

The Light or the Pill: Unpacking Treatment Options for Myogenous Temporomandibular Joint Disorders

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Abstract

Purpose

Temporomandibular disorders (TMDs) are common musculoskeletal conditions causing orofacial pain and restricted jaw function. While pharmacological agents provide relief, they carry systemic side effects, and photobiomodulation (PBM) has emerged as a non-invasive alternative with limited direct comparisons to combination pharmacotherapy. This study aimed to compare the clinical efficacy of 1064 nm PBM versus combination pharmacotherapy in managing myogenous temporomandibular disorders.

Methods

In this randomized controlled trial, 30 patients (18–60 years) diagnosed with myogenous TMD per DC/TMD criteria, presenting with masseter and/or temporalis muscle pain, were randomized into two equal groups. Group A received 1064 nm PBM on alternate days; Group B received a combination of oral ibuprofen (400 mg), paracetamol (325 mg), and chlorzoxazone (250 mg) twice daily for 7 days. Pain (VAS) and maximal mouth opening (MMO) were assessed at baseline and one week post-treatment and follow up for one month.

Results

All 30 patients completed the study. Post-treatment VAS scores showed no significant difference between the PBM (2.47 ± 2.07) and combination pharmacotherapy (1.47 ± 1.46) groups ($p = 0.137$). MMO improvement was significantly greater in the PBM group (51.47 ± 4.34 mm) than the combination pharmacotherapy group (46.93 ± 5.81 mm) ($p = 0.022$). No adverse events were reported in either group.

Conclusion

1064 nm PBM achieved pain relief comparable to combination pharmacotherapy, with significantly greater short-term improvement in maximal mouth opening. Given its non-invasive nature and favourable safety profile, PBM represents a promising conservative treatment option for myogenous TMD, warranting larger trials with longer follow-up.

Trial registration:

CTRI/2025/09/094267, registered on 4 September 2025 (prospectively registered).

Introduction

Temporomandibular disorders (TMDs) comprise a group of musculoskeletal conditions involving the temporomandibular joint, masticatory muscles, and associated structures. Clinically, patients commonly present with orofacial pain, restricted mouth opening, joint sounds, and functional limitations affecting mastication and speech^{1,2}. The reported prevalence of TMD ranges from 21.5% to 50.5%, with a higher predilection observed in females^{1,3}. Chronic TMD-related pain has been shown to adversely affect quality of life, daily activities, and psychological well-being^{2,4}.

Temporomandibular disorders are multifactorial in nature, arising from a wide range of contributing etiological factors, and hence no single definitive treatment modality is universally effective. In this context, symptomatic management assumes an important role, as effective relief of pain, improvement in mouth opening, and restoration of function allow patients to better tolerate and benefit from further definitive treatment. Commonly employed therapies for symptomatic management include muscle relaxants, nonsteroidal anti-inflammatory drugs (NSAIDs), occlusal splints, and physical modalities such as ultrasound therapy, transcutaneous electrical nerve stimulation (TENS), and thermotherapy^{5,6}. However, pharmacological agents are often associated with systemic adverse effects, including drowsiness, gastrointestinal disturbances, and potential dependency^{5,7}. Furthermore, muscle relaxants primarily reduce muscular hyperactivity without addressing the underlying inflammatory process^{1,2}, resulting in limited long-term efficacy^{2,8}.

Photobiomodulation (PBM) has recently emerged as a non-invasive therapeutic alternative with promising clinical outcomes in the management of TMD^{3,9}. Several studies have evaluated PBM at wavelengths such as 810 nm, 630 nm, and 640 nm in the management of myogenous TMD, reporting variable outcomes in pain reduction and functional improvement^{10,11,12}. However, there remains a paucity of literature evaluating the 1064 nm wavelength specifically for myogenous TMD, despite its distinct tissue-penetration characteristics compared to these more commonly studied wavelengths.

The present study focused specifically on myogenous TMD, where muscular involvement predominates, to allow more accurate evaluation of the therapeutic effect of this wavelength. Evidence from randomized controlled trials and systematic reviews supports the efficacy of PBM in reducing pain intensity and improving mandibular function^{9,13}. However, direct comparisons between 1064 nm PBM and conventional pharmacological therapies remain limited^{5,6}. Therefore, the present study aims to evaluate and compare the clinical effectiveness of 1064 nm photobiomodulation therapy with combination pharmacotherapy (analgesic, anti-inflammatory, and muscle relaxant) in the management of myogenous temporomandibular disorders.

Materials and Methods

Study Design and Setting

This randomized controlled trial was conducted in the outpatient clinics of the Department of Oral Medicine and Radiology. Institutional ethical clearance was granted prior to the study's commencement,

and written informed consent was obtained from all participants. The trial is registered with the Clinical Trials Registry - India (CTRI Registration No: CTRI/2025/09/094267).

Study Population

A total of 30 patients between 18 and 60 years of age, presenting with masticatory muscle pain suggestive of myogenous temporomandibular disorder, were enrolled in the study. Diagnosis of myogenous TMD was established using the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), and clinical examination included palpation of the masticatory muscles to confirm the presence of myofascial pain. Inclusion criteria required a minimum pain score of 3 on the Visual Analog Scale (VAS), tenderness on palpation of the masticatory muscles and willingness to attend follow-up visits for a minimum period of one week.

Patients were excluded if they had a history of maxillofacial trauma; systemic conditions such as collagen vascular diseases; temporomandibular joint internal derangement, arthritis, or degenerative joint disorders; or arthrogenous TMD as per DC/TMD classification. Additional exclusion criteria included recent use of analgesics or muscle relaxants, presence of psychiatric or neurological illness, pregnancy or lactation, macrotrauma, renal impairment and hepatotoxicity unwillingness to provide informed consent, and inability to attend the minimum required follow-up period.

Randomization and Interventions

Participants were randomly allocated into two equal groups (15 per group) using a simple randomization method (coin toss), performed by an investigator not involved in treatment delivery or outcome assessment, to minimize allocation bias.

Group A (Photobiomodulation Therapy)

Patients received extraoral application of 1064 nm photobiomodulation using a FotonaLightWalker laser system (Fotona, Slovenia) with ATS mode, using the MarcCo™ medium handpiece with a beam diameter of 22 mm, which delivers a collimated, flat-top beam over identified tender points. Tender areas were marked at each site using a marker, and PBM was delivered using the stamping method at every session prior to irradiation, ensuring reproducible and precise treatment localization. Each point was irradiated for 30 seconds at a power output of 0.2 W, delivering an energy density of 4.5 J/cm² per session, while the patient was asked to perform mandibular opening and closing movements during irradiation. Treatment was administered on alternate days until clinical improvement was achieved.

Group B (Combination Pharmacotherapy)

Patients were prescribed a combination oral medication consisting of ibuprofen (400 mg), paracetamol (325 mg), and chlorzoxazone (250 mg), taken twice daily for a duration of seven days. In addition,

patients were advised to follow a soft diet and minimize excessive mandibular movements.

Outcome Assessment

Pain intensity was evaluated using the Visual Analog Scale (VAS), and functional improvement was assessed by measuring maximal mouth opening (MMO), recorded as the interincisal distance in millimetres using a digital vernier calliper. Both parameters were recorded at baseline and at each follow-up visit, with patients monitored over a total follow-up period of one month following treatment. The statistical comparisons presented in this study correspond to the one-week post-treatment assessment. Outcome measurements were recorded by an assessor blinded to group allocation, minimizing the risk of detection bias despite the subjective nature of the VAS. All 30 enrolled participants completed the study with no dropouts or loss to follow-up. The study was prospectively registered with the Clinical Trials Registry - India (CTRI/2025/09/094267), and the reported outcomes (VAS, MMO) are consistent with the pre-specified study objectives. No adverse events were reported by any of the participants during the study period.

Statistical Analysis

Data analysis was performed using SPSS software (version 22). Intragroup comparisons were conducted using paired t-tests, while intergroup differences were analyzed using independent t-tests. Categorical variables were assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results

Demographic Characteristics

The mean age of the study population was 34.6 ± 5.2 years, with equal distribution between the two groups. Baseline comparison of age, gender distribution, and pre-treatment VAS and MMO scores revealed no statistically significant differences between the two groups ($p > 0.05$), confirming comparability of the groups prior to intervention.

Table 1
Comparison of Pain Assessment (VAS) Between Groups at One-Week Follow-Up

Group	N	Mean $\pm$ SD	Std. Error	t-value	p-value
PBM	15	2.47 $\pm$ 2.07	0.53	1.532	0.137
Combination Pharmacotherapy	15	1.47 $\pm$ 1.46	0.38		

Comparison of Visual Analog Scale (VAS) scores between the two groups at the one-week post-treatment follow-up revealed no statistically significant difference ($t = 1.532, p = 0.137$). The mean VAS

score in the photobiomodulation (PBM) group was 2.47 ± 2.07 , whereas the pharmacotherapy group demonstrated a mean score of 1.47 ± 1.46 . Although the pharmacotherapy group showed comparatively lower pain scores, the difference between the groups was not statistically significant.

Table 2 Comparison of Maximal Mouth Opening (MMO) Between Groups at One-Week Follow-Up					
Group	N	Mean $\pm$ SD	Std. Error	t-value	p-value
PBM	15	51.47 ± 4.34	1.50	2.420	0.022*
Combination Pharmacotherapy	15	46.93 ± 5.81	1.12		

A statistically significant difference was observed in maximal mouth opening between the groups following treatment ($t = 2.420$, $p = 0.022$). The photobiomodulation (PBM) group demonstrated a higher mean MMO (51.47 ± 4.34 mm) compared to the pharmacotherapy group (46.93 ± 5.81 mm), indicating better improvement in mandibular mobility in patients receiving PBM therapy.

Overall, intergroup analysis demonstrated no statistically significant difference in pain reduction between the two treatment groups, indicating comparable analgesic outcomes following therapy. However, a statistically significant improvement in maximal mouth opening was observed in the PBM group compared with the pharmacotherapy group, suggesting better short-term functional improvement in mandibular mobility in patients receiving photobiomodulation therapy.

FIGURE 1

Figure 1.PBM over the masseter region Fig. 2: Measuring mouth opening at each visit

Discussion

Temporomandibular disorders are multifactorial musculoskeletal conditions characterized by pain, muscle dysfunction, and restricted mandibular movement, and the principal objectives of management are reduction of pain, restoration of function, and improvement in quality of life.

Photobiomodulation is thought to exert its analgesic effect through stimulation of mitochondrial cytochrome-c oxidase activity, increased ATP synthesis, reduction of pro-inflammatory mediators, and improved local microcirculation, collectively enhancing tissue repair and reducing nociceptive signalling^{9,14}. Several clinical studies have reported meaningful analgesic benefit from PBM in TMD populations. Regulski et al. described symptomatic improvement, including reduced pain, in a patient with TMJ disk displacement treated with a 1064 nm Nd:YAG laser¹³. Randomized evidence from Aisaiti et al. and systematic reviews of low-level laser therapy have similarly reported significant reductions in TMD-related pain following PBM¹⁰.The findings of the present study are consistent with previous evidence supporting the effectiveness of photobiomodulation therapy (PBMT) in the management of temporomandibular disorders. Farshidfar et al., in an updated systematic review of randomized

controlled trials, concluded that PBMT significantly reduced pain intensity and improved mandibular function in patients with TMD. The authors further reported that infrared diode lasers with wavelengths ranging from 780 to 980 nm, output power ≤ 500 mW, energy density < 100 J/cm², and treatment protocols comprising at least six sessions demonstrated the most consistent clinical benefits. Although the present study utilized a 1064-nm Nd:YAG laser, which differs from the wavelengths used in most previous studies, significant pain reduction observed in the PBM group corroborates the growing evidence supporting PBMT as an effective conservative treatment modality for myogenous temporomandibular disorders¹⁵.

In the present study, PBM did not demonstrate superiority over pharmacotherapy for pain relief; however, the comparable outcome between the two modalities suggests that PBM may offer similar analgesic benefit without the systemic exposure associated with pharmacological agents such as NSAIDs and muscle relaxants^{5,16}. This is clinically relevant for patients who cannot tolerate pharmacotherapy or who prefer a drug-sparing treatment approach.

In line with the pain outcomes, both treatment groups demonstrated improvement in maximal mouth opening; however, the PBM group exhibited significantly greater improvement than the combination pharmacotherapy group. The superior functional recovery observed with PBM may be attributed to its cumulative biostimulatory effects, including enhanced local microcirculation, reduction of muscle spasm and protective guarding, and improved joint lubrication. This result is consistent with several reports describing improved mandibular mobility following PBM therapy. Kusek highlighted clinical observations of improved jaw opening when PBM was integrated into broader conservative management¹⁷. Karic and Penny, in a narrative review, described cumulative neuromuscular relaxation and improved joint lubrication with repeated PBM sessions¹⁸, and Demirkol et al. similarly reported improvement in masticatory function following multiple low-level laser sessions¹⁹. Despite the favorable functional effects reported for PBMT, improvements in mandibular function have not been consistently demonstrated across all studies. Farshidfar et al. observed considerable heterogeneity among randomized clinical trials regarding improvements in maximum mouth opening, which was attributed to variations in laser wavelength, energy density, irradiation protocol, treatment duration, and patient selection. These observations are in agreement with the variability observed in the present study regarding functional outcomes and emphasize that differences in laser parameters and treatment protocols may influence mandibular mobility¹⁵. The matching between these reports and the present findings supports the role of PBM in facilitating meaningful short-term functional recovery, although differences in treatment frequency, energy density, and total duration of therapy across studies, as well as variation in patient selection and TMD subtype, remain recognized sources of variability in the PBM literature^{7,20}.

In addition to the significant functional improvement observed with PBM in this study, photobiomodulation retains several other clinical advantages. It is non-invasive, painless, well tolerated, and free of the systemic adverse effects associated with long-term pharmacological use.^{14,21} Carvalho

et al. demonstrated dose-dependent anti-inflammatory and reparative effects of PBM in an experimental model of temporomandibular joint inflammation, supporting a biological rationale for its use beyond symptomatic relief²¹. PBM may also be incorporated as part of a multimodal management strategy alongside physiotherapy, occlusal therapy, and behavioural interventions; Carvalho et al. described the use of PBM within a broader multidisciplinary protocol for TMD and orofacial pain²². Other minimally invasive interventions, such as botulinum toxin injection, have also been explored for refractory TMD and may warrant future comparative study against PBM²³. In comparison, the analgesic effect observed in the combination pharmacotherapy group may be attributed to the combined pharmacological actions of ibuprofen, paracetamol, and chlorzoxazone. Ibuprofen exerts anti-inflammatory effects through cyclooxygenase inhibition, paracetamol provides central analgesia, while chlorzoxazone acts as a centrally acting skeletal muscle relaxant. Current evidence suggests that pharmacological therapy is effective for short-term symptomatic management of painful temporomandibular disorders, although no single drug has demonstrated consistent superiority across all clinical scenarios²⁴.

The present findings largely align with the existing literature. Several earlier studies have reported superior outcomes with PBM for both pain and jaw function, and the present study similarly found comparable pain control between PBM and pharmacotherapy, with significantly greater short-term functional improvement in the PBM-treated group. This consistency strengthens the evidence base for 1064 nm PBM as an effective conservative modality in myogenous TMD, although inconsistency in wavelength, dosage, exposure time, and treatment interval across studies continues to limit broader comparability and reproducibility of results^{7,20}. Notably, Herman et al. also reported no significant difference between pharmacological and non-pharmacological approaches for TMD-related jaw pain, a finding consistent with the comparable pain outcomes observed in the present study⁵. This study contributes to the existing evidence by providing a direct clinical comparison between 1064 nm PBM and a combination pharmacological regimen, an area in which comparative data remain limited, and further supports the functional benefit of PBM reported in the wider literature.

The 1064 nm wavelength was specifically selected for this study due to its superior tissue-penetration characteristics compared to shorter wavelengths commonly used in low-level laser therapy (e.g., 810 nm or 830 nm). Owing to reduced absorption by melanin and hemoglobin at this wavelength, 1064 nm light penetrates deeper into muscular and periarticular tissues, enabling more effective targeting of both the masticatory muscles and deeper temporomandibular joint structures involved in myogenous TMD^{4,25}. This deeper penetration is thought to allow more efficient photonic energy delivery to mitochondria within affected muscle fibers, enhancing ATP synthesis and biomodulatory effects at a tissue depth that is often inadequately reached by lower-wavelength devices^{3,9}. This may explain the meaningful functional improvement observed with PBM in the present study.

PBM and pharmacotherapy were selected for comparison as they represent the two most commonly employed conservative modalities for myogenous TMD in routine clinical and hospital-based practice^{2,5,6}. In practical clinical settings, the choice between these modalities is often guided by patient-

specific factors rather than efficacy alone. Patients who are unable to attend multiple hospital visits required for repeated PBM sessions may find pharmacotherapy more feasible, whereas patients already on multiple systemic medications, or those seeking to avoid additional drug burden and associated side effects, are often better suited to PBM as a drug-sparing alternative^{5,7}. Given that these two modalities are among the most widely used and accessible in clinical practice, a direct comparison was considered clinically relevant for guiding evidence-based modality selection based on patient needs and constraints.

An additional factor that may have influenced the favorable clinical outcomes observed in the PBM group is that patients were instructed to perform gentle mouth opening and closing movements during laser application. These movements may have enhanced the therapeutic effects of PBMT by improving muscle flexibility, reducing muscle guarding, and promoting local circulation. Therefore, the improvements observed in the present study may represent the combined effect of PBMT and active mandibular exercises rather than PBMT alone. Further controlled studies are required to determine the independent contribution of these exercises.

Limitations

While this study provides encouraging preliminary evidence, certain limitations should be acknowledged. The sample size was adequate to detect significant differences between groups, but still relatively limited, larger cohorts would help confirm how well these findings generalize. Additionally, outcomes were assessed using well-established clinical and patient-reported measures (VAS and MMO); incorporating objective diagnostic tools such as surface electromyography (EMG) to assess masticatory muscle activity, along with imaging modalities such as MRI or ultrasonography, and assessing inflammatory markers for pain assessment in future studies could provide further mechanistic insight into the tissue-level changes underlying the observed clinical improvement. Building on these promising results, larger-scale, multicentre randomized trials with extended follow-up, standardized PBM protocols, and objective electrophysiological and imaging assessments are recommended to further validate and expand upon the findings of this study.

Conclusion

This randomized controlled trial demonstrated that 1064 nm photobiomodulation therapy achieved pain reduction comparable to combination pharmacotherapy while providing significantly greater short-term improvement in maximal mouth opening in patients with myogenous temporomandibular disorders. These findings support PBM as an effective, safe, and reliable conservative treatment, offering superior functional recovery along with the benefits of being non-invasive, painless, and free from the systemic side effects of pharmacotherapy. Accordingly, 1064 nm PBM represents a promising alternative or adjunctive treatment for myogenous TMD. Further large-scale, multicentre randomized controlled trials with standardized treatment protocols and longer follow-up are warranted to validate these findings and establish its long-term clinical effectiveness.

Declarations

Ethical consideration:

This study was registered with the Clinical Trials Registry of India (CTRI) under registration number CTRI/2025/09/094267, registered on 4 September 2025, prior to the enrolment of participants.

Funding:

None

Author Contribution

Keerthi Mounavica Javvadi: Conceptualization, literature search, data curation, methodology, writing—original draft preparation, visualization, and corresponding author responsibilities. Jyothirmai Koneru: Conceptualization, supervision, methodology, critical review and editing of the manuscript, project administration, and final approval of the manuscript. R. Sudhakara Reddy: Supervision, methodology, validation, critical review and editing of the manuscript, and final approval of the manuscript. Sreekar Katru: Literature review, methodology, data interpretation, writing—review and editing, and validation. Divya Bhavani Vasamsetti: Data interpretation, data curation, writing—review and editing, and literature review. Sravani Jampana: Literature review, data interpretation, writing—review and editing, visualization, and validation. Sai Susmitha Gollu: Literature search, data curation, writing—review and editing, and reference management. All authors contributed to the development of the manuscript, read and approved the final version, and agree to be accountable for all aspects of the work.

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Figures



Figure 1

PBM over the masseter region

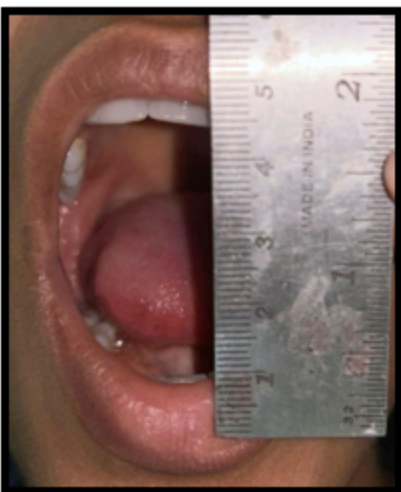


Figure 2

Measuring mouth opening at each visit