Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

Management of Temporomandibular Joint Dysfunction Syndrome by Occlusal Splint Therapy and Facial Muscles Exercise-A Comparative Study

Md Jakirul Islam[1*], Md Khairul Islam Mridha[2], Mohammad Lanzur Rahman[3], Md Ikbal Hosen[4]

[1]Classified Specialist, Military Dental Centre Dhaka, Bangladesh Armed Forces, Bangladesh.
Email: jakirislam69@yahoo.com,
Orcid ID: 0009-0006-7996-3812
[2]Classified Specialist, Military Dental Centre Dhaka, Bangladesh Armed Forces, Bangladesh.
Email: mridhaomf8075@gmail.com,
Orcid ID: 0009-0009-5359-9719
[3]Assistant Professor, Dhaka Dental College, Dhaka, Bangladesh
Email: lanzurrahman1982@gmail.com,
Orcid ID: 0009-0001-5486-7764
[4]Junior Consultant, Chattogram Medical College Hospital, Chattogram, Bangladesh.
Email: ikbal2082@gmail.com,
Orcid ID: 0009-0004-6128-4884

*Corresponding Author

Received: 31 March 2024
Revised: 20 May 2024
Accepted: 05 June 2024
Published: 30 June 2024

Abstract

Background: Temporomandibular joint (TMJ) dysfunction syndrome is a type of degenerative musculoskeletal conditions associated with morphologic and functional deformities. It includes abnormalities of the intra-articular discal position and/or structure as well as dysfunction of the associated musculature. This study aimed to compare the role of night guard as a simple soft occlusal splint therapy and facial muscular exercise therapy for the treatment of patients having myofascial pain dysfunction syndrome. **Material & Methods:** This comparative study was conducted at the Department of Oral and Maxillofacial Surgery, Military Dental Centre, Combined Military Hospital (CMH), Dhaka and Dhaka Dental College and hospital, Bangladesh, from January 2014 to December 2015. A total of 40 patients were selected as study subjects following the convenience sampling technique. Patients were divided into two groups; Group A was treated with an occlusal splint and Group B was treated with facial muscular exercise. Each group consisted of 20 patients. Data were processed and statistically analyzed by the template of SPSS version 16.0. **Results:** During the follow-up period, there was a consistent reduction in pain scores, muscle tenderness, TMJ (Temporomandibular joint) clicking, and tenderness associated with various jaw movements, along with a significant enhancement in mouth opening observed in patients from both groups. Notably, the improvement in Group A reached 80%, surpassing that of Group B, which achieved a 65% improvement and this difference was statistically significant (p-value ≤ 0.01). **Conclusions:** Occlusal splint therapy of TMJ using a soft night guard has better and long-term improvement in reducing the symptoms of MPD (Myofascial pain dysfunction) syndrome.

Keywords:- Occlusal splint, Nightguard, Temporo-mandibular joint, Myofascial pain dysfunction.

INTRODUCTION

Temporomandibular joint (TMJ) dysfunction syndrome represents a class of degenerative musculoskeletal conditions marked by morphologic and functional deformities.[1] This syndrome involves abnormalities in the intra-

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

articular disc's position and/or structure coupled with dysfunction of the associated musculature.[2] Symptoms and signs encompass painful joint noises, restricted or deviating range of motion and muscular pain. Notably, TMD symptoms exhibit a disproportionately between the sexes, with a substantially higher incidence reported in women; female-to-male ratios range between 2:1 and 8:1. The majority of patients presenting with symptoms are typically within the 20 to 50 years age group.[3] Various etiologic factors have been postulated to elucidate disc derangements. Traumatic events may induce stretching, tearing or rupture of the disc, lateral ligament or capsule. In cases where bleeding occurs, fibrotic or hyperplastic intra-articular reactions may ensue, resulting in restricted joint mobility and pain. Additionally, less overt injuries to the TMJ may prompt soft-tissue responses, potentially leading to permanent intra-articular changes with enduring effects on disc function.[4,5] Bruxism has been identified as a potential contributor to disc derangements as compressive overloading can impact the connective tissue of the temporomandibular joint (TMJ). Morphological changes in the lateral pterygoid muscle (LPM), such as hypertrophy, atrophy or contracture have been observed in individuals with anterior disc displacement without reduction.[4,6] Exercise therapy aims to enhance the coordination of masticatory muscles, alleviate muscle spasms and enhance jaw closure. The therapeutic approach encompasses various techniques, including massage of painful muscles, muscle stretching, gentle isometric tension exercises against resistance, guided opening and closing movements, manual joint distraction, disc/condyle mobilization, and correction of body posture.[7,8] A bite splint, also known as an occlusal splint, bite plane, or night guard, is a removable appliance typically made of resin. It is frequently employed in the treatment of patients with temporomandibular joint dysfunction and related conditions like tension headache and neck pain.[9] Occlusion plays a significant role in influencing the functioning of jaw muscles and this, in turn, impacts the temporomandibular joint (TMJ). Changes in a patient's occlusion can potentially affect jaw muscles and TMJ structures.[7,8,10] When addressing temporomandibular joint pain dysfunction syndrome, initial treatments typically involve conservative, nonsurgical approaches, reserving surgery as a last resort. The majority of patients with TMJ dysfunction can find successful treatment through nonsurgical means including medication, muscular exercises, splints, arthrocentesis, discectomy, or prosthesis.[11] Occlusal splint therapy is valuable for both diagnosing and managing various disorders of the masticatory system.[12] An overarching objective of occlusal splint treatment is to safeguard TMJ discs from dysfunctional forces that could lead to perforations or permanent displacements. Additionally, the treatment aims to enhance jaw-muscle function and alleviate associated pain by establishing a stable, balanced occlusion. As cognitive awareness increases, factors contributing to the disorder are mitigated resulting in a reduction of symptoms.[13] The utilization of a splint has been justified for various reasons, encompassing the management of pain and dysfunction in masticatory muscles, modification of intermaxillary relationships and occlusal force distribution, reduction of parafunctional activity, elimination of occlusal

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

interferences, alteration of intracapsular structural relationships in the temporomandibular joint (TMJ) and control of tooth wear and mobility, all while being easy to manipulate and cost-effective.[14] Exercise therapy, another component of the treatment approach, aims to enhance the coordination of masticatory muscles, diminish muscle spasms and modify jaw closure pattern. This involves various techniques such as massage for painful muscles, muscle stretching, gentle isometric tension exercises against resistance, guided opening and closing movements, manual joint distraction, and mobilization of the disc/condyle. Additionally, the correction of body posture is addressed. The therapeutic regimen extends to relaxation techniques, incorporating deep breathing and exercises involving contrasting muscle tension and relaxation.[15,16] So, this study aimed to compare the role of night guard as a simple soft occlusal splint therapy and facial muscular exercise therapy for the treatment of patients having myofascial pain dysfunction syndrome.

MATERIAL AND METHODS

General Objectives

To assess the role of night guard as a simple soft occlusal splint therapy and facial muscular exercise therapy for the treatment of patients having myofascial dysfunction syndrome.

Specific Objectives

- To know the age and gender distribution of the respondents.
- To observe the predisposing factors of the condition.
- To analyze the types of the problem.

Methods

This comparative study was undertaken at the Department of Oral and Maxillofacial Surgery,Combined Military Hospital (CMH) Dhaka and Dhaka Dental College and hospital,Bangladesh, during the period from January 2014 to December 2015. The study population consisted of individuals aged 15 to 50 years seeking care at the Department of Oral & Maxillofacial Surgery. A total of 40 patients were included as study subjects, selected through the convenience sampling technique.

Inclusion Criteria

- Patients between 15 years to 50 years of age.
- Patient having unilateral or bilateral TMJ dysfunction with restricted mouth opening.
- Patients who had given consent to participate in the study.

Exclusion Criteria

- Patients with ankylosis of TMJ.
- Children under 15 years of age.
- Non-cooperative patients.
- Patients who had severe systemic disease.
- Patients who did not give consent to participate in the study.

The patients were divided into two groups for the study. Group A received treatment with occlusal splints, while Group B underwent facial muscular exercises. Each group comprised 20 patients and a data collection sheet was used to document essential information. Detailed histories were recorded at the time of diagnosis including onset, duration and progression of symptoms along with characteristics of pain such as type, nature and severity. Pain responses to jaw activities like

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

mastication, phonation and deglutition were noted. Pain intensity was measured using the Visual Analog Scale (VAS, 10 cm line). Patients were followed up monthly for 4 months to assess the condition of both groups. The collected data were analyzed and comparisons were made between pre and post-treatment follow-up. The success criteria included the absence of pain or minimal pain, mouth opening exceeding 38mm and the absence of clicking sounds. The data obtained were processed and statistically analyzed using the SPSS (Statistical Package for Social Science) version 16 template. The agreement between the two groups was assessed by the percentage 'Z' test with significance set at a p-value <0.05 at a 95% confidence interval. The results were presented in the form of tables and charts with descriptive frequency displayed in a frequency table. Ethical clearance was obtained from the Ethical Committee of the hospital. Patients were provided with a detailed explanation of the procedure and the research's anticipated outcomes and written consent was obtained from each participant.

RESULTS

Among the 40 patients included in the study, 15 (37.5%) were within the 15-20 years age group, representing the relatively highest incidence. The majority of patients in this series 26(65%) were female, while the remaining 14 (35%) were male, resulting in a male-female ratio of 1:1.8. Bilateral TMJ dysfunction was observed in 24(60%) of the cases, followed by 12(30%) on the right side and the remaining 4(10%) on the left side. A history of trauma was reported by 16(40%) of the subjects, malocclusion by 12(30%), psychological disturbance by 8(20%), and inflammatory conditions in and around the TMJ by 4(10%). Joint pain was reported by 24(60%) of the patients, restricted jaw movement by 13(33%), and noise during jaw movement by 3(7%). The improvement of mouth opening showed a highly negative correlation with pain scores, with the most significant improvement observed at the 2nd to 3rd-month interval. The study revealed a notable enhancement in mouth opening across all-time intervals with the most substantial improvement observed between the 2nd and 3rd months post-treatmently. TMJ clicking persisted until the 2nd post-treatment month without significant improvement, weakened in the 3rd post-treatment month with a notable improvement, and was completely absent in the 4th post-treatment month. Pain scores demonstrated a significant improvement across all intervals, with the most significant enhancement occurring between the 2nd and 3rd months post-treatmently. The analysis identified a highly negative correlation between the improvement in mouth opening and pain scores. The significant improvement in mouth opening between intervals was most pronounced between the 2nd and 3rd post-treatment months. In the study, there was no significant improvement in TMJ clicking until the 2nd month, after which it weakened in the 3rd postoperative month with a significant improvement and was completely absent in the 4th post-treatment month. In Group A (n=20), 16 patients were cured of pain, 16 patients showed improvement in restricted mouth opening, and 13 patients demonstrated improvement in TMJ noise. In Group B (n=20), 13 patients were cured of pain, 12 patients improved in restricted mouth opening, and 14 patients exhibited improvement in TMJ noise. The study observed that the improvement rate

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

in Group A was 16 (80%), while in Group B, it was 13 (65%), with a significant difference (P=0.01). Moreover, in comparing the pain, mouth opening, and TMJ clicking scores between the groups we found statistically significant correlations where the P-values were 0.002, <0.001 and 0.006 respectively.

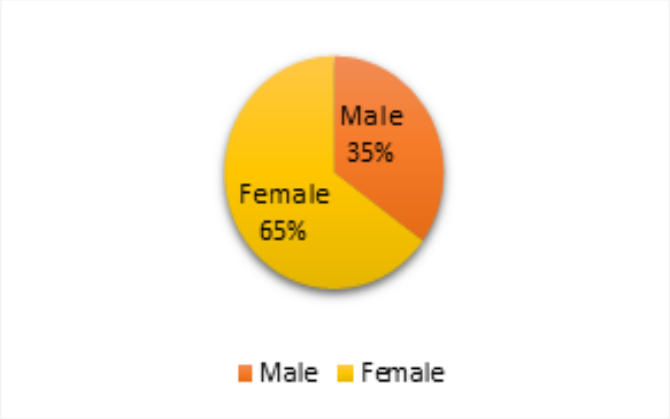

Figure 1: Gender distribution of the respondents (N=40)

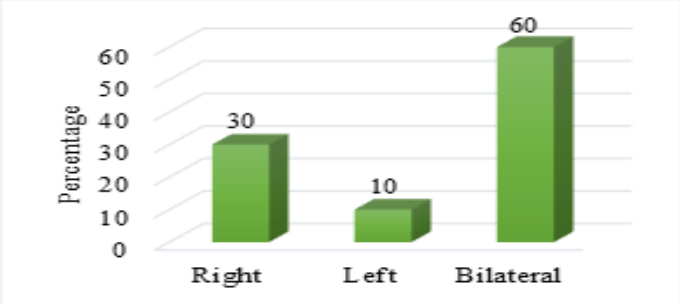

Figure 2: Distribution of patients by affected side

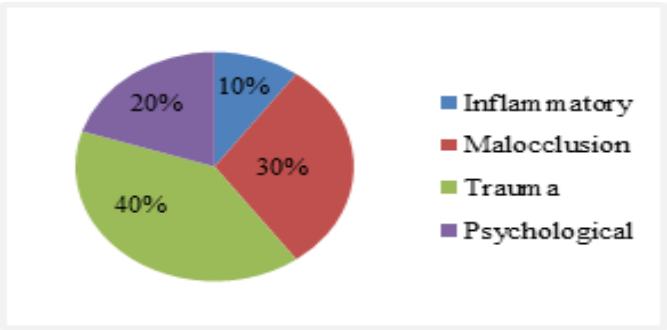

Figure 3: Distribution of study subjects according to predisposing factor

Table 1: Distribution of patients by age (N=40)

Age (Years)	n	%
15-20	15	37.5
21-30	10	25
31-40	08	20
41-50	07	17.5

Table 2: Mean values of pain level during whole follow-up periods (Group A; n=20)

Follow up	Sum	Average
Pretreatment	174	9.25
1 Month	143	8.02
2 Month	120	6.12
3 Month	57	2.86
4 Month	15	1.57

Table 3: Mean values of mouth opening during whole follow-up periods (Group A; n=20)

Follow up	Sum	Average
Pretreatment	520	25.92
1 Month	556	28.03

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

2 Month	588	30.21
3 Month	675	35.57
4 Month	710	39.22

Table 4: Mean values of TMJ clicking during whole follow-up intervals (Group A; n=20)

Follow up	Sum	Average
Pretreatment	52	2.51
1 Month	50	2.13
2 Month	47	2.32
3 Month	35	1.72
4 Month	20	1.00

Table 5: Mean values of pain level during whole follow-up periods (Group B; n=20)

Follow up	Sum	Average
Pretreatment	164	8.19
1 Month	141	7.031
2 Month	117	5.84
3 Month	58	2.91
4 Month	10	0.47

Table 6: Mean values of mouth opening during whole follow-up periods (Group B; n=20)

Follow up	Sum	Average
Pretreatment	521	26.03
1 Month	558	27.88
2 Month	587	29.34
3 Month	666	33.28
4 Month	704	35.22

Table 7: Mean values of TMJ clicking during whole follow-up intervals (Group B; n=20)

Follow up	Sum	Average
Pretreatment	53	2.66
1 Month	51	2.56
2 Month	49	2.44
3 Month	33	1.62
4 Month	20	1.00

Table 8: Outcome of complaints between Group A and Group B (N=40)

Complaints	Group A (n=20)	Group B (n=20)
TMJ Pain	16 (80%)	13 (65%)
Mouth Opening	16 (80%)	12 (60%)
TMJ Noise	13 (65%)	14 (70%)

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

Table 9: Follow-up treatment outcome (N=40)

Group	n	Improvement	%	P value
Group A	20	16	80%	0.01
Group B	20	13	65%	

Table 10: Comparison of pain, mouth opening and TMJ clicking scores between the groups

Follow up	Group A	Group B	P-value
	Average		
Pain level			
Pretreatment	9.25	8.19	0.002
1 Month	8.02	7.031	
2 Month	6.12	5.84	
3 Month	2.86	2.91	
4 Month	1.57	0.47	
Mouth opening			
Pretreatment	25.92	26.03	<0.001
1 Month	28.03	27.88	
2 Month	30.21	29.34	
3 Month	35.57	33.28	
4 Month	39.22	35.22	
TMJ clicking			
Pretreatment	2.51	2.66	0.006
1 Month	2.13	2.56	
2 Month	2.32	2.44	
3 Month	1.72	1.62	
4 Month	1.00	1.00	

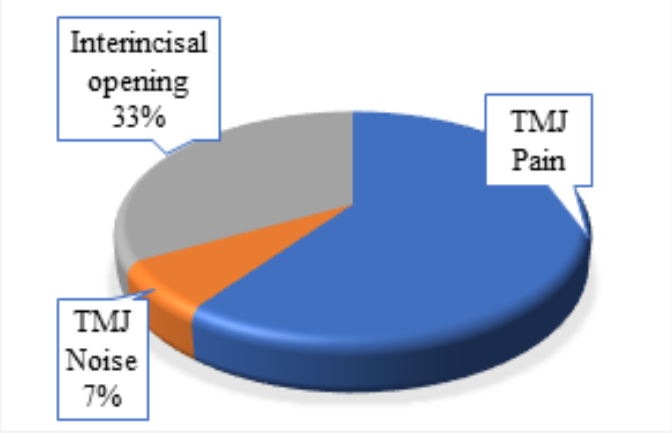

Figure 4: Distribution of respondents according to types of problem (N=40)

DISCUSSION

In the current study, it was observed that TMJ pain dysfunction was most prevalent in the 15-20 years age group 15(37.5%), followed by the age groups of 21-30 years 10(25%), 31-40 years 8(20%), and 41-50 years 7(17.5%). The age range of patients experiencing TMJ disorder is broad. While only 25% of the population may encounter symptoms of TMJ dysfunction, most patients with symptoms are typically between 20 and 50 years of age.[3,17] TMJ dysfunction can affect individuals of all age groups but its prevalence is lower in children and adolescents

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

and it is rare in those over 60 years of age.[18,19,20] Although symptoms are generally evenly distributed between men and women, the prevalence is four times higher in women than in men. Additionally, in younger and middle-aged populations, it is observed to be twice as prevalent in women compared to men.[21,22] In the current study, the male 14(35%) to female 26(65%) ratio was 1:1.8. The incidence of symptoms has been confirmed to affect 6-12% of the general population, with a women-to-men ratio of 2:1.[23] Temporomandibular disorders (TMDs) are complex in nature and can be influenced by various factors. Trauma, especially during extraction is identified as the most common factor leading to TMJ dislocation and subsequent pain.[21] In this study, 16(40%) of patients reported a history of previous trauma, which is the highest among other factors considered. Limited mouth opening is a primary complaint due to fibrosis, adhesion, or inflammation around joint spaces. Sometimes, patients may exhibit an abnormally wide mouth opening, indicating chronic dislocation and joint noise may also be present. In Group A, comprising 20 patients, 16 (80%) showed improvement after treatment, 16 patients experienced relief from pain and restricted mouth opening, and 13 patients were free from TMJ noise. However, 3(15%) patients did not respond to treatment and 1(5%) patient experienced deterioration. In Group B, which included 20 patients, 13 (65%) showed improvement. After treatment, 13(65%) patients experienced relief from pain, 12(60%) patients showed improvement in restricted mouth opening and 14(70%) patients reported a reduction in TMJ noise. However, 5(25%) patients did not respond to treatment and 1(5%) patient experienced deterioration. The results were favorable for Group A. The pretreatment mean Visual Analog Scale (VAS) score for pain for Group A and Group B was 9.2510 and 8.1875, respectively. After 4 months of treatment, the VAS scores for pain were recorded at 1.5692 and 0.46875, showing a significant reduction in both groups. The overall improvement in pain was 80% in Group A and 65% in Group B. The baseline mean maximum comfortable opening (MCO) of Group A and Group B were 25.9215 and 26.03125, respectively. After treatment, there was an increase in the mean MCO in both groups, with Group A and Group B recording 39.21875 and 35.21875, respectively. The overall improvement in oral opening was 80% in Group A and 60% in Group B. Joint clicking noise improved by 65% in Group A and 70% in Group B. On the Z percentage test, $Z=2.409$; $p=0.01$ (<0.05), which was deemed significant. Both Group A and Group B in this study demonstrated improvement in pain, maximum comfortable opening (MCO), and joint noise. Notably, in this study, in comparing the pain, mouth opening and TMJ clicking scores between the groups, statistically significant correlations were observed with P-values of 0.002, <0.001, and 0.006, respectively. While there was no interaction between the groups and time, an association was observed between the groups over the study period. Group A showed a more effective result compared to Group B. Carraro and Caffesse,[24] suggested that the adoption of an occlusal splint could reduce TMJ pain by approximately 70% and muscle pain related to increased muscle activity by around 85.2%. According to De Leeuw et al,[25] a nonsurgical approach achieved long-term effects for patients with internal derangement in a 30-year follow-up study. The

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

initiation of splint use within a short period after symptom onset was found to increase treatment efficiency.[26]

Limitations of the study

The study had limitations to acknowledge. Therapeutic exercises were not administered in isolation but were combined with other conservative procedures. The small sample size, absence of a control group, and insufficient details on exercise parameters (intensity, repetition, frequency and duration) are notable limitations. Consequently, the findings may have limited applicability to the broader population.

CONCLUSIONS

The case series suggests that TMJ pain dysfunction syndrome in most patients is characterized by limited symptoms, with rare and minor complications. The combined approach of physical exercise therapy and splint therapy proves effective in managing TMJ pain dysfunction syndrome. The temporary use of a stabilization splint with an occlusal opening aligned with the mandible's rest position promotes muscular balance and proves effective for TMJ pain dysfunction syndrome. Multiple factors, including biological, psychosocial, habitual and behavioral aspects, contribute to TMJ pain dysfunction syndrome.

REFERENCES

1. Zarb GA, Carlsson GE. Temporomandibular disorders: Osteoarthritis. J Oroface Pain. 1999; 13:295-306.
2. Tanaka E, Detamore MS, Mercuri LG. Degenerative disorders of the Temporomandibular joint: Etiology, diagnosis, and treatment. J Dent Res. 2008; 87:296-307.
3. Maraes AR. Sanches UL, Ribeiro EC. Therapeutic exercise for the control of temporomandibular disorders, Dental Press J Orthod. 2013;18(5): 134-9.
4. Molinari F, Manicone PF, Raffaelli L, Raffaelli R, Pirronti T, Bonomo L. Temporomandibular joint soft-tissue pathology, I: Disc abnormalities. Semin Ultrasound CT MR. 2007;28(3):192-204.
5. Katzberg RW, Westesson PL, Tallents RH, Drake CM. Anatomic disorders of the temporomandibular joint disc in asymptomatic subjects. J Oral Maxillofac Surg. 1996;54(2):147-53.
6. Taskaya-Yilmaz N, Ceylan G, Incesu L, Muglali M. A possible etiology of the internal derangement of the temporomandibular joint based on the MRI observations of the lateral pterygoid muscle. Surg Radiol Anat. 2005;27(1):19-24.
7. Dolwick MF, Katzberg RW, Helms CA. Internal derangements of the temporomandibular joint: fact or fiction? J Prosthet Dent. 1983;49(3):415-8.
8. Nicolakis P, Erdogmus B, Kopf A, Djaber-Ansari A, Piehslinger E, Fialka-Moser V. Exercise therapy for craniomandibular disorders. Arch Phys Med Rehabil. 2000;81(9):1137-42.
9. Ramfjord SP, Ash MM Jr. Significance of occlusion in the etiology and treatment of early, moderate, and advanced periodontitis. J Periodontol. 1981;52(9):511-7.
10. Albagieh H, Alomran I, Binakresh A, Alhatarisha N, Almeteb M, Khalaf Y, et al. Occlusal splints-types and effectiveness in temporomandibular disorder management. Saudi Dent J. 2023;35(1):70-79.
11. Ingawalé S, Goswami T. Temporomandibular joint: disorders, treatments, and biomechanics. Ann Biomed Eng. 2009;37(5):976-96.
12. Sundqvist B. Individual prediction of treatment outcome in patients with temporomandibular disorders. A quality improvement model. Swed Dent J Suppl. 2007;(186):8-42.
13. Boero RP. The physiology of splint therapy: a literature review. Angle Orthod. 1989;59(3):165-80.
14. Widmalm SE. Use and abuse of bite splints. Compend Contin Educ Dent. 1999;20(3):249-54, 256, 258-9.
15. Crider AB, Glaros AG. A meta-analysis of EMG biofeedback treatment of temporomandibular disorders. J Orofac Pain. 1999;13(1):29-37.

Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-4 | July-August 2024
https://doi.org/10.53339/aimdr.2024.10.4.4
Page no- 21-30 | Section- Research Article (Dentistry)

16. Nicolakis P, Erdogmus B, Kopf A, Djaber-Ansari A, Piehslinger E, Fialka-Moser V. Exercise therapy for craniomandibular disorders. Arch Phys Med Rehabil. 2000;81(9):1137-42.
17. Solberg WK, Woo MW, Honston JB, Prevalence of mandibular dysfunction in young adults. J Am Dent Assoc. 1979; 98:25-34.
18. Klausner JJ. Epidemiology of Chronic facial pain: diagnostic usefulness in patient care Am Dent Assoc. 1994; 125:1604-11.
19. Keeling SD, McGorray S, Wheeler TT, King GJ. Risk factors associated with temporomandibular joint sounds in children 6 to 12 years of age. Am J Orthod Dentofacial Orthop. 1994;105(3):279-87.
20. Slager GE, Otten E, van Eijden TM, van Willigen JD. Mathematical model of the human jaw system simulating static biting and movements after unloading. J Neurophysiol. 1997;78(6):3222-33.
21. Dimitroulis G. Temporomandibular disorders: a clinical update. BMJ. 1998;317(7152):190-4.
22. LeResche L. Epidemiology of temporomandibular disorders: implications for the investigation of etiologic factors. Crit Rev Oral Biol Med. 1997;8(3):291-305.
23. Marbach JJ. Temporomandibular pain and dysfunction syndrome. Rheumatic Disease Clinics of North America.1996;22:477-98.
24. Carraro JJ, Caffesse RG. Effect of occlusal splints on TMJ symptomatology. J Prosthet Dent. 1978; 40:563-6.
25. De Leeuw R, Boering G, Stegenga B, de Bont LG. Symptoms of temporomandibular joint osteoarthrosis and internal derangement 30 years after non-surgical treatment. Cranio. 1995; 13:81-8.
26. Emshoff R. Clinical factors affecting the outcome of occlusal splint therapy of temporomandibular joint disorders. J Oral Rehabil. 2006; 33:393-401.

Source of Support: Nil,

Conflict of Interest: None declared