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Original Article

Effect of simultaneous application of arthrocentesis and occlusal splint versus splint in management of non-reducing TMJ disc displacement

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Abstract *Background/Purpose:* This study aimed to compare the effect of four approaches in the treatment of TMJ disc displacement without reduction (DDwoR).
Materials and methods: Thirty-two patients (40 joints) with mean age 28.025 ± 7.18 (23 female patients and nine male patients) were assigned randomly into four groups (10 joints in each group). Group I, patients were treated by centric splint. Group II, patients were treated by distraction splint. Group III, patients were treated by arthrocentesis and centric splint, while group IV patients were treated by arthrocentesis and distraction splint. The groups were compared in terms of joint function (mouth opening), joint pain through joint palpation, and use of visual analog scale (VAS). These records were taken preoperatively, two weeks, one month, three, and six months postoperatively. Also, the presence of disc recapture was evaluated in all patients on MRI at the end of the treatment period.
Results: Significant improvements in all parameters were recorded in all groups. At two weeks postoperatively, there was a significant improvement in all parameters in group III and group IV than group I and group II, while there was no statistical difference between group III and group

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IV. Regarding mouth opening and joint palpation, there was a significant improvement in group III than group I and group II. Also, there was a significant improvement in group IV than group II at the subsequent follow-up periods. Regarding VAS, at one and three months postoperatively, there was a significant improvement in group III than other groups.
Conclusion: However, both types of splints provide better results without a statistical difference; the simultaneous application of arthrocentesis and occlusal splint decreases pain and improving the function effectively and more rapidly.

Introduction

Disc displacement without reduction (DDwoR) of TMJ is the worst stage of internal derangement. In this condition, the disc is displaced from the condyle and does not return back to its original position during jaw movement. Macro- and micro-trauma constitute the most common etiology of DDwoR.[1]

DDWoR of TMJ can give rise to TMJ pain and limited opening (painful locking), occasionally termed a closed lock. It may be acute or chronic conditions according to the duration of locking. It is estimated that DDwoR affects 2%—8% of patients with temporomandibular disorders (TMD).[1–3]

Treatment of DDwoR includes conservative and surgical methods. Conservative methods include manipulation, medical, physical, and splint therapy.[4] Surgical methods include arthrocentesis, arthroscopy, and open arthrotomy. The contemporary treatment for internal derangement (ID) of the TMJ consists of conservative methods initially. If failed, arthrocentesis is performed as a second step therapy.[1,5]

Splint therapy is used to reduce the excessive joint load, relax the muscles of mastication, and support the regenerative processes in the joint. There are three types of occlusal splint used for the treatment of DDwoR: stabilization, distraction, and protrusive splints.[1,6]

Protrusive splint aimed to re-establish physiological disc condyle relation. However, the stability of disc recapture affected by the range of disc displacement. In cases of DDwoR protrusive splint does not lead to disc recapture, but has a pain-relieving effect.[6] Stabilization splint increases the vertical dimension of the occlusion. The occlusal contacts are located bilaterally on the splint; this may lead to a significant decrease in symptoms of the closed lock.[7] The distraction splint causes a greater intra-articular stress release. The occlusal contacts are placed mostly in the posterior part of the splint. Schmitter et al. reported that stabilization splint seems to be more effective than distraction splint in closed lock therapy.[8]

However, splint therapy is often successful, but the length of time required to achieve asymptomatic joint function is a negative factor.[9] Therefore this approach may delay the accomplishment of efficient treatment, and this may worsen the joint condition. Alternatively, arthrocentesis removes inflammatory products directly, causing rapid healing.[10] Promising results have been reported with the use of arthrocentesis as an initial treatment method in DDwoR.[11,12] The first-line treatment for DDwoR has been argued in the literature. Several studies have investigated the efficiency of the occlusal splint, arthrocentesis, and a combination of these two modalities for the management of TMD.[9,12–14]

However, investigations comparing these modalities are very rare. So, this study aimed to compare the effectiveness of different treatment modalities, stabilization, and distraction splint alone or in combination with arthrocentesis, on symptoms associated with DDWoR.

Materials and methods

This prospective study was accomplished in the Oral & Maxillofacial Surgery Clinic, Al-Farabi Private College for Dentistry and Nursing. The study was done in accordance with the Declaration of Helsinki on medical protocol and approved by the ethical committee of Al-Farabi Private College for Dentistry and Nursing. All patients were informed about the study and signed a consent form before participation in the study.

Thirty-two patients (40 joints) 23 females and nine males were included in the study. The patients' age ranged between 18 - 40 years. All Patients included in this study presented clinically with joint and muscle pain on palpation, jaw dysfunction, and previous history of click. The diagnosis of ADDwoR also confirmed Radiographically by MRI. At least one antagonistic molar contact on each side should exist to ensure the support of the splint by natural teeth.

Patients were excluded from the study if they had congenital malformation or previous surgical treatment in TMJ. Also, patients with uncontrolled systemic diseases that may affect TMJ integrity were excluded from the study.

All patients were evaluated clinically before treatment to assess joint function, pain, and noise. Also, the radiographic evaluation was performed by MRI to confirm the clinical diagnosis. Orthopantogram was performed preoperatively to exclude any osseous pathosis.

Joint function was evaluated through assessment of maximum active mouth opening (MMO) by measuring the distance between the incisal edges of the upper and lower central incisors in millimeters. Assessment of joint pain was achieved by palpating the TMJ bilaterally by placing the index finger over the condyle in front of the tragus. The degree of joint pain was ranged from 0 to 3 (0 = no pain; 1 = mild pain; 2 = moderate pain; 3 = severe pain). Also, the Visual Analog Scale (VAS),[6] ranged from 0 to 10, was used for joint pain assessment. Zero refers to no pain, while ten indicates severe pain.

Patients were assigned into four equal groups according to the treatment method. ***Group 1*** patients were treated by stabilization splint. ***Group II*** patients were treated by distraction splint. ***Group III*** patients were treated by arthrocentesis plus sodium hyaluronate injection and stabilization splint. ***Group IV,*** patients were treated by arthrocentesis plus sodium hyaluronate injection and distraction splint.

Maxillary stabilization splint was constructed as described by Okeson[1] and adjusted to have a uniform and simultaneous contacts with the occlusal surface of the opposing arch. Distraction splint was constructed from acrylic resin and adjusted intraorally as described by Sears,[15] with a bilateral pivot in the area of the second molar. In group III and group IV, the splint was prefabricated before the arthrocentesis. All patients were instructed to use the splint 24 h except at mealtime for six months.

Arthrocentesis was performed under local anesthesia, to block the auriculotemporal nerve.[16,17] After TMJ was prepared aseptically, and the field was isolated by sterile towels, arthrocentesis was achieved as described by Nitzan et al.[18]

Two points were placed over the affected joint indicating the anterior and posterior recesses of the upper joint space. The first point located 10 mm anterior to the middle of the tragus and 2 mm below the canthal—tragus line, while the second point placed 10 mm anterior to the middle of the tragus and 10 mm below the same line. A 19-gauge needle was introduced into the superior joint space at the posterior mark, followed by the injection of 2 ml of lactated Ringer's solution to distend the joint space. Then the second 19-gauge needle was inserted into the distended joint space in the area of articular eminence to allow drainage of the superior joint space (Fig. 1).

The upper joint space was irrigated with 200—300 ml of Ringer's lactate solution. At the end of joint lavage, 2 mL (20 mg) hyaluronic acid (Hyruan plus; LG Life Sciences, Seoul, Korea) was injected into the joint space, followed by the removal of the needles. After arthrocentesis, all patients have prescribed 500 mg Amoxicillin thrice daily for a period of 5 days along with nonsteroidal anti-inflammatory drug thrice daily for seven days.

After arthrocentesis, all patients were evaluated clinically at two weeks one month, three and six months thereafter, as described before. Magnetic resonance imaging (MRI) was performed six months after treatment to assess the disc position.

Figure 1 Needle insertion for TMJ arthrocentesis.

The success criteria for TMJ internal derangement management that have been proposed by the American Association of Oral and Maxillofacial Surgeons (AAOMS) include the absence of or mild pain, range more than 35 mm for vertical motion.[19]

The statistical analysis was performed using Statistical Package for Social Sciences program (SPSS) version 26.0 software (Chicago, IL, USA). As the data were normally distributed, general linear models and multivariable tests [analysis of variance (ANOVA)] were conducted to compare among the four groups. Also, after analysis of mean and standard error, the test of Within-Subjects Contrasts and Tests of between — Subjects effects were performed to determine the variance among groups and the variance within the groups using post hoc test and Tukey test. The mean difference is considered significant at the 0.05 level.

Results

This study was conducted on 32 patients, 23 females and nine males (40 joints) with mean age 28.025 ± 7.18. Eight patients presented with bilateral DDwoR and 24 patients with unilateral DDwoR.

There were two patients in group I and group IV with bilateral DDwoR, while group II and group III contain one patient and three patients with bilateral DDwoR, respectively. The mean patients' age was 27.20 ± 7.13, 28.20 ± 7.82, 28.20 ± 8.33, and 28.50 ± 6.41 for groups I, II, III, and IV, respectively.

Group II and group III contained five female patients, while group I and group IV contained 6 and 7 patients, respectively.

There was no significant difference between different groups regarding mean age and sex distribution. Also, there was no significant difference between groups regarding all evaluated parameters including mouth opening, joint palpation, and VAS at the preoperative period.

There was a significant increase in mouth opening in all patients throughout all follow-up periods. At two weeks postoperatively, there was a significant improvement in group III and group IV than group I and group II, while there was no statistical difference between group III and group IV. At the subsequent follow-up periods, there was a significant improvement in group III than group I and group II. Also, there was a significant improvement in group IV than group II. At six months postoperatively, there was no statistical difference among all groups (Fig. 2).

Significant improvement in joint palpation was reported in all patients throughout all follow-up intervals. At two weeks postoperative period, there was a significant improvement in group III and group IV than group I and group II, while there was no statistical difference between group III and group IV. At one month postoperatively, there was a significant improvement in group III than group II. At six months postoperatively, there was no statistical difference among all groups (Fig. 3).

There was a significant reduction in the value of VAS in all patients at all postoperative follow up intervals. There was no statistical difference among different groups at six months postoperatively. At two weeks, one month and three months postoperative periods, there was a significant

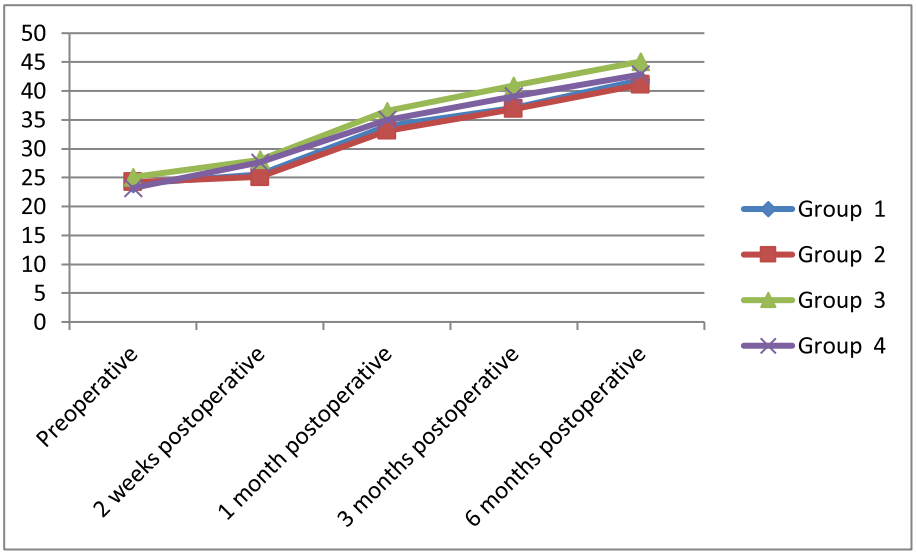

Figure 2 Mean active mouth opening in all groups through different follow-up periods.

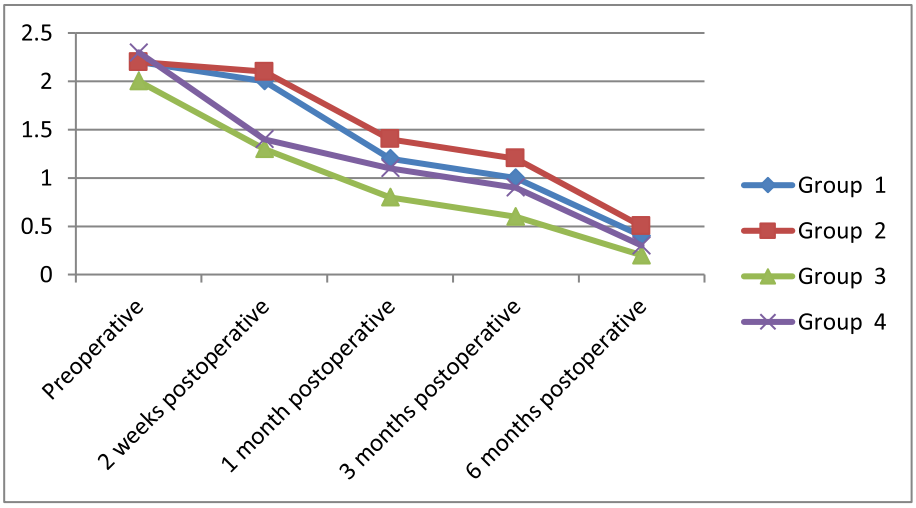

Figure 3 Mean value of pain assessed by joint palpation in all groups through different follow-up periods.

improvement in group III than other groups, while there was no statistical difference between other groups except at two weeks follow up period, there was a significant difference in group IV than group I and group II (Fig. 4).

Discussion

Internal derangement of TMJ is a complicated condition that includes inflammatory changes in the articular structures, alteration in intraarticular pressure, changes in the structure and volume of the synovial fluid, and disc distortion.[20,21]

Occlusal splints are considered to cause modulation in the mechanical sensory input arising from the periodontium and masticatory system and so, allowing a reduction in the intra-articular pressure in TMJ. Therefore, a splint is used for the management of ID of the TMJ to decrease bruxism and excessive loading on the joint.[20]

Stabilization and distraction splints are the most commonly used for the treatment of ADDwoR. However, stabilization splint has shown to be effective in the treatment of ADDwoR; the distraction splint is recommended by some investigators as the occlusal contacts are located mostly in the posterior part of the splint so that it may result in greater release in intraarticular stress.[7,8]

Although there is a consensus on the occlusal splint therapy as it is generally accepted as first-line treatment, some investigators have suggested that arthrocentesis can be used as a first-line treatment of the internal derangement of TMJ with a high success rate.[11,12,22,23] So, the current study was designed to compare among stabilization splint, distraction splint, and combined use of each splint after arthrocentesis in the management of TMJ DDwoR.

Among 32 patients with TMD, 23 patients were female, and nine patients were male. The higher incidence of TMD in females documented in this study agrees with the findings of Al-Hasson et al.,[24] who observed the increased

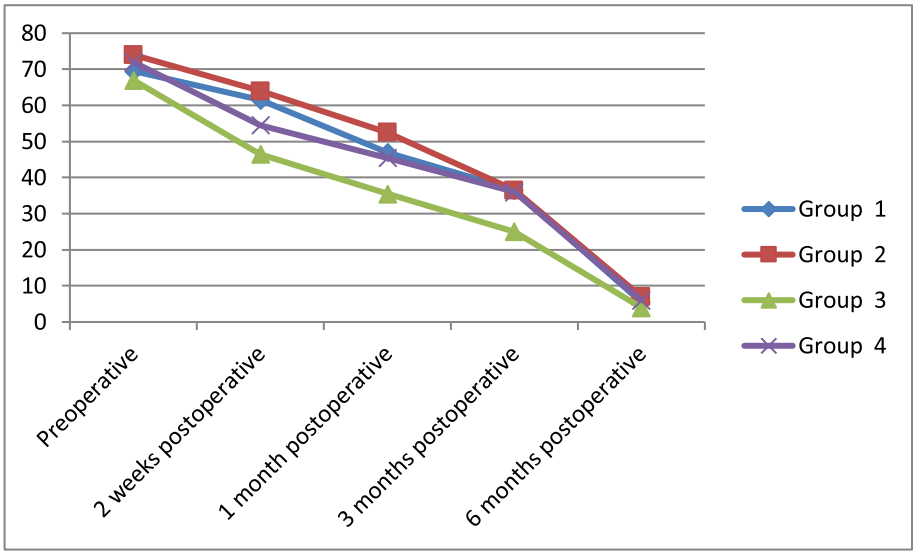

Figure 4 Mean value of VAS in all groups through different follow-up periods.

prevalence of women seeking treatment for TMD in relation to males. This is related to hormonal and constitution factor, and behavior or psychological status between sexes. In this study, there was no statistical difference regarding age and sex distribution. Also, there was no statistical difference in preoperative evaluation among groups, which ensured more consistent results.

Based on the result of this study, all treatment approaches provide significantly improved outcomes regarding pain, joint dysfunction, and psychological status of the patients compared to preoperative condition.

In this study, there was a significant improvement in active mouth opening in all postoperative period as compared to baseline. There was no statistical difference between group I (stabilization splint) and group II (distraction splint) or between group III (arthrocentesis and stabilization splint) and group IV (arthrocentesis and distraction splint). Significant improvement was observed in group III and group IV than group I and group II.

These results are in accordance with the study of Schmitter et al.,[8] who found that comparable results obtained through using centric and distraction splint in the treatment of DDwoR. Also, in agreement with Muhtarogullari M et al.,[25] who concluded that using pivot splints as an exercise regimen along with a stabilization splint may be a viable treatment option for patients with DDwoR as the normal mandibular range of motion was established and the pain was eliminated. Also, in agreement with Lee HS et al.[9] and Tatli et al.,[26] the former stated that the simultaneous application of arthrocentesis and occlusal splints could reduce patient discomfort more quickly. The later found that arthrocentesis and combined splint and arthrocentesis showed comparable outcomes that were superior to the group of the centric splint. Also, they concluded that arthrocentesis reduces pain and functional impairment more rapidly and effectively than splint therapy in patients with DDwoR.

In the current study, there was a significant improvement in pain, assessed by joint palpation, reported in all groups throughout all follow-up intervals. At earlier postoperative periods (two weeks and one month), there was a significant improvement in group III and group IV than group I and group II, while there was no statistical difference between group III and group IV. These results were in accordance with previous studies.[8,17,26]

A significant reduction in VAS was reported in all patients throughout all postoperative periods. There was a significant improvement in group III and group IV than group I and group II at two weeks. Also, significant improvement was reported in group III than in other groups at one and three months postoperative periods. These results agree with another study,[8] comparing stabilization splint against distraction splint. Also, in agreement with Dıracoglu D et al.,[27] who concluded that early treatment, either with conservative methods or with arthrocentesis, is beneficial in DDw/oR. However, arthrocentesis appears to be superior regarding pain management. So, arthrocentesis may be recommended in patients where painful complaints overwhelm despite other conservative treatments.

The more rapid and highly significant results associated with combined arthrocentesis and splint may be attributed to the added effects of arthrocentesis. This includes the removal of inflammatory products through joint lavage and improving joint lubrication through the injection of sodium hyaluronic acid, which directly causing rapid healing. The lubricating action of sodium hyaluronic acid was effective in the first three months. It can be interpreted that sodium hyaluronic acid could allow smooth sliding movement of the articular surfaces, which decrease the wear and share in the nutrition of the avascular parts of the disc and condylar cartilage.[28]

This study showed that disc reduction was not reported in all study groups, as demonstrated on MRI. However, these were alterations in signal intensity of the posterior attachment. These changes can be explained as a pseudo disc that substitutes permanently displaced disc. This agreed with the study of Westesson and Lundh[29] and Kurita et al.[30]

This study concluded that despite both types of splints provide good results without a statistical difference; the simultaneous application of arthrocentesis and occlusal splint decreases pain and improving the function effectively and more rapidly.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

References

1. Okeson JP. Joint intracapsular disorders: diagnostic and nonsurgical management considerations. *Dent Clin North Am* 2007;51:85—103.
2. Poveda-Roda R, Bagan JV, Sanchis JM, Carbonell E. Temporomandibular disorders. A case-control study. *Med Oral Patol Oral Cir Bucal* 2012;17:794—800.
3. Saito T, Yamada H, Nakaoka K, et al. Risk factors for the poor clinical outcome of visually guided temporomandibular joint irrigation in patients with chronic closed lock. *Asian J Oral Maxill Surg* 2010;22:133—7.
4. Elmohandes WA, Altaweel AA. Evaluation of combined splint and arthrocentesis therapy for treatment of temporomandibular joint internal derangement. *Egy J Oral Maxil Surg* 2013;4:67—71.
5. Dolwick MF. Temporomandibular joint surgery for internal derangement. *Dent Clin North Am* 2007;51:195—208.
6. Eberhard D, Bantleon HP, Steger W. The efficacy of anterior repositioning splint therapy studied by magnetic resonance imaging. *Eur J Orthod* 2002;24:343—52.
7. Shoji YN. Nonsurgical treatment of anterior disk displacement without reduction of the temporomandibular joint: a case report on the relationship between condylar rotation and translation. *Cranio* 1995;13:270—3.
8. Schmitter M, Zahran M, Duc JM, Henschel V, Rammelsberg P. Conservative therapy in patients with anterior disc displacement without reduction using 2 common splints: a randomized clinical trial. *J Oral Maxillofac Surg* 2005;63:1295—303.
9. Lee HS, Baek HS, Song DS, et al. Effect of simultaneous therapy of arthrocentesis and occlusal splints on temporomandibular disorders: anterior disc displacement without reduction. *J Korean Assoc Oral Maxillofac Surg* 2013;39:14—20.
10. Sato S, Kawamura H, Motegi K. Management of nonreducing temporomandibular joint disk displacement. Evaluation of three treatments. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1995;80:384—8.
11. Alpaslan C, Kahraman S, Guner B, Cula S. Does the use of soft or hard splints affect the short-term outcome of temporomandibular joint arthrocentesis? *Int J Oral Maxillofac Surg* 2008;37:424—7.
12. Guven O, Tekin U, Salmanoglu B, Kaymak E. Tumor necrosis factor-alpha levels in the synovial fluid of patients with temporomandibular joint internal derangement. *J Cranio-Maxillo-Fac Surg* 2015;43:102—5.
13. Ungor C, Atasoy KT, Taskesen F, Pirpir C, Yilmaz O. Long-term outcome of arthrocentesis plus hyaluronic acid injection in patients with wilkes stage ii and iii temporomandibular joint internal derangement. *J Craniofac Surg* 2015;26:2104—8.
14. Vos LM, Huddleston Slater JJ, Stegenga B. Arthrocentesis as initial treatment for temporomandibular joint arthropathy: a randomized controlled trial. *J Cranio-Maxillo-Fac Surg* 2014;42:134—9.
15. Sears VH. Occlusal pivots. *J Prosthet Dent* 1956;6:332—8.
16. Holmlund A, Hellsing G. Arthroscopy of the temporomandibular joint. An autopsy study. *Int J Oral Surg* 1985;14:169—75.
17. McCain JP. Arthroscopy of the human temporomandibular joint. *J Oral Maxillofac Surg* 1988;46:648—55.
18. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. *J Oral Maxillofac Surg* 1991;49:1163—7.
19. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. *J Craniomandib Disord* 1992;6:301—55.
20. Casares G, Thomas A, Carmona J, Acero J, Vila CN. Influence of oral stabilization appliances in intra-articular pressure of the temporomandibular joint. *Cranio* 2014;32:219—23.
21. Damlar I, Esen E, Tatli U. Effects of glucosamine-chondroitin combination on synovial fluid il-1beta, il-6, tnf-alpha and pge2 levels in internal derangements of temporomandibular joint. *Med Oral Patol Oral Cir Bucal* 2015;20:278—83.
22. Alpaslan C, Dolwick MF, Heft MW. Five-year retrospective evaluation of temporomandibular joint arthrocentesis. *Int J Oral Maxillofac Surg* 2003;32:263—7.
23. Carvajal WA, Laskin DM. Long-term evaluation of arthrocentesis for the treatment of internal derangements of the temporomandibular joint. *J Oral Maxillofac Surg* 2000;58:852—5. discussion 6-7.
24. Al-Hasson HK, Ismail AI, Ash Jr MM. Concerns of patients seeking treatment for tmj dysfunction. *J Prosthet Dent* 1986;56:217—21.
25. Muhtarogullari M, Avci M, Yuzugullu B. Efficiency of pivot splints as jaw exercise apparatus in combination with stabilization splints in anterior disc displacement without reduction: a retrospective study. *Head Face Med* 2014;10:42.
26. Tatli U, Benlidayi ME, Ekren O, Salimov F. Comparison of the effectiveness of three different treatment methods for temporomandibular joint disc displacement without reduction. *Int J Oral Maxillofac Surg* 2017;46:603—9.
27. Diracoglu D, Saral IB, Keklik B, et al. Arthrocentesis versus nonsurgical methods in the treatment of temporomandibular disc displacement without reduction. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108:3—8.
28. Alpaslan GH, Alpaslan C. Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in treatment of internal derangements. *J Oral Maxillofac Surg* 2001;59:613—8. discussion 8-9.
29. Westesson PL, Lundh H. Arthrographic and clinical characteristics patients with disk displacement who progressed to closed lock during a 6-month period. *Oral Surg Oral Med Oral Pathol* 1989;67:654—7.
30. Kurita H, Ohtsuka A, Kurashina K, Kopp S. A study of factors for successful splint capture of anteriorly displaced temporomandibular joint disc with disc repositioning appliance. *J Oral Rehabil* 2001;28:651—7.