Evaluation of the effect of low level LASER therapy versus printed occlusal splint on mandibular movements in patients with TMJ muscular disorders by using ARCUS digma

Marwa Abou El Foutouh Abdelrehim[1], Rami Maher Ghali [2], Dina Essam Bahig [3]

Aim: This research was carried out to evaluate the effectiveness of low level LASER therapy (LLLT) with Michigan splint vs the use of Michigan splint only on the range of mandibular movements in patients with temporomandibular joint disorders (TMDs) by the use of ARCUS digma.

Materials and methods: In this in-vivo study 14 patients were selected. Afterwards they were randomly divided into 2 equal groups, 7 patients in each group. For group (A), patients received hard occlusal stabilization splint (Michigan splint) constructed on the maxillary teeth. For group (B), patients received Michigan splint followed by the application of LLLT using semiconductor InGaAsp 940 nm diode LASER type.

Results: It was found that group (B) recorded statistically significant higher median horizontal condylar inclination (HCN), higher mean Maximum Mouth opening (MMO), and lower median pain score than group (A).

Conclusion: LLLT therapy with the use of Michigan splint showed a reduction in the pain associated with TMDs and showed an improvement in the range of mandibular movements. Also, it led to long term results due to its curative effect.

Keywords: LLLT, TMDs, Bruxism, Muscular pain disorders, ARCUS digma II facebow.

1. Teaching assistant at faculty of dentistry, Nahda university.
2. Professor of Oral and Maxillofacial Prosthodontics, Faculty of Dentistry, Ain Shams University, Vice Dean for Community Service and Environmental Development, Ain Shams University.
3. lecturer of Oral and Maxillofacial prosthodontics, faculty of dentistry, Ain shams university.
Corresponding author: Marwa Abou El Foutouh Abdelrehim, email: marwaelgarably@gmail.com

Introduction

Temporomandibular joint disorders are a class of musculoskeletal illnesses that impair the structure and operation of the temporomandibular joint (TMJ), it is sometimes accompanied by pain in the jaw and/or chewing muscles.[1] TMD is a collective term that encompasses a wide range of clinical joint and muscle issues in the orofacial region.[2-3]

Bruxism is thought to be one of the most prevalent parafunctional behaviors nowadays and has been implicated in the development of TMD and myofascial pain (MFP) disorders.[4]

It is a condition with a multifaceted aetiology, the causes of bruxism have been documented to fall into the following categories: Occlusion related factors (e.g., occlusal interferences, malocclusion, and temporomandibular disorders), psychological (e.g. stress, anxiety, socioeconomic issues), and central nervous system originating factors (e.g. use of certain drugs like L-DOPA and antidepressant drugs).[5-6]

An occlusal splint is a reversible, diagnostic, relaxing, and repositioning device. Any removable artificial occlusal surface used for diagnosis or therapy influencing the relationship between the mandible and the maxilla is referred to as an "occlusal splint" in the lexicon of prosthodontic words.[7]

Low level laser therapy (LLLT), also referred to as (cool or soft laser therapy). Is a type of treatment that has lately gained popularity in the treatment of a wide range of medical and dental issues, including soft tissue injuries (sports injuries), low back pain, arthritis, and skin wounds.[8]

The visual analogue scale (VAS) in the form of Wong-Baker faces, which ranges from "no pain" to "worst pain". Is a popular tool for determining the degree of pain, in an emergency, it is a true and dependable indicator of intense pain.[9] It is a very accurate tool for determining the intensity of both acute and chronic pain.[10]

The recently created ARCUS digma system uses an ultrasonic electronic sensor to record and analyze mandibular movements in three dimensions in order to quantify condylar guidance. It is a useful tool for diagnosis of TMDs.[11]

Materials and Methods

Patients selected for this research aged 15-45 years, no sex predilection, with one or more missing teeth. They were suffering from T.M.J muscular disorders with no clicking or deviation, only Pain in the T.M.J region that might be worse in the morning and associated with eating, tenderness of T.M.J with palpation at rest, pain and /or tenderness of masticatory muscles especially masseter and temporalis muscles, and headache.

They were selected with occlusal disharmony and bruxism with the presence of special finding for bruxism as wear of teeth, presented as multiple smooth and shiny facets on the occlusal surface of the teeth. A questionnaire and a clinical examination were done to asses and diagnose bruxism, which cause TMDs.

A power analysis was done and it revealed a suitable sample size of 7 patients per group.[12] The study was conducted on 14 patients randomly divided into two equal groups by simple coin flipping method. Group (A), patients in this group received hard occlusal stabilization splint (Michigan splint) constructed on the maxillary teeth. Group (B), patients in this group received Michigan splint followed by the application of LLLT using semiconductor InGaAsp 940 nm diode LASER type (Epic 10 Biolase company, class IV LASER).

The study was approved by the research ethical committee of the Faculty of Dentistry, Ain shams University (FDASU-

Rec IM112001). Accordingly, written consent from each patient was obtained to share their data in the scientific context.

Fabrication of Michigan splint of 2 mm thickness on the maxillary arch: using rubber base putty impression material (silaxil, italy) in an appropriately sized stock tray, impressions of the maxillary and mandibular arches were created. Then they were instantly poured by using stone.

Anterior deprogramming device was used to obtain a centric occluding relation record in order to mount the mandibular cast after the maxillary cast had been mounted on the semi-adjustable articulator (Bio art semi adjustable articulator, Arcon type) using a facebow record.

The articulator was opened vertically to create a 2 mm gap between the posterior teeth, which corresponds to the thickness of the eventual splint. A protrusive record was made, and the articulator's lateral condylar guidance, and protrusive condylar guidance were both modified.

Scanning of both casts mounted on the articulator at the required thickness of the splint was done by using a desktop scanner (VYLO, Korean 3D desktop scanner), then the protrusive and lateral values were added to the software program (Exocad 2.4 software) on the virtual articulator.

The Michigan splint was made digitally using the following measurements: incisal edges of the anterior teeth slightly more than 2 mm, across the equator of the buccal surfaces of the posterior teeth, the palatal border following the dental arch, including the hard palate in the shape of a horseshoe to finish behind the last molar, and an adjustment of the occlusal surface was done by making contact with the working cusps of all the mandibular premolars. Ramps were built in the canine region to prevent the posterior teeth from occluding together during lateral and protrusive movements. To increase splint stability and prevent any

occlusal alterations in the lower arch, the buccal cusps of all mandibular posterior teeth must be in touch with the splint's flat surface as in figure (1).
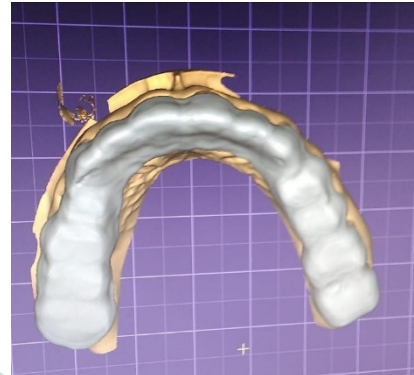

Figure (1): Fabrication of the Michigan splint digitally

Based on the data introduced for lateral and protrusive movements, the virtual articulator replicated the protrusive and lateral movements to verify that ramps produced interrupted disocclusion of the posterior teeth. These ramps were represented by the continuous v shape on the canine areas. The final splint was finished, smoothed, and sections that represented contact with lower functioning cusps were made. Then the splint was printed using 3D printer (desktop digital dental 3D printer (DDDP), Egypt).

By using articulating paper placed at the area of the canine ramps, while the patient wearing the splint. He was asked to protrude the mandible and move from one side to the other side to check for proper disocclusion of the posterior teeth during lateral and protrusive movements. The patient was asked to wear the Michigan splint every day while sleeping during the treatment period. Patients in both groups were asked to use Michigan splint for one month.

Protocol of application of LLLT:

Group (B): Patients received LLLT therapy of 940nm wavelength diode LASER (Epic 10 Biolase company, class IV LASER), with continuous mode of operation, in addition to Michigan splint.

The procedure was done in the following sequence:

-First, a 70 percent alcohol gel was used to clean the region where the laser beam would be delivered.

-Locations of discomfort, trigger points, and patterns of referred pain were identified by palpating the muscles of mastication in the areas where the LASER mode was administered.

-On the field where the LASER beam will travel, all synthetic clothing were taken off.

- Safety eyewear designed for 940 nm diode LASER wavelength was worn by both the patient and the operator.

-Patient was seated with the neck free, in a semi-supine position. Diode laser (940 nm) parameters were set to the proper values, pain therapy mode, and 2.5 watts of power were applied for 30 seconds to each trigger point as in figure (2).

Figure (2): Application of LASER beam on the trigger point of pain.

LASER beam was applied to the points of most discomfort referred as (the trigger points of pain). These trigger points are small, localized areas where physical pressure causes soreness. Also, these areas were susceptible to tingling or numbness from prolonged pressure. Each patient got a total 12 sessions over the course of four weeks, distributed as follows: Three times per week, with 2.4 watt for 30 seconds on each trigger point on each side of the face.

Whitening hand piece was used to deliver the LASER beam to the trigger points.

Evaluation of the mandibular range of movements was done by using ARCUS II digma facebow (ARCUS II digma facebow, KAVO, Germany), before the treatment, after the end of the treatment and after the follow up (one month from the end of the treatment).

Before the appointment the Para occlusal clutch (spoon) was prepared (It is a tool used to attach the lower sensory facebow of the ARCUS II digma facebow to the lower arch of the patient) by adapting it to the previously taken patient's cast using light cured resin applied around the clutch's arms, and into the interdental embrasures of teeth. During dental appointment the assembly was adapted into the patient's mouth using temporary crown material to ensure optimum retention. It must not interfere occlusally thus the material should be 2 mm short of occlusal surfaces of the teeth.

The lower facebow of the ARCUS II digma was fastened to the lower arch of the patient using the Para occlusal clutch, and the upper facebow of the ARCUS II digma was secured to the upper arch of the patient. The facebow record was initially taken while the patient remained wearing the ARCUS digma to determine the spatial orientation of the maxilla on the software, with the patient sitting upright (90 degrees) as in figure (3).

Figure (3): ARCUS digma II facebow

While the patient was wearing the apparatus, he was asked to perform his mandibular movements (lateral right and left records), the patient condylar path inclinations (HCN) were calculated and real time reproduced on the screen.

These records were obtained before the treatment, at the end of the treatment, and after one month follow up from the end of the treatment to assess the range of mandibular movements in TMDs patients.

The opening measures of the patients of both groups were taken by the use of a millimeter rule. The measurements were performed from the incisal edge of the upper incisors to the incisal edge of the lower incisors before the treatment, after the end of the treatment, and after one month follow up from the end of the treatment.

Patients in both groups were asked about their visual analogue scale to measure the pain intensity by the use of Wong-Baker faces pain rating scale. It is easy in application ranges from 0 to 5, 0 indicates no pain while 5 indicates worst pain. The (VAS) was measured before the treatment, after the end of the treatment, and after one month follow up from the end of the treatment to asses which treatment modality is much more effective.

Results:

Numerical data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). Pain scores and horizontal condylar inclination data showed non-normal (non-parametric) distribution while maximum mouth opening (MMO) data showed normal (parametric) distribution. Data were presented as median, range, mean and standard deviation (SD) values. For non-parametric data, Mann-Whitney U test was used to compare between the two groups. For parametric data, repeated measures ANOVA test was used to compare between the two

groups. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Pre-operatively as well as after one month, there was no statistically significant difference between the two groups (P-value = 0.599, Effect size = 0.265) and (P-value = 0.600, Effect size = 2.401), respectively. After two months, LASER group showed statistically significantly higher median HCN than stent group (P-value = 0.012, Effect size = 1.623), as shown in table (1).

Table (1): Descriptive statistics and results of Mann-Whitney U test for comparison between horizontal condylar inclinations (º) in the two group.

Time	Laser (n = 7)		Stent (n = 7)		P-value	Effect size (d)
	Median (Range)	Mean (SD)	Median (Range)	Mean (SD)		
Pre-operative	14.9 (0.1-41.8)	18.3 (13.3)	13.3 (1.9-23.1)	12.8 (6.9)	0.599	0.265
1 month	18.5 (6.4-54.3)	22.7 (15.8)	14.5 (2.7-39)	18.3 (12.1)	0.600	2.401
2 months	30.7 (17.9-61)	33.3 (14.6)	16 (6.4-30.5)	16.7 (8.2)	0.012*	1.623

*: Significant at P ≤ 0.05

Pre-operatively as well as after one month, there was no statistically significant difference between the two groups (P-value = 0.670, Effect size = 0.016) and (P-value = 0.958, Effect size = 0.0002), respectively. After two months, LASER group showed statistically significantly higher mean MMO than stent group (P-value = 0.006, Effect size = 0.475), as shown in table (2).

Pre-operatively; there was no statistically significant difference between the two groups (P-value = 0.530, Effect size = 0.241). After one as well as two months, LASER group showed statistically significantly lower median pain score than stent group (P-value = 0.023, Effect size = 1.089) and (P-value = 0.003, Effect size = 2.401), respectively as shown in table (3).

Table (2): Descriptive statistics and results of repeated measures ANOVA test for comparison between MMO (mm) in the two groups

Time	Laser (n = 7)		Stent (n = 7)		P-value	Effect size (Partial Eta Squared)
	Mean	SD	Mean	SD		
Pre-operative	3.36	0.45	3.24	0.53	0.670	0.016
1 month	3.77	0.39	3.79	0.58	0.958	0.0002
2 months	4.3	0.42	3.5	0.49	0.006*	0.475

*: Significant at P ≤ 0.05

Table (3): Descriptive statistics and results of Mann-Whitney U test for comparison between pain (VAS) scores in the two groups

Time	Laser (n = 7)		Stent (n = 7)		P-value	Effect size (d)
	Median (Range)	Mean (SD)	Median (Range)	Mean (SD)		
Pre-operative	5 (4-5)	4.71 (0.49)	5 (4-5)	4.86 (0.38)	0.530	0.241
1 month	2 (2-3)	2.43 (0.53)	3 (3-3)	3 (0)	0.023*	1.089
2 months	1 (1-2)	1.29 (0.49)	4 (2-5)	3.57 (1.27)	0.003*	2.401

*: Significant at P ≤ 0.05

Discussion

The use of a questionnaire and a clinical examination were effective ways to assess and diagnose bruxism, which has been linked to the emergence of TMDs and myofascial pain (MFP) disorders and is one of the most common parafunctional behaviors today.[4,13]

ARCUS II digma facebow was an efficient method for evaluating the range of mandibular movements and the condition of muscular disorders (TMDs) before the treatment, after the end of the treatment, and after one month follow up from the end of the treatment.[11,14]

Visual analogue scale was (VAS) was an efficient method for evaluating and diagnosing the pain intensity before the treatment, after the end of the treatment, and after one month follow up from the end of the treatment.[15]

The range of mandibular movements in group B increased due to the biostimulatory effect of the low level LASER therapy, which was caused by the anti-inflammatory, regenerative, and high cellular metabolism therapeutic LASER light. This was seen in the horizontal condylar path inclinations (HCN) and tooth guidance. Additionally, it boosted biological processes that occur naturally and primarily impact the cells by reducing oxidation-reduction (redox) reactions. The cells were acidic when they were in the low redox stage, but after LASER irradiation, the cells become more alkaline and were able to function at its best.[16-19] In contrast to cells with poor redox conditions, which will be stimulated by the laser energy, healthy cells cannot significantly enhance their redox condition and as a result will not respond strongly to the laser energy.[16-19]

Several studies have significantly proved a great efficacy of the low level LASER therapy in the treatment of TMDs patients, which moves in an alignment with this study.[20-22]

The effectiveness of LLLT appeared due to the increase of the production of adenosine triphosphate (ATP) (the cell's fuel in the mitochondria). Nitric oxide (NO) inhibits the photoacceptor enzyme cytochrome-c oxidase, which is the respiratory chain's final product (Krebs cycle). Nitric oxide and cytochrome-c oxidase's binding were broken up by laser light, allowing low-level laser therapy to resume ATP generation and muscle relaxation.[16-19]

The effectiveness of LLLT also appeared through greater cytoplasmic alkalization and the stimulation of nucleic acid synthesis. The electron transport chain was able to give the cell higher amounts of promotive force. Since ATP serves as a cell's unit of energy, the LLLT had a potent effect that stimulates a cell's regular operation. [16-19]

Studies have shown that, the effectiveness of the low level LASER therapy were appeared when LASER was applied to the points of the greatest pain, which are called the trigger points of pain. These trigger points are localized spots in which tenderness is felt upon manual pressure. Sustained pressure in this area causes tingling or numbness.[23,24]

Studies have shown that, the greatest LASER photobiomodulation effectiveness appeared to be linked to higher irradiation protocol, as well as to the greatest number of sessions, and the frequency protocol.[23,24] Also, studies have shown that, LLLT with infrared wavelength are the most suitable due to its greatest penetration, the most commonly used are located in the electromagnetic spectrum from 780nm to 940nm. [16-19] Therefore, each patient in this study received total number 12 sessions for 4 weeks, distributed as follows: Three times per week, with 2.4 watt for 30 secs on each trigger point on each side of the face.

In group B, the range of mandibular movements significantly improved than group A, because in group B the cause was eliminated by the occlusal splint and muscle pain was cured by the LLLT, where in group A the condition improved only as long as the Michigan splint (which eliminate the occlusal disharmony that causes bruxism) was under use.[13,18,19,25]

Several studies have shown a significant improvement in the condition of the range of mandibular movements in patients with TMJ muscular disorders when they received LLLT against occlusal splint.[12,26-28]

In contrary some studies have shown a non-significant difference in the improvement of the condition when LLLT was compared to the occlusal splint.[25]

Patients' pain levels were assessed using a visual analogue scale (VAS) at the beginning of the study and periodically throughout it to track changes. We used survival analysis statistics to see how different treatment modalities affected this event, which in this case was the decline in pain scores. Group B[1,3,5] had a significantly lower pain levels than group A[3,4,5].

The remarkable reduction in pain in group B was attributable to the local action of low level laser therapy, which raised the levels of beta endorphin and serotonin (endogenous painkillers), increased pain discharge threshold, decreased edema, manipulated nerve cell membrane, potentially inhibited Cox, and reduced local proinflammatory substance. These effects resulted in immediate pain relief and reduced muscle spasm for better performance.[18,19,25,29]

In group A, the pain intensity was not remarkably decreased as the muscle pain was still not cured as in group B, the condition only subsided for a period of time due to elimination of the cause of the bruxism (occlusal disharmony), then increased again due to removal of the stent which only resolved the problem for a certain period of time.[18,19]

In group B there was a remarkable increase in the range of mandibular movements and remarkable decrease in the pain intensity even after the end of the treatment and follow up by one month, the immediate curative effect of LLLT was maintained with time shown by the one month follow up period. Several studies have shown the efficacy of LLLT in treatment of similar condition with prolonged effect lasts up to 6 months follow up and up to 2 years follow up When LLLT was applied with different treatment modalities.[26-28]

Conclusion

Within the limitations of this study, it can be concluded that: Low level LASER therapy with the use of Michigan splint resulted in reduction of the pain associated with TMDs and resulted in improvement in the range of mandibular movements. The

treatment of LLLT with the use of Michigan splint led to long term results due to its curative effect.
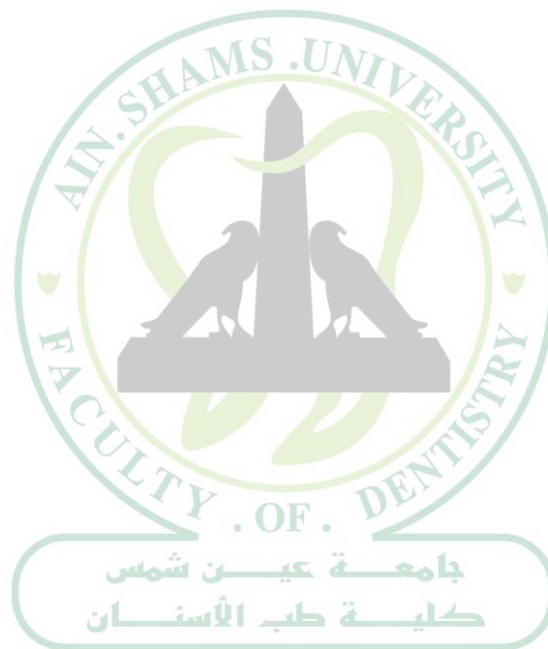
References

1. Manfredini D, Lobbezoo F. Relationship between bruxism and temporomandibular disorders: a systematic review of literature from 1998 to 2008. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2010; 109(6):e26-50.

2. Carlsson GE, Magnusson T. Management of Temporomandibular Disorders in the General Practice. Postgraduate textbook. Quintessence; 2000: 192

3. Jeffrey P. Okson: management of tempromandibular disorders and occlusion.7thedition.2013: 504.

4. Oral K, Bal Küçük BU, Ebeoğlu B, Dincer S. Etiology of temporomandibular disorder pain. Agri. 2009; 21(3):89-94.

5. Antonio AG, Santos da Silva Pierro V, Maia LC. Bruxism in children: a warning sign for psychological problems. Journal of the Canadian Dental Association. 2006; 72(2): 155-160.

6. Melis M, Abou-Atme YS. Prevalence of bruxism awareness in a Sardinian population. CRANIO®. 2003; 21(2):144-151.

7. Yadav S, Karani JT. The essentials of occlusal splint therapy. Int J Prosthet Dent. 2011; 2(1):12-21.

8. Coluzzi DJ. Fundamentals of lasers in dentistry: Basic science, tissue interaction, and instrumentation. J Laser Dent, 2008; 16: 4-10.

9. Garra G, Singer AJ, Taira BR, Chohan J, Cardoz H, Chisena E, Thode HC. Validation of the Wong-Baker FACES pain rating scale in pediatric emergency department patients. Academic Emergency Medicine. 2010; 17(1):50-54.

10. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. Academic emergency medicine.2001; 8(12):1153-1157.

11. Park C. Application of ARCUS digma I, II systems for full mouth reconstruction: a case report. Journal of Dental Rehabilitation and Applied Science. 2016;32(4):345-350.

12. Núñez SC, Garcez AS, Suzuki SS, Ribeiro MS. Management of mouth opening in patients with temporomandibular disorders through low-level laser therapy and transcutaneous electrical neural stimulation. Photomedicine and laser surgery. 2006; 24(1):45-49.

13. Carvalho CM, de Lacerda JA, dos Santos Neto FP, Cangussu MC, Marques A, Pinheiro AL. Wavelength effect in temporomandibular joint pain: a clinical experience. Lasers in medical science. 2010; 25(2):229-232.

14. Wieckiewicz M, Zietek M, Nowakowska D, Wieckiewicz W. Comparison of selected kinematic facebows applied to mandibular tracing. BioMed Research International. 2014 May 7; 2014:1-6.

15. Simunovic Z. Low level laser therapy with trigger points technique: a clinical study on 243 patients. Journal of clinical laser medicine & surgery. 1996; 14(4):163-167.

16. Shinozaki EB, dos Santos MB, Okazaki LK, Marchini L, Junior AB. Clinical assessment of the efficacy of low-level laser therapy on muscle pain in women with temporomandibular dysfunction, by surface electromyography. Brazilian Journal of Oral Sciences. 2010; 9(4):434-438.

17. Rohlİg BG, Kipirdi S, Capan N, Keskİn H. Masticatory Muscle Pain and Low-Level Laser Therapy: A Double-Blind and Placebo-Controlled Study. Turkish Journal of Physical Medicine & Rehabilitation/Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi. 2011; 57(1): 31-37.

18. Dalal S, Shetty O, Mistry G. Occlusal splints. International of Dental and Medical Sciences (IOSR-JDMS). 2018; 17(4):51-56.

19. Santos TD, Piva MR, Ribeiro MH, Antunes AA, Melo AR, Silva ED. Lasertherapy efficacy in temporomandibular disorders: control study. Brazilian journal of otorhinolaryngology. 2010; 76:294-299.

20. Fikácková H, Dostálová T, Navrátil L, Klaschka J. Effectiveness of low-level laser therapy in temporomandibular joint disorders: a placebo-controlled study. Photomedicine and laser surgery. 2007; 25(4):297-303.

21. Cetiner M, Salepci T, Atesoglu EB, Gumus M, Guven A, Undar L, Tuglular TF, Bayik M. Rituximab-CHOP Versus CHOP Alone in Patients with Diffuse Large B Cell Lymphoma. Blood. 2006; 108(11):4708.

22. Ayyildiz S, Emir F, Sahin C. Evaluation of low-level laser therapy in TMD patients. Case Reports in Dentistry. 2015 Oct 26; 2015:1–6.

23. Maia ML, Bonjardim LR, Quintans JD, Ribeiro MA, Maia LG, Conti PC. Effect of low-level laser therapy on pain levels in patients with temporomandibular disorders: a systematic review. Journal of Applied Oral Science. 2012; 20(6):594-602.

24. Hubbard DR, Berkoff GM. Myofascial trigger points show spontaneous needle EMG activity. Spine. 1993; 18(13):1803-1807.

25. Demirkol N, Sari F, Bulbul M, Demirkol M, Simsek I, Usumez A. Effectiveness of occlusal splints and low-level laser therapy on myofascial pain. Lasers in medical science. 2015; 30(3):1007-1012.

26. Shuman MA. Clinical outcomes of low level laser therapy (LLLT) in the management of temporomandibular joint disorders. 2017; 20(3): 267-

274.

27. Sayed N, Murugavel C, Gnanam A. Management of temporomandibular disorders with low level laser therapy. Journal of maxillofacial and oral surgery. 2014; 13(4):444-450.

28. Lassemi E, Jafari SM, Motamedi MH, Navi F, Lasemi R. Low-Level Laser Therapy in the Management of Temporamandibular Joint Disorder. Journal of Oral Laser Applications. 2008;8(2): 1-4.

29. Lassemi E, Jafari SM, Motamedi MH, Navi F, Lasemi R. Low-Level Laser Therapy in the Management of Temporamandibular Joint Disorder. Journal of Oral Laser Applications. 2008; 8(2): 83-86.

ASDJ

Ain Shams Dental Journal