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Particularities of the edentulous patients with rheumatoid arthritis treated with complete dentures

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ABSTRACT

Background and aim. This study aims at emphasizing specific aspects of prosthetic treatment for rheumatoid arthritis patients that are completely edentulous.

Material and method. In December 2023, a search was conducted through three medical databases: PubMed, Scopus, and Web of Science.

Results. Concerning their unique signs and symptoms, the management of edentulous patients with rheumatoid arthritis with removable dentures has several unique features throughout the clinical stages. Some patients have difficulty keeping dental appointments from the initial phase of treatment due to mobility issues, particularly in severe forms where several joints are impacted, resulting in stiffness that can restrict the ability to move. In such situations, the dental professional must insist on a thorough examination of the oral tissues that are going to sustain the prosthetic device or come into its proximity. In cases in which temporomandibular joint damage limits mouth opening, it can also be challenging to examine the denture's supporting tissues and take impressions because rheumatoid arthritis patients have been shown to have modifications in the joint's elements and function.

Conclusion. To improve the outcomes and overall well-being of rheumatoid arthritis patients who are completely edentulous, it is essential to thoroughly consider the options for treatment when utilizing prosthetic devices and additional therapies.

Keywords: rheumatoid arthritis, complete edentulism, temporomandibular joint osteoarthritis, complete dentures

INTRODUCTION

Rheumatoid arthritis (RA) is an ongoing, complex autoimmune disease that triggers inflammatory conditions [1]. The existence of certain self-antibodies and joint pain are two traits of RA that can be observed in people who are susceptible to the disease even before it manifests clinically as arthritis [2]. The synovial membrane is the primary target of RA inflammatory processes, which can cause damage to bone and cartilage as well as, on rare occasions, deformities in the joints [3]. RA has a major effect on individual well-being and social expenses [4]. Rheumatoid arthritis patients' oral condition has a significant impact on their quality of life [5].

Individuals with RA may also experience dry mouth, which makes wearing dentures extremely difficult [6]. It has been found that RA patients have increased rates of TMD, xerostomia, and periodontal manifestations [7].

Completely edentulous individuals may show lower degrees of systemic biochemical variables, like calcium, and phosphorus, and greater amounts of mandibular residual crest bone loss [8]. Being fully toothless appears to put the individual at risk for several systemic conditions, like RA, therefore, the main aim of the dental treatment should be to reduce the deterioration of the remaining alveolar ridges by providing beneficial complete denture therapy and establishing regular recall protocols [9].

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Severe periodontitis is a significant source of neglected dental requirements in RA patients [10], which may cause tooth loss. Tooth loss and periodontal disease may be correlated with RA [11].

Completely edentulous patients had a higher risk of RA occurrence when compared with those who had lost fewer than five teeth, with no proof linking RA to complete edentulism [12]. Patients with RA had an increased number of complete and removable partial dentures, filled, decayed, or missing teeth, and a higher frequency of temporomandibular joint disorders (TMD), especially degenerative joint disorders [13]. Edentulous subjects with RA may have limited mandibular movements, with unfavorable general consequences, but wearing a prosthesis has a beneficial influence on those movements [14]. The masticatory function may be compromised by rheumatoid arthritis, and elderly patients with RA may benefit greatly from the placement of a well-fitting removable denture [15]. In individuals who are edentulous and have removable prosthetic dentures, the onset of systemic conditions like RA and the use of medications for these conditions may result in a lack of signs and manifestations of related oral fungal infections [16].

TMDs in immune-driven rheumatic diseases have an important effect in the medical field of rheumatology, therefore it is essential to identify TMDs early and treat them in a team that encompasses dentists, prosthodontists, and temporomandibular joint specialists to minimize structure destruction within the TMJ and increase patient quality of life [17]. Individuals with RA reported greater amounts of pain magnitude from TMDs, as well as greater orofacial discomfort than healthy people [18].

Subjects with associated arthritis and TMD may exhibit preauricular pain or inflammatory processes, joint stiffness upon waking, joint sounds, muscle pain, and restricted jaw movement [19]. Subjects with greater duration of the RA length exhibit a higher frequency of temporomandibular joint (TMJ) involvement [20]. Panoramic images can differentiate between healthy and RA-affected mandibular condyles based on the trabecular structure within the condyles [21].

Compared to the general population, rheumatoid arthritis patients have a higher incidence of oral tissue diseases, therefore, it is recommended to treat these patients through a proper collaboration between rheumatologists and dental specialists [22].

To manage edentulism in RA patients it is essential to have extensive knowledge of the systemic manifestations of rheumatoid arthritis and how it may affect oral health.

Highlighting the necessity of a comprehensive and team-based approach to improve treatment outcomes and overall quality of life of completely edentulous RA patients, this study aims to reveal the major factors that influence prosthetic treatment. Therefore, this study aims to highlight certain aspects of prosthetic treatment for patients with rheumatoid arthritis who are completely edentulous.

MATERIAL AND METHOD

A comprehensive, computer-generated search was conducted in September 2023 across three medical databases: PubMed, Scopus, and Web of Science. Where appropriate, MeSH terms were employed. The investigation included the application of targeted keywords to enhance the search procedure and guarantee an accurate retrieval of significant literature. The following keywords were incorporated into the search: “rheumatoid arthritis”, “polyarthritis rheumatica”, “edentulous”, “tooth loss”, “complete denture”, “temporomandibular joint”, “temporomandibular joint osteoarthritis”, “conservative treatment”, “splint”, “low-level light therapy”, “photobiomodulation therapy”, “low level laser therapy”, “hyaluronic acid”, “platelet-rich plasma”. The selection process of the research was carried out by three researchers, who extracted the relevant articles (C.B., M.T., O.A.) and approved the relevant publications. Six additional researchers verified the gathering procedure and acknowledged the decision (S.B., A.C., I.D., A.Z., R.T., A.I.).

RESULTS

A total of eighteen articles related to the RA TMJ arthritis treatment have been analyzed. The treatment of edentulous patients with rheumatoid arthritis by using removable dentures has several particularities all along the clinical steps because of their specific symptoms and particularities. From the beginning of the treatment, for some individuals there are difficulties in respecting the dental visits because of the motility problems especially in the severe forms when multiple joints are affected, causing stiffness that can limit the body movement.

The examination of the denture supporting tissues and the impression taking is also difficult to be done when the inflammation of the temporomandibular joint restricts the opening of the mouth and of the mandibular movements, as specific changes in the temporomandibular joint components and functions were described in patients with rheumatoid arthritis [17,23,24]. The dentist must insist in these cases to perform a good investigation of the oral tissues that will be covered by the prosthesis or will be in contact with it.

Important information and data can be gathered sometimes by digital recording of the oral area using a small registration device. These can ease access to

the distal areas of the prosthetic field, without causing a great discomfort to the patient. The use of the small oral camera can be more accepted by these patients as it reduces the effort for large mouth opening and of the gag reflex sometimes caused by the trays and the impression materials, also reducing the overall time of this clinical step.

In the second step of the conventional treatment, the functional impression is done for the detailed registration of the denture supporting tissues. Special attention must be paid for an optimal adaptation of the custom tray especially in the marginal area, where the visibility can be limited because of the restricted mouth opening in cases when the temporal joint is affected by rheumatoid arthritis. The dentist will assist the patient in the functional movements needed for the marginal molding of the impression material exerting, when needed, special pressures and rotations on the perioral tissues (cheeks, buccal sulcus areas) and on the mouth angles to help the obtaining of a good conformation of the future denture's margins.

The determination of the jaw relation in edentulous patients is a key step of the treatment. The dentist must first carefully examine the stability of the bite blocks and then the conformation of the vestibular curvature is analyzed and perfected according to the overall aspect of the face. Then the vertical dimension of the lower height of the face is determined, most often using the rest position. The centric relation is the last step of this clinical phase, where the most distal position of the mandible is determined and registered. In all these specific treatment sequences, special care should be dedicated in the case of the patients with rheumatoid arthritis, where the limitations of the mouth opening and of the mandibular movements can increase the difficulty of the treatment. Repeated determinations should be performed whenever it is necessary, using the same technique or comparing determinations done with different techniques (e.g. anthropometric, functional or rest position methods used for vertical dimension of occlusion determination) for a better precision and accuracy.

The trial denture is a good opportunity to check the correctitude of the future denture or to improve some characteristics that are altered by imperfect determinations in the previous treatment steps. Improvements in tooth positions, incisal occlusal plane, or even in the vertical dimension of occlusion or centric relation can be corrected in the dental office or sometimes with the help of the dental technician.

If digital methods and techniques are used (e.g. Avadent, Dentca) the duration of the treatment can be reduced from five visits to two or three visits, a very important issue for patients with mobility limitations.

Problems can occur for the patients with RA during accommodation with denture wear because of the xerostomia that is found in some cases and in these situations the use of artificial saliva or increased liquid intake can help for an optimal environment for the denture base.

The denture and oral hygiene can be difficult for patients with stiffness and limitations of the hand movements, so the cleaning should be assisted by the care helpers or by the family members.

Treatment for temporomandibular joint osteoarthritis aims to improve patients' quality of life, restore normal mandibular movements, and eliminate or reduce pain [25].

Regular check-ups should be performed to evaluate the oral and denture status to permit optimal functions of the dental maxillary system and of the general well-being of the patient.

DISCUSSION

The mandibular movements in patients with rheumatoid arthritis were evaluated in a study on thirty partially or completely edentulous elderly patients, showing reduced opening angles during chewing, and reduced openings of the mouth and of the lateral movements [19].

Prevalence of TMJ disorders and of denture treatment in 285 female patients with (142) and without RA (143), and also the distribution of the symptoms was analyzed in a study conducted by Yamakawa [13]. The symptoms associated with TMJ involvement in RA and TMJ changes were also described by Bayar in a study from 2016 [26].

Treatment options for temporomandibular joint osteoarthritis fall into three main categories based on degree of complexity: conservative measures (medication, low-level laser therapy and low-intensity pulsed ultrasound, occlusal splints, patient education and counseling, and physical therapy, either manual therapy or at-home muscle exercise), less invasive surgical methods (arthrocentesis with or without occlusal splint therapy, arthroscopy alone or in conjunction with intraarticular injection (IAI) of pharmacologic agents such as hyaluronic acid (HA), corticosteroid (CS), morphine, and/or growth factors as found in platelet-rich plasma (PRP), and surgical methods (open joint surgeries, minimally invasive arthroscopic procedures) [27].

Conservative approach

The conservative management of osteoarthritis of the temporomandibular joint includes physiotherapy, splint therapy, analgesics, and jaw movement restriction [3]. When treating osteoarthritis, nonsteroidal anti-inflammatory drugs (NSAIDs) are the first-choice medication. NSAIDs prevent the synthe-

sis of prostaglandins, which are crucial mediators of inflammation, by inhibiting cyclooxygenase. Diclofenac sodium is a prime example of an NSAID with analgesic and anti-inflammatory qualities [28]..

It has been demonstrated that low-level laser therapy (LLLT) can lessen TMJ-OA symptoms and enhance joint function [29]. The term "soft-tissue laser" refers to the low energy output and wavelengths in the 630–1300 nm range that are used in its operation. Its effects therefore have more to do with the absorption of light than with thermal energy [30]. A systematic review [31] on low-level laser therapy for the treatment of osteoarthritis including seven trials in total, with 161 patients receiving a placebo laser and 184 patients receiving a laser concluded that low laser therapy may be efficient in pain management.

Low-level laser therapy (LLLT) was tested in 20 patients with TMJ osteoarthritis in a double-blind clinical trial. Using an 810 nm low-level laser (peak power 80 W, average power 50 mW, 1500 Hz, 1 ms pulse width, 120 seconds, 6 J, 3.4 J/cm^2 per point), the patients in the laser group were exposed to radiation on four points surrounding their TMJs and on sore muscles three times a week for four weeks. The same treatment as in the laser group was administered to the placebo group, but with laser simulation. For patients with TMJ osteoarthritis, LLLT with the current laser parameters was no more successful at reducing pain and improving mouth opening than the placebo treatment [32].

Stabilization splints ease muscle tension and guard against overloading the temporomandibular joint [33]. Because stabilization splints enable clinicians to determine the true mandibular position and subsequently create an appropriate, personalized treatment plan, they are also important in the pre-orthodontic and pre-prosthodontic diagnostic process [25]. A retrospective study [34] of 57 temporomandibular joint osteoarthritis patients which included 18 patients who had undergone splint therapy (SS group) and 39 patients that had not received SS therapy (non-SS group). Condylar bone formation and cortical thickening were assessed using cone beam computed tomography images. The anterior division of the condylar head showed favorable bone remodeling because of SS therapy for temporomandibular joint osteoarthritis.

Arthrocentesis

A minimally invasive surgical technique called arthrocentesis is typically carried out under local anesthesia. Physiological solution can be used to rinse the temporomandibular joint (TMJ) following the insertion of both needles into the superior compartment [35]. Arthrocentesis may also be paired with injections of platelet-rich plasma, corticosteroids, or hyaluronic acid.

Arthrocentesis with Hyaluronic

Hyaluronic Acid (HA) is a low, medium, or high molecular weight polysaccharide that has been effectively used as a TMJ injection to lessen inflammation and replenish natural lubrication thereby being effective in reinstating proper nourishing of the joint space and stabilizing joints [36]. Machon et al. [37] suggest that the advantages of HA in arthrocentesis and/or arthroscopy may surpass the advantages of merely avoiding intraarticular bleeding, as this may promote intraarticular scarring. One study [38] assessed pain reduction at a four years period of time after undergoing arthrocentesis for two groups of patients with temporomandibular joint osteoarthritis: first group underwent arthrocentesis with lavage alone and the second group underwent arthrocentesis in addition to hyaluronic acid. No significant differences in the two groups regarding pain reduction and jaw motion improvements. In contrast Gorrela et al. [39] concluded that the group receiving sodium hyaluronate injection had a significantly lower level of pain than the group receiving arthrocentesis alone in a total of sixty-two arthrogenous TMJs.

Arthrocentesis with Platelet-Rich Plasma

By centrifuging the patient's blood, platelet-rich plasma (PRP) is extracted in large quantities; its concentration is three to four times that of platelets in human plasma. PRP can restore cartilage and contains a wealth of chondrogenic growth factors. Growth factors found in PRP include insulin-like growth factor (IGF), transforming growth factor beta 2 (TGF-β2), vascular endothelial growth factor (VEGF), and platelet-derived growth factor (PDGF) [40]. It is believed that cells involved in periodontal wound healing grow and differentiate in response to polypeptide growth factors, or PGFs. They could control a variety of biological processes in bone and connective tissue, such as cell differentiation, migration, adhesion, and proliferation. PRP is essential for cartilage repair, and there is a wealth of pertinent research on this topic [41].

Wu's et al. study [42] on the efficacy of platelet-rich plasma combined with splints for 31 patients with TMJ osteoarthritis revealed a mean pain index score of 6.1 prior to treatment and 4.1 six months later. There was a statistically significant difference ($p < 0.05$) between the preoperative and posttreatment pain index scores. The maximum comfortable mouth opening (MCMO) measured six months after treatment was 34.8 mm, compared to the mean of 27.6 mm pretreatment. There was a significant increase in the MCMO ($p < 0.05$).

For treatment of arthrogenous TMDs in short- and intermediate-term periods, the minimally invasive procedures (arthrocentesis, each in combination with PRP or HA) are indisputable superior to the

non-invasive or conservative procedures for reducing pain and increasing maximum mouth opening in patients with osteoarthritis [27].

CONCLUSION

Complete edentulism in patients with rheumatoid arthritis must consider a special set of prosthetic treatment considerations, presenting both special opportunities and difficulties.

The association of the systemic effects of rheumatoid arthritis and edentulism necessitates an advanced strategy to meet these patients' oral health requirements.

In RA patients the thorough examination of the prosthetic field permits the proper selection of the treatment options, designed to cover the complexities of their medical condition while simultaneously recognizing and reducing the difficulties resulting from the inflammation of the joints and other systemic symptoms related to rheumatoid arthritis. Conservative approaches using anti-inflammatory medication, laser therapy or stabilization splints can be associated with the prosthetic treatment of the edentulous patient suffering from RA. Minimally invasive procedures like arthrocentesis with hyaluronic acid or platelet-rich plasma also showed favorable results in increasing the mouth opening while reducing the joint inflammation and the TMJ pain intensity. It is essential to carefully analyze the denture bear area and the associated difficulties as to select the optimal treatment alternatives to maximize the results and general health of completely edentulous patients suffering from rheumatoid arthritis.

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REFERENCES

1. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO, et al. 2010 Rheumatoid arthritis classification criteria: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Rheum.* 2010;62:2569–81. doi: 10.1002/art.27584.
2. Van Boheemen L, Van Schaardenburg D. Predicting Rheumatoid Arthritis in At-risk Individuals. *Clin Ther.* 2019;41:1286–98. doi: 10.1016/j.clinthera.2019.04.017.
3. Felton DA. Complete Edentulism and Comorbid Diseases: An Update. *J Prosthodont*. 2016;25:5–20. doi: 10.1111/jopr.12350.
4. Boonen A, Severens JL. The burden of illness of rheumatoid arthritis. *Clin Rheumatol.* 2011;30:3–8. doi: 10.1007/s10067-010-1634-9.
5. Blaizot A, Monsarrat P, Constantin A, Vergnes J-N, De Grado GF, Nabet C, et al. Oral health-related quality of life among outpatients with rheumatoid arthritis. *Int Dent J.* 2013;63:145–53. doi: 10.1111/idj.12023.
6. Turner M, Jahangiri L, Ship JA. Hyposalivation, xerostomia and the complete denture. *J Am Dent Assoc.* 2008;139:146–50. doi: 10.14219/jada.archive.2008.0129.
7. Kroese JM, Volgenant CMC, Van Schaardenburg D, Van Boheemen L, Van Selms MKA, Visscher CM, et al. Oral health-related quality of life in patients with early rheumatoid arthritis is associated with periodontal inflammation and painful temporomandibular disorders: a cross-sectional study. *Clin Oral Investig.* 2022;26:555–63. doi: 10.1007/s00784-021-04034-z.
8. Kalavathy N, Anantharaj N, Sharma A, Chauhan T. Effect of serum vitamin D, calcium, and phosphorus on mandibular residual ridge resorption in completely edentulous participants: A clinical study. *J Prosthet Dent*. 2022;127:93–99. doi: 10.1016/j.prosdent.2020.07.019.
9. Felton DA. Edentulism and comorbid factors. *Tex Dent J.* 2010;127:389–401. PMID: 20446489.
10. Mok MY, Kong WY, Leung KCM, Chow MK, Lo Y, Tsang CPL, et al. Severe Periodontitis Is a Major Contributory Factor to Unmet Dental Healthcare Needs among Rheumatoid Arthritis Patients in Hong Kong. Spagnuolo G, editor. *Int J Dent.* 2022;2022:1–11. doi: 10.1155/2022/8710880.
11. de Pablo P, Dietrich T, McAlindon TE. Association of periodontal disease and tooth loss with rheumatoid arthritis in the US population. *J Rheumatol.* 2008;35:70–6. PMID: 18050377.
12. Demmer RT, Molitor JA, Jacobs DR, Michalowicz BS. Periodontal disease, tooth loss and incident rheumatoid arthritis: results from the First National Health and Nutrition Examination Survey and its epidemiological follow-up study. *J Clin Periodontol.* 2011;38:998–1006. doi: 10.1111/j.1600-051X.2011.01776.x.
13. Yamakawa M, Ansai T, Kasai S, Ohmaru T, Takeuchi H, Kawaguchi T, et al. Dentition Status and Temporomandibular Joint Disorders in Patients with Rheumatoid Arthritis. *CRANIO®*. 2002;20:165–71. doi: 10.1080/08869634.2002.11746207.
14. Dev S, Perti S, Garhnayak M, Sahoo KK, Dhal A, Garhnayak L. Intricate Estimation and Evaluation of Mandibular Movements in Geriatric Patients Suffering from Rheumatoid Arthritis. *J Contemp Dent Pract.* 2017;18:781–4. doi: 10.5005/jp-journals-10024-2126.
15. Andrade KM, Alfenas BFM, Rodrigues Garcia RCM. Influence of removable prostheses on mastication in elderly subjects with rheumatoid arthritis. *J Oral Rehabil.* 2018;45:295–300. doi: 10.1111/joor.12592.
16. Gacon I, Wieczorek A. Coexistence of Lack of Clinical Manifestation of Oral Mycosis and Systemic Diseases in Edentulous Patients Using Removable Prosthetic Restorations. *Int J Environ Res Public Health.* 2020;17:6348. doi: 10.3390/ijerph17176348.
17. Hysa E, Lercara A, Cere A, Gotelli E, Gerli V, Paolino S, Pizzorni C, Sulli A, Smith V, Cutolo M. Temporomandibular disorders in immune-mediated rheumatic diseases of the adult: A systematic review. Semin Arthritis Rheum. 2023;61:152215. doi: 10.1016/j.semarthrit.2023.152215.
18. Mesic VF, Laskarin A-M, Kehler T, Spalj S, Dozet M, Pavicic DK. Characteristics of Temporomandibular Disorders and Orofacial Pain in Individuals with Rheumatoid Arthritis. *Int J Prosthodont.* 2023;36:630–6. doi: 10.11607/ijp.8145. PMID: 36484668.
19. Andrade KMD, Alfenas BFM, Campos CH, Rodrigues Garcia RCM. Mandibular movements in older people with rheumatoid arthritis. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2017;123:e153–e159. doi: 10.1016/j.oooo.2017.01.014.
20. Jalal RA, Ahmed KM, Saeed SM, Qaradaghi TA. Correlation of clinical findings of temporomandibular joint with serological results in rheumatoid arthritis patients. *Clin Exp Dent Res.* 2022;8:1270–6. doi: 10.1002/cre2.621.
21. Türkmenoğlu A, Yüksel HT, Karahan AY. Evaluation of mandibular condyle trabecular structure in patients with rheumatoid arthritis using fractal analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2022;133:229–37. doi: 10.1016/j.oooo.2021.08.011.

22. Aliko A, Alushi A, Tafaj A, Lela F. Oral mucosa involvement in rheumatoid arthritis, systemic lupus erythematosus and systemic sclerosis. *Int Dent J.* 2010;60:353–8. PMID: 21141208.
23. Mustafa MA, AL-Attas BA, Badr FF, Jadu FM, Wali SO, Bawazir YM. Prevalence and Severity of Temporomandibular Disorders in Rheumatoid Arthritis Patients. *Cureus*. 2022. doi: 10.7759/cureus.21276.
24. Burns M, Chapman S, Creedon A, Bailey M. An unusual and severe presentation of rheumatoid arthritis in the temporomandibular joint. *Oral Surg.* 2020;13:182–7. doi: 10.1111/ors.12480.
25. Derwich M, Mitus-Kenig M, Pawlowska E. Interdisciplinary Approach to the Temporomandibular Joint Osteoarthritis—Review of the Literature. *Medicina* (Mex). 2020;56:225. doi: 10.3390/medicina56050225.
26. Bayar N, Kara SA, Keles I, Koç MC, Altinok D, Orkun S. Temporomandibular Joint Involvement in Rheumatoid Arthritis: A Radiological and Clinical Study. *CRANIO®.* 2002;20:105–10. doi: 10.1080/08869634.2002.11746198.
27. Al-Moraissi EA, Wolford LM, Ellis E, Neff A. The hierarchy of different treatments for arthrogenous temporomandibular disorders: A network meta-analysis of randomized clinical trials. *J Cranio-Maxillofac Surg.* 2020;48:9–23. doi: 10.1016/j.jcms.2019.10.004.
28. Pereira-Leite C, Nunes C, Reis S. Interaction of nonsteroidal anti-inflammatory drugs with membranes: In vitro assessment and relevance for their biological actions. *Prog Lipid Res.* 2013;52:571–584. doi: 10.1016/j.plipres.2013.08.003.
29. Fikácková H, Dostálová T, Navrátil L, Klaschka J. Effectiveness of Low-Level Laser Therapy in Temporomandibular Joint Disorders: A Placebo-Controlled Study. *Photomed Laser Surg*. 2007;25:297–303. doi: 10.1089/pho.2007.2053.
30. Gerschman JA, Ruben J, Gebart-Eaglemont J. Low level laser therapy for dentinal tooth hypersensitivity. *Aust Dent J.* 1994;39:353–7. doi: 10.1111/j.1834-7819.1994.tb03105.x.
31. Brosseau L, Robinson V, Wells G, deBie R, Gam A, Harman K, et al. Low level laser therapy (Classes I, II and III) for treating osteoarthritis. In: The Cochrane Collaboration, editor. Cochrane Database Syst Rev. Chichester, UK: John Wiley & Sons, Ltd; 2004. p. CD002046.pub2. Available from: https://doi.wiley.com/10.1002/14651858.CD002046.pub2.
32. Madani AS, Ahrari F, Nasiri F, Abtahi M, Tunér J. Low-level laser therapy for management of TMJ osteoarthritis. *CRANIO®.* 2014;32:38–44. doi: 10.1179/0886963413Z.0000000004.
33. Ok S-M, Jeong S-H, Ahn Y-W, Kim Y-I. Effect of stabilization splint therapy on glenoid fossa remodeling in temporomandibular joint osteoarthritis. *J Prosthodont Res*. 2016;60:301–7. doi: 10.1016/j.jpor.2016.03.001.
34. Ok S-M, Lee J, Kim Y-I, Lee J-Y, Kim KB, Jeong S-H. Anterior condylar remodeling observed in stabilization splint therapy for temporomandibular joint osteoarthritis. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2014;118:363–70. doi: 10.1016/j.oooo.2014.05.022.
35. Tvrdy P, Heinz P, Pink R. Arthrocentesis of the temporomandibular joint: A review. *Biomed Pap.* 2015;159:031–4. doi: 10.5507/bp.2013.026.
36. 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. doi: 10.1097/SCS.0000000000002078.
37. Machon V, Hirjak D, Lukas J. Therapy of the osteoarthritis of the temporomandibular joint. *J Cranio-Maxillofac Surg.* 2011;39:127–30. doi: 10.1016/j.jcms.2010.04.010.
38. Bergstrand S, Ingstad HK, Møystad A, Bjørnland T. Long-term effectiveness of arthrocentesis with and without hyaluronic acid injection for treatment of temporomandibular joint osteoarthritis. *J Oral Sci.* 2019;61:82–8. doi: 10.2334/josnusd.17-0423.
39. Gorrela H, Prameela J, Srinivas G, Reddy BVB, Sudhir M, Arakeri G. Efficacy of Temporomandibular Joint Arthrocentesis with Sodium Hyaluronate in the Management of Temporomandibular Joint Disorders: A Prospective Randomized Control Trial. *J Maxillofac Oral Surg.* 2017;16:479–84. doi: 10.1007/s12663-016-0955-x.
40. Chandra L, Goyal M, Srivastava D. Minimally invasive intraarticular platelet rich plasma injection for refractory temporomandibular joint dysfunction syndrome in comparison to arthrocentesis. *J Fam Med Prim Care.* 2021;10:254. doi: 10.4103/jfmpc.jfmpc_1633_20.
41. Marmotti A, Rossi R, Castoldi F, Roveda E, Michielon G, Peretti GM. PRP and Articular Cartilage: A Clinical Update. *BioMed Res Int.* 2015;2015:1–19. doi: 10.1155/2015/542502.
42. Wu C-B, Sun N-N, Zhang D, Wang Q, Zhou Q. Efficacy analysis of splint combined with platelet-rich plasma in the treatment of temporomandibular joint osteoarthritis. *Front Pharmacol.* 2022;13:996668. doi: 10.3389/fphar.2022.996668.