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Role of Proprioceptive Neuromuscular Facilitation Technique in Functional Recovery During the Thawing Stage of Frozen Shoulder: Case Study

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ABSTRACT
Background: Adhesive capsululitis (frozen shoulder): It is a disabling musculoskeletal disease that occurs in 2-5% of the population where the shoulder pain increases gradually accompanied by limited glenohumeral movement. A 12-42 months thawing stage is a sensitive period in the treatment where specific rehabilitation may have a significant effect on functional outcomes, but is underestimated in the literature of rehabilitation.
Case Presentation: Case Presentation: A 45-year-old woman reported that she has persistent shoulder pain (NPRS 6/10) and restricted range of motion, scapular dyskinesia, and functional limitations (SPADI 62/100) at the thawing phase of adhesive capsulitis.
Intervention: PNF protocol was used, glenohumeral diagonal patterns (D1/D2 flexion-abduction-external rotation) contraction-relax/hold-relax-agonist-contract method, scapular PNF was combined with it, scapulohumeral rhythm was restored, and moist heat was used as an adjunct. Therapy started to be in lying postures then in sitting postures with the focus on neuromuscular coordination and functional patterns of movement.
Result: The results after the intervention were as follows: pain decreased to 3/10 NPRS with nocturnal symptoms being cured, active range of motion was significantly increased (flexion: 120° to 155°, abduction: 100° to 145°, external rotation: 35° to 55°), muscle strength was increased to 4 +/5, scapulohumeral rhythm was restored, and functional disability was reduced to 62/100 to 28/100
Conclusion: The PNF intervention applied at the stage of thawing of adhesive capsulitis resulted in significant pain, mobility, neuromuscular control, and functional independence. Glenohumeral diagonal patterns used together with scapular facilitation techniques seem to improve motor relearning, as well as faster functional recovery as compared to traditional methods. These results encourage PNF as a fundamental rehabilitation element in the management of frozen shoulders especially at the recovery phases. To confirm these results, larger controlled trials should be conducted to provide standard clinical standards.

Keywords: inhibiting stage, Adhesive capsulitis, frozen shoulder, thawing stage, Proprioceptive neuromuscular facilitation, PNF, finance scapulohumeral rhythm, rehabilitation, functional recovery.

INTRODUCTION

Frozen shoulder, also known as adhesive capsulitis, is a widespread and debilitating musculoskeletal disorder, which is associated with progressive shoulder pain and general limitation of active and passive shoulder joint movement. It has a prevalence rate of about 2-5 per cent of the general population and much higher prevalence has been documented among people with diabetes mellitus . Recurrent pain, stiffness, and functional incapacity are important predictors of quality of life and impair the activities of daily living. On a pathophysiological level adhesive capsulitis is initiated by an inflammatory response characterized by the presence of excess cytokine activity followed by capsular fibrosis, thickening and contraction of intra and extra-articular structures in particular coracohumeral ligament and rotator cuff interval.

The adhesive capsulitis normally follows a series of stages namely the freezing, frozen and thawing stages with each having different clinical features. The recovery phase or also known as the thawing stage is where pain fades gradually and incomplete recovery of the shoulder mobility may take 12-42 months. Whereas it has traditionally been regarded as a self-limiting condition, according to recent findings, spontaneous recovery is not commonplace and many patients have residual pain, stiffness, and functional defects without active treatment . Thus, the thawing phase is a significant period in the treatment process when the right choice of rehabilitation techniques can significantly affect the functional results of the long-term perspective.

The cornerstone of the management during the thawing stage is still physiotherapy, and its focus should be on the restoration of joint mobility, enhancement of neuromuscular control, and restoration of normal scapulohumeral rhythm .

Proprioceptive Neuromuscular Facilitation is one method of therapeutic exercise that combines both functional-based diagonal movement patterns as well as neuromuscular facilitation techniques to elicit motor response as well as enhance neuromuscular control and coordinated movements . The basic concept of PNF is that the development of the mobility, control over the movement, and joints coordination are achieved by systematic application of the proprioceptive, cutaneous, and auditory stimuli to produce certain motor reactions .These methods use the spiral and diagonal movement patterns that are replicated of the natural functional movements of the human body.

Neurophysiological mechanisms that explain PNF effectiveness are due to the stimulation of proprioceptors by using maximum resistance, stretch reflexes and the irradiation patterns that aid in muscle contraction and motor learning . Some PNF methods popularly used are hold-relax, contract-relax, rhythmic initiation and slow reversal which are used to treat various types of dysfunctions on movement . Considering the frozen shoulder, these methods may be used in the upper limb diagonal forms, D1 and D2 flexion-abduction-external rotation forms, and scapular forms to treat the complicated shoulder girdle biomechanics..

New studies endorse the usefulness of the PNF in the treatment of adhesive capsulitis, showing new advancements in pain treatment, shoulder mobility, especially the external rotation and abduction, and functional performance rates compared to traditional physiotherapy treatment methods . Besides managing the glenohumeral joint limits, PNF enables the ideal scapular management and incorporation of multi-planar functional motions, which tends to be lost in the course of becoming useless due to the extended durations of pain and immobility. Considering that the stage of thawing is associated with the favorable tissue extensibility and the low level of inflammatory activity, PNF techniques can be specifically effective in facilitating functional recovery.

The current case study attempts to explain the benefits of proprioceptive neuromuscular facilitation methods in supporting functional recovery in thawing of frozen shoulder, its clinical use, and role in alleviating pain, mobility, strength, and functional activities.

Scope of the study

This paper evaluates how well PNF reduces pain, increases the range of motion in the shoulder and improves functional reach in the situation of thawing of the frozen shoulder. It sends the note on musculature promotions, scapular, and scapulohumeral complacence, scapulohumeral data concerning functional recovery by utilizing SPADI, and pinpoints the necessity of Multi-planar movement preparation in addition to instructing on stage-precise physiotherapy and future standardized guidelines on PNF preparations.

CASE PRESENTATION

A 45-year-old woman is reporting on chronic shoulder-level pain and an increasing loss of mobility which can be attributed to adhesive capsulitis. The intensity of pain was 6/10 according to Numerical Pain Rating Scale (NPRS) and mechanical in nature, worsened by dressing, activities behind the back, and overhead and improved by relaxation and easy movements. Also in comparison to the previous stages, the patient experienced a lower level of pain and a higher quality of sleep because of the lesser level of nocturnal pain but still, a stiffness in the shoulder performed as the main functional limitation. The patient had problems with housekeeping, bathing, dressing herself up, and overhead dressing. The restriction of movement was of the normal capsular pattern of adhesive capsulitis with internal rotation being the most restricted followed by flexion, abduction, and external rotation.

The postural examination showed forward position of the head with rounded shoulders and slight protraction of affected shoulder. It was observed that there was shoulder asymmetry, slight atrophy of deltoid and supraspinatus muscles, and compensatory scapular elevation and ipsilateral trunk side-flexion during arm elevation. Palpation revealed local tenderness of the anterior shoulder, increase in sensitivity in the long head of the biceps tendon and rotator cuff insertions. The upper trapezius, levator scapulae and posterior capsular musculature appeared to have an increased muscle tone and palpationally evident spasm, indicative of compensatory overactivity.

Active and passive shoulder range of motion (ROM) were limited worldwide, with the passive ROM being slightly higher in comparison to active ROM. The active and passive flexions were 120° and 140° and abduction was 100 ° and 120 °. It was found that external rotation was restricted to 35 ° actively and 45° passively, and internal to the L5 vertebral level actively and the L3 vertebral level passively. There was a firm, consistent end-feel of the capsule, which suggested the presence of capsular tightness that was persistent and featured in the thawing phase of adhesive capsulitis.

Oxford Scale (Manual Muscle Testing) revealed 4/5 strength in flexors and abductors of the shoulder and internal rotators of the shoulder, and 3+/5 strength in external rotators and scapular stabilists. The scapular evaluation showed that protraction and elevation were more pronounced at rest position and the activation was delayed and the upward rotation was slower in rising the arm, which is a sign of scapular dyskinesis. Functional status was calculated with the Shoulder Pain and Disability Index (SPADI) with a baseline of 62/100 which is moderate to severe disability with the greatest impact on overhead reaching, grooming, dressing, carrying objects and domestic activities. Special tests such as the apprehension, Neer tests and the Hawkins-Kennedy tests were negative. Severe limitation of Passive External Rotation Test without acute pain was a confirmation of adhesive capsulitis on thawing stage.

Therapeutic Intervention

The evidence-based multimodal approach used to develop the treatment plan was suitable to the stage of the thawing in the adhesive capsulitis and has been created in collaboration with the patient.

- **Short-term Objectives**: -Improved pain score to 2/10 on NPRS, active shoulder flexion and abduction 20-30°, external rotation 10-15°, active basic activities (grooming, etc).
- **Medium-term Objectives** - To gain 75-80 % of normal shoulder function, to eliminate pain, and to gain functional range of motion pain-free, to increase SPADI scores by 30-40 , and to be able to resume household functions with very little restriction.
- **Long-term Objectives**: -Oriented to achievement of full or near-full functional range of movements, full independence in the activities of daily living, recreation of occupational and recreational interests, and the preservation of achievement by an independent home exercise program.

PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUE

Glenohumeral Diagonal Patterns

The primary PNF intervention applied flexion-abduction-external rotation diagonal pattern, which was chosen based on its capacity to cover the most limited movements in adhesive capsulitis and is not too different in resembling functional reaching activities. Treatment was first initiated on the supine position to maintain the posture and reduce the gravitational load. The hand and wrist were pressed with manual contacts to improve proprioceptive input and the degree of resistance was applied to ensure that the muscles could be activated without affecting the quality of movement.

One end of the range was reached and the contract-relax technique was used at this point .The patient was forced to make a 6-second isometric contraction against resistance at the opposite diagonal and then relaxed and moved passively into the newly acquired range which was then actively maintained at 10 seconds. The repetition was done with 3-5 repetitions in the session with progressive within-session improvements in mobility.

With the improvement in tolerance, the hold-relax-agonist-contract was also introduced to expand the range of motion and neuromuscular control even further. This development involved an active concentric contraction after relaxation, which strengthened the stability and stability at the new range that was obtained. The diagonal patterns were later done in a sitting position, and this added functional relevance to neuromuscular demand.

Shoulder Complex Integration and PNF Scapular

Scapular PNF technique was incorporated in all the rehabilitation to correct the scapulohumeral rhythm. Rhythmic initiation was also applied to enhance the scapular mobility and motor awareness in the patient positioning him side-lying. With manual facilitation, emphasis was on elevation-depression, protraction-retraction and upward-downward rotation.

The **hold-relax** method was used selectively to alleviate overactivity of upper trapezius and levator scapulae to allow scapular depression and up-rotation. The strategy was useful in reversing compensatory elevation trends generated in the previous phases of the disease.

Four weeks later, pattern changes in the combined glenohumeral-scapular PNF were added to reinstate the coordinated function of the shoulder complex . Manual resistance and verbal cueing focused on quality of movement, time and coordination such as that of maximal range but was more comparable to functional overhead activities.

Intravascular Thermal Intervention

The sessions were introduced with 10 minutes of moist heat application with the use of hydrocollator pack Thermal preparation enhanced soft tissue extensibility, decreased muscle guarding, and maximized patient comfort, thus, enabling the successful implementation of the further PNF treatments.

Uniqueness of the Study

- Focuses on the thawing (recovery) phase of frozen shoulder, often considered self-limiting.
- Applies PNF in a stage-specific manner rather than a general shoulder rehab program.
- Emphasizes neuromuscular control and restoration of scapulohumeral rhythm, not just range-of-motion improvements.

RESULT

Proprioceptive neuromuscular facilitation–based rehabilitation, the patient demonstrated clinically meaningful improvements. Pain decreased from 6/10 to 3/10 on the Numerical Pain Rating Scale, with resolution of nocturnal pain. Active shoulder range of motion improved, with flexion increasing from 120° to 155°, abduction from 100° to 145°, and external rotation from 35° to 55°. Internal rotation improved from the L5 to T12 vertebral level. Muscle strength of the rotator cuff and scapular stabilizers improved to 4+/5, with improved scapulohumeral rhythm and reduced compensatory movements. Functional disability, measured using the Shoulder Pain and Disability Index, improved from 62/100 to 28/100.

DISCUSSION

The results of the observed improvements reveal the efficiency of the PNF-based, stage-specific intervention of the adhesive capsulitis thawing stage. The decrease in pain and the increase in the range of motion can be explained by a better quality of capsular extensibility and neuromuscular inhibition ensured by contract-relax and hold-relax methods. Recovery of scapulohumeral rhythm after scapular PNF augments available literature to the effect that scapular dyskinesis is one of the components of perennial dysfunction in frozen shoulders. The combination process of the functional diagonal patterns, presumably, aided in relearning of motor tasks and enhanced coordination transferring the gains into functional recovery. Such results agree with the results of other researchers who have reported better results of PNF in comparison to the traditional stretching based on mobility, pain alleviation, and supportive functioning. The gradual widening of the passive facilitation to active control seems especially helpful in the thawing phase, at which the extent of tissue extensibility permits an efficient remodeling.

CONCLUSION

Proprioceptive neuromuscular facilitation (PNF) with a stage specific stimulation at the thawing stage of adhesive capsulitis is capable of decreasing pain, increasing the mobility of the shoulder and scapula, and enhancing functional independence. Attack of glenohumeral and scapulothoracic parts best improves neuromuscular synchronisation and speed of recovery. These findings justify the use of PNF in the late-stage frozen shoulder rehabilitation. Additional controlled experiments are required to establish efficacy as well as come up with uniform clinical guidelines.

Future Recommendations

- Carry out bigger control studies to confirm the effect of PNF on frozen shoulder.
- Compare the PNF and the other physiotherapy interventions to establish relative efficacy

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