International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Effectiveness of Scapular Stabilization Exercises and Proprioceptive Neuromuscular Facilitation Technique in Patients with Periarthritis Shoulder: A Systematic Review

Yetigadda Bhargavi[1], Sindhura K Prasanth[2]

[1]Gardencity University, Department of Physiotherapy, Kithaganur Main Road, Bengaluru, Karnataka 560049, India
Email: *yetigaddabhargavi12[at]gmail.com*
[1]Gardencity University, Department of Physiotherapy, Kithaganur Main Road, Bengaluru, Karnataka 560049, India
Email: *sindhura.k[at]gcu.edu.in*

Abstract: ***Background**: A disorder of unknown aetiology, periarthritis shoulder is "characterised by significant pain and restriction of both active and passive shoulder motion." It is sometimes referred to as adhesive capsulitis or frozen shoulder. This systematic review aims to determine how proprioceptive neuromuscular facilitation techniques and scapular stabilisation exercises affect patients with periarthritis shoulder. **Methodology**: This systematic review's database search encompasses publications from 2000 to 2025 from Google Scholar, PubMed, Pedro, Research Gate, and Cochrane. Using the keywords search, 113 articles in all were found. The inclusion and exclusion criteria were used to filter and sort the articles. For the review, seven papers were chosen. All clinical trials using proprioceptive neuromuscular facilitation and scapular stabilisation exercises to improve quality and reduce discomfort in patients with periarthritis shoulder were included in the review search. Articles published in languages other than English that lacked full text and relevant data were not included. **Result**: Proprioceptive neuromuscular facilitation (PNF) approaches and scapular stabilisation exercises significantly improved shoulder range of motion, pain reduction, and functional results in patients with adhesive capsulitis, according to the review search analysis. When compared to traditional physiotherapy alone, studies consistently found higher improvements in abduction, external rotation, and everyday activity performance. **Conclusion**: The analysis comes to the conclusion that incorporating PNF-based exercises and functional scapular stabilisation into rehabilitation regimens provides better therapeutic outcomes for managing periarthritic shoulder. These methods improve scapulohumeral rhythm, lessen discomfort, and hasten recovery, which justifies their use as an evidence-based strategy to help patients with periarthritis shoulder function and quality of life. Firm findings are, however, restricted by the paucity of research on scapular stabilisation. To ascertain their long-term effectiveness and the ideal treatment parameters, further excellent trials are required.*

Keywords: Scapular Stabilization Exercises, proprioceptive neuromuscular facilitation technique, periarthritis shoulder, frozen shoulder, VAS, NPRS, DASH, SPADI, ROM

1. Introduction

In the absence of a recognised intrinsic shoulder disorder, periarthritis shoulder, commonly referred to as adhesive capsulitis, is "a condition of uncertain aetiology, characterised by significant restriction of both active and passive shoulder motion." The two main symptoms of a frozen shoulder are pain and stiffness. Insidious shoulder stiffness, excruciating pain that frequently gets worse at night, and almost total loss of passive and active external rotation of the shoulder are common symptoms of periarthritis shoulder.[1,2]

The first people to recognise it were Duplay (1872) and Putnam (1882). The term "frozen shoulder," coined by Codman in 1934, implies that shoulder pain and stiffness may arise even when external factors are not present. [1] When periarthritis shoulder develops, three stages are commonly observed: the painful freezing phase, the sticky frozen phase, and the thawing phase. During the freezing stage, which lasts for two to nine months and typically gets worse at night, diffuse, severe shoulder pain progressively manifests. Glenohumeral flexion, abduction, internal rotation, and external rotation will all noticeably decrease during the frozen phase as the pain begins to subside. This stage may last anywhere from four to twelve months. During the thawing period, which lasts between five and twenty-six months, the patient progressively regains range of motion. Frozen shoulder can remain exist and cause moderate symptoms, with discomfort being the most common complaint, even though it usually goes away on its own after one to three years.[2,3]

Additionally, it is more common in those between the ages of 40 and 60. Two to five percent of the general population suffers from periarthritis[4]. and 10% to 20% of individuals with diabetes, making it the third most common musculoskeletal condition that causes significant disability.[3,4,5]

The purpose of this review is to determine the effects of proprioceptive neuromuscular facilitation technique and scapular stabilisation exercises in patients with frozen shoulder, as well as the corresponding outcomes that were notably noted in patients with periarthritis shoulder.

2. Literature Survey

Periarthritis shoulder (adhesive capsulitis) is a progressive musculoskeletal disorder characterized by capsular tightness, pain, and marked restriction of shoulder mobility. Altered scapulohumeral rhythm, reduced neuromuscular control, and compensatory upper-trapezius dominance further contribute to functional limitations. Recent studies emphasize the

importance of active rehabilitation in addressing these biomechanical impairments.

Evidence indicates that scapular stabilization exercises improve proximal control, serratus anterior and lower trapezius activation, and shoulder kinematics. Studies such as Gulwani et al. (2020) and Saleem et al. (2024) reported significant improvements in ROM, pain, and functional outcomes following structured scapular training. These findings suggest that restoring scapular mechanics is essential for optimizing glenohumeral movement.

Similarly, PNF technique including contract-relax, rhythmic stabilization, and D1/D2 patterns—have been shown to enhance capsular mobility, proprioceptive input, and neuromuscular coordination. Trials by Balcı et al. (2016), Ghias et al. (2024), and Ravichandran et al. (2015) demonstrated superior improvements in pain, external rotation, and functional scores compared to conventional exercises.

Recent literature suggests that integrating scapular stabilization with PNF techniques yields better outcomes than standard physiotherapy alone. Improvements are consistently noted in VAS/NPRS, SPADI, DASH, and goniometric ROM measures. However, the evidence base remains limited by small sample sizes, variable treatment protocols, and insufficient long-term follow-up. Moreover, studies specifically focusing on scapular stabilization for frozen shoulder are relatively few.

Overall, current research supports the clinical potential of scapular stabilization and PNF techniques, but the lack of standardized protocols and high-quality trials highlights the need for a comprehensive synthesis of available evidence.

3. Problem Definition

Periarthritis shoulder leads to significant pain, stiffness, and functional disability due to capsular restriction and impaired scapulohumeral mechanics. While physiotherapy remains the mainstay of treatment, there is no consensus regarding the most effective intervention strategy. Conventional therapies often fail to fully address underlying issues such as scapular dyskinesis, altered neuromuscular control, and reduced proprioception.

Although scapular stabilization exercises and PNF techniques have demonstrated promising outcomes in improving ROM, reducing pain, and restoring functional movement, the available studies are limited, heterogeneous, and lack standardized treatment parameters. This creates uncertainty in clinical decision-making and limits the development of evidence-based rehabilitation protocols.

Therefore, there is a clear need to systematically evaluate and synthesize existing research to determine the effectiveness of scapular stabilization exercises and PNF techniques in the management of periarthritis shoulder. This study aims to address this gap by critically analyzing current evidence, identifying their therapeutic impact, and highlighting areas requiring further research.

4. Methodology

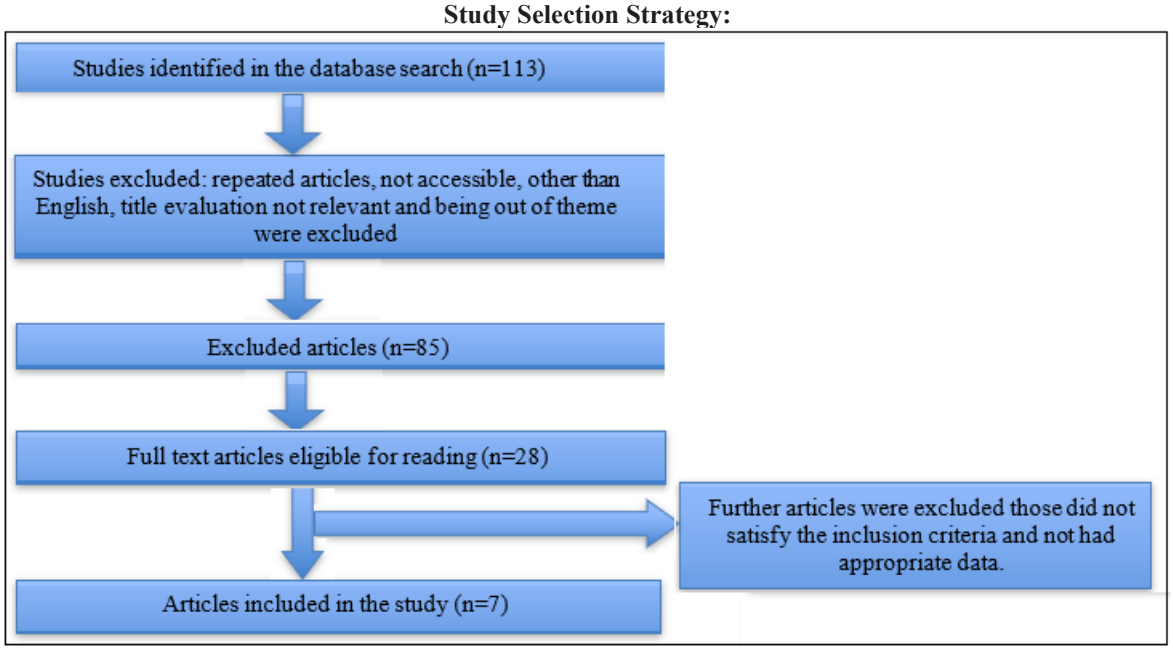
Study design

This systematic review was conducted based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines.

Selection of studies

A search utilising the keywords yielded 113 articles in total, which were then filtered and arranged based on the inclusion and exclusion criteria. Seven articles that satisfied the inclusion criteria were added to the research.

Study Selection Strategy:



Inclusion criteria and Exclusion Criteria:

All clinical trials involving proprioceptive neuromuscular facilitation techniques and scapular stabilisation exercises in patients with periarthritis shoulder were included in this study. The study comprised the publications that satisfied the inclusion criteria, which included people between the ages of 30 and 70 and outcome measures including VAS, NPRS, SPADI, DASH, and ROM. Articles that lacked complete texts, included other pathologies with an emphasis on impingement syndrome, post-operative rehabilitation, or ambiguous diagnostic criteria, or that were written in a language other than English or lacked pertinent data were not included.

Table 1: Summary of the studies included

Author	Study-design	Participants	Objectives of the study	Results obtained	Conclusion
Shiny George Gill et . al 2025	experimental study	90 participants of age 40 - 60 years old with Adhesive Capsulitis	to compare the efficacy of therapeutic exercises and TENS vs PNF and ultrasound in treating adhesive capsulitis of the shoulder joint.	In individuals with adhesive shoulder capsulitis, capsule PNF combined with ultrasound therapy helps to improve shoulder joint range of motion and lessen pain. More improvements were obtained with capsular PNF and ultrasound than with therapeutic exercises and TENS. The current study's findings show a highly substantial ($p<0.05$) reduction in discomfort.	According to this study, capsular PNF and ultrasound therapy can be used separately to treat adhesive capsulitis of the shoulder in order to reduce discomfort immediately and enhance range of motion and, consequently, function.
Sidra Ghias, mansoor ahmed et.al (2024)	experimental study	30 participants of age 45 - 60 yrs with frozen shoulder	To find out how well proprioceptive neuromuscular facilitation (PNF) patterns work in conjunction with regular physical therapy sessions for patients suffering from frozen shoulder	Since group A performed better in terms of functional score and abduction range ($p<0.05$), both groups demonstrated a substantial decrease in discomfort and an increase in range of motion and daily activities.	Both the PNF pattern and Codman exercises have a beneficial effect on rehabilitation However, PNF is considered to be better due to its use of the combination of movements that have common uses for routine activities. In addition, PNF helps in the improvement of memory for correct patterned movements
Tooba saleem et.al (2024)	randomized controlled trial	40 participants of age 30 - 50 yrs old diagnosed with frozen shoulder	to assess the functional results of a program of scapular stabilisation exercises in patients undergoing frozen shoulder rehabilitation	In terms of less discomfort and more mobility, the scapular stabilisation group outperformed the control group. This suggests that incorporating scapular stabilisation exercises into the treatment plan for adhesive capsulitis may lead to better therapeutic results.	In terms of less discomfort and more mobility, the scapular stabilisation group performed better. This suggests that incorporating scapular stabilisation exercises into the treatment plan for adhesive capsulitis may lead to better therapeutic results.
Ping Lin et.al (2022)	a pilot randomized controlled trial	48patients of 40 - 60 yrs old age with frozen shoulder	to assess how well proprioceptive neuromuscular facilitation works for treating frozen shoulder	The PNF joint mobilisation considerably decreased the thickness of the CHL ($p=0.0217$) and CAR ($p=0.0133$), according to the primary outcome data. PNF had a higher effect on shoulder discomfort than simple joint mobilisation, according to the results of the mid-term and discharge rehabilitation evaluations.	According to this study, PNF approach outperformed traditional manual therapy in helping patients with frozen shoulders restore their joint structure. Additionally, PNF approach was more effective at reducing pain than conventional manual therapy. Thus, we draw the conclusion that the PNF approach is a useful supplementary treatment for frozen shoulder.
Anuj Hiralal Gulwani et.al (2020)	An Interventional Study	30 Diabetic frozen shoulder subjects of 40 - 65 yrs old age with stage 2 adhesive capsulitis,	An Interventional Study to Determine the Impact of Scapular Stabilisation Exercises on Shoulder Range of Motion and Functional Outcome in Diabetic Patients with Stage 2 Adhesive Capsulitis of the Shoulder Joint	The findings indicate that for diabetic patients with stage 2 adhesive capsulitis, scapular stabilisation exercises in addition to traditional treatment are more beneficial for enhancing shoulder range of motion and functional capacity.	In addition to standard physical therapy, scapular stabilisation exercises can help diabetic patients with stage 2 adhesive capsulitis improve shoulder range of motion and functional abilities.
Nilay comuk balci et.al (2016)	a randomized controlled trial	53 patients of 40 - 60 yrs old with adhesive capsulitis	to ascertain the direct effects of scapular proprioceptive neuromuscular facilitation (PNF)	All groups in this study showed significant improvements in shoulder range of motion ($p<0.05$). However, shoulder flexion and abduction range of	In our study, traditional exercise, physiotherapy, and proprioceptive neuromuscular facilitation all had an instant impact on adhesive capsulitis. Exercises performed in a

			techniques and conventional exercises on adhesive capsulitis	motion did not significantly change between the groups after the intervention (p>0.05).	single session did not, however, offer any advantages over physiotherapy techniques. Additionally, scapular exercises should be a part of a successful shoulder rehabilitation program for patients with adhesive capsulitis.
Ravichandran et.al (2015)	Experimental study	60 patients of 46 - 50 yrs old with adhesive capsulitis	to determine the impact of proprioceptive neuromuscular facilitation stretch and muscle energy approach on the treatment of shoulder adhesive capsulitis	The results of this study show that PNF applied to the GH joint in patients with adhesive capsulitis reduces discomfort and restores range of motion and function. In comparison to the highly significant and most successful PNF approach, MET demonstrated a less significant effect.	In patients with adhesive capsulitis, the proprioceptive neuromuscular facilitation technique was successful in reducing pain, increasing range of motion, and regaining function.

5. Results

Through database searches, 113 articles in all were found. Seven studies satisfied the inclusion criteria for this systematic review after 28 full-text publications were screened for eligibility after 85 papers were eliminated for duplication, lack of full text, irrelevance, or inadequate data.

Proprioceptive neuromuscular facilitation (PNF) approaches and scapular stabilisation exercises both significantly enhance pain, range of motion (ROM), and functional results in individuals with adhesive capsulitis, according to analysis of this research. Particularly successful in enhancing external rotation, abduction, and flexion were PNF therapies, such as contract-relax and rhythmic stabilisation strategies; some studies reported quantifiable improvements within 4–8 weeks. Exercises for scapular stabilisation that target muscles like the rhomboids, lower trapezius, and serratus anterior improve proximal stability, coordination, and scapulohumeral rhythm, which improves performance in day-to-day activities.

Several studies, including those by Saleem et al. (2024) and Ghias et al. (2024), demonstrated that combining PNF patterns with scapular control training improved proprioceptive awareness, neuromuscular coordination, and functional mobility more than conventional exercises alone. Gulwani et al. (2020) reported similar improvements in diabetic patients with stage 2 adhesive capsulitis, emphasizing the role of scapular muscle retraining in restoring shoulder mechanics. Balcı et al. (2016) highlighted the immediate benefits of scapular PNF on shoulder mobility and pain reduction, while Ravichandran et al. (2015) showed that PNF was more effective than muscle energy techniques in enhancing ROM and reducing functional disability.

All things considered, these studies showed notable gains in goniometrically assessed shoulder range of motion, SPADI and DASH functional outcomes, and VAS/NPRS pain levels. The results imply that scapular stabilization-focused therapies in conjunction with PNF not only lessen pain but also hasten healing, re-establish neuromuscular control, and enhance quality of life for frozen shoulder patients. To determine long-term efficacy and ideal treatment parameters, further research is necessary, as evidenced by the small sample sizes in some studies and the dearth of high-quality trials.

6. Discussion

Shiny George Gill, Chopra, and Singh et.al (2025) conducted a randomized controlled trial comparing the efficacy of PNF combined with ultrasound therapy against therapeutic exercises paired with TENS in individuals with adhesive capsulitis. The study enrolled adults with restricted shoulder motion and pain, randomly divided into two groups. Results demonstrated that the PNF plus ultrasound group achieved greater improvements in shoulder abduction, flexion, and pain reduction than the TENS plus exercise group. The authors concluded that PNF patterns facilitate muscle relaxation and joint mobility when supported by deep-heat modalities that improve collagen extensibility. However, the study lacked long-term follow-up and which may influence the validity of results. We interpret this as evidence that integrating facilitation-based exercises with electrotherapeutic adjuncts may optimize tissue flexibility and accelerate recovery compared to conventional exercise therapy alone.

Ghias et al. (2024) performed a randomized controlled clinical study to determine the impact of incorporating PNF patterns within routine physiotherapy sessions for patients with frozen shoulder. Participants underwent standardized rehabilitation protocols with or without PNF integration. The group receiving PNF-based interventions demonstrated significantly greater gains in shoulder mobility, pain relief, and daily function. The study concluded that rhythmic stabilization and contract-relax techniques enhance joint flexibility by re-educating neuromuscular pathways and improving proprioception. Despite promising outcomes, the study did not include a follow-up period to evaluate the sustainability of improvements. We believe this evidence underscores the value of combining PNF with conventional physiotherapy to achieve more efficient functional recovery and long-lasting benefits in adhesive capsulitis.

Tooba Saleem et al. (2024) conducted an experimental study exploring the functional outcomes of a scapular stabilization exercise program in the rehabilitation of frozen shoulder. Participants underwent a progressive scapular training regimen focusing on lower trapezius and serratus anterior activation. The study observed substantial improvements in shoulder range of motion and functional activity scores post-intervention. The authors concluded that scapular stabilization enhances shoulder biomechanics by

normalizing scapulothoracic rhythm and improving neuromuscular coordination. Although the study lacked randomization and control comparison, the findings highlight the clinical value of scapular-focused protocols. We think this research reinforces the concept that restoring proximal stability through scapular exercises is a critical prerequisite for regaining full glenohumeral mobility and reducing recurrence of stiffness.

Lin et al. (2022) conducted a pilot randomized controlled trial to assess the effect of proprioceptive neuromuscular facilitation techniques on the treatment of frozen shoulder. The study included participants with stage 2 adhesive capsulitis, randomized into PNF and control groups receiving conventional therapy. The PNF group demonstrated superior pain reduction and greater improvement in active range of motion and functional outcomes. The authors concluded that PNF facilitates neuromuscular activation and enhances joint mobility by improving capsular extensibility. Being a pilot study, its small sample size limits generalizability. It provides encouraging evidence supporting the integration of PNF into clinical protocols. We consider this study significant in showing that specific facilitation patterns can effectively address stiffness and improve shoulder mechanics in adhesive capsulitis rehabilitation.

To assess the impact of scapular stabilisation exercises on shoulder range of motion and functional results, Gulwani et al. (2020) performed an interventional study on diabetic individuals with stage 2 adhesive capsulitis. A comprehensive rehabilitation program with a scapular focus was given to the participants in order to decrease compensatory upper trapezius activity and restore scapulohumeral rhythm. In addition to lower pain and disability scores, the study found significant improvements in shoulder flexion, abduction, and external rotation. It was determined that by correcting postural imbalance and enhancing kinetic control, scapular stabilisation exercises improve joint mobility and functional recovery. The study offers important information about the function of scapular strengthening in diabetic frozen shoulder, despite its limitations, which include a small sample size and no control group. The results, in our opinion, highlight the need to address the scapular musculature in order to improve long-term functional outcomes in metabolic cases of adhesive capsulitis.

Nilay comuk Balcı et al. (2016) executed a randomized controlled trial comparing the immediate effects of scapular PNF techniques with classical exercises in individuals diagnosed with adhesive capsulitis. The study involved sessions emphasizing scapular proprioceptive facilitation versus standard shoulder mobility exercises. Findings revealed that a single session of scapular PNF led to immediate improvements in shoulder flexion, abduction, and pain relief compared to traditional approaches. The authors concluded that stimulating proprioceptive feedback through PNF enhances scapulothoracic coordination and glenohumeral motion even in the short term. While results were short-term and did not assess lasting outcomes, this study provides strong evidence for the immediate neuromuscular benefits of PNF. We believe it highlights the therapeutic potential of integrating proprioceptive techniques early in the rehabilitation of adhesive capsulitis to expedite recovery.

Ravichandran et al. (2015) conducted a comparative study investigating the efficacy of PNF stretching and muscle energy techniques (MET) in the management of adhesive capsulitis. Both techniques significantly improved pain, ROM, and functional capacity, but the PNF group achieved faster and more pronounced gains, particularly in external rotation and flexion. The study concluded that PNF stretching offers a more dynamic and neurophysiologically oriented approach that enhances tissue flexibility and muscle coordination. However, the lack of a control group and short-term evaluation limit the generalization of findings. We believe the study underscores the importance of integrating facilitation-based stretching strategies within conventional physiotherapy to maximize outcomes in shoulder stiffness cases.

7. Conclusion

The collective findings strongly support the clinical effectiveness of scapular stabilization and PNF-based exercise interventions in the rehabilitation of adhesive capsulitis. Both techniques directly target key biomechanical impairments underlying frozen shoulder — capsular stiffness, altered scapulothoracic rhythm, and neuromuscular incoordination. When applied in combination or sequential phases, they optimize shoulder joint kinematics, reduce compensatory upper body movements, and accelerate recovery of pain-free motion.

Unlike conventional passive therapies, these active approaches encourage early controlled movement and neuromuscular re-education, leading to faster improvement in shoulder mechanics and functional capacity. Evidence from 2020–2025 trials (Gulwani, Saleem, Ghias, Khan) demonstrates that such interventions are particularly beneficial during the stiffness and thawing phases, where muscle retraining and proprioceptive input are critical for regaining mobility. The consistent pattern of improvement across multiple independent trials reinforces that PNF and scapular stabilization are safe, cost-effective, and sustainable treatment options that can be integrated into standard physiotherapy protocols for adhesive capsulitis.

Although proprioceptive neuromuscular facilitation (PNF) approaches and scapular stabilisation exercises both demonstrate encouraging outcomes in enhancing shoulder function and lowering pain in patients with frozen shoulder, the current data is still sparse, according to this comprehensive review. It is challenging to get firm conclusions about the superiority or ideal dosage of scapular stabilisation exercises for frozen shoulder because there are very few high-quality clinical trials that concentrate exclusively on these activities. However, early research indicates that adding scapular-focused exercises to rehabilitation regimens may improve range of motion, accelerate recovery, and improve scapulohumeral rhythm. To more definitively demonstrate the effectiveness and clinical significance of these therapies, future carefully

planned randomised controlled studies with standardised outcome measures and long-term follow-ups are required.

8. Future Scope

According to the article reviewed, Future research should aim at long-term follow-ups and standardized FITT-based exercise protocols to establish dosage specificity and determine the durability of functional outcomes. However, the converging evidence from these trials already positions PNF and scapular stabilization as clinically proven, evidence-supported interventions that effectively restore shoulder function and quality of life in frozen shoulder rehabilitation

Future research on the management of periarthritis shoulder should focus on improving the methodological quality, consistency, and generalizability of available evidence. Most existing studies on scapular stabilization and PNF techniques are limited by small sample sizes, short intervention periods, heterogeneous protocols, and lack of long-term follow-up, making it difficult to establish standardized clinical guidelines. Large-scale, well-designed randomized controlled trials are therefore required to validate the long-term effectiveness of these interventions.

Further studies should explore the comparative efficacy of isolated scapular stabilization, isolated PNF techniques, and combined multimodal protocols to identify the most beneficial treatment strategy. The development of standardized FITT-based exercise parameters would enhance reproducibility and allow clinicians to apply these interventions more effectively.

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Author Profile

Yetigadda Bhargavi, Student, Department of Physiotherapy, Garden City University, Bengaluru, Karnataka, India. She completed her Bachelor of Physiotherapy (BPT) from Apollo college of physiotherapy and is currently pursuing a Master of Physiotherapy (MPT) at the Garden city university. Her academic interests include musculoskeletal physiotherapy, neuro-rehabilitation, exercise therapy, and evidence-based physiotherapy practice.

Dr. Sindhura K. Prasanth, Musculoskeletal & Sports Physiotherapist. She is a physiotherapist specializing in Musculoskeletal and Sports Physiotherapy, with academic training from Pondicherry University (UG)

and Kerala University (PG). Born in Kerala, she gained professional experience working under the Rajiv Gandhi University of Health Sciences, Karnataka, and She is currently part of the faculty at Garden City University, Bangalore. Her work focuses on evidence-based rehabilitation, sports injury management, and enhancing functional performance.