

Proprioceptive neuromuscular facilitation activity in frozen shoulder

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ABSTRACT

Frozen shoulder, also termed adhesive capsulitis, is a painful condition marked by progressive loss of both active and passive shoulder motion, especially external rotation, and often follows a prolonged clinical course with persistent stiffness and functional limitation. Contemporary rehabilitation literature suggests that proprioceptive neuromuscular facilitation (PNF) may serve as a useful adjunct within conservative management by targeting pain, mobility restriction, neuromuscular control, and functional movement patterns.

This paper examines the role of PNF in frozen shoulder using current evidence from a pilot randomized controlled trial and an established clinical practice guideline for adhesive capsulitis. The available evidence indicates that PNF-based treatment may improve pain, passive range of motion, and selected MRI-based structural measures when compared with conventional manual therapy alone, although the present evidence base remains limited by small samples and the absence of large multicenter trials.

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Introduction

Frozen shoulder is a common musculoskeletal disorder characterized by shoulder pain and global restriction of glenohumeral motion, with external rotation commonly showing the greatest early limitation. The condition is clinically important because it interferes with sleep, grooming, dressing, reaching, work performance, and overall quality of life, and symptoms may persist for 12 to 18 months or longer in some patients

The pathology is associated with synovial inflammation, capsuloligamentous fibrosis, and contracture, particularly involving the coracohumeral ligament and capsular structures of the axillary recess. Clinical practice guidelines support conservative care built around patient education, stretching, mobility exercise, and in selected cases joint mobilization and corticosteroid injection, but PNF is not yet established as a core standalone recommendation in major guidelines.

PNF is a rehabilitation approach that uses diagonal movement patterns, resisted motion, alternating contractions, and relaxation techniques to facilitate neuromuscular responses and improve coordinated movement. In frozen shoulder, PNF has been proposed as a method to restore shoulder and scapular movement, reduce pain, and enhance motion by combining sensorimotor activation with manual mobilization strategies.

Problem statement

Despite the broad use of physiotherapy for adhesive capsulitis, uncertainty remains regarding the specific value of PNF compared with standard manual therapy and exercise-based care. This gap is clinically relevant because frozen shoulder often requires prolonged rehabilitation, and even modest gains in pain relief and motion may influence activities of daily living and treatment adherence.

Aim and objectives

The aim of this research paper is to evaluate the activity and therapeutic role of proprioceptive neuromuscular facilitation in patients with frozen shoulder.

The objectives are:

To describe the clinical and pathological basis of frozen shoulder.

- To explain the principles of PNF relevant to shoulder rehabilitation.

- To review the evidence on PNF for pain relief, range of motion, and structural change in adhesive capsulitis.

- To discuss the implications of current evidence for physiotherapy practice and future research.

Research question

Does proprioceptive neuromuscular facilitation improve pain, range of motion, and functional recovery in patients with frozen shoulder more effectively than conventional manual therapy alone?

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Review of literature Frozen shoulder overview

The APTA/JOSPT clinical practice guideline describes adhesive capsulitis as a continuum of pain and mobility loss with staged progression, and notes that patients commonly present with gradual onset of pain, sleep disturbance, and restricted active and passive movement in elevation and rotation. The guideline also identifies diabetes mellitus, thyroid disease, age between 40 and 65 years, female sex, and previous contralateral adhesive capsulitis as important risk factors.

The disorder has important structural correlates. The guideline highlights fibrosis and contracture of the capsuloligamentous complex, while the 2022 pilot randomized trial specifically examined thickening of the coracohumeral ligament and capsule in the axillary recess using MRI as indicators of structural abnormality in frozen shoulder.

PNF principles in rehabilitation

According to the pilot trial, the PNF program was applied under an International Classification of Functioning framework and used dynamic reversal, stability reversal, rhythmic stabilization, hold-relaxation, and contraction-relaxation techniques during shoulder mobilization and functional training. The intervention emphasized diagonal upper-limb patterns and scapular girdle movements, aligning treatment with controlled functional movement rather than isolated stretching alone.

The proposed rationale is that PNF stimulates proprioceptors, enhances neuromuscular responses, modulates abnormal muscle tone, and improves coordinated movement around the diseased joint. For frozen shoulder, these effects may be especially relevant because pain, stiffness, and altered movement patterns frequently coexist and reinforce each other during the freezing and frozen stages.

Evidence on PNF in frozen shoulder

In the 2022 pilot randomized controlled trial, 48 patients with frozen shoulder were randomly assigned to a traditional manual therapy group or a PNF group for a 4-week treatment period. Both groups also received adjunctive physical agents, while the PNF group underwent structured PNF-based mobilization and movement training.

The study reported that the PNF group showed greater reduction in coracohumeral ligament thickness and capsule-in-axillary-recess thickness on MRI after 4 weeks, with statistically significant between-group differences. The PNF group also had significantly lower pain scores than the control group at the 2-week and 4-week assessments.

For passive shoulder motion, the PNF group demonstrated significantly better mid-term improvements in abduction, anteflexion, and external rotation, and external rotation remained significantly better at discharge. The authors concluded that PNF may be an effective adjunctive treatment rather than a replacement for broader conservative management, because the evidence is still preliminary and derived

from a small pilot sample.

Guideline context

The clinical practice guideline supports stretching exercises, patient education, and selected use of glenohumeral joint mobilization for adhesive capsulitis, with intra-articular corticosteroid injection plus mobility and stretching offering stronger short-term evidence than exercise alone. Notably, the guideline does not identify PNF as a primary evidence-based recommendation, which suggests that PNF currently occupies an adjunctive or emerging role rather than a fully established standard intervention in guideline-based care.

Methodological perspective

This dissertation-style paper is based on narrative review of two key evidence sources: a peer-reviewed pilot randomized controlled trial examining PNF for frozen shoulder and clinical practice guideline synthesizing evidence on adhesive capsulitis diagnosis and intervention. The approach is suitable for an academic overview because it combines primary interventional evidence with broader guideline-level interpretation, though it does not constitute a full systematic review.

Findings and discussion Effects on pain

Pain reduction is one of the most meaningful outcomes in frozen shoulder because pain contributes to sleep disturbance, guarding, low participation in exercise, and progressive functional limitation. In the pilot trial, the PNF group achieved significantly better VAS pain scores at both mid-treatment and discharge than the manual therapy group, suggesting that PNF may enhance short-term pain relief when added to rehabilitation.

Effects on range of motion

Loss of passive external rotation is a hallmark finding in adhesive capsulitis and is central to diagnosis and treatment planning. The pilot trial found superior short-term gains in passive abduction, anteflexion, and external rotation in the PNF group at mid-term, with external rotation remaining significantly improved at discharge, which is clinically relevant because external rotation restriction often has a disproportionate impact on dressing and grooming.

Effects on tissue structure

A distinctive contribution of the pilot trial is its MRI-based assessment of structural change, showing greater reduction in coracohumeral ligament and axillary recess capsule thickness in the PNF group after treatment. These findings are important because both the trial and the guideline link capsular and ligamentous thickening or fibrosis with pain and mobility restriction in frozen shoulder.

Clinical interpretation

The current evidence supports viewing PNF as an adjunctive rehabilitation tool rather than a standalone

cure. In practical physiotherapy settings, PNF may be most useful when integrated with patient education, staged stretching, mobility work, irritability-based progression, and functional retraining consistent with guideline recommendations.

adhesive capsulitis guidelines do not yet position PNF as a primary recommendation, it should be interpreted as a promising complementary intervention within comprehensive conservative management rather than an independently established gold-standard treatment.

Clinical applications

PNF activity in frozen shoulder may be clinically applied through:

- Scapular and upper-limb diagonal movement patterns to improve coordinated motion.
- Hold-relax and contract-relax techniques to address movement restriction and guarded musculature.
- Rhythmic stabilization and resisted patterns to improve neuromuscular control around the shoulder complex.
- Integration with stretching and joint mobilization according to irritability and stage of disease
- Monitoring with outcomes such as pain scales, passive ROM, and validated tools including SPADI, DASH, or ASES.

Limitations of evidence

The most important limitation is that the main direct evidence identified here is a single-center pilot randomized controlled trial with a relatively small sample and short follow-up. In addition, both groups in that study received other concurrent therapies, which makes it difficult to isolate the effect of PNF alone.

The guideline evidence base predates this trial and therefore does not fully incorporate more recent PNF-specific studies. As a result, the evidence is promising but not yet strong enough to position PNF above better-established conservative treatments in all patients with adhesive capsulitis.

Implications for future research

Future studies should compare standardized PNF protocols with stretching-only, mobilization-only, and multimodal physiotherapy programs using larger samples and longer follow-up periods. Research should also examine whether PNF effectiveness differs by disease stage, irritability level, diabetes status, and duration of symptoms, because adhesive capsulitis is heterogeneous in presentation and recovery pattern.

Functional outcomes deserve more emphasis in future trials. Alongside pain and ROM, future research should evaluate disability scales, return to work, sleep quality, adherence, and cost-effectiveness to determine the true practical value of PNF in routine care.

Conclusion

Available evidence suggests that proprioceptive neuromuscular facilitation has beneficial activity in frozen shoulder, particularly as an adjunctive physiotherapy technique that may reduce pain, improve passive range of motion, and favorably influence selected MRI-detected structural abnormalities. However, because current support rests mainly on limited direct trial evidence and broader