

A COMPARATIVE STUDY OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) VERSUS GOLDFISH EXERCISE IN REDUCING PAIN AND IMPROVING RANGE OF MOTION AMONG PATIENTS WITH TEMPOROMANDIBULAR JOINT DYSFUNCTION

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ABSTRACT

Background: Temporomandibular disorders (TMD) are a collective term for conditions affecting the temporomandibular joint (TMJ), the masticatory muscles, and associated structures, characterised by pain, joint sounds, and restricted mandibular movement. Reported prevalence in the adult population ranges from approximately 20% to 31%, with a higher occurrence in women and in individuals aged 20–40 years. **Aim:** To compare the effectiveness of proprioceptive neuromuscular facilitation (PNF) and Goldfish exercise in reducing pain and improving range of motion (ROM) among patients with TMJ dysfunction. **Methodology:** A comparative experimental study was conducted on 30 participants aged 20–50 years with myogenic TMJ pain, randomly allocated into two equal groups. Group A (n = 15) received PNF and Group B (n = 15) received Goldfish exercise, five sessions a week for six weeks. **Outcome Measures:** Pain was assessed using the Visual Analogue Scale (VAS), and jaw mobility was assessed using maximum mouth opening (MMO), measured in millimetres. **Results:** Both groups showed a statistically significant reduction in pain and improvement in ROM from pre- to post-intervention ($p < 0.001$). The improvement was greater in Group A than in Group B. **Conclusion:** Both PNF and Goldfish exercise are effective in reducing pain and improving ROM in TMJ dysfunction, but PNF produced a greater improvement.

KEYWORDS: Temporomandibular disorders; Proprioceptive neuromuscular facilitation; Goldfish exercise; Visual analogue scale; Range of motion.

INTRODUCTION

The temporomandibular joints are among the most frequently used joints in the body, opening and closing up to 2,000 times a day during chewing, speaking, swallowing, and yawning, yet they receive comparatively little clinical attention.^[1] The jaw, cervical spine, and dental occlusion are closely interrelated, and dysfunction in any of these regions can contribute to a

temporomandibular joint (TMJ) disorder. The American Academy of Orofacial Pain defines temporomandibular disorders (TMD) as a collective term for clinical problems involving the masticatory muscles, the temporomandibular joint, and associated structures.

TMD is characterised by pain, joint sounds, and restricted mandibular movement, and its exact

pathogenesis remains unclear. Proposed contributing factors include physical causes (trauma, muscle spasm, chronic malocclusion, and bruxism), biochemical factors (vitamin inadequacy), and psychological factors (anxiety, stress, and depression).^[2] TMD is reported in 20–31% of the adult population, and is more common in individuals aged 20–40 years and in women.^[3] Although rarely life-threatening, TMD can substantially affect quality of life when symptoms become chronic. A wide range of treatments — pharmacological, oral appliance therapy, cognitive-behavioural approaches, and physical therapy — have been described in the literature, with disparate outcomes across studies.^[4]

Physical therapy aims to relieve musculoskeletal pain, reduce inflammation, and restore oral motor function, and is generally recommended before invasive or irreversible interventions such as orthodontic treatment or surgery.^[5] Commonly used physical therapy approaches for TMD include electrophysical modalities, therapeutic exercise, and manual therapy directed at the masticatory and cervical musculature.^[6,7]

Proprioceptive neuromuscular facilitation (PNF) was developed by Kabat and Knott in the 1950s for patients with musculoskeletal pain and paralysis. The technique combines isometric muscle contraction with relaxation and stretching, and is thought to act through post-contraction and reciprocal inhibition to relieve tension in muscles such as the masseter, temporalis, and pterygoids.^[8,9]

Goldfish exercise was developed by the Japanese practitioner Seigo Nishi, inspired by the swimming motion of a goldfish, and is known in Japan as “Kingyo Undo.” It involves controlled jaw-opening and closing movements guided by the fingers placed over the TMJ and chin, and is used to improve mandibular coordination and mobility.

Forward head posture, increasingly common with prolonged use of phones and computers, has been associated with abnormal cervical alignment and TMD.^[10] Reported prevalence estimates for TMD vary widely across populations and diagnostic criteria — from around 5–12% in children and adolescents to more than 30% in adults — and women are affected roughly twice as often as men. Despite this substantial burden, relatively few studies have directly compared a structured neuromuscular technique such as PNF against a simpler, self-administered technique such as Goldfish exercise in this population. This study was undertaken to address that gap.

AIM OF THE STUDY

To determine the effectiveness of proprioceptive neuromuscular facilitation (PNF) versus Goldfish exercise among patients with temporomandibular joint disorder.

OBJECTIVES

- To determine the effect of PNF on pain and range of motion (ROM) in TMJ dysfunction.
- To determine the effect of Goldfish exercise on pain and ROM in TMJ dysfunction.
- To compare the effect of PNF and Goldfish exercise on pain and ROM in TMJ dysfunction.

Hypotheses

Null hypothesis (H₀): There is no significant difference between the effects of PNF and Goldfish exercise on pain and ROM in TMJ dysfunction.

Alternate hypothesis (H₁): There is a significant difference between the effects of PNF and Goldfish exercise on pain and ROM in TMJ dysfunction.

MATERIALS AND METHODS

Study Design and Setting

This was an experimental, comparative study conducted over a period of six weeks.

Participants

Thirty participants meeting the eligibility criteria were enrolled and randomly allocated into two equal groups of 15 by simple random sampling.

Inclusion Criteria

- Male and female participants.
- Age group 20–50 years.
- Patients with myogenic TMJ pain.
- Limited and painful jaw movement of less than 3 months’ duration.
- Willing participants providing informed consent.

Exclusion Criteria

- Mandibular fracture or other injury.
- Inflammatory joint conditions or TMJ arthritis.
- Systemic cardiac or respiratory conditions.
- ENT (ear, nose and throat) disorders.

Outcome Measures

Pain: assessed using the Visual Analogue Scale (VAS), a 100-mm horizontal line anchored by “no pain” and “worst imaginable pain,” on which participants marked their perceived pain intensity; pain intensity was recorded as the distance from the “no pain” end.^[11]

Range of motion: assessed as maximum mouth opening (MMO), measured in millimetres between the upper and lower central incisors at maximal opening, using a ruler and callipers.^[12]

Materials Used

Ruler, Visual Analogue Scale sheet, mirror, chair.

Procedure

After screening against the inclusion and exclusion criteria, written informed consent was obtained from all participants, and baseline VAS and MMO were recorded.

Participants were randomly allocated to Group A (PNF) or Group B (Goldfish exercise), 15 in each group. Both interventions were administered five times a week for six weeks, with each session lasting approximately 30 minutes.

Group A: Proprioceptive Neuromuscular Facilitation Protocol

Each session began with a 5-minute warm-up comprising gentle jaw mobilisation (slow opening/closing, lateral, and forward-backward gliding movements) and self-massage of the masseter, temporalis, and pterygoid muscles. This was followed by 10–15 minutes of PNF technique — a hold-relax technique to reduce muscle tightness and a contract-relax technique to increase mandibular mobility — each performed for 3–5 sets of 5–10 repetitions with isometric holds of 5–10 seconds. Sessions concluded with a 5-minute cool-down of gentle jaw stretching, diaphragmatic breathing, and light self-massage.

Group B: Goldfish Exercise Protocol

Participants were positioned in front of a mirror with one finger placed over the TMJ and the other on the chin (supported technique) or on the contralateral TMJ (unsupported technique). With the tongue resting on the palate, participants opened the mouth maximally while the jaw was guided down and back up with finger assistance; this was repeated six times per session.

Data Analysis

Data were tabulated and analysed using SPSS version 24.0. Descriptive statistics (mean and standard deviation) were calculated for VAS and ROM at pre- and post-intervention, and a paired t-test was used to compare pre- and post-intervention values within each group. A p-value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Group A and Group B were comparable at baseline, with no meaningful difference between groups in pre-intervention VAS or ROM scores (Table 1, Table 2).

Table 1: Comparison of VAS Scores (Pre- and Post-Intervention) in Group A and Group B

Group	N	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	t-value	p-value
Group A (PNF)	15	6.87 $\pm$ 0.74	2.47 $\pm$ 0.52	18.83	< 0.001
Group B (Goldfish)	15	6.87 $\pm$ 0.74	3.53 $\pm$ 0.13	14.26	< 0.001

Table 2: Comparison of Range of Motion (mm) (Pre- and Post-Intervention) in Group A and Group B

Group	N	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	t-value	p-value
Group A (PNF)	15	26.00 $\pm$ 2.65	40.67 $\pm$ 2.35	16.05	< 0.001
Group B (Goldfish)	15	25.93 $\pm$ 2.69	37.87 $\pm$ 2.45	12.73	< 0.001

Within-group comparison showed a statistically significant reduction in VAS pain scores and a significant increase in ROM from pre- to post-intervention in both Group A and Group B ($p < 0.001$ for all comparisons); the null hypothesis was therefore rejected. In Group A, the mean VAS score fell from 6.87 $\pm$ 0.74 to 2.47 $\pm$ 0.52, while in Group B it fell from 6.87 $\pm$ 0.74 to 3.53 $\pm$ 0.13. Similarly, mean ROM increased from 26.00 $\pm$ 2.65 mm to 40.67 $\pm$ 2.35 mm in Group A, and from 25.93 $\pm$ 2.69 mm to 37.87 $\pm$ 2.45 mm in Group B. The post-intervention mean VAS score was lower, and the post-intervention mean ROM was higher, in Group A than in Group B, indicating a numerically greater improvement with PNF; the present study design (paired t-tests within each group) did not include a formal between-group statistical comparison, and this should be interpreted as a descriptive rather than an inferential finding unless a between-group analysis is added.

These findings are broadly consistent with the literature supporting the effectiveness of exercise-based interventions for TMD.^[13] PNF's proprioceptive stimulation may activate deep muscle fibres more effectively than Goldfish exercise, which could explain the numerically greater improvement observed in Group A. Goldfish exercise, while effective for strengthening jaw musculature and correcting movement patterns, may

provide comparatively less neuromuscular facilitation than PNF. Prior work has also linked TMD to abnormal cervical alignment and postural factors, and to structural changes following musculoskeletal injury, which may partly explain the variability in treatment response reported across studies.

CONCLUSION

Both PNF and Goldfish exercise, administered over six weeks, were effective in reducing pain and improving range of motion in patients with TMJ dysfunction, with a numerically greater improvement observed following PNF. PNF may therefore be considered a beneficial rehabilitation approach for managing TMJ dysfunction, alongside Goldfish exercise as a simpler self-administered alternative.

This study was limited by its short duration, restricted age range, limited outcome measures, and small sample size, and did not include a formal statistical comparison between groups. Future studies with larger samples, broader age groups, longer follow-up, and additional outcome measures — along with a planned between-group statistical comparison — are recommended to confirm these findings.

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