https://doi.org/10.6624/isd.2016.46.2.127 PMid:27358820 PMCid:PMC4925649

44. Pokorny PH, Wiens JP, Litvak H. Occlusion for fixed prostheses: a historical perspective of the gnathological influence. J Prosthet Dent. 2008;99:299-313. https://doi.org/10.1016/j.socp.2004.11.020. PMid:18394129

45. Forssell H, Kirveskari P, Kangasniemi P. Effect of occlusal adjustment on mandibular dysfunction. A double-blind study. Acta Odontol Scand. 1986;44:63–9. https://doi.org/10.3109/00016358609041309 PMid:3524093

46. Wieczorek A, Loster J, Loster BW. Relationship between Occlusal Force Distribution and the Activity of Masseter and Temporalis Muscles in Asymptomatic Young Adults. Anterior Temporalis Muscles in Asymptomatic Young Adults. Research Article. BioMed Research International. 2013;35401:7.

47. Pokorny PH, Wiens JP, Litvak H. Occlusion for fixed prosthodontics: a historical perspective of the gnathological influence. J Prosthet Dent. 2008;99:299-313. https://doi.org/10.1016/j.socp.2004.11.020. PMid:18394129

http://www.mjms.mk/ http://www.id-press.eu/mjms/