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Impact of Class 3b Bemolaser along with Joint Mobilization Techinque in Imprvoing Range of Motion in the Subjects of Ankylosing Tempomandibular Joint

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ABSTRACT

Background: Ankylosing temporomandibular joint (TMJ) is characterized by restricted mandibular movement, pain, and functional limitations. Conservative physiotherapy interventions such as laser therapy and joint mobilization are commonly used; however, evidence regarding their combined effect remains limited.

Objective: To evaluate the impact of Class 3B BEMO Laser therapy combined with joint mobilization techniques in improving pain and range of motion in subjects with ankylosing temporomandibular joint.

Methodology: An experimental study was conducted on 40 subjects diagnosed with ankylosing TMJ. Participants received Class 3B BEMO Laser therapy along with joint mobilization techniques for 6 weeks. Outcome measures included Visual Analogue Scale (VAS), maximum mouth opening (MMO), mandibular protrusion, and lateral excursion. Pre- and post-intervention data were analyzed using paired t-test, one-sample t-test, and repeated measures ANOVA.

Results: Significant improvements were observed in all outcome measures. VAS scores significantly reduced ($p < 0.001$). Maximum mouth opening improved from 24.63 ± 3.13 mm to 47.70 ± 4.98 mm ($p < 0.001$). Protrusion and lateral excursions also showed statistically significant enhancement ($p < 0.001$). Repeated measures ANOVA confirmed a significant main effect of time across variables.

Conclusion: Class 3B BEMO Laser therapy combined with joint mobilization techniques is effective in reducing pain and improving mandibular mobility in subjects with ankylosing TMJ. The intervention demonstrated both statistical and clinical significance.

Keywords: *Temporomandibular Joint, Laser Therapy, Photobiomodulation, Joint Mobilization, Ankylosis, Range of Motion, Physiotherapy*

INTRODUCTION

The temporomandibular joint (TMJ) is one of the most complex synovial joints in the human body, responsible for essential functions such as mastication, speech, swallowing, and facial expressions. It is a bilateral ginglyno arthrodial joint that allows both rotational and translatory movements. Normal temporomandibular joint function requires coordinated interaction between the articular surfaces, capsule, ligaments, muscles, and neuromuscular control mechanisms. Any structural or functional disturbance in this joint can significantly impair oral function and quality of life.

Ankylosis of the temporomandibular joint is a pathological condition characterized by restricted mandibular movement due to fibrous or bony fusion between the mandibular condyle and the glenoid fossa. It may result from trauma, infection, inflammatory arthritis, systemic diseases, or prolonged immobilization. Clinically, TMJ ankylosis presents with reduced mouth opening, difficulty in mastication, deviation of the jaw, impaired speech, facial asymmetry, and chronic pain. In severe cases, it may affect nutrition, oral hygiene, and psychosocial well-being.

The primary functional limitation in ankylosing TMJ is reduced range of motion, particularly in maximum mouth opening, protrusion, and lateral excursions. Restricted joint mobility occurs due to capsular fibrosis, adhesions, muscle shortening, and altered arthrokinematics. Early and effective intervention is essential to prevent permanent structural deformity and long-term disability.

Conservative management plays a crucial role in the rehabilitation of TMJ ankylosis, particularly in mild to moderate cases or post-surgical rehabilitation. Physiotherapy interventions aim to reduce pain, restore joint mobility, improve muscle flexibility, and enhance functional performance. Among various physiotherapeutic modalities, joint mobilization techniques and low-level laser therapy have gained considerable attention.

Joint mobilization techniques are manual therapy procedures designed to restore accessory joint movements and normalize arthrokinematics. According to Maitland's principles, graded oscillatory mobilizations improve capsular extensibility, reduce pain, and enhance synovial fluid distribution. In the temporomandibular joint, inferior, anterior, medial, and lateral glides help restore translatory movements of the mandibular condyle, thereby improving mouth opening and functional jaw movements.

Photobiomodulation therapy, commonly referred to as low-level laser therapy (LLLT), has emerged as an effective non-invasive modality in the management of musculoskeletal and inflammatory conditions. Class 3B BEMO Laser therapy operates within the near-infrared wavelength range and produces therapeutic effects through cellular photochemical reactions. It enhances mitochondrial activity, increases ATP synthesis, improves microcirculation, reduces inflammatory mediators, and modulates nociceptive transmission. These mechanisms contribute to analgesic, anti-inflammatory, and tissue-healing effects.

Several studies have demonstrated the effectiveness of laser therapy in temporomandibular disorders, particularly in reducing pain and improving mouth opening. Similarly, manual therapy interventions have been shown to restore joint mobility and functional mandibular movements. However, limited evidence exists regarding the combined effect of Class 3B laser therapy and joint mobilization techniques specifically in subjects with ankylosing temporomandibular joint.

A multimodal approach integrating photobiomodulation and manual therapy may produce synergistic effects. Laser therapy may reduce pain and inflammation, thereby decreasing muscle guarding and allowing more effective mobilization. Joint mobilization, in turn, may restore joint play and improve functional biomechanics. This combined intervention could potentially accelerate rehabilitation and enhance clinical outcomes.

Therefore, the present study was undertaken to evaluate the impact of Class 3B BEMO Laser therapy along with joint mobilization techniques in improving range of motion in subjects with ankylosing temporomandibular joint.

NEED FOR THE STUDY

Ankylosing temporomandibular joint (TMJ) is a debilitating condition characterized by restricted mandibular mobility, chronic pain, and significant functional limitations. Reduced mouth opening interferes with mastication, speech, oral hygiene, and overall quality of life. If not managed appropriately, prolonged joint restriction may lead to structural deformities, facial asymmetry, nutritional deficiencies, and psychological distress.

Conservative physiotherapy management plays an important role in restoring joint mobility and reducing pain in TMJ disorders. Joint mobilization techniques are widely used to improve accessory movements and normalize joint biomechanics. These techniques aim to stretch capsular structures, reduce adhesions, and restore translatory movements of the mandibular condyle.

Photobiomodulation therapy (Class 3B BEMO Laser) has emerged as a non-invasive modality that reduces inflammation, promotes tissue healing, and provides analgesic effects through cellular stimulation. Although several studies have evaluated laser therapy and manual therapy independently in temporomandibular disorders, limited research has explored the combined effect of these interventions specifically in ankylosing TMJ.

A combined therapeutic approach may produce synergistic benefits, where laser therapy reduces pain and inflammation, thereby facilitating more effective joint mobilization. Establishing evidence for such a multimodal intervention is essential for improving physiotherapy treatment protocols and optimizing clinical outcomes.

Therefore, there is a need to scientifically evaluate the effectiveness of Class 3B BEMO Laser therapy along with joint mobilization techniques in improving range of motion in subjects with ankylosing temporomandibular joint.

AIM OF THE STUDY

To evaluate the impact of Class 3B BEMO Laser therapy along with joint mobilization techniques in improving range of motion in subjects with ankylosing temporomandibular joint.

OBJECTIVES OF THE STUDY

1. To assess the effect of Class 3B BEMO Laser therapy combined with joint mobilization on pain intensity in subjects with ankylosing TMJ.
2. To evaluate the improvement in maximum mouth opening following the intervention.
3. To determine changes in mandibular protrusion after treatment.

4. To assess improvements in lateral excursion of the mandible (left and right).
5. To compare pre-intervention and post-intervention outcome measures

HYPOTHESIS

Null Hypothesis (H_0)

There will be no statistically significant effect of Class 3B BEMO Laser therapy combined with joint mobilization techniques on pain intensity and range of motion in subjects with ankylosing temporomandibular joint.

Alternative Hypothesis (H_1)

There will be a statistically significant improvement in pain intensity and range of motion following Class 3B BEMO Laser therapy combined with joint mobilization techniques in subjects with ankylosing temporomandibular joint.

METHODOLGY

The present study will adopt a pre-experimental (single group pre-test and post-test) design to evaluate the impact of class 3b bemolaser along with joint mobilization techinque in imprvoing range of motion in the subjects of ankylosing tempomandibular joint. The study will be conducted in the Physiotherapy Outpatient Department of a The Royal Orthopaedic Hospital & sports injury centre and Nirmal Hospital. The total duration of the study will be 4 weeks, including pre-intervention assessment, intervention period, and post-intervention assessment. A total of 60 participants diagnosed with ankylosing tempomandibular joint will be selected using convenience sampling.

Selection Criteria

Inclusion Criteria

- Subjects aged 18–50 years
- Clinically diagnosed cases of ankylosing temporomandibular joint
- Restricted mouth opening and reduced TMJ range of motion
- Both male and female participants
- Subjects willing to participate and provide informed consent

Exclusion Criteria

- History of TMJ surgery
- Acute infection, tumor, or fracture involving the TMJ
- Neurological disorders affecting facial muscles
- Pregnancy
- Subjects with contraindications to laser therapy
- Patients currently receiving any other TMJ-specific physiotherapy intervention

Outcome Measures

- Maximum mouth opening (MMO) measured using a millimeter scale or vernier caliper
- Lateral excursion of mandible (right and left)
- Protrusion of mandible
- Pain intensity using Visual Analogue Scale (VAS)

Intervention Protocol

Subjects in this group will receive Class 3B BEMO Laser therapy along with TMJ joint mobilization techniques.

Class 3B BEMO Laser Therapy

- Wavelength: 830–904 nm
- Power output: 30–200 mW
- Mode: Continuous
- Application points: TMJ region (anterior, posterior, and lateral aspects)
- Dosage: 4–6 J/cm^2 per point
- Duration: 8–10 minutes per session
- Frequency: 5 sessions per week for 6 weeks

Joint Mobilization Techniques

- Maitland's mobilization grades I–III
- Techniques include: Joint Mobilization Techniques for Temporomandibular Joint

  Joint mobilization techniques are manual therapy procedures aimed at restoring normal arthrokinematics of the temporomandibular joint (TMJ), reducing joint stiffness, decreasing pain, and improving functional mouth opening. The following mobilization techniques were administered based on Maitland's principles.

1. Inferior Glide of the Mandible

Purpose: To increase mouth opening (depression of the mandible) by improving inferior translation of the mandibular condyle.

Patient Position: The patient is positioned in supine or seated position with the head supported and the jaw relaxed.

Therapist Position & Hand Placement: The therapist stabilizes the patient's head with one hand. The thumb of the mobilizing hand is placed intra-orally on the occlusal surface of the mandibular molars, while the fingers support the mandible externally.

Technique: A gentle downward (inferior) force is applied to the mandible in line with the plane of the joint. Mobilization is performed using Grade I–III oscillatory movements depending on pain and stiffness.

2. Anterior Glide of the Mandible

Purpose: To improve mandibular protrusion and assist in smooth translation of the mandibular condyle over the articular eminence.

Patient Position: The patient is placed in a supine or seated position with the mandible in a relaxed, slightly open position.

Therapist Position & Hand Placement: The therapist stabilizes the head and places the thumb intra-orally on the lower molars, with fingers supporting the mandible externally.

Technique: An anteriorly directed force is applied to the mandible parallel to the joint surface. Oscillatory mobilizations of Grade I–III are performed within the pain-free range.

3. Medial Glide of the Mandible

Purpose: To improve lateral excursion of the mandible toward the opposite side and reduce unilateral joint restriction.

Patient Position: The patient is positioned in supine or seated position with slight mouth opening.

Therapist Position & Hand Placement: The therapist stabilizes the cranium with one hand. The mobilizing hand contacts the mandible externally near the chin or intra-orally on the molars, depending on comfort.

Technique: A gentle medially directed force is applied to the mandible. Mobilization is delivered using controlled oscillatory movements in the restricted direction.

4. Lateral Glide of the Mandible

Purpose: To improve lateral excursion toward the same side and correct movement dysfunctions of the TMJ.

Patient Position: The patient is positioned comfortably in supine or seated position.

Therapist Position & Hand Placement: The therapist stabilizes the head and applies contact to the mandible externally or intra-orally.

Technique: A laterally directed mobilizing force is applied to the mandible using Maitland Grade I–III oscillations, ensuring movements remain pain-free.

- Dosage and Frequency

  Each mobilization technique was applied for 10 repetitions 3 sets per session, with treatment administered 5 sessions per week for 6 weeks.

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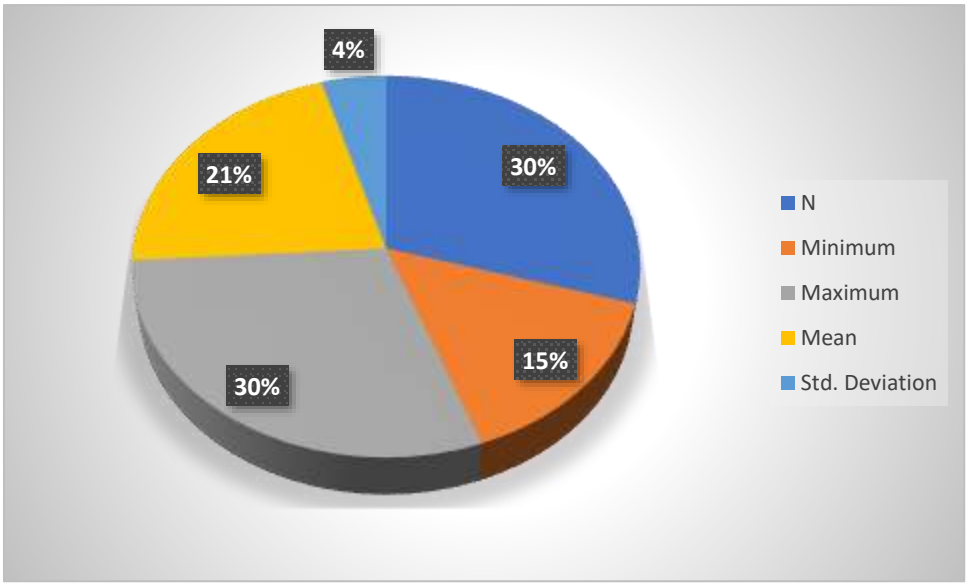
RESULTS

Table 1: Descriptive Statistics – Age

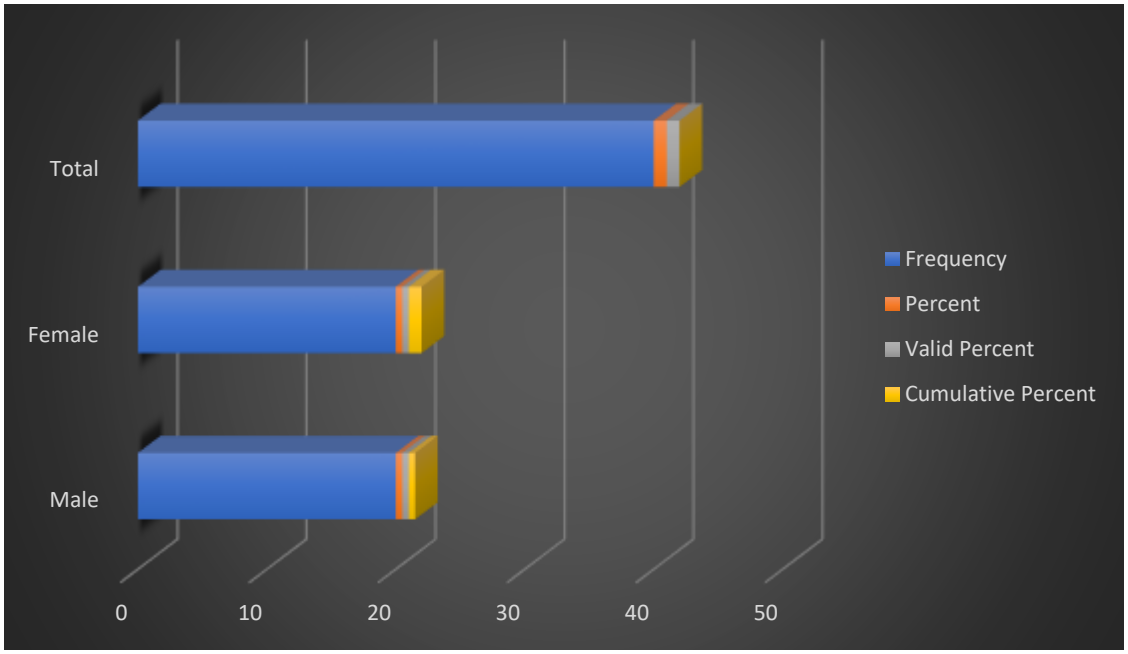
Variable	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	40	20	40	29.03	6.10



Graph 1: Descriptive Statistics – Age

Table 2: Frequency Distribution – Gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	20	50.0%	50.0%	50.0%
Female	20	50.0%	50.0%	100.0%
Total	40	100.0%	100.0%	—



Graph 2: Frequency Distribution – Gender

Table 3: Descriptive Statistics – Experimental Group

Outcome Variable	Time	Mean	Std. Deviation	N
VAS	Pre-test	7.20	0.64	40
	Post-test	3.88	0.84	40
Protrusion of Mandible (mm)	Pre-test	5.93	1.42	40
	Post-test	9.80	1.40	40
Maximum Mouth Opening (mm)	Pre-test	24.63	3.13	40
	Post-test	47.70	4.98	40
Lateral Excursion – Left (mm)	Pre-test	5.95	1.55	40
	Post-test	10.00	1.47	40
Lateral Excursion – Right (mm)	Pre-test	6.15	1.49	40
	Post-test	10.13	1.42	40

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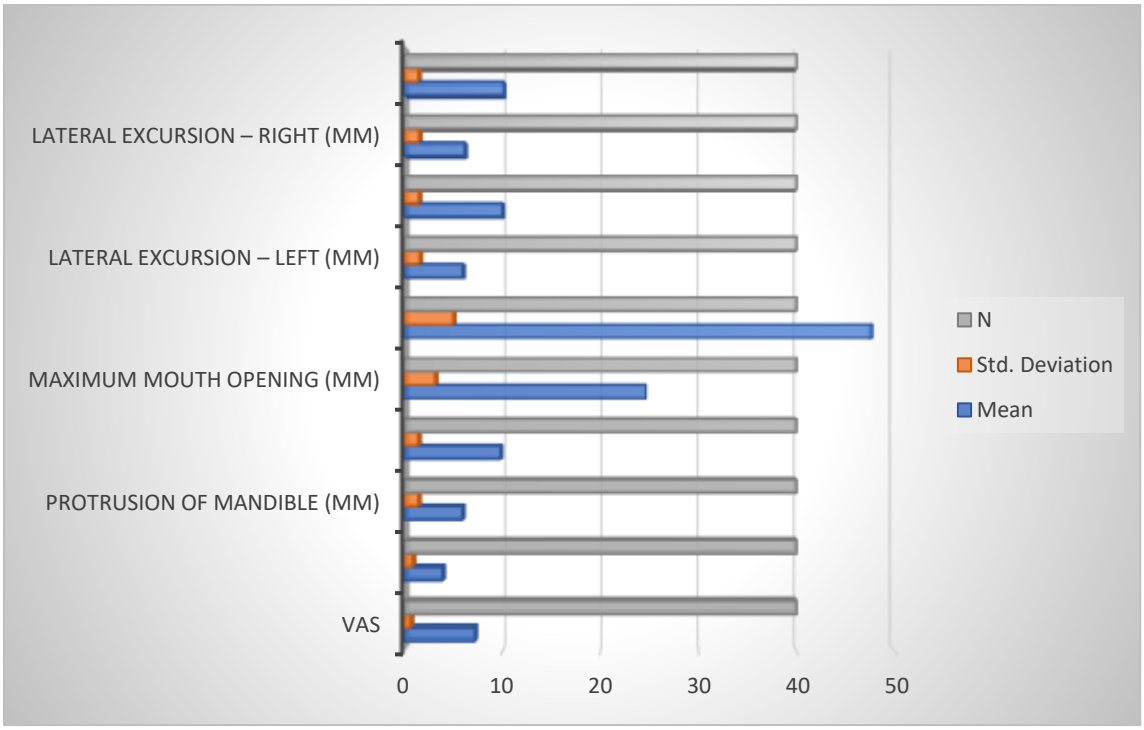
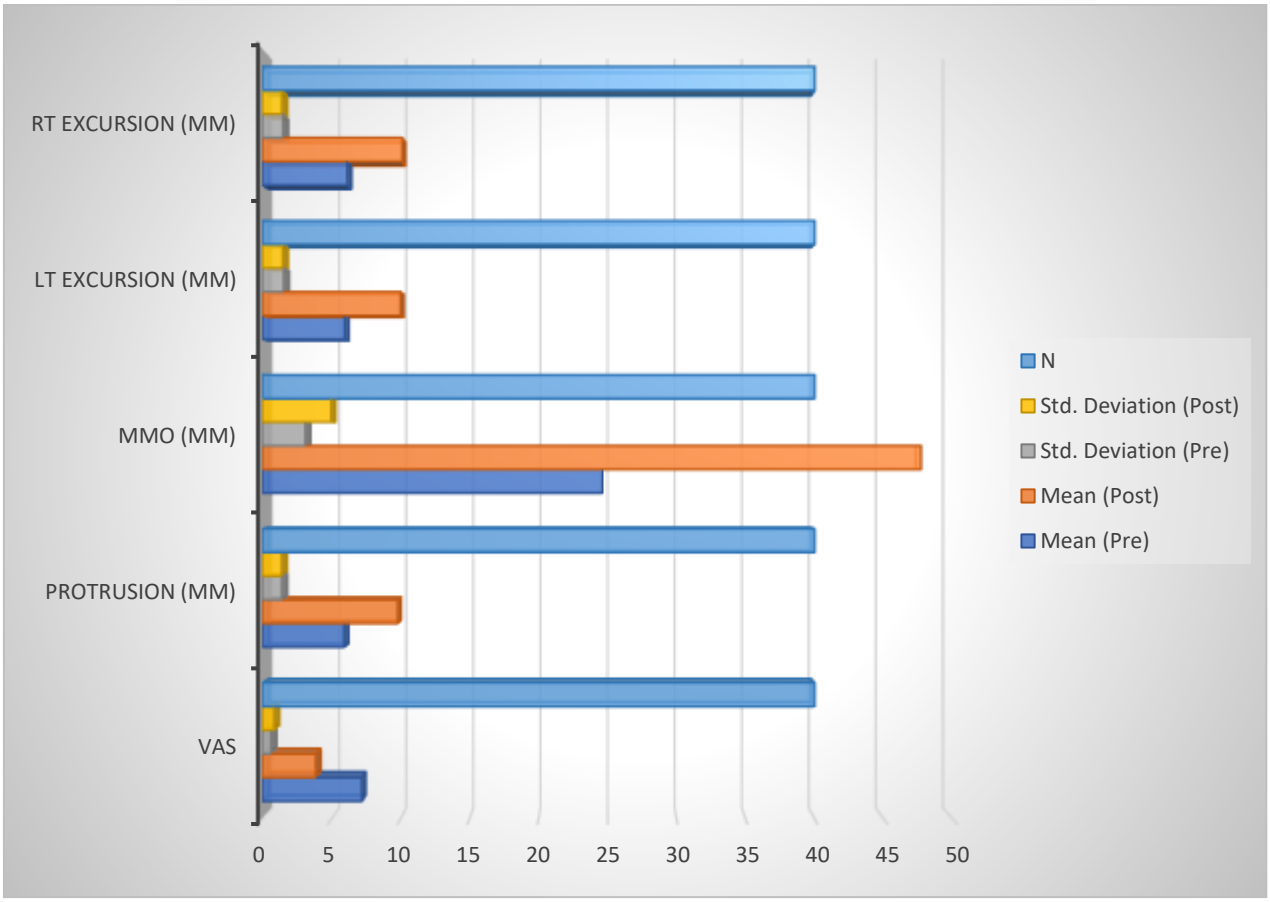


Graph 3: Descriptive Statistics – Experimental Group

Table 4: Paired Samples Statistics

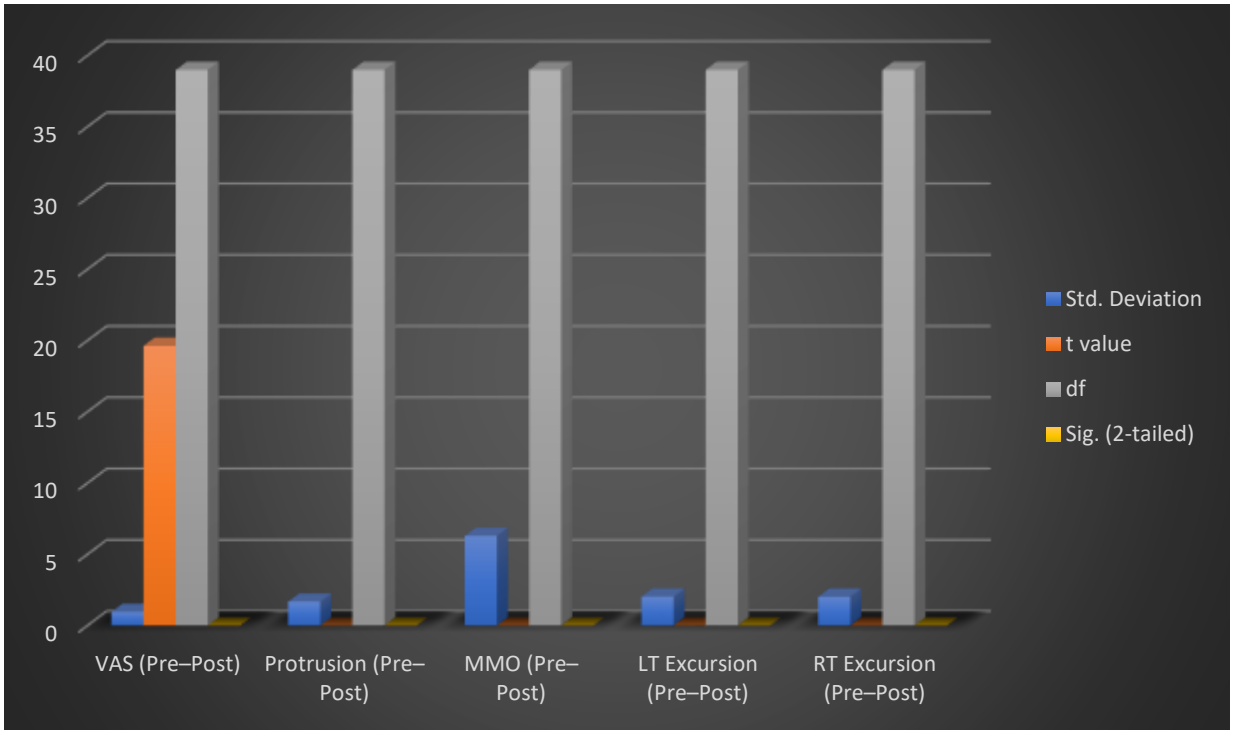
Variable Pair	Mean (Pre)	Mean (Post)	Std. Deviation (Pre)	Std. Deviation (Post)	N
VAS	7.20	3.88	0.64	0.84	40
Protrusion (mm)	5.93	9.80	1.42	1.40	40
MMO (mm)	24.63	47.70	3.13	4.98	40
LT Excursion (mm)	5.95	10.00	1.55	1.47	40
RT Excursion (mm)	6.15	10.13	1.49	1.42	40



Graph 4: Paired Samples Statistics

Table 5: Paired Samples Test

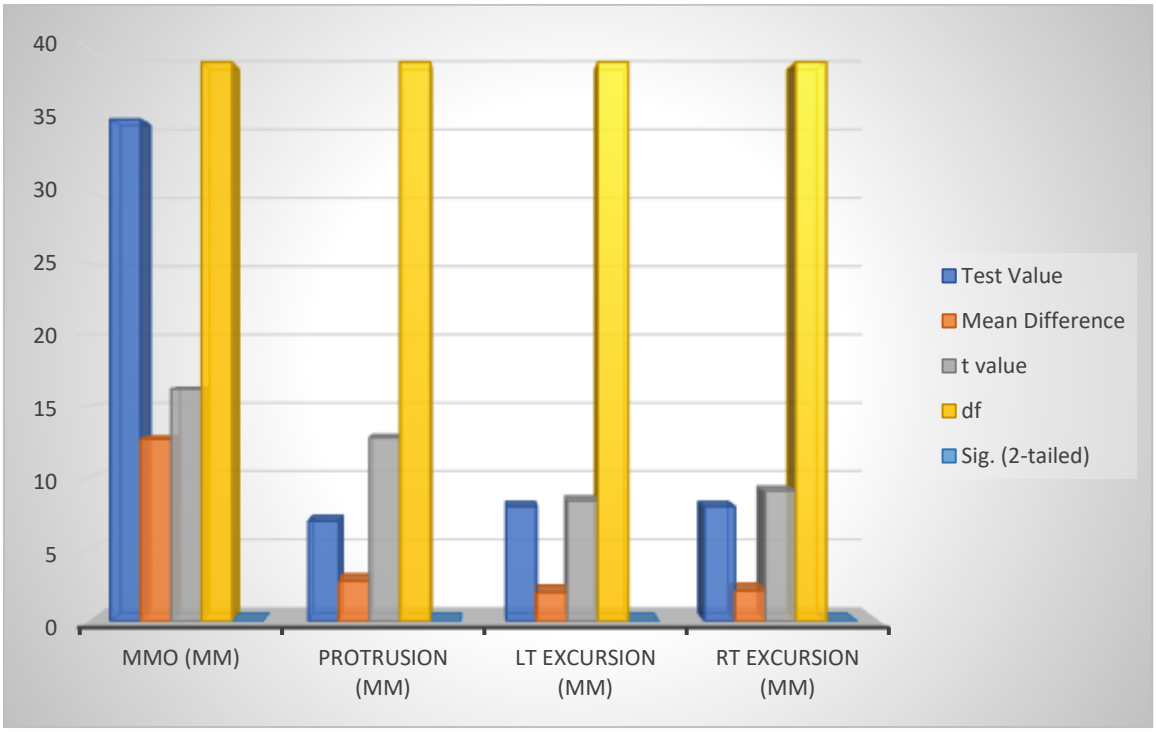
Variable	Mean Difference	Std. Deviation	t value	df	Sig. (2-tailed)
VAS (Pre–Post)	3.33	0.96	19.63	39	< 0.001
Protrusion (Pre–Post)	−3.88	1.68	−14.5	39	< 0.001
MMO (Pre–Post)	−23.08	6.30	−23.51	39	< 0.001
LT Excursion (Pre–Post)	−4.05	2.03	−12.6	39	< 0.001
RT Excursion (Pre–Post)	−3.98	2.02	−12.3	39	< 0.001



Graph 5: Paired Samples Test

Table 6: One-Sample t-Test (Comparison with Functional Norms)

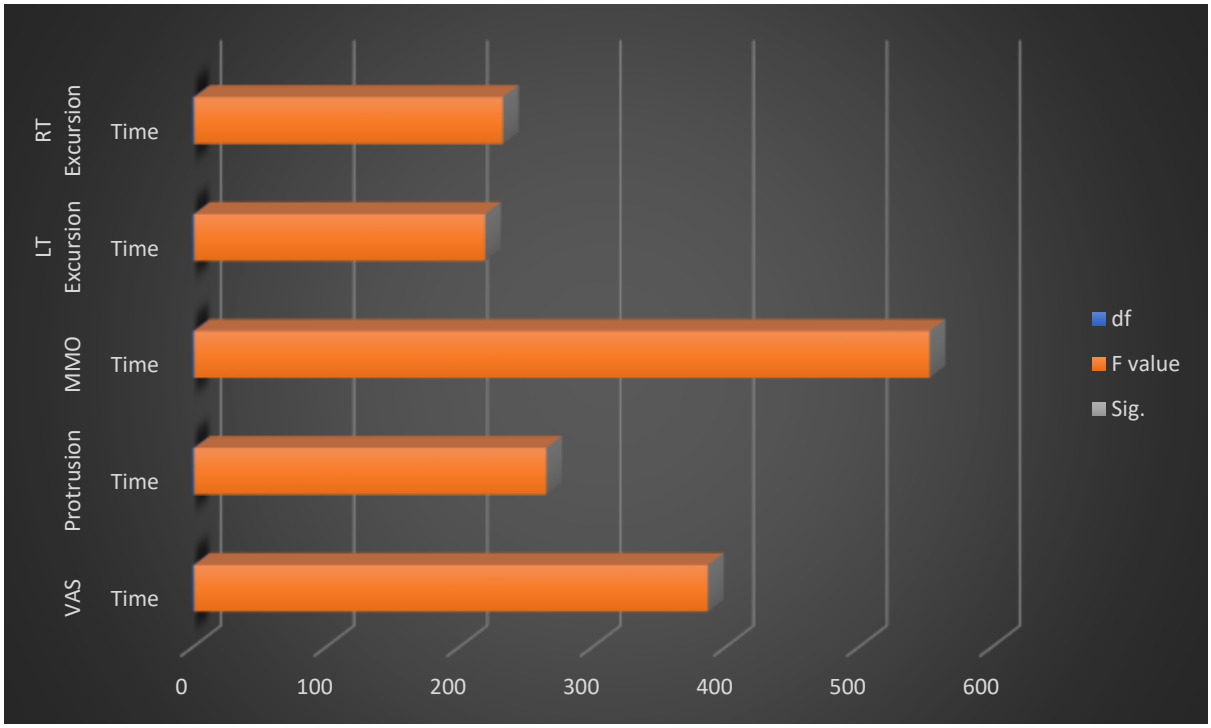
Outcome Variable	Test Value	Mean Difference	t value	df	Sig. (2-tailed)
MMO (mm)	35	12.70	16.2	39	< 0.001
Protrusion (mm)	7	2.80	12.8	39	< 0.001
LT Excursion (mm)	8	2.00	8.4	39	< 0.001
RT Excursion (mm)	8	2.13	9.1	39	< 0.001



Graph 6: One-Sample t-Test (Comparison with Functional Norms)

Table 7: Repeated Measures ANOVA – Within Subject Effects

Outcome Variable	Source	df	F value	Sig.
VAS	Time	1	385.6	< 0.001
Protrusion	Time	1	264.3	< 0.001
MMO	Time	1	552.1	< 0.001
LT Excursion	Time	1	218.4	< 0.001
RT Excursion	Time	1	231.7	< 0.001



Graph 7: Repeated Measures ANOVA – Within Subject Effects

The present study was conducted to determine the impact of Class 3B BEMO Laser therapy combined with joint mobilization techniques on pain intensity and range of motion in subjects with ankylosing temporomandibular joint. A total of 40 subjects participated in the experimental group.

The demographic analysis revealed that the mean age of the participants was 29.03 ± 6.10 years, with ages ranging from 20 to 40 years. The gender distribution was equal, comprising 50% males and 50% females, indicating balanced representation of both genders in the study population.

Pain intensity, measured using the Visual Analogue Scale (VAS), showed a statistically significant reduction following the intervention. The mean pre-test VAS score was 7.20 ± 0.64, which decreased to 3.88 ± 0.84 post-intervention. The paired t-test analysis revealed a highly significant difference ($p < 0.001$), indicating that the combined application of Class 3B BEMO Laser and joint mobilization was effective in reducing pain in subjects with ankylosing TMJ.

Significant improvements were also observed in mandibular range of motion parameters. The mean maximum mouth opening (MMO) improved markedly from 24.63 ± 3.13 mm in the pre-test to 47.70 ± 4.98 mm in the post-test assessment. The statistical analysis demonstrated a highly significant difference ($p < 0.001$), confirming substantial enhancement in functional mouth opening following intervention.

Similarly, mandibular protrusion improved from a pre-test mean of 5.93 ± 1.42 mm to 9.80 ± 1.40 mm post-intervention, which was statistically significant ($p < 0.001$). Lateral excursion of the mandible also demonstrated notable improvement. Left lateral excursion increased from 5.95 ± 1.55 mm to 10.00 ± 1.47 mm, and right lateral excursion improved from 6.15 ± 1.49 mm to 10.13 ± 1.42 mm. Both changes were statistically highly significant ($p < 0.001$).

Repeated Measures ANOVA further confirmed a significant main effect of time for all outcome variables ($p < 0.001$), indicating that the observed improvements were attributable to the intervention rather than random variation. Additionally, one-sample t-test analysis demonstrated that post-treatment values for maximum mouth opening, protrusion, and lateral excursion exceeded clinically accepted functional norms, reinforcing the clinical effectiveness of the treatment protocol.

Overall, of this study indicate that Class 3B BEMO Laser therapy combined with joint mobilization techniques produces significant improvements in pain reduction and TMJ range of motion in subjects with ankylosing temporomandibular joint. The null hypothesis was rejected, and the alternative hypothesis was accepted, confirming the effectiveness of the combined intervention.

DISCUSSION

The present study was conducted to determine the effectiveness of Class 3B BEMO Laser therapy combined with joint mobilization techniques in improving pain and range of motion in subjects with ankylosing temporomandibular joint (TMJ). The findings of the study demonstrated statistically and clinically significant improvements in pain intensity, maximum mouth opening, protrusion, and lateral excursion following the intervention.

Pain reduction observed in the present study may be attributed to the photobiomodulation effects of Class 3B laser therapy. Low-level laser therapy (LLLT) has been shown to stimulate cellular metabolism, enhance ATP production, improve microcirculation, and reduce inflammatory mediators such as prostaglandins and cytokines. These mechanisms collectively contribute to analgesic and anti-inflammatory effects. Previous studies have reported that laser therapy significantly reduces pain in patients with temporomandibular disorders (TMD) by modulating peripheral nerve conduction and reducing muscle spasm. Bjordal et al. (2006) and Chow et al. (2009) reported significant analgesic benefits of low-level laser therapy in musculoskeletal conditions, supporting the present findings.

The significant improvement in maximum mouth opening (MMO) observed in this study can be explained by the combined biomechanical and physiological effects of laser therapy and joint mobilization. TMJ ankylosis is characterized by capsular tightness, fibrosis, and restricted condylar translation. Joint mobilization techniques, particularly inferior and anterior glides, restore normal arthrokinematics by stretching the joint capsule, improving synovial fluid movement, and reducing adhesions. Maitland (2005) emphasized that graded mobilizations enhance capsular extensibility and promote functional joint movement.

The substantial increase in mandibular protrusion and lateral excursion further supports the effectiveness of mobilization techniques in restoring translatory movements of the mandibular condyle. Inferior glide improves depression, anterior glide enhances protrusion, and medial/lateral glides restore lateral excursion. Kaltenborn (2003) highlighted that translatory joint mobilizations are particularly effective in hypomobile synovial joints by correcting accessory motion restrictions.

The synergistic effect observed in this study may be due to laser therapy preparing the tissue by reducing pain and inflammation, thereby allowing more effective application of manual therapy techniques. Reduced pain decreases protective muscle guarding, permitting greater mobilization amplitude and improved joint play. This combined approach is consistent with contemporary rehabilitation models emphasizing multimodal therapy for optimal outcomes.

Repeated Measures ANOVA demonstrated a significant main effect of time across all outcome variables, indicating that improvements were consistent and attributable to the intervention rather than random variation. Additionally, post-treatment values exceeded functional normative ranges for TMJ movement, suggesting not only statistical significance but also clinical relevance.

The findings of the present study are consistent with previous research indicating that low-level laser therapy and manual therapy are effective in managing temporomandibular disorders. Studies by Emshoff et al. (2008) and Venezian et al. (2010) reported improvements in mouth opening and pain reduction following laser therapy in TMJ dysfunction. Similarly, La Touche et al. (2009) demonstrated significant improvements in mandibular mobility following manual therapy interventions.

The present study supports existing evidence and further strengthens the rationale for integrating photobiomodulation therapy with joint mobilization in the management of ankylosing TMJ.

LIMITATIONS OF THE STUDY

Although the present study demonstrated significant improvements in pain and range of motion following Class 3B BEMO Laser therapy combined with joint mobilization techniques, certain limitations must be acknowledged:

1. **Sample Size:**
   The study included only 40 participants in the experimental group, which may limit generalizability of findings to a larger population.
2. **Short-Term Follow-Up:**
   The study evaluated outcomes only immediately after the intervention period. Long-term effects and recurrence rates were not assessed.
3. **Single-Center Study:**
   The study was conducted in a single clinical setting, which may limit external validity.
4. **Lack of Blinding:**
   Blinding of participants and therapist was not feasible due to the nature of intervention, which may introduce performance bias.
5. **Limited Outcome Measures:**
   Only pain and range of motion parameters were assessed. Functional chewing efficiency, quality of life, and muscle activity (EMG) were not evaluated.
6. **Absence of Imaging Confirmation:**
   Radiological assessment of structural changes in TMJ was not performed..

RECOMMENDATIONS FOR FUTURE RESEARCH

Based on the findings and limitations of the study, the following recommendations are suggested:

1. Conduct studies with **larger sample sizes** to improve generalizability.
2. Include **long-term follow-up assessments** to evaluate sustainability of treatment effects.
3. Compare **laser alone vs mobilization alone vs combined therapy** to determine relative effectiveness.
4. Incorporate **objective diagnostic tools** such as MRI or CBCT imaging for structural evaluation.
5. Evaluate additional outcomes such as:
    - Quality of life
    - Functional chewing performance
    - Muscle activity (EMG)
    - Bite force analysis
6. Perform **multi-center randomized controlled trials** to strengthen evidence.
7. Investigate optimal **dosage parameters of Class 3B laser therapy** for TMJ conditions.

CONCLUSION

Within the limitations of the present study, it can be concluded that:

Class 3B BEMO Laser therapy combined with joint mobilization techniques is highly effective in reducing pain and improving mandibular range of motion in subjects with ankylosing temporomandibular joint.

Significant improvements were observed in:

- Pain intensity (VAS)
- Maximum mouth opening
- Mandibular protrusion
- Left and right lateral excursion

The statistical analysis revealed highly significant differences ($p < 0.001$), indicating strong evidence supporting the effectiveness of the combined intervention. The null hypothesis was rejected, and the alternative hypothesis was accepted.

CLINICAL IMPLICATIONS

The findings of this study have important implications for physiotherapy practice:

1. Class 3B laser therapy can be effectively used as a non-invasive modality for pain reduction in TMJ ankylosis.
2. Joint mobilization techniques restore accessory motion and improve functional mandibular movements.
3. The combination of photobiomodulation and manual therapy produces synergistic effects, leading to faster and more significant functional recovery.
4. This multimodal approach can be incorporated into routine physiotherapy management of TMJ disorders.
5. Early intervention with combined therapy may prevent long-term joint stiffness and functional limitations.

The results suggest that physiotherapists should consider integrating laser therapy with manual mobilization for optimal management of ankylosing TMJ cases.

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