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Effectiveness of Jaw Exercises Combined with Cervical Strengthening Exercises Versus Ultrasound Therapy in Patients with Temporomandibular Joint Disorders: A Comparative Study

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Abstract

Background: Temporomandibular joint disorders are a group of musculoskeletal conditions involving the temporomandibular joint, masticatory muscles, and associated craniofacial and cervical structures. Patients commonly present with jaw pain, restricted mandibular movement, joint sounds, and functional limitations during activities such as chewing, speaking, and yawning. Cervical dysfunction and altered head posture may also contribute to the persistence of temporomandibular joint symptoms.

Objective: To compare the effectiveness of jaw exercises combined with cervical strengthening exercises versus ultrasound therapy in improving functional limitation and neck-related disability among patients with temporomandibular joint disorders.

Methods: A comparative study was conducted on 20 individuals with temporomandibular joint disorders. Participants who fulfilled the inclusion and exclusion criteria were divided into two groups of 10 participants each. Group A received jaw exercises combined with cervical strengthening exercises, while Group B received ultrasound therapy. Both interventions were administered five sessions per week for four weeks. The Jaw Functional Limitation Scale and Neck Disability Index were assessed before and after completion of the intervention. Data were analysed using descriptive and inferential statistics. Paired t-test was used for within-group comparison, and independent t-test was used for between-group comparison.

Results: Both groups demonstrated significant improvement between pre-test and post-test values. In the Jaw Functional Limitation Scale, Group A improved from 122.50 ± 4.11 to 25.10 ± 3.60, whereas Group B improved from 122.80 ± 5.39 to 26.30 ± 3.88. In the Neck Disability Index, Group A improved from 77.70 ± 7.00 to 12.00 ± 2.58, whereas Group B improved from 75.90 ± 8.25 to 10.50 ± 3.02.

Conclusion: Both jaw exercises combined with cervical strengthening and ultrasound therapy were associated with significant improvement in functional outcomes among patients with temporomandibular joint disorders. The present study concluded that jaw exercises combined with cervical strengthening demonstrated beneficial effects in the management of temporomandibular joint disorders.

Key Words: Temporomandibular joint disorder, jaw exercises, cervical

strengthening, ultrasound therapy, Jaw Functional Limitation Scale, Neck Disability Index.

INTRODUCTION

Temporomandibular joint disorders (TMDs) refer to a group of musculoskeletal conditions involving the temporomandibular joint, masticatory muscles, and associated craniofacial structures. The condition may be characterized by pain, impaired jaw movement, joint sounds, and functional limitations affecting oral activities. TMDs may present as joint-related dysfunction, muscle-related dysfunction, or a combination of both[1,2].

The development of temporomandibular joint disorders is considered multifactorial and may involve mechanical, muscular, postural, psychological, and behavioural factors. Alterations in the masticatory system and cervical region may contribute to the development and persistence of TMD symptoms[1,2].

Mechanical stress associated with altered mandibular positioning and occlusal relationships may influence loading of the temporomandibular joint. Parafunctional activities and abnormal muscle activity may place repetitive stress on the temporomandibular joint and masticatory muscles. Trauma involving the jaw, face, or cervical region may also influence joint mechanics and neuromuscular control[2,3].

The underlying mechanisms of temporomandibular joint disorders involve biomechanical and neuromuscular alterations. Abnormal joint loading may affect mandibular movement and the relationship between the articular structures, potentially contributing to restricted movement and joint sounds. Prolonged masticatory muscle activity may also contribute to muscle tenderness, fatigue, and altered mandibular movement patterns[2,4].

Patients with temporomandibular joint disorders may experience pain in the jaw, face, temples, head, or neck. Symptoms may increase during activities such as chewing, speaking, yawning, and prolonged mouth opening. Limitation or deviation of mandibular movement may also occur, while joint sounds such as clicking, popping, and crepitus may be present during jaw movements[1,2].

The cervical spine has an important relationship with the temporomandibular joint because of the anatomical and neuromuscular interaction between the head, neck, and mandibular regions. Altered cervical posture and impaired cervical muscle control may influence mandibular function. Cervical stabilization and neck exercise interventions have been reported to influence pain, jaw function, and cervical musculoskeletal outcomes in individuals with TMDs[5,6].

Physiotherapy plays an important role in the conservative management of temporomandibular joint disorders. Major goals of physiotherapy include reduction of pain, improvement of mandibular mobility, restoration of muscle function, correction of postural abnormalities, and improvement of functional performance. Evidence supports the use of therapeutic exercise and other physiotherapy interventions as part of conservative TMD management[3,7].

Jaw exercises are intended to improve mandibular mobility, coordination, and muscle control. Controlled jaw-opening and other therapeutic exercises may be used to improve mandibular movement and reduce pain. Therapeutic exercise approaches have been described as including mobility, coordination, strengthening, relaxation, and endurance exercises for individuals with TMDs[8,9].

Cervical strengthening exercises, particularly exercises targeting cervical stabilizing musculature, are intended to improve head and neck posture and cervical muscle control. Improved cervical function may contribute to better coordination between the cervical spine and mandibular structures. Recent clinical research has demonstrated beneficial effects of cervical stabilization and neck exercise training on pain and jaw-related outcomes in individuals with TMDs[5,6].

Ultrasound therapy is commonly used as an electrotherapeutic modality in musculoskeletal rehabilitation. In patients with TMDs, therapeutic ultrasound has been investigated for its potential effects on pain and functional limitation. Low-intensity ultrasound therapy has been reported to improve pain and functional measures in patients with temporomandibular joint disorders, while ultrasound combined with exercise has also been studied in TMD-related conditions[10,11].

The Jaw Functional Limitation Scale is a patient-reported outcome measure used to assess limitations in jaw-related activities, while the Neck Disability Index is used to evaluate disability associated with neck symptoms. Because cervical dysfunction may coexist with temporomandibular joint disorders, assessment of both jaw function and neck-related disability is relevant to the clinical evaluation of these patients.

Therefore, the present study was conducted to compare the effectiveness of jaw exercises combined with cervical strengthening exercises and ultrasound therapy among patients with temporomandibular joint disorders.

METHODS

A comparative study was conducted among 20 patients with Temporomandibular joint disorders who fulfilled the inclusion and exclusion criteria participants were selected using purposive sampling and randomly allocated into two groups through the lottery method. Group A received jaw exercise combined with cervical strengthening exercise, while group B received ultrasound therapy. Both groups received their respective interventions for the study period. The effectiveness of the interventions was assessed using the jaw functional limitation scale and neck disability index before and after the treatment.

Ethical Clearance Number: IEC-(RIPT/DT/21/0524)

Participants

A total of 20 participants who fulfilled the inclusion and exclusion criteria were selected and divided into two groups.
Group A: Jaw exercises combined with cervical strengthening exercises.
Group B: Ultrasound therapy.

Inclusion Criteria

- Both male and female participants.
- Age between 18 and 40 years.
- Myofascial pain with or without mouth limitation.
- Unilateral or bilateral temporomandibular joint impairment.
- Forward head posture.

Exclusion Criteria

- Areas with sensory deficit.
- Temporomandibular joint infection.
- Whiplash injury.
- Fibromyalgia.
- Malignant tumors of the face or jaw.
- Trigeminal neuralgia.

Intervention

Group A: Jaw Exercises Combined with Cervical Strengthening Exercises

The intervention was administered for approximately 30 minutes per session, five sessions per week, for four weeks. Each exercise was performed for 10 repetitions within the pain-free range.

Jaw Exercises

The jaw exercise programme included:

- Maximal jaw opening.
- Laterotrusion.
- Protrusion.

- Maximal jaw opening with mild resistance.
- Laterotrusion with mild resistance.
- Protrusion with mild resistance.

The participant was positioned in upright sitting with appropriate support for the head, neck, and back. Jaw movements were performed slowly and within the pain-free range while maintaining proper cervical alignment.

Cervical Strengthening Exercises

The cervical exercise programme included:

- Deep cervical flexor strengthening.
- Cervical rotation exercises.

Deep cervical flexor strengthening was performed in a supported supine position with the cervical spine maintained in neutral alignment. The participant performed a gentle nodding movement with controlled activation of the deep cervical muscles.

Cervical rotation was performed through slow and controlled axial movements while avoiding excessive stretching or flexion.

Group B: Ultrasound Therapy

Participants received ultrasound therapy for five sessions per week for four weeks.

The participant was positioned comfortably in upright sitting with support for the head and neck. Coupling gel was applied over the temporomandibular joint region and the surrounding masseter and temporalis muscles.

The ultrasound transducer was moved slowly over the treatment area using controlled circular or linear movements.

The protocol described in the project included:

Frequency: 3 MHz’s

Intensity: 2.0 W/cm².

Treatment duration: approximately 7 minutes per session.

The intervention was intended to reduce pain, promote muscle relaxation, improve local circulation, and improve jaw function.

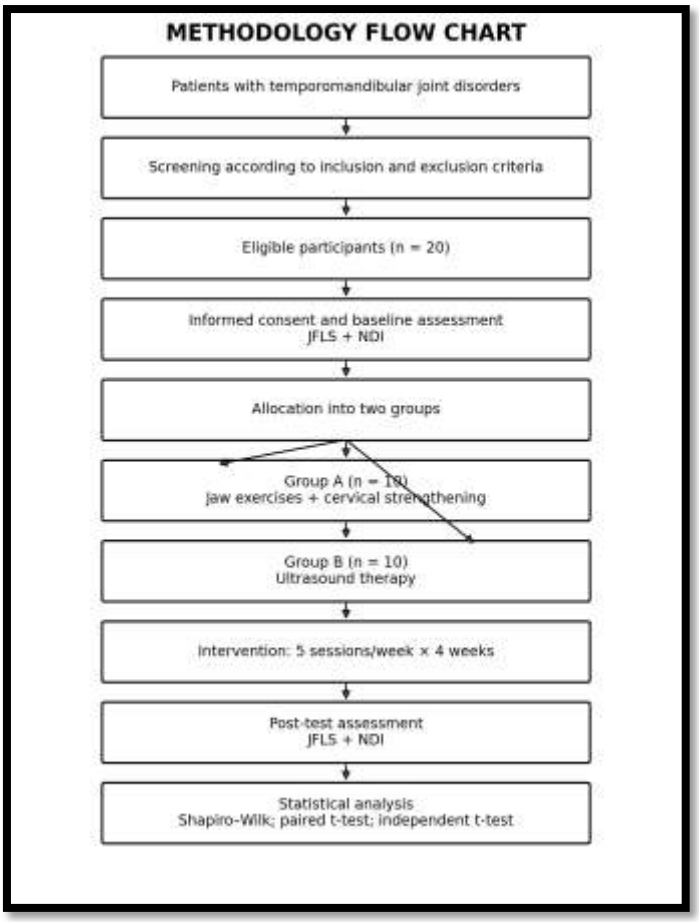


Fig 2. Methodology flow chart

Outcome measures

Jaw Functional Limitation Scale

The Jaw Functional Limitation Scale was used to assess limitations during jaw-related functional activities. Higher scores represented greater functional limitation, whereas lower scores represented better functional ability.

Neck Disability Index

The Neck Disability Index was used to assess the effect of neck-related symptoms and disability on daily functional activities. Both outcome measures were assessed before the intervention and after completion of the four-week treatment programme.

Statistical analysis

The collected data were tabulated and analysed using descriptive and inferential statistics. Statistical analysis was performed using SPSS version 24. The level of significance was set at $p < 0.05$ with a 95% confidence interval.

The Shapiro-Wilk test was used to assess the normality of the data. The data were reported as normally distributed at $p > 0.05$; therefore, parametric statistical tests were used.

Paired t-test was used to compare pre-test and post-test values within each group. Independent t-test was used to compare Group A and Group B.

Results

A total of 20 participants with temporomandibular joint disorders completed the study. The participants were divided into two groups of 10 participants each.

Group A received jaw exercises combined with cervical strengthening exercises, whereas Group B received ultrasound therapy for four weeks.

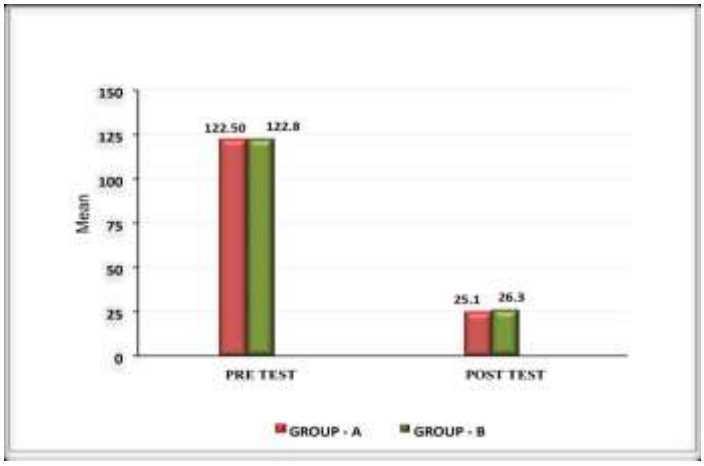
Jaw Functional Limitation Scale

Table 1: Mean, standard deviation, t-test, degree of freedom and p-value between Group A and Group B in pre-test and post-test

Test	Group A Mean	Group A SD	Group B Mean	Group B SD	t-test	df	p-value
Pre-test	122.50	4.11	122.80	5.39	-0.140	18	0.890
Post-test	25.10	3.60	26.30	3.88	-0.716	18	0.483

(*p > 0.05 – Not significant).

Graph 1: Graphical Representation of Comparison of Jaw Functional Limitation Scale Score Between Group – A and Group – B in Pre and Post-Test



GRAPH – I

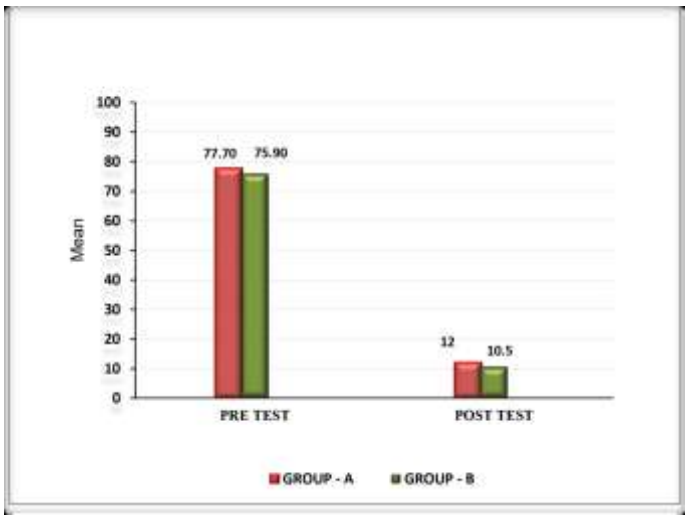
Neck Disability Index

Table 2: Mean, standard deviation, t-test, degree of freedom and p-value between Group A and Group B in pre-test and post-test

Test	Group A Mean	Group A SD	Group B Mean	Group B SD	t-test	df	p-value
Pre-test	77.70	7.00	75.90	8.25	0.526	18	0.605
Post-test	12.00	2.58	10.50	3.02	1.19	18	0.249

(*p > 0.05 – Not significant).

Graph 2: Graphical Representation of Comparison of Neck Disability Index Score Between Group – A and Group – B In Pre and Post Test



GRAPH – II

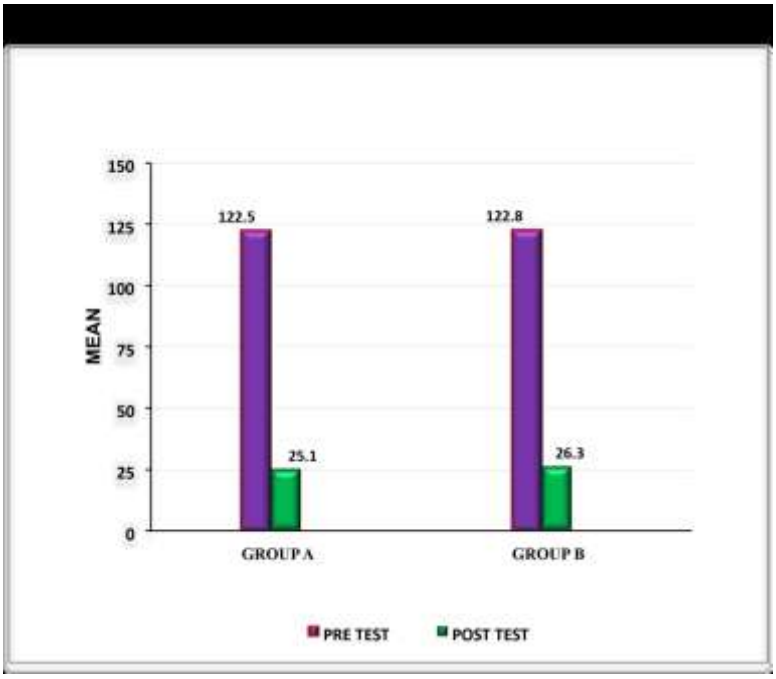
Within-group analysis

Table 3: Mean, standard deviation, t-value and p-value between pre-test and post-test within Group A and Group B for Jaw Functional Limitation Scale.

Group	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	t-test	p-value
Group A	122.50	4.11	25.10	3.60	-0.271	0.001
Group B	122.80	5.39	26.30	3.88	50.66	0.001

(**p ≤ 0.05 – Significant).

Graph 3: Graphical Representation of Comparison of Jaw Functional Limitation Scale Score Within Group – A and Group – B Between Pre and Post Test



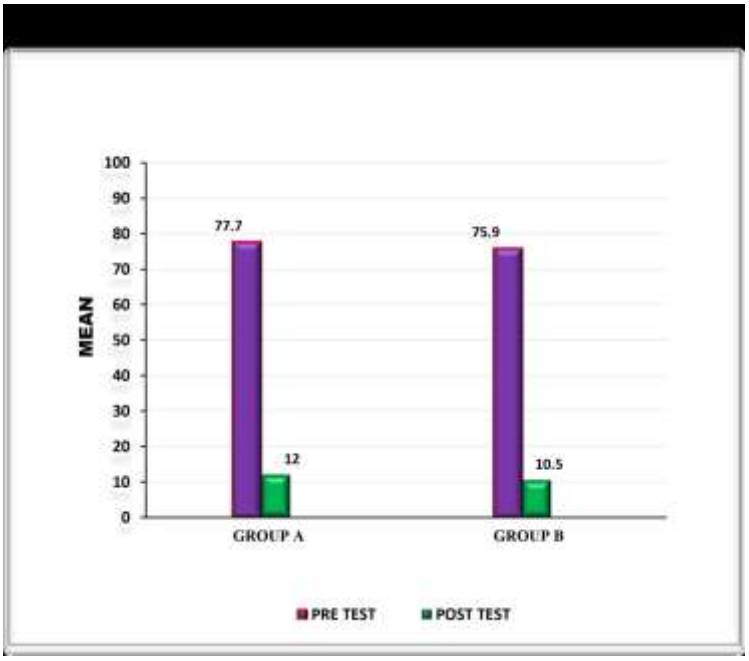
GRAPH - III

Table 4: Mean, standard deviation, t-value and p-value between pre-test and post-test within Group A and Group B for Neck Disability Index.

Group	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	t-test	p-value
Group A	77.70	7.00	12.00	2.58	34.20	0.001
Group B	75.90	8.25	10.50	3.02	25.88	0.001

(p ≤ 0.05 – Significant).**

Graph- 4: Graphical Representation of Comparison of Neck Disability Index Score Within Group – A and Group – B Between Pre and Post Test



GRAPH – IV

Both groups demonstrated statistically significant improvement between pre-test and post-test measurements.

Discussion

The present study was conducted to compare the effectiveness of jaw exercises combined with cervical strengthening exercises and ultrasound therapy among individuals with temporomandibular joint disorders.

Twenty participants were selected based on the inclusion and exclusion criteria and were divided into two groups of 10 participants each. Group A received jaw exercises combined with cervical strengthening exercises, whereas Group B received ultrasound therapy. Both interventions were administered five sessions per week for four weeks.

The results demonstrated improvement in the Jaw Functional Limitation Scale and Neck Disability Index scores following the intervention in both groups.

The use of cervical strengthening in temporomandibular joint disorders is based on the close anatomical, biomechanical, and neuromuscular relationship between the cervical spine and the temporomandibular joint. Altered cervical posture and reduced cervical muscle endurance may influence mandibular alignment and increase mechanical stress on the masticatory and cervical musculature.

Jaw exercises may contribute to improved mandibular movement by improving mobility, muscle coordination, and neuromuscular control. Repeated controlled movements may promote improved movement patterns and functional performance during activities such as chewing and speaking.

When jaw exercises are combined with cervical strengthening, the intervention addresses both local mandibular dysfunction and associated cervical impairment. Strengthening of the deep cervical flexors may improve cervical stability and postural control. Improved cervical muscle control may also contribute to better coordination between the jaw and cervical regions.

The improvement observed following ultrasound therapy may be associated with its effects on soft tissues. Ultrasound may contribute to improved local circulation, reduced muscle tension, and improved tissue extensibility. Reduction in pain and stiffness may allow improved performance of functional jaw activities.

The findings of the present study showed statistically significant improvement within both groups. Therefore, both intervention programme were associated with improvement in jaw-related functional limitation and neck-related disability following four weeks of treatment.

Conclusion

The present study was undertaken to compare the effectiveness of jaw exercises combined with Cervical strengthening exercises and ultrasound therapy among patients with temporomandibular Joint disorders.

Twenty participants were included and divided into two groups. Group A received jaw exercises Combined with cervical strengthening exercises, while Group B received ultrasound therapy for Four weeks.

The Jaw Functional Limitation Scale and Neck Disability Index were assessed before and after the Intervention.

The results demonstrated statistically significant improvement within both groups following Treatment. Therefore, both jaw exercises combined with cervical strengthening and ultrasound Therapy were effective in improving the measured functional outcomes among participants with Temporomandibular joint disorders.

Limitations

- The present study had the following limitations:
- The sample size was small, which may limit generalization of the findings.
- Psychological factors were not assessed.
- The intervention duration was short, limiting evaluation of long-term effects.
- Objective assessment methods were not used.

Recommendations

Future studies should consider:

- Larger sample sizes.
- Inclusion of participants with different age groups and severity levels.
- Long-term follow-up to evaluate sustained treatment effects.
- Inclusion of psychological assessment.
- Use of additional objective outcome measures.

Conflict Of Interest

The authors declare that there was no conflict of interest related to this study.

Acknowledgments

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Author' Contribution

The authors contributed to the conception and design of the study, literature review, development Of the methodology, recruitment of participants, administration of the interventions, collection and Analysis of data, interpretation of results, preparation of the manuscript, and review of the final Manuscript.

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