PAIN AND MANDIBULAR TRISMUS RESPONSE TO LASER THERAPY AND THERABITE EXERCISES AFTER HEAD AND NECK CANCER SURGERIES

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Abstract

Purpose: to assess the effectiveness of laser treatment and Therabite exercises in alleviating post-operative pain and mandibular trismus following neck cancer surgeries. Assessment tools (visual analogue scale (VAS), mandibular function impairment questionnaire (MFIQ), as well as measurement of the maximum interincisal opening (MIO)).

Methods: Sixty patients (30 males and 30 females) suffering from trismus after head and neck cancer surgery and getting radiotherapy were participated in the current study and these patients were selected randomly in three groups from out-patient clinics of National cancer institute, Cairo University, and age from 40 to 60 years were distributed into 3 groups. The three groups received the traditional exercise program (gentle stretching, strengthening exercises in addition to passive range of motion exercise) for three successive months. Group (A) composed of 20 patients underwent Laser therapy. Group (B) underwent the therabite exercises. Group (C) composed of 20 patients underwent Laser therapy and TheraBite exercises.

Results and conclusion: Results demonstrated that combining traditional exercise program with laser therapy and therabite exercises significantly reduced pain and mandibular trismus within cancer patients undergoing head and neck surgery who had radiotherapy. This was supported by the highly significant improvements in MIO and declines in MFIQ and VAS.

Keywords: Laser therapy, Trismus, Therabite exercises, Maximal interincisal opening, Mandibular Function Impairment and Visual Analogue Scale

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Introduction

A narrowed opening of the mouth, known as a trismus, is considered to be 35 mm or smaller. It is a widely reported side effect of treating cancer of the head and neck. Trismus is present in 5% to 38% of the population. Head and neck surgery patients must have improved management of edema, discomfort, and trismus, according to several specialists. As an example, oral as well as maxillofacial surgeons execute third molar extractions more often than any other treatment. The practitioner may better advise high-risk patients, diagnose and treat more frequent issues, and be aware of less prevalent sequelae and the most beneficial methods of care if they have a complete awareness of the difficulties connected with this surgery. Pain, edema, trismus, and overall oral dysfunction are common side effects following third molar extraction surgery. Strict adherence to postoperative instructions and careful surgical technique might lessen the possibility as well as severity of complications (4,12).

Trismus has the potential to cause significant complications, including difficulties with speaking, dental care, oral hygiene, and cancer follow-up. In addition, trismus has a detrimental effect on mandibular function and overall well-being. Joint function, collagen reorganization, and jaw function restoration may all be aided by passive motion, according to many studies, (12,13,19).

Oral surgical procedures involving the ramus and mandibular angle often result in postoperative trismus, often known as lockjaw. Furthermore, trismus is directly proportional to the intervention's intensity and the extent of tissue and bone loss. It seems that the position of the lower third molars, especially those impacted, complicated removals as well as the circulation features in the region make the trismus occurrence more common following the removal of these teeth rather than following other oral surgical procedures (5,8,11).

In usual practice, a mandibular block may induce reduced mouth opening for 2-5 days following the procedure, which is another major cause of trismus. Commonly, this is because the inferior nerve block was administered with the needle positioned incorrectly. Properly inserting the needle into the pterygoid space—enclosed on two sides by the internal oblique ridge of the mandible as well as the pterygomandibular raphe-is the best way. On occasionally, a small bleed can result from an unintentional puncture of the medial pterygoid muscle or a punctured vascular, leading to a haematoma in the muscle bed. This haematoma might then organize, resulting in fibrosis. The resulting trismus, if severe, may last for a long time (6, 9,10).

Normal mouth opening has been reported to be approximately 40-60 mm when measured as the distance between the edges of the incisors of the mandible and the maxilla. There is a tendency towards a smaller mouth opening in women compared to men and a decrease in width in elderly compared to younger individuals. The mouth opening ability is related to the length of the mandible and also related to the height of a person. A practical rule of thumb is that an individual who can open the mouth as wide as the Width of three fingers can be considered to have a normal mouth opening (1,2,3, 7).

A Latin word meaning "grinding" or "rasping," "trismos" is an ancient Greek word. As a result of restricted mandible mobility, those with trismus may have difficulty opening their mouth fully. The dental arch is bounded by the maxilla and mandible, two bones. One of the two maxillae is immobile and fixed, whereas mandible is capable of upwards and downwards mobility with a limited forward and backward mobility too (3,6,8,14).

A cutoff threshold for determining trismus is a maximum interincisal opening (MIO) of 35 mm or more. Full ankyloses is indicated by a MIO fewer than 5 mm. When introduced sideways, at least three fingers should be able pass through the mouth opening. Because mandible motion mostly takes place at the temporomandibular joint, Kazanjian 2 differentiated between two forms of TM joint ankyloses: true and false. False ankyloses refers to mobility limits brought on by extra-articular joint problems, while true ankyloses of the TM joint is often caused by disease affecting the joint. "Trismus" is the medical name used to describe this type of false ankyloses (7,9,15).

Principles of bio-stimulation and laser-catalysed reactions; It refers to the use of low-level laser therapy (LLLT) to apply electromagnetic energy to bodily tissues, with the goal of stimulating various cellular activities. It is believed that the effects include influencing biochemical, physiological, in addition to proliferative processes. The effect's strength seems to be dose and wavelength dependent.

The photochemical effects of LLLT cause cellular responses by modifications to photo acceptor molecules, additionally known as chromophores (molecules that can absorb light). The precise way that LLLT works is not well understood. Nevertheless, it is well-established that chromophores include photonic energy that cells receive during laser irradiation, hence enhancing cellular metabolism.

A number of neurological, musculoskeletal, and soft tissue disorders are currently being conservatively treated using low intensity laser radiation. The bio stimulating effect of LLLT is its anti-mflammatory, analgesic and anti-edematous effect on tissues. The microcirculation is absolutely enhanced, leading to faster ATP, RNA, and DNA production as well as improved oxygenation and nourishment of tissues. Additionally, the analgesic impact is stimulated, tissue regeneration is improved, as well as interstitial fluid absorption is increased.

A new hypothesis has the potential to clarify the little-known function of LLL as a biophysical therapeutic technique. The following is the working theory on the free radical processes that activate LLL, which is used in the treatment of several inflammatory disorders. Lipid peroxidation and other free radical processes are triggered by the absorption of starting radicals, which are themselves induced by light absorption. Ion permeability, particularly for Ca, is enhanced due to modified lipid peroxidation in cell membranes. When the calcium concentration in the leukocyte cytosol is high, a process known as calcium-dependent cellular priming takes place. This priming manifests as an improvement in the functional potential of the cells and leads to the following stimulation of the leukocyte cells to produce more pro-oxidants.

This passive motion concept serves as the foundation for the TheraBite Jaw Motion Rehabilitation System. Patients with mandibular hypo mobility and restricted mouth opening will benefit greatly from its unique design. The goal is to strengthen the jaw and increase its range of motion by restoring mobility and flexibility to the jaw muscles, joints, and connective tissues by repeated passive motion along with stretching. Evidence from prior research suggests that the TheraBite (TB) device's passive motion provides significant benefits, including more range of motion (ROM) and less pain. Among the many tools used to treat and prevent trismus, one of the most popular is the TheraBite Jaw Motion Rehabilitation System TM. Additionally, this device is also utilized to carry-out the 'Open Swallow Exercise', which is intended to improve or maintain hyolaryngeal elevation. Although the benefits of TheraBite as a preventative measure are well recognized, it would be helpful to have additional information on the costs and efficacy of this technique, both in the short and long run (16,18,20).

Material and Methods

Subjects

This study was done on sixty patients suffering from trismus following head and neck surgery were participated in the current study and these patients were selected randomly in three groups from out-patient clinics of National cancer institute, Cairo University.

Design of the study

Group A: (LLLT group)

It included 20 patients with trismus following head and neck cancer surgery that received LLLT over the area of mastication mainly the masseter muscle for 10 minutes unilaterally day after day per week with the traditional exercise program (gentle stretching and passive ROM exercise) for three successive months.

Group B: (TheraBite exercises group)

It included 20 patients with trismus following head and neck cancer surgery that received the TheraBite exercises for 10 minutes' day after day per week with the traditional exercise program (gentle stretching and passive ROM exercise) for three successive months.

Group C:(Laser therapy and TheraBite exercises group)

It included 20 patients with trismus following head and neck cancer surgery that received the LLLT over the area of mastication mainly the masseter muscle for 5 minutes unilaterally day after day per week with the traditional exercise program (gentle stretching and passive ROM exercise) in addition to 5 minutes TheraBite exercises for day after day per week for three successive months.

Instrumentation

In this study the measurement tools were the TheraBite range of motion scale that measured the MIO, Mandibular Function Impairment Questionnaire (MFIQ) as well as the Visual analogue scale (VAS): for the assessment of pain, while the therapeutic equipment was the Laser apparatus, TheraBite Jaw Motion Rehabilitation and Stacked tongue depressors, (2,6,17,23).

Procedures

Evaluation

1.TheraBite range of motion scale

Maximal interincisal opening (MIO) measurement in millimeters: The mean opening of the intrinsic vertical mouth was 40 to 50 mm. An opening of 25 to 35 mm is functional, while an opening of 10 to 24 mm is extremely limited. Males had larger values for maximum mouth opening measurements compared to females. For male participants, measurements vary from 40 to 77 mm, with more common values ranges from 50 to 60 mm, while for female participants, measurements ranges from 32 to 75 mm, with more common values ranges from 45 to 55 mm. subjects were instructed to open their mouths as wide as they can. Then, utilizing a disposable scale identified as the Therabite range of motion scale, the examiner measured the longest distance from the centre of the mandibular central incisors to the incisal border of the maxillary central incisors. open your mouth as much as you can without pain. Slide the range of motion scale onto a lower incisor (tooth) until the notch touches its edge. The ROM scale should be rotated until it touches an upper incisor. Get a reading just where the two surfaces meet. Ensure that the measurement is recorded on the opposite side of the ROM scale or in the different patient progress log (12,24).

2. Mandibular Function Impairment Questionnaire (MFIQ)

The instrument most used in the Portuguese language to assess temporomandibular joint disorders (TMD) was the questionnaire proposed by the American Academy of Orofacial Pain, Index of Anamnesic, MFIQ and the Research Diagnostic Criteria for TMD. The questionnaire included 11 items that evaluated the perceived challenges associated with mandibular function throughout social activities, speaking, chewing hard food, eating a large bite, chewing soft food, work and/or daily activities, drinking, laughing, chewing resistant food, yawning, and kissing. Six items evaluate the perceived challenges in mandibular function related to the eating of a firm cookie, meat, raw carrots, French bread, peanuts/almonds, along with an apple. The process of eating includes biting down, chewing, and then swallowing. Zero, no difficulty; one, a little difficulty; two, some degree of difficulty; three, much difficulty; and four, very much or impossible without assistance were the available answers. A total score (ranging from 0 to 68) is obtained by adding the scores. A MFIQ score of 0 implies no impairment in mandibular functioning, whereas a higher score suggests greater perceived limitations (7,13,22).

In the current study, the English version of the questionnaire was used, and therapist filled.

3. Visual analogue scale (VAS)

To use VAS, make a mark that represents the intensity of the back pain between no pain and unbearable pain. The pain level will be assessed by VAS before starting treatment and after 3 months of treatment. VAS is a 10-centimeter-long line with numbers along it that represents the range of pain, from no pain at all to extremely terrible pain.

Treatment procedures of the three groups

1.Group (A): (LLLT group)

With patient in a comfortable relaxed sitting position the LLLT was done over the area of mastication mainly the masseter muscle for 10 minutes unilaterally day after day per week with the traditional exercise program (gentle stretching as well as passive ROM exercise) for three successive months. The contact technique was used to apply the laser in a precise and continuous manner to the most painful areas over the affected muscle (masatteter muscle) (13,22).

2.Group (B): (Therabite exercises group)

The training program included a structured 12-week plan with five times of exercise (each time for 2 minutes) per day (about 10 minutes as a total time a day). The program involved subsequent steps: (10,13,14)

- Warming up exercise such as jaw opening 10 times as well as small sideway movements of the jaws 10 times without using the jaw device.
- Passive stretching, with TheraBite, 30 seconds (if possible), repeated five times.
- Perform 5 repetitions of active exercise with a resistance bite.
- Between sessions, patients were told to rest.
- Additionally, to prevent pain or damage, patients were advised to progressively increase the volume as well as intensity of the exercises.
- The MFIQ and other activities were introduced to the 2nd and 3rd groups within a single familiarization session.
- Before entering into the primary training sessions, it was made sure that everyone used the right approaches throughout the familiarization session.

3. Group (C): (LLLT and Therabite exercises group)

With patient in a comfortable relaxed sitting position the LLLT was done over the area of mastication mainly the masseter muscle for 10 minutes unilaterally day after day per week with the traditional exercise program (gentle stretching as well as passive ROM exercise) for three successive months. The contact technique was used to apply the laser in a precise and continuous manner to the most painful areas over the affected muscle (masatteter muscle) in addition to The terabyte exercise program included the training program with structured 12-week plan with five times of exercise (each time for one minutes) per day (about 5 minutes as a total time per day) according to the seven aforementioned steps (13,14)

Data analysis

The MIO in mm, MFIQ in grades and VAS in degrees were assessed at baseline as a 1st measurement and after three months as a 2nd measurement post treatment in the three groups. Computerized statistical analysis was performed using the collected data, and descriptive statistics such as mean, standard deviation, minimum, as well as maximum have been calculated for every group. Using a t-test, we compared the two groups' means both before and after the treatment, as well as the means within each group. The threshold of significance was set at an alpha value of 0.05 (21).

Results

The findings of the study were listed in the following tables

(Table 1, Figure 1) The 1st study group had an average MIO value of (20.150 ± 2.434) mm at baseline and (33.800 ± 2.093) degrees following treatment, as seen in table (1) and figure (1). This study's findings showed a significantly higher mm value (P < 0.0001). while, the 2nd group of participants in this study had a mean MIO of (20.100 ± 3.1772) mm at baseline and (33.1500 ± 2.1095) mm after treatment. There was a highly significant improvement (P < 0.0001) shown by these findings. Whereas the 3rd group of participants in this study had a mean MIO of (20.0500 ±2.4165) mm at baseline and (47.000±7.9472) mm after treatment. Additionally, these findings showed a highly significant improvement (P < 0.0001) (Table 2, Figure 2).

The 1st study group had a mean MFIQ score of 40.150± 2.644 degrees at baseline and 15.2500± 6.6641 degrees following treatment, as seen in table (2) and figure (2). In the 2nd group of participants, the MFIQ value dropped significantly from 40.800±2.5533 degrees at baseline to 15.400±6.4878 degrees after treatment, indicating a highly significant decline in MFIQ (P < 0.0001). whereas the 3rd study group had a significantly lower mean MFIQ (P < 0.0001) after therapy (12.700±0.841) degrees compared to (40.850±2.554) degrees at baseline (Table 3, Figure 3).

According to table (3) and figure (3), the 1st study group's mean VAS score at baseline was 9.000±0.551 grades, while following treatment it was 2.950±0.754 grades. According to these findings, there was a significant decline in the VAS (P < 0.0001) in the 1st study group, whereas in the 2nd group, the mean VAS score at baseline was (8.950±0.510) grades and after treatment was (3.350±0.487) grades. The 3rd group of participants in this study had a significantly lower mean VAS score (8.9000±0.5251) at baseline and (2.4400±0.75915) after treatment, indicating a significant reduction in VAS (P < 0.0001).

Discussion

This study aimed to examine the impacts of LLLT and TheraBite exercises on pain and mandibular trismus in patients with head and neck cancer who underwent surgery and received radiotherapy. The study included 60 participants with post-treatment trismus, divided into three groups receiving different combinations of therapeutic interventions. The outcomes were assessed using Maximal Interincisal Opening (MIO), the MFIQ, and the VAS.

The findings revealed that all intervention groups LLLT, TheraBite exercises, and the combination of both demonstrated significant improvements in MIO and reductions in pain (VAS) and mandibular dysfunction (MFIQ) compared to baseline. Among the three, the combined intervention group showed the most pronounced improvements, suggesting a synergistic effect when LLLT is paired with TheraBite exercises.

Previous research has examined the efficacy of therabite therapy in patients whose head and neck cancer has limited their maximal mouth opening. The therabite was utilized to mobilize the jaw. The device is designed with a mandibular mouthpiece that descends in an appropriate manner when the handle is pressed. The force is distributed to protect the teeth by means of large mouthpieces that include foam cushions. Slow opening and exact setting are made possible by a precision-adjusting screw. During the stretching technique, a C-shaped -hand aid -helps the patient or assistance to keep their fingers open. The program was designed to include 10 sets of stretches performed in a row, with brief rest periods in between, with each set lasting 30

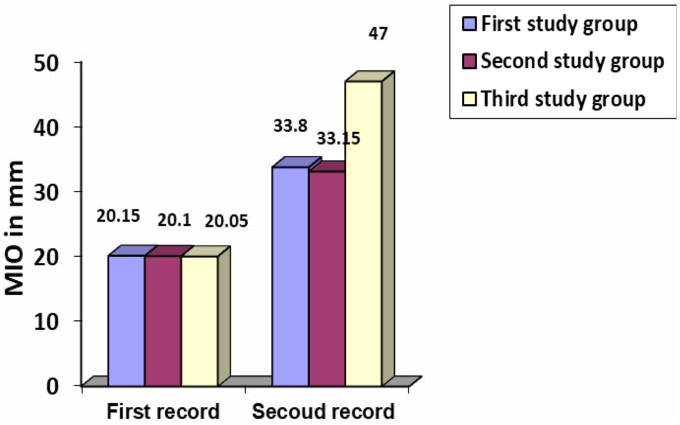

Figure 1. Mean values of the MIO before and after treatment in three groups.

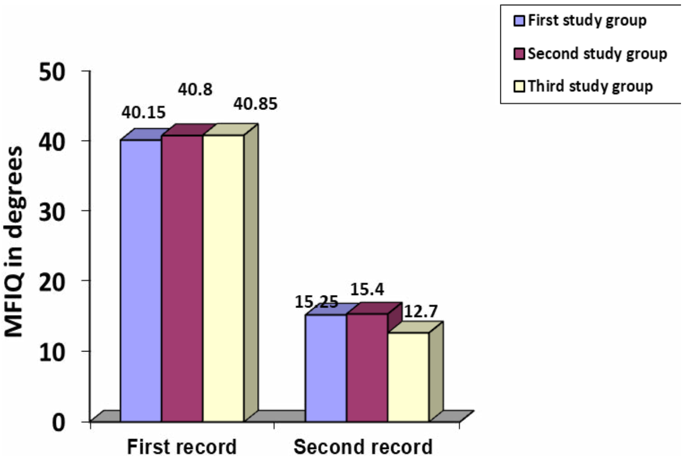

Figure 2. Mean values of VASA of the 2 records in three groups.

Table 1. Comparison of the mean values of the Maximal interincisal opening (MIO) in mm via the TheraBite range of motion scale before and after treatment in the three groups.

	Before treatment		After treatment		Mean difference	T-value	P. value	Level of significance
	Mean	SD	Mean	SD				
First Study Group	20.150	2.434	33.800	2.093	-13.6500	-19.02	0.0001	Highly significant increase
Second study Group	20.100	3.1772	33.1500	2.1095	-13.0500	-15.30	0.0001	Highly significant increase
Third Study group	20.0500	2.4165	47.000	7.9472	-26.9500	-14.51	0.0001	Highly significant increase

Table 2. Comparison of the mean values of the Mandibular Function Impairment Questionnaire (MFIQ) in degrees before and after treatment in the three groups.

	Before treatment		After treatment		Mean difference	T-value	P.value	Level of significance
	Mean	SD	Mean	SD				
First Study Group	40.150	2.6443	15.2500	6.6641	24.9000	15.53	0.0001	Highly significant Decrease
Second Study group	40.800	2.5533	15.400	6.4878	25.4000	16.29	0.0001	Highly significant decrease
Third Study group	40.850	2.554	12.700	0.841	28.1500	46.82	0.0001	Highly significant decrease

Table 3. Comparison of the mean values of the VAS in grades before and after treatment in the three groups.

	Before treatment		After treatment		Mean difference	T-value	P.value	Level of significance
	Mean	SD	Mean	SD				
First Study Group	9.000	0.551	2.950	0.754	6.05000	28.97	0.0001	Highly significant Decrease
Second Study group	8.950	0.510	3.350	0.487	5.6000	35.91	0.0001	Highly significant decrease
Third Study group	8.9000	0.5251	2.4400	0.75915	6.46000	31.30	0.0001	Highly significant decrease

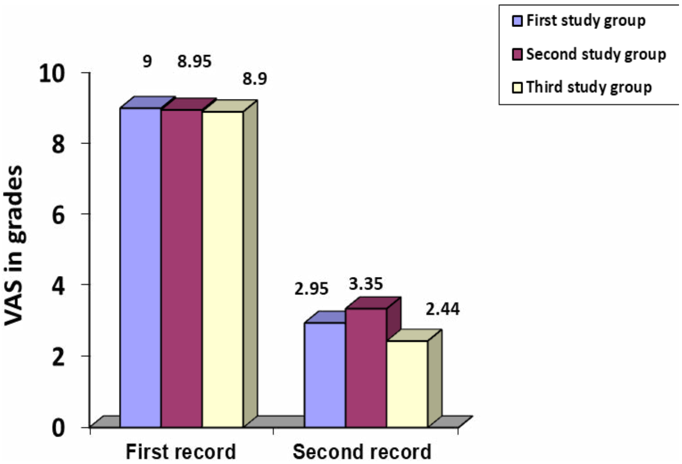

Figure 3. Mean values of VAS of the 2 records in three groups.

seconds. Assistants were told to squeeze the handle in cases when the patient was too weak to do it themselves, (14,16, 18,21).

Gibbons and Abulhoul, 2007 and Weber et al., 2010. revealed that the concept of passive movement is the basis of the TheraBite Jaw Motion Rehabilitation System. It is designed especially for patients who are experiencing mandibular hypo mobility and restricted mouth opening. The goal is to strengthen the jaw and increase its range of motion by restoring mobility and flexibility to the jaw muscles, joints, and connective tissues by repeated passive motion as well as stretching. In terms of ROM and pain reduction, previous study suggests that the TheraBite (TB) device's passive motion provides significant improvement (11,23).

These results are consistent with previous studies indicating that trismus, commonly resulting from surgery and radiotherapy in head and neck cancer patients, can be managed effectively through targeted physical therapy. Kamstra et al. (2011) and Weber et al. (2010). reported that radiation-induced fibrosis of the masticatory muscles significantly contributes to trismus, and that passive motion therapy, such as TheraBite, enhances muscle flexibility and joint mobility. Similarly, Azadgoli and Baker (2016). highlighted the potential of LLLT in reducing muscle fatigue and promoting muscle recovery through its bio-stimulatory and anti-inflammatory effects (19,23,3).

The statistical analysis confirmed highly significant increases in MIO across all intervention groups. For instance, in the group receiving only LLLT, MIO increased from a mean of 20.15 mm to 33.8 mm. Comparable trends were observed in the TheraBite group and the combined group, where post-treatment MIO reached up to 47 mm. These changes are clinically meaningful, surpassing the commonly accepted trismus cutoff of 35 mm, as suggested by Connoie et al (2007) (7).

Pain scores (VAS) decreased significantly in all treatment groups, indicating not only functional improvement but also enhanced patient comfort and quality of life. The MFIQ scores also showed significant reductions, reflecting improved mandibular function. Importantly, the control group, which received only conventional exercises, exhibited minimal changes, reinforcing the effectiveness of the targeted interventions.

Our findings support the growing body of evidence advocating for the use of combined modalities in trismus management. The data indicate that integrating LLLT and TheraBite with conventional therapy yields superior outcomes than using any single modality alone. This aligns with findings from studies by Bensadoun et al. (2010), Bond et al. (2013), and Rose et al. (2009), who emphasized the importance of multimodal rehabilitation approaches (4,6,22).

Conclusion

Using laser and therabite exercises decreased trismus following head and neck surgery in patients undergoing radiation for head and neck cancer. This was supported by a statistically significant improvement in mean MIO values and a significant reduction in MFIQ and VAS scores.

In conclusion, the integration of LLLT and TheraBite exercises presents a valuable strategy for improving mandibular mobility and reducing pain in head and neck cancer patients suffering from trismus. Future research should focus on long-term outcomes and cost-effectiveness to support widespread clinical adoption of this combined therapeutic approach.

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