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The Impact of Electromyography Biofeedback Training on Myofascial Pain on Patients with Bruxism

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Abstract

Background: Bruxism is a movement disorder affecting the masticatory muscles characterized by hyperactivity leading to myofascial pain and disability. The use of the Electromyography biofeedback training is widely used in management of such cases.

Aim of Study: This study aimed to evaluate the effect of electromyography biofeedback training on myofascial pain on patients with bruxism.

Material and Methods: A randomized control trial was conducted in the Electromyography Research Lab of the faculty of physical therapy in Misr University for science and technology (MUST). The study was conducted in 29/11/2020 and ended up in 4/2/2021, patients had been diagnosed and referred from oral and maxillofacial department, college of Oral and Dental Surgery, Misr University for Science and Technology (MUST). Thirty patients of both genders definite bruxism had been recruited in this study.

Patients had been divided equally and randomly into two equal groups; group (A): Treated by pharmacological therapy including muscle relaxant and non-steroidal anti-inflammatory drug (NSAID) and group (B): Treated by the same pharmacological therapy in addition to electromyography biofeedback training for four weeks with frequency of three sessions per week, day after day.

Myofascial pain was assessed pre- and post- study using the visual analogue scale (VAS) and the digital palpating scale (DPS).

Results: Statistical analysis showed that there was significant difference between the pre- and post- study values of VAS in both groups; group A and B, (p=0.008) and (p=0.001) respectively. There was a highly significant difference in post-study values of DPS in group B (p=0.001) compared to group A in which the mean ± SD of DPS for subjects in group A were 1±0.59 while in group B was 0±0.

Conclusion: This study showed that electromyography biofeedback training is an effective line of treatment for myofascial pain for patients suffering from bruxism.

Key Words: *Bruxism – Biofeedback – Electromyography – Pain.*

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Introduction

BRUXISM is a movement disorder characterized by a hyperactivity of the masticatory muscles that accompanied by clenching and/or grinding of the teeth [1]. That affects from 50% to 95% of the adult population [2]. Bruxism is subconsciously co-contraction of the masticatory muscles putting them under tension most of the time leading to myofascial pain [3,4].

Stomatognathic system is formed of facial bones, teeth, soft tissues, temporomandibular joint and masticatory muscles can be affected by bruxism which is a parafunctional motor habit, if the magnitude and direction of the forces exerted exceeds the physiological capacity of the temporomandibular joint [5].

Symptoms of bruxism include orofacial pain that affect the patient's quality of life in different manners such as anxiety, stress, fatigue, headache especially in the temporal zone, reduction in range of mouth opening (ROM) and adhesions on meniscus or even internal derangement of temporomandibular joint [6,7].

Bruxism occurs due to an affection of proprioceptive mechanism that protects the masticatory system from the possible damage that may be due to the excessive force applied on the oral structure. Generally, teeth contact or being in occlusion

immediately inhibits masticatory muscle activity, on the other hand, in bruxism the abnormal peripheral stimuli from the oral structures result in increase in the reflex activity within jaw closing lead to co-contraction [8].

Commonly, management of myofascial pain in patients with bruxism is based on pharmacotherapy as non-steroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, anticonvulsants, antidepressants, and others. Other treatment modalities have been used as, Botulinum toxin type A (BTX) injection, Platelet-rich plasma injection (PRP) which are considered temporally and don't treat the underlying pathophysiology. Complications of those medications on the long-term usage as sleepiness, abdominal pain, drowsiness, gastrointestinal adverse effect as ulcer and erosion were reported [9,10].

On the other hand, the use of the electromyography biofeedback training (EMBT) is considered efficacious in treating bruxism according to the Association for Applied Psychophysiology and Biofeedback (AAPB) [11,12].

Electromyography biofeedback training in bruxism simply considered as "sensory trick" targeting the proprioceptive that made the patient aware of the muscle tension by bring this subconscious movement to the conscious level and taught the patient how to control it [13,14].

Aim of this work:

This study aimed to evaluate the effect of electromyography biofeedback training on myofascial pain on patients with bruxism.

Patients and Methods

This was a randomized control trial in which 38 adult patients were presented to Oral and Maxillofacial department, college of Oral and Dental surgery, Misr university for science and technology (MUST). Participated in this study, but only 30 patients who met the inclusion criteria were recruited as shown in Fig. (1).

The study was conducted in the Electromyography Research Lab of the College of Physical Therapy, Misr University for Science and Technology.

Only patients with mild to moderate bruxism were selected according to the BRUX scale [15-17] which includes four questions to be answered by the patient, each answer is equivalent to grade from 0-4 as shown in the Table (1). The four obtained grades are added, and the resultant is categorized as mild, moderate, or severe.

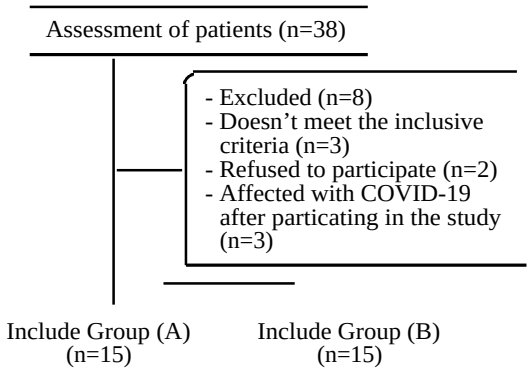

Fig. (1): The participant flowchart.

Table (1): BRUX scale of the oral parafunctional questionnaire for the assessment of the self-reported bruxism.

Questions:

How often do you clench your teeth during sleeping?
How often do you grind your teeth during sleeping?
How often do you clench your teeth during awake?
How often do you grind your teeth during awake?

Answers:

0=Never
1=Sometimes
2=Regularly
3=Often
4=Always

Result	Grade
3-5	Mild
6-10	Moderate
11 and above	Severe

Study design:

This was a randomized control study. The participants enrolled from the Egyptian population and have been divided equally into two groups. Patients were divided into two groups randomly using envelops selection, 30 identical unmarked envelops each contains a line of treatment under studying were presented to all patients to choose freely.

Group (A): Who will be treated by pharmacological therapy including muscle relaxant and non-steroidal anti-inflammatory drug (NSAID) as prescribed by the oral and maxillofacial surgeon, while group (B): Will be treated by pharmacological therapy including muscle relaxant and NSAID in addition to electromyography biofeedback training (EMBT) for four weeks with a frequency of 3 sessions/week.

Patient selection:

Inclusion criteria:

- Age 20-40 (Both gender).
- Mild to moderate bruxism.

Exclusion criteria:

- Received Botulinum toxin type A (BTX) or Platelet-rich plasma injections (PRP) injection as a treatment for this condition for the last six months.
- Had any advanced periodontal disease.
- Any intraoral fixed prothesis.
- Pregnancy.
- Hypertensive patients.
- Patient under psychiatric care.
- Parkinson.
- Had any visual or auditory impairment.
- Any cervical posture abnormalities.

Ethical considerations:

Full consent providing sufficient information has been obtained from the participants prior to the study and assured about taking part that allowed the participants to understand the implications of participation and reached a fully informed, considered and freely given decision about whether or not to do so without any pressure or coercion.

Assessment method:

At the end of the fourth week which is the end of the study, pain was assessed after using:

1- Visual analogue scale (VAS) **[18,19,20]** where patient will be asked to select a number that can describe the pain he feels as shown in Fig. (2).

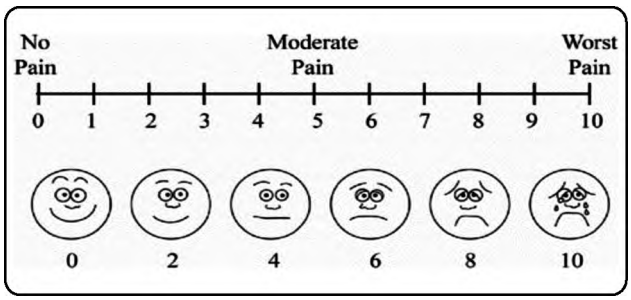

Fig. (2): The Visual analogue scale (VAS).

2- Digital palpating scale (DPS) **[8,21,22]**.

In which palpation of master muscle was performed and tenderness reported by the patient in form of 4-points scale. as shown in Table (2).

Table (2): The digital palpating scale.

Tenderness score	Interpretation
0	No pain
1	Mild
2	Moderate
3	Severe

Management of Group A:

Group A was managed using pharmacological therapy, muscle relaxant in form of Cyclobenzaprine 1 0mg tablets every 12 hours for four weeks and Ibuprofen 600mg every 12 hours for two weeks as non-steroidal anti-inflammatory drug (NSAID) and non-selective COX inhibitor.

Management of Group B:

They were managed using the same pharmacological treatment received by group A for the same time and same doses in addition to electromyography biofeedback training (EMBT) usage.

Procedure:

Electromyography biofeedback training performed according to the guidelines of the Evidence-Based practice. The session was 40 minutes with a frequency of 3 sessions/week for four weeks treatment day after day **[23]**. Targeting the Masseter muscle as the masseter muscle has been chosen as it's the initiator of the clenching as it works before the temporalis **[24]**.

Preparation of the patient:

1- All the electromyography feedback training procedures and goals has been explained for the patient before starting, in terms matches the patient's level of understanding.
2- The patient was given instruction to keep the posture erect to avoid any movement artifacts.
3- Fully relaxed position had been confirmed before starting the treatment session.
4- Patient has been familiar with the visual and auditory display.
5- At the beginning the patient hasn't been told to relax it was important to see patient actual tension usually the normal reading for muscle tension at rest and how the patient recovered on his own an instruction would interfere with the natural response, which might be not the relaxation.
6- The potential has been recorded and displayed in digital millivolt meter.
7- An adequate amount of 30sec relaxation period between each trail has been given to the patient so he could swallow or change his position **[25]**.

Device Set up:

1) A quiet warm room with non-distracting environment has been chosen; 2) It has been sure that there wasn't any sort of cross talk from other muscles, heart, respiration, movement, fluorescent light, electric motors; 3) All the mobiles phones have been switched off to avoid any cross talk; 4) The high fluorescent light in the room has been turned off; 5) Skin asepsis with alcohol swap has been prepared for the electrode placement; 6) The electrodes have been placed parallel to the muscle fibres direction, with interelectrode distance 2cm measured from the centre of the electrode to the other [13]. 7) The electrode placement has been assured to be in the same place at each training session by using the template (3cm above and anterior to the mandibular angle); 8) The reference electrode has been attached first then the recording; 9) Pressing down with fingers on the electrode has been applied to ensure secured electrode to avoid any electrode movement artifact; 10) The surface electrode has been placed over the target muscle as far as possible from the other muscles that might contaminate the signals, as shown in Fig. (3).

Fig. (3) Surface electrode placement.

Procedure:

Many patients with muscle tension and muscle related pain disorders are not aware of increased tension until the pain has already set in, so it's important to help the patient to recognize the early stage of rising tension and release the tension before the pain starts as following:

1- An anchor point has been put to the patient to help the patient recognize when the tension above or below it.
2- The patient has been asked to focus on the masseter muscle and produce tension while looking at the computer screen the patient has been asked to pay attention to the proprioceptive signals of what that level of tension feels like.
3- After 20 seconds the patient has been asked to release the tension.
4- After 20 seconds of relaxation, the patient has been asked to repeat it again.
5- when the patient has been reached the anchor tension level the reached tension level has been repeated several times without looking at the screen. After the desired tension level has been accomplished freezing the screen has been done and the computer screen has been turned to the patients to see the accomplished tension level repeating took place till success at least 70% of the time achieved. By the end of the treatment session the patient became familiar with the muscle tension if it's at, above or below the anchor so he could control the pain before starting [26].

Statistics analysis:

The collected data was conducted using SPSS for Windows, version 20 (SPSS, Inc., Chicago, IL). The p-value was set at <0.05. Data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. Shapiro-Wilk test for normality showed that all measured variables were not normally distributed, so Wilcoxon test to for within subjects' comparison and Mann-Whitney U tests for between groups comparison.

Results

The study has been completed with 30 participants who met the inclusion criteria. A demographic data of the participants is provided in Table (3).

Table (3): Descriptive statistics and t-test comparing the mean age, weight, and height of the two groups.

	Group A	Group B	t-value	p-value	Significance
	X ±SD	X ±SD			
Age (years)	22.5±3.6	23±4.8	0.229	0.767	NS
Weight (kg)	65.1±10.9	68.1±11.1	0.731	0.471	NS
Height (cm)	164.9±6.4	166.5±6.7	0.666	0.511	NS

Myofascial pain was assessed in the pre- study period and at post-study period which is the end of the fourth week of the study for both groups using VAS as shown in Table (4) and Fig. (4).

Table (4): Comparison between the pre- and post- study mean values of VAS among groups.

VAS (score)	Pre- study Mean ± SD	Post- study Mean ± SD	p-value
Group A	4.7±1.4	4±1.2	0.008*
Group B	4.6±1	1.4±1	0.001 *
(p-value)	0.967	0.001 *	

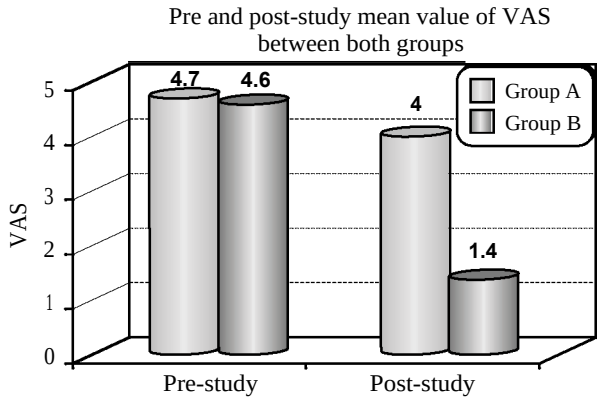

Fig. (4): Mean values of VAS in the pre- and post- study periods between both groups.

As demonstrated in Fig. (4) and shown in Table (4):

- Pre-study values of VAS between groups showed that, the mean ± SD of VAS for subjects in both groups (A and B) were 4.7 ± 1.4 and 4.6± 1 respectively. There was no statistically significant difference in pre-study mean values of VAS between the two groups (p=0.967).

- Post-study values of VAS between groups showed that, the mean ± SD of VAS for subjects in both groups (A and B) were 4 ± 1.2 and 1.4± 1 respectively. There was statistically significant difference in post-study mean values of VAS among the two groups (p=0.001) in favour to group B.

The second assessment method of myofascial pain was the using the DPS, values of pre-and post- study periods for both groups were shown in Table (5) and Fig. (5).

Table (5): Comparison between the pre- and post-study mean values of DPS among groups.

DPS	Pre- study Mean ± SD	Post- study Mean ± SD	p-value
Group A	1.1±0.4	1±0.59	0.157
Group B	1.2±0.25	0±0	0.001 *
(p-value)	0.539	0.001 *	

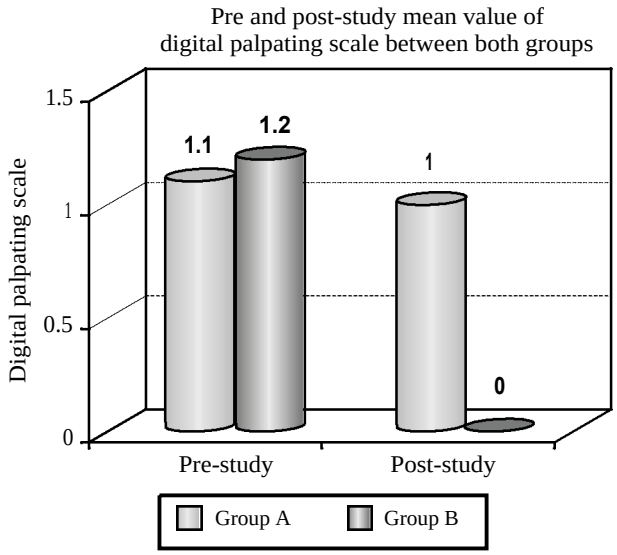

Fig. (5): Mean values of DPS in the pre- and post-study periods between both groups.

As demonstrated in Fig. (5) and shown in Table (5):

- Pre-study values of DPS between groups showed that, the mean ± SD of digital palpating scale for subjects in two groups (A and B) were 1.1 ±0.25 and 1.2±0.4 respectively. There was no statistically significant difference in pre-study mean values of muscle tenderness between the two groups (p=0.539).

- Post-study values of DPS between groups showed that, the mean ± SD of digital palpating scales for subjects in two groups (A and B) were 1 ±0.59 and $0^{\pm 0}$ respectively. There was statistically significant difference in post-study mean values of muscle tenderness between the two groups (p=0.001) in favor to group B.

Regarding the comparison of VAS values of the pre-and post-study periods within each group, there was a statistically significant difference between pre- and post-study mean values of VAS within the two groups A and B as p-value were (0.008) & (0.001) respectively. As shown in Fig. (6).

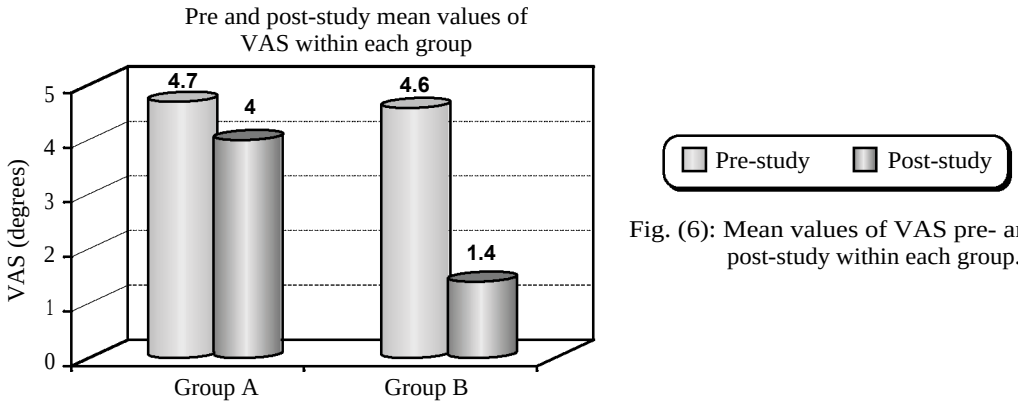

Fig. (6): Mean values of VAS pre- and post-study within each group.

On the other hand, the comparison of DPS values of the pre-and post-study periods within each group showed that, there was no statistically significant difference between pre- and post-study mean values of digital palpating scale (DPS) in group A, p-value was (0.157). While there was statistically significant difference between pre- and post-study mean values of DPS in group B as p-value was (0.001) as shown in Fig. (7).

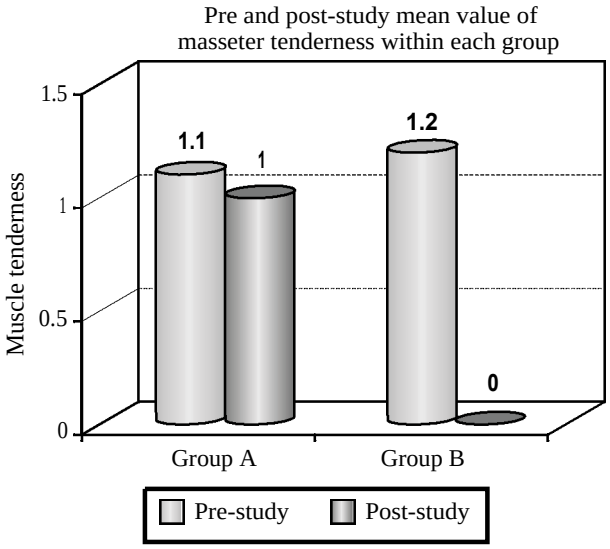

Fig. (7): Mean values of DPS pre- and post-study within each group.

Discussion

This study was conducted to evaluate the effect of the electromyography biofeedback training on controlling of mild and moderate myofascial pain resulting from muscle hyperactivity in patients with bruxism that may lead to reduction of the pain threshold, headache and sleep disturbance leading to a vacuous circle of pain and sleep disorder which ultimately lead to dramatic change in the quality of life, anxiety and maybe depression. **[27,28]**.

Using of pharmacological treatment in management of pain associated with muscle hyperactivity is one of treatment modalities that are commonly used, in the form of muscle relaxants and non-steroidal anti-inflammatory drug (NSAID) **[29-36]**.

Cyclobenzaprine is a muscle relaxant that is used for management of generalized chronic muscle pain, it provides relief of muscle pain and may improves sleep quality. It can be used for a period of 30 days **[37,38]**, this duration of application is coinciding with the protocol followed in this study.

Generally, using of muscle relaxants is associated with risk of adverse reactions especially with prolonged periods of administration that extend up to three months **[37]**. Adverse reactions may include daytime sleepiness, dry mouth, abdominal pain, drowsiness, confusion, as reported in many studies, **[39,40]** which is also reported by patients in our study.

On the other hand, NSAIDs are widely used effectively in management of pain associated with bruxism, care should be considered with the prolonged use above two weeks which is the minimum duration need to improve pain associated with masticatory complex **[41]**. Ibuprofen which is the NSAID used in this study for the minimum duration, is safer than other NSAID, this is supported by a study conducted by Ouanounou **[37]**.

Based on our results, group A showed no obvious reduction in VAS values between pre-study and post-study periods, while reduction in VAS values recoded was remarkable in group B. DPS values showed statistically significant difference between pre- and post-study mean values in group B, we can report that using of muscle relaxant with conjunction of NSAIDs may not significantly improve the bruxism nor the pain associated with it which is matching with what reported by other authors **[35,36]**. In addition, Wieckiewicz **[35]** reported that pharmacological treatment is of no interest and may not have supporting evidence, it also may lead to dependence and other side effects specially on the long term therapy. On the other hand, some studies report that addition of NSAID to cyclobenzaprine adds value in improvement of muscle pain rather than using cyclobenzaprine alone **[42,43]**.

Using of EMBT could impact the neurophysiological control of the central nervous system on the muscle activity leading to inhibition of hyperactivity by targeting the masseter muscle using the surface electrodes. Through motor learning process targeting the primary controllers, the patient can decrease the activity of the target muscle **[11]**.

The concept of this study is based upon what is approved by other authors **[44,45,46]**, that surface electromyography can directly control the pain resulting from muscle hyperactivity moreover, the artificial visual and auditory cues of the device act as error detectors which are more sensitive than the intrinsic sensory system.

In this study, results of the group B with incorporation of EMBF in the treatment plan are matching with findings of a recent study that showed that biofeedback training improves the previous bruxers' problems by a consequence of central

changes related to motor learning process **[47]**, beside that, the long term change in behavior has a potential improve on the treatment outcome with elimination off symptoms as declared by IIovar et al. and others **[48,49]**.

It is also reported by many authors **[50,51]** that the use of biofeedback is promising adjunctive treatment modalities of bruxism and can reduce the pain associated with it, at the same time it can help in reduction of the medication doses used.

The findings of the present study agreed with a recent study **[52]** stated that EMBT targeting the masticatory muscle hyperactivity during the day-time can be an effective method to regulate and decrease pain suffering from bruxism.

On the contrary, a recent research conducted by Muzalev et al., **[53]** reported that, there is a negative correlation between bruxism and pain diagnosed by polysomnographic. This contradiction may be attributed to the different methods of assessment. Moreover, Bussadori **[54]** reported the deficiency of evidence supporting the use of electromyography biofeedback training despite the promising results.

We can recommend that, results might suggest new questions and further future research, this is also mentioned by Wilmont **[51]**. Incorporation of different specialties in management off such multifactorial disorder can add value in treatment which is coinciding with the concept of Lobbezoo **[33]** who reported that management of bruxism and associated manifestation is not merely medication and it should be adjunct with other treatment modalities. The idea is to focus on the roots of the disorder not only on the symptoms.

Results of the study were limited as it was conducted in the period of the pandemic attack (COVID-19) since, inadequate follow-up carried out due to the quarantine period, three patients caught the virus, hence were excluded, one patient refused to participate as the procedure was carried on the face.

The results might suggest new questions for further future research studies.

Conclusion:

The study showed a significant decrease in the masseter muscle tenderness and pain in the group managed with pharmacological therapy and electromyography biofeedback in comparison to the group managed with pharmacological therapy alone. Electromyography biofeedback training is an effective line of treatment for myofascial pain for patients suffering from bruxism.

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تأثير التدريب بالتغذية المرجعية بواسطة رسم العضلات الكهربائى على الألم فى مرضى صرير الأسنان

يمثل صرير الأسنان نوع من أنواع الاضطرابات العضلية العصبية الأكثر شيوعاً على مستوى عضلات الفك التى تؤدى إلى آلام الفك الناتجة عن النغمة العضلية الغير طبيعية.

الهدف من الدراسة: تقيم تأثير التغذية المرجعية باستخدام جهاز رسم العضلات على آلام عند مرضى صرير الأسنان.

الطريقة: أجريت الدراسة الحالية على ثلاثين مريضاً يعانون من صرير الأسنان من الجنسين يتراوح أعمارهم بين ٢٠ إلى ٤٠ عاماً، تم تقسمهم عشوائياً إلى مجموعتين متساويتين مجموعة الدراسة ومجموعة ضابطة. مجموعة الدراسة خضعت لجلسات التغذية المرجعية باستخدام جهاز رسم العضلات بالإضافة إلى العلاج الدوائى (مسكن آلام) بينما خضعت المجموعة الضابطة للعلاج الدوائى (مسكن آلام) فقط.

تم تقيم آلام قبل بدء الدراسة وبعد شهر من العلاج بواسطة (DPS) و (VAS).

النتائج: أظهرت نتائج البحث تحسن على مستوى آلالم بين المجموعتين عند مقارنة النتائج قبل وبعد العلاج. كما أثبتت الفروق الإحصائية عند مقارنة نتائج المجموعتين بعد العلاج لصالح مجموعة الدراسة.

الاستنتاج: استعمال التغذية المرجعية بواسطة جهاز رسم العضلات له تأثير إيجابى فى تحسن آلام عند استخدامه بالتزامن مع العلاج الدوائى على علاج مرضى صرير الأسنان.