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Fluoroscopy-guided suprascapular and subscapular articular nerve blocks for chronic shoulder pain: A 12-week observational study

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ABSTRACT

Introduction: Chronic shoulder pain is a common musculoskeletal complaint. This study evaluates the effectiveness of fluoroscopy-guided suprascapular (SSN) and subscapular (SCN) articular branch blocks in managing chronic shoulder pain. The primary objective was to assess pain relief using a numerical rating scale (NRS) and functional improvement using Shoulder Pain and Disability Index (SPADI) over 12 weeks.

Methods: This prospective, single-arm observational study included 70 adults with chronic shoulder pain (≥3 months) meeting predefined criteria. All patients underwent fluoroscopy-guided SSN and SCN articular branch blocks with bupivacaine (2 ml, 0.5 %) and triamcinolone (0.5 ml, 20 mg) per site. NRS and SPADI were recorded at baseline and biweekly for 12 weeks. Secondary outcomes included range of motion (ROM) improvements and night pain resolution. Statistical analysis involved repeated measures ANOVA for normally distributed data and non-parametric tests for skewed data ($p < 0.05$ considered significant).

Results: At 12 weeks, 78 % of patients achieved ≥50 % pain reduction. Mean NRS decreased from 7.6 ± 1.1 to 3.9 ± 1.1, while SPADI pain and disability scores improved by 57.1 % and 57.4 %, respectively ($p < 0.001$). Night pain resolved in all affected patients within two weeks. Repeated measures ANOVA confirmed significant improvements in pain and disability scores ($p < 0.001$). Mean lateral abduction improved by 29° (95 % CI: 22.8°–35.2°, $p < 0.001$).

Conclusion: Fluoroscopy-guided SSN and SCN articular branch blocks provide significant pain relief and functional improvement in chronic shoulder pain, offering a potential alternative to intra-articular injections or surgery in select patients.

1. Introduction

Chronic shoulder pain is a prevalent condition, affecting approximately 16 % of the population, making it the third most common musculoskeletal complaint. The annual incidence is around 37.8 per 1000 individuals with women being more affected than men [1,2]. A variety of treatment modalities, including physiotherapy, medications, intra-articular steroid injections, and nerve blocks are used for management [3].

The shoulder joint receives complex innervation from the suprascapular (SSN), subscapular (SCN), axillary (AN), and lateral pectoral (LPN) nerves. Of these, the SSN and SCN play dominant roles in transmitting nociceptive signals from the glenohumeral joint. The highest density of nociceptors is concentrated in an arc from the 10–2 o'clock position, corresponding to areas primarily innervated by the SSN and SCN [4,5].

Unlike traditional SSN blocks performed at the suprascapular notch, targeting the articular branches of the SSN and SCN may provide selective pain relief while preserving motor function, making it a promising approach for chronic shoulder pain [5]. Traditional SSN blocks at the suprascapular notch under ultrasound carry risks of vascular injury and inadvertent motor blockade. Fluoroscopy allows for more accurate needle placement at the glenoid rim, minimizing these risks and optimizing drug delivery to the primary nociceptive regions. Additionally,

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this approach facilitates reproducibility, particularly in patients with altered anatomy or limited ultrasound window [6–8].

We hypothesized that fluoroscopy-guided SSN and SCN articular branch blocks will provide significant pain relief and functional improvement in patients with chronic shoulder pain.

The primary objective of this study was to evaluate reductions in pain using Numerical Rating Scale (NRS) and disability with Shoulder Pain and Disability Index (SPADI) over 12 weeks. Secondary objectives included assessing improvements in range of motion (ROM) and the resolution of night pain.

2. Methods

This prospective, single-arm observational study was conducted at a tertiary care teaching hospital. The study was conducted over 18 months (September 2022 to March 2024). Ethical approval was obtained from the Institutional Ethics Committee (IHEC-PGR/2022/PG/Jan/05). The first patient was enrolled on September 22, 2022. Given that this was a non-randomized, single-arm study focusing on an established intervention, clinical trial registration was not required per the Indian Clinical Trial Registry protocol.

Participants included adults aged 18 years or older with chronic shoulder pain persisting for at least three months due to adhesive capsulitis, rotator cuff tendinopathy, or mild/moderate osteoarthritis, refractory to conservative treatments such as physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), or intra-articular steroid injections. Eligible patients had a baseline Numerical Rating Scale (NRS) pain score of 6 or higher out of 10. Exclusion criteria included patients with glenohumeral joint instability, full-thickness rotator cuff tears, inflammatory arthritis (rheumatoid arthritis, lupus, or ankylosing spondylitis) affecting the shoulder, post-surgical shoulder pain, non-consenting individuals, and pregnant patients. Patients with uncontrolled hypertension (blood pressure >160/100 mmHg) or uncontrolled diabetes (HbA1c >8.5 %) were also excluded. Additional exclusion criteria comprised neurological or cognitive impairments that could interfere with pain perception or reporting, bilateral shoulder pain to minimize confounding pain sources, and a history of recent trauma within the past three months affecting the shoulder.

All patients provided written informed consent, and demographic data—including NRS, SPADI, and ROM. The ROM was collected using a standardized goniometer. ROM measurements were recorded for abduction, flexion, and external rotation, which are essential for functional shoulder mobility. Based on established criteria, a critical ROM threshold of 90° for abduction, 90° for flexion, and 70° for external rotation is required for performing daily activities [9]. All data collection, including ROM assessment, was conducted by an independent assessor.

All procedures were performed in the operation theatre under strict aseptic precautions. Patients were positioned in a supine decubitus position. A portable C-arm (Canon Electron Tubes and Devices Co. Ltd, Japan, model E5830SD-P7A) was used to obtain fluoroscopic images.

The main fluoroscopic view while performing the SSN and SCN block was true AP view also called as the Grashey's view (Fig. 1A and B). For the SSN, the needle was inserted at the midpoint between the suprascapular notch and the spinoglenoid notch, targeting the 12 o'clock position of the glenoid (Y-view) (Fig. 1C and D). For the SCN, the needle was advanced to the middle third of the glenoid margin, approximately 1–1.5 cm medial to the lateral glenoid edge (Fig. 1C) [8]. Contrast (0.5–1 ml) was injected to confirm appropriate spread under fluoroscopy (Figs. 1D and 2). Medication injection: 2 ml of 0.5 % Bupivacaine +0.5 ml Triamcinolone (40 mg/ml) was injected at each site. Patients were observed for 30 min for adverse reactions and were discharged with paracetamol for analgesia and NSAIDs as needed.

Patients were followed up fortnightly for 12 weeks, with assessments conducted at 2, 4, 6, 8, 10, and 12 weeks post-procedure. At each follow-up visit, NRS, SPADI, and ROM were systematically evaluated. For recording the SPADI the patients were asked to simulate the action as described in scoring. All clinical outcomes were assessed by an independent, trained evaluator using standardized protocols to ensure reliability and minimize bias.

2.1. Sample size calculation

The sample size was calculated using *G* Power 3.1 software based on data from Lee et al. [8], where the mean pre-procedure Visual Analog Scale (VAS) score was 72 ± 21. Assuming a clinically meaningful pain reduction of ≥20 % over 12 weeks, with a power of 80 % and a significance level of 0.05, the required sample size was calculated as 64 patients. Accounting for a 10 % dropout rate, the final sample size was set at 70 patients.

3. Statistics

Data was analysed using SPSS version 27 (IBM, Chicago, IL, USA). Normality was assessed using the Kolmogorov-Smirnov test. Parametric tests (Independent *t*-test, paired *t*-test, repeated measures ANOVA) were used for normally distributed data. Greenhouse-Geisser correction was applied where sphericity was violated. Non-parametric tests (Mann-Whitney *U* test, Wilcoxon signed-rank test, Friedman test) were used for skewed data. Categorical data were analysed using the Chi-square test or Fisher's exact test as appropriate.

4. Results

A total of 86 patients were screened, of whom 70 met the eligibility criteria and were enrolled in the study (Fig. 3). The remaining 16 patients were excluded due to the following reasons: 7 had bilateral shoulder pain, 4 had uncontrolled diabetes/hypertension, 3 had recent shoulder trauma, and 2 had cognitive impairments affecting pain assessment. All 70 enrolled patients completed the 12-week follow-up, with no loss to follow-up, ensuring complete dataset analysis.

The study cohorts (N = 70) baseline characters are represented in Table 1. No significant differences in baseline characteristics were observed between male and female participants ($p = 0.42$) or between diabetic and non-diabetic subgroups ($p = 0.55$). Normality testing using the Kolmogorov-Smirnov test confirmed that baseline data were normally distributed.

At 12 weeks, patients demonstrated a statistically significant reduction in pain and disability scores: NRS scores decreased by 48 %, from 7.6 ± 1.1 to 3.9 ± 1.1 ($p < 0.001$, Cohen's $d = 2.5$). SPADI pain scores improved by 57.1 %, from 74.4 % to 31.9 % ($p < 0.001$, Cohen's $d = 2.7$). SPADI disability scores decreased by 57.4 %, from 73.03 % to 31.1 % ($p < 0.001$, Cohen's $d = 2.6$) (Table 2). The distribution of SPADI pain and disability score is depicted in Table 3. A clinically meaningful reduction (≥50 %) in NRS was achieved by 78 % of patients at 12 weeks.

Repeated measures ANOVA showed significant reductions in NRS, SPADI pain, and SPADI disability scores over the study duration (Table 4). Since the assumption of sphericity was violated, a Greenhouse-Geisser correction was applied. The effect size for these repeated measures analyses was reported using partial eta-squared (ηp2), with values of ηp2 = 0.72 for NRS, 0.81 for SPADI pain, and 0.85 for SPADI disability, indicating large effect sizes.

ROM significantly improved over 12 weeks (Table 5). At baseline, 47.1 % of patients (33/70) reported night cries; by week 2, all affected patients experienced complete resolution ($p < 0.001$). No major complications, infections, or adverse effects were observed throughout the study duration.

Subgroup analysis revealed no significant differences in pain relief or functional improvement based on: Gender (Male vs. Female, $p = 0.28$) Symptom duration (<12 months vs. >12 months, $p = 0.34$) Diabetes status (Diabetic vs. Non-Diabetic, $p = 0.40$). However, men demonstrated a slightly lower likelihood of achieving a ≥50 % reduction in

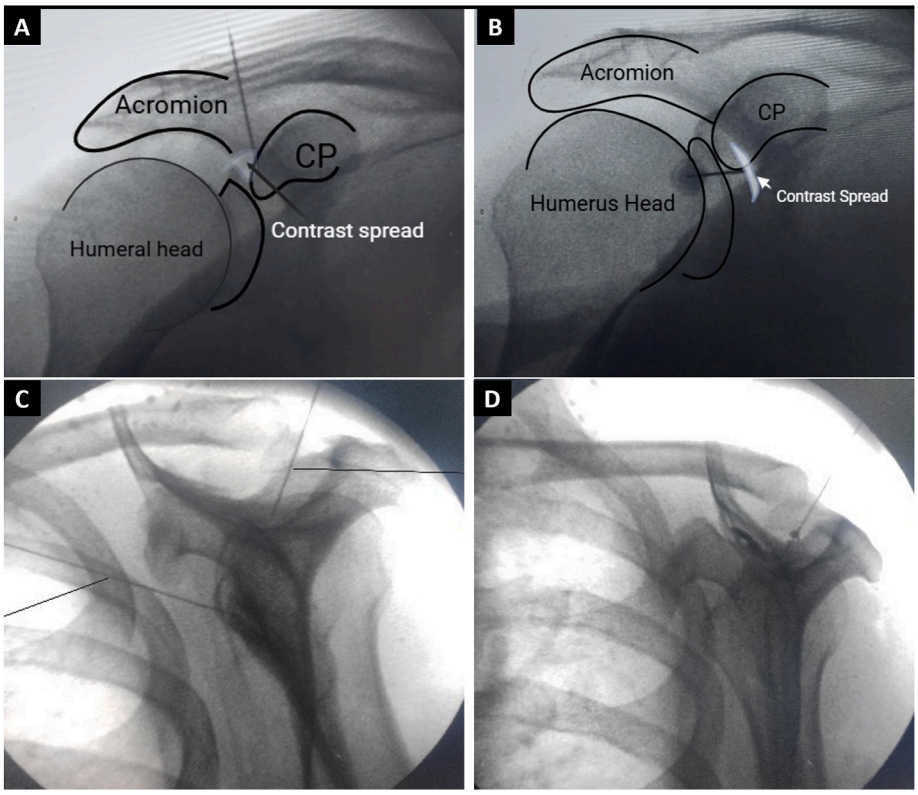

Fig. 3. Fluoroscopic images of the suprascapular and subscapular nerve blocks. Figure 1A and B showing true anteroposterior (Grashey's) view with marked bony landmarks. Figure 1A: Needle position for suprascapular nerve block with desired region of contrast spread. Figure 1B: Needle position for subscapular nerve block with desired region of contrast spread. Figure 1C and D showing Y-view of shoulder joint. Figure 1C: Showing both the needle tip in suprascapular fossa at the top of glenoid and subscapular nerve region, in the lateral view. Figure 1D: Showing the needle in suprascapular fossa with contrast spread. CP; Coracoid process.

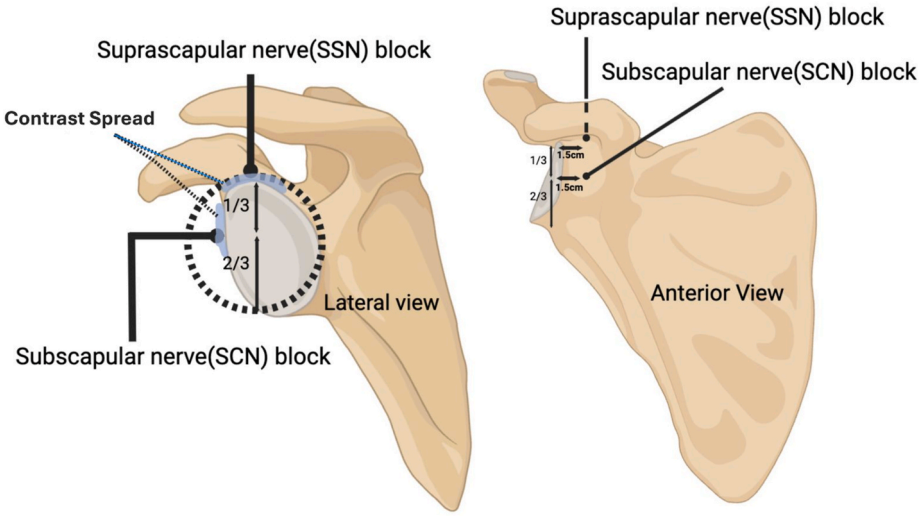

Fig. 1. Illustration showing the anterior and lateral view of the scapula with final needle positions required for suprascapular and subscapular articular branch block with desired contrast spread.

pain (OR = 0.76, 95 % CI: 0.54–0.98, p = 0.028).

The overall model fit was evaluated using the pseudo-R^2 value (0.1795), indicating that the model explains approximately 18 % of the variability in pain reduction outcomes. The log-likelihood ratio test (p = 0.1601) suggests that the model, as a whole, was not statistically significant, limiting its predictive strength. This indicates that additional factors—such as psychosocial influences, adherence to rehabilitation, or differences in pain processing—may play a role in determining outcomes.

Among the independent variables, gender was the only statistically significant predictor (p = 0.028). The negative coefficient (−1.5474) suggests that males were less likely to achieve significant pain relief compared to females (Table 6). The odds of a male achieving a ≥50 % reduction in pain were OR = 0.76 (95 % CI: 0.54–0.98), indicating a 24 % lower likelihood compared to females. This may be due to differences in pain perception, hormonal influences, or post-procedure adherence.

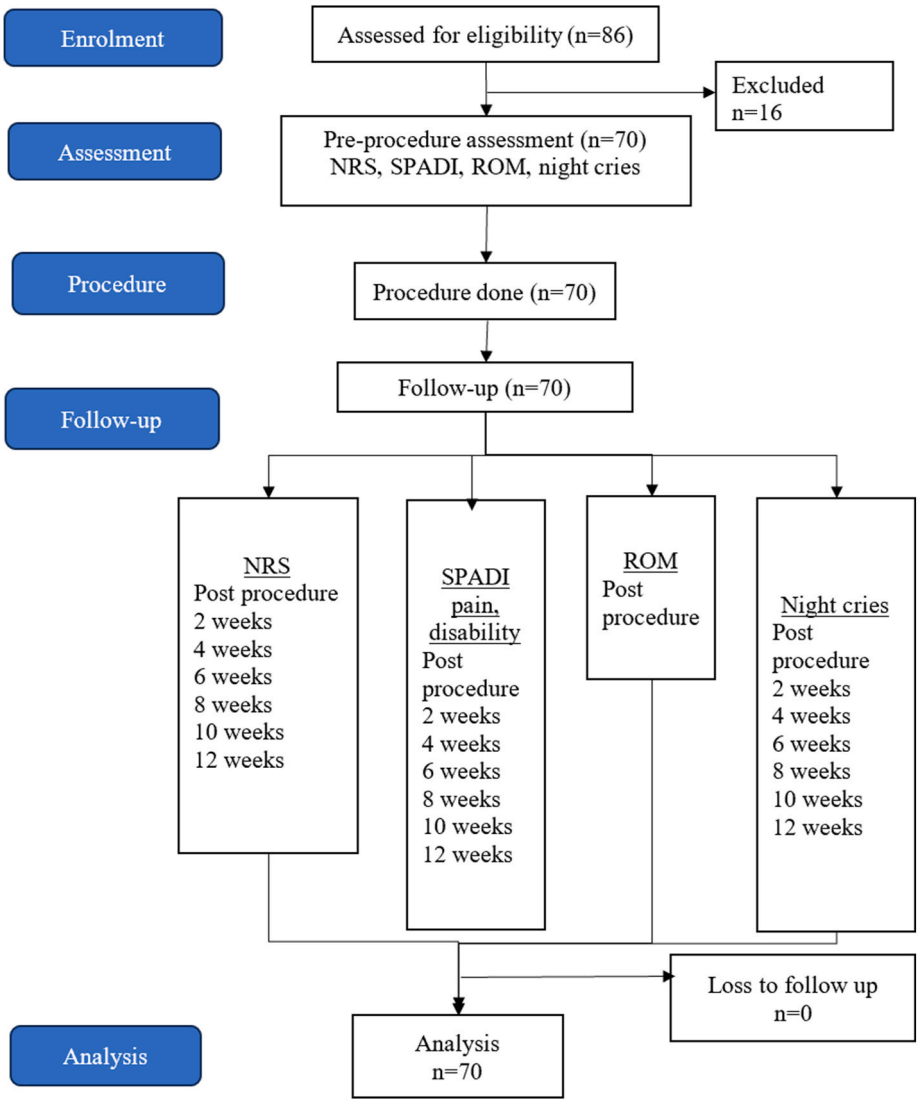

Fig. 2. STROBE flow diagram illustrating enrolment, assessment, procedure, follow-up and analysis of participants in the study. NRS - Numerical Rating Scale, SPADI - Shoulder Pain and Disability Index, ROM - Range of Motion.

Table 1
Showing Demographic and baseline data in the studied cohort.

Parameter	Mean ± SD (N = 70)	Range
Mean age (in years)	47.7 ± 11.4	32–80
Duration of pain (in months)	11.25 ± 4.27	7–24
Male: Female	60 % (42/70): 40 % (28/70)	
Patients having Diabetes Mellitus (%)	37 % (26/70)	
Pre-procedure NRS	7.56 ± 1.01	6–9
Pre-procedure SPADI pain score (%)	74.4 ± 3.90	68–88
Pre-procedure SPADI disability score (%)	73.03 ± 4.65	65–82.5
Active Range of motion: Abduction (degree)	89.2 ± 22.8	40–110
Passive Range of motion: Abduction (degree)	103.85 ± 20.8	60–120
Patients with night cries (%)	47.1 % (33/70)	
ROM abnormality (Abduction: External rotation: Forward flexion)	29:9:32	

Other independent variables—including age, symptom duration, diabetes, and baseline pain/disability scores—were not significant predictors. Notably, symptom chronicity and diabetes were expected to impact pain relief but did not reach statistical significance, suggesting that the intervention may be effective across a wide range of patient profiles, regardless of comorbidities or chronicity.

Table 2
NRS, SPADI pain and SPADI disability, pre-procedure and during post procedure follow ups.

Time	NRS	SPADI pain (%)	SPADI disability (%)
Baseline	7.6 ± 1.1	74 ± 3.9	73.03 ± 4.65
Post-procedure	3.1 ± 0.9	33.2 ± 5.1	37.4 ± 3.4
2 weeks	4.0 ± 1.0	32.1 ± 4.1	31.7 ± 3.6
4 weeks	3.9 ± 0.8	33.2 ± 3.9	31.4 ± 3.7
6 weeks	4.1 ± 0.7	33.1 ± 3.9	31.7 ± 3.6
8 weeks	4.1 ± 1.1	32.9 ± 4.1	31.6 ± 3.6
10 weeks	4.1 ± 0.9	31.9 ± 5.1	31.4 ± 3.6
12 weeks	3.9 ± 1.1	31.9 ± 4.2	31.1 ± 3.5

NRS; Numerical Rating Scale, SPADI; Shoulder Pain and Disability Index.

5. Discussion

Chronic shoulder pain remains a challenging condition to treat, particularly in patients unresponsive to conservative management. Our study demonstrates that fluoroscopy-guided articular branches of SSN and SCN blocks provide significant pain relief, functional improvement and gain in ROM in patients with chronic shoulder pain. Over 12 weeks, patients experienced a 48 % reduction in NRS scores (Cohen's d = 3.36)

Table 3
Table showing the distribution of SPADI Pain and Disability score during the study duration.

Pain/Disability score	0-10 (%)	11-20 (%)	21-30 (%)	31-40 (%)	41-50 (%)	51-60 (%)	61-70 (%)	71-80 (%)	81-90 (%)	91-100 (%)
Pre procedure	0/0	0/0	0/0	0/0	0/0	0/0	18.5/27.3	74.3/60	7.2/12.8	0/0
Post procedure	0/0	0/1.4	38.5/51.4	54.2/47.2	7.2/0	0/0	0/0	0/0	0/0	0/0
2 weeks	0/0	0/28.6	47.2/71.4	50/0	2.8/0	0/0	0/0	0/0	0/0	0/0
4 weeks	0/0	0/32.9	42.9/67.1	51.4/0	5.7/0	0/0	0/0	0/0	0/0	0/0
6 weeks	0/0	0/28.6	37.2/71.4	57.2/0	5.6/0	0/0	0/0	0/0	0/0	0/0
8 weeks	0/0	0/28.6	37.2/71.4	55.7/0	7.1/0	0/0	0/0	0/0	0/0	0/0
10 weeks	0/0	0/31.4	50/68.6	42.8/0	7.2/0	0/0	0/0	0/0	0/0	0/0
12 weeks	0/0	0/32.9	52.9/67.1	42.9/0	4.2/0	0/0	0/0	0/0	0/0	0/0

SPADI; Shoulder Pain and Disability Index.

Table 4
Table showing Repeated measures ANOVA analysis for NRS and SPADI scores.

Parameter	Sphericity value	df	Correction applied	F-value	P-value
Within subjects NRS	0.003	5.7	GG	180.0	<0.001*
Within subjects SPADI pain	0.049	5.9	GG	898.2	<0.001*
Within subjects SPADI disability	<0.001	5.4	GG	1032.28	<0.001*

*Indicates P value is significant.
GG; Greenhouse-Geisser correction, NRS; Numerical Rating Scale, SPADI; Shoulder Pain and Disability Index.

and a 57 % improvement in SPADI scores, with 78 % of patients achieving a ≥50 % pain reduction. ROM significantly improved, particularly in lateral abduction ($\eta p^2 = 0.72$). These findings support the use of SSN and SCN articular branch blocks as a safe, effective intervention, particularly for patients with adhesive capsulitis or chronic post-traumatic shoulder pain, where conventional treatments often provide suboptimal relief.

Our study differs significantly from the study by Lee et al. [8], which also examined SSN and SCN blocks in chronic shoulder pain. Notably, our sample size was larger, cohort was younger and had higher baseline NRS and disability scores. Compared to the 30 % reduction in pain and disability reported by Lee et al. [8], our study demonstrated a 65 % reduction, with significant improvements persisting at the 12-week follow-up. This faster and greater improvement may be attributed to our use of a depot steroid preparation (Triamcinolone acetate), which remains at the injection site longer than the aqueous solution used in the previous study, potentially prolonging pain relief and improving adherence to physical therapy.

A key methodological difference is that Lee et al. [8], grouped patients based on immediate post-procedure response to predict long-term outcomes. In contrast, our findings suggest that final pain and disability scores were comparable regardless of early post-procedure improvement. Needle soreness may transiently mask the immediate effects of nerve blocks, explaining why patients with less than 50 % early relief still showed substantial improvement at 12 weeks.Despite these differences, both studies confirm that targeting the articular branches of SSN and SCN leads to sustained pain relief, reinforcing this technique as a viable alternative to intra-articular steroid injections.

A particularly noteworthy finding was the complete resolution of night pain within 2 weeks. This suggests that a combination of localized steroid action and early physical therapy plays a crucial role in optimizing pain relief outcomes.

In a recent work by Pulgarin et al. [10] reinforced the benefits of articular branch blocks over traditional blocks. Their study found that blocking the articular branches of SSN and AN provided superior pain relief while preserving motor function, a key advantage for functional rehabilitation. Our findings corroborate this, suggesting that articular branch-specific targeting is crucial for optimizing analgesic efficacy while minimizing side effects.

While our study confirms the efficacy of corticosteroid-based articular branch blocks, the growing body of evidence on RFA techniques suggests that neuroablative approaches may provide longer-lasting relief. Saikumar et al., [11] demonstrate that RFA of SSN and SCN is already in use, but primarily targets the main nerve trunks rather than their articular branches. This distinction is critical because ablating the articular branches specifically may further optimize pain relief while preserving overall nerve function.

Burnham et al. [12] proposed that radiofrequency ablation (RFA) of the articular branches of SSN, SCN, AN, and LPN may provide sustained relief in rotator cuff pathology and osteoarthritis. However, direct clinical trials evaluating this approach are currently lacking, and targeting multiple articular branches remains technically complex. The risk of vascular injury must also be carefully considered in future investigations.

Despite the overall efficacy, our predictive model had limited explanatory power, accounting for only 18 % of the variability in pain

Table 6
Logistic regression analysis results for predicting a 50 % reduction in pain score.

Variable	Coefficient	P-value	95 % CI Lower Bound	95 % CI Upper Bound
Intercept	−6.1174	0.537	−25.525	13.291
Age (years)	−0.0128	0.731	−0.086	0.06
Sex	−1.5474	0.028*	−2.924	−0.171
Duration (months)	−0.0114	0.89	−0.174	0.151
Diabetes	−0.3729	0.64	−1.934	1.188

*Significant ($p < 0.05$).
CI; Confidence interval.

Table 5
Restriction of mobility in comparison to the minimum required range of motion.

Parameter	Pre-procedure restriction	Post-Procedure restriction	Restriction at 12 weeks	F-value for ANOVA	dF	P-value	Cohen's effect size
Lateral Abduction (90°-actual ROM)	41° ± 20.58°	31.3° ± 24.7°	12.0° ± 19.7°	21.38	207	<0.0001*	1.46
Forward Flexion (90°-actual ROM)	−3.1°±-21.7°	−7.58°±-24.5°	−31.0°±-19.1°	41.1	207	<0.001*	1.36
External Rotation (70°-actual ROM)	−2.2°±-29.48°	−12.2°±-26.4°	−18.9°±-16.1°	3.3	207	0.06	0.7

reduction outcomes (pseudo-$R^2 = 0.1795$). The lack of statistical significance for symptom duration, diabetes, and baseline pain levels was unexpected, suggesting that fluoroscopy-guided articular branch blocks provide pain relief across a wide range of patient profiles, independent of comorbidities.

Among the variables analysed, only gender significantly influenced pain relief outcomes, with males being 24 % less likely than females to achieve ≥50 % pain reduction (OR = 0.76, 95 % CI: 0.54–0.98). While the exact mechanism is unclear, potential contributors include hormonal influences, differences in pain perception, and variations in adherence to post-procedural rehabilitation. Further research is needed to determine whether sex-specific rehabilitation strategies could optimize outcomes in male patients.

Given the significant pain reduction and functional improvement, fluoroscopy-guided SSN and SCN articular branch blocks should be considered a primary intervention for chronic shoulder pain, particularly in patients with adhesive capsulitis, post-traumatic shoulder pain, or refractory cases where intra-articular steroid injections have failed. Unlike intra-articular injections, which provide temporary relief (typically 4–6 weeks), articular branch blocks appear to have a longer duration of effect (≥12 weeks) and target peripheral nociceptive inputs more directly. Furthermore, the safety profile in our study was excellent, with no major complications reported, reinforcing its feasibility in clinical practice.

5.1. Study limitations

Despite the promising results, several limitations should be acknowledged.

1. Single-arm study design – Without a control group (e.g., placebo or alternative treatment), the observed pain reduction may partly be due to the placebo effect. Future randomized controlled trials (RCTs) are needed to validate these findings.
2. Limited follow-up duration – While our study confirms sustained relief for 12 weeks, a longer-term follow-up of at least 6 months would provide greater insight into treatment durability.
3. Predictive model limitations – Logistic regression analysis showed that gender was the only significant predictor, but the overall model fit was weak (pseudo-$R^2 = 0.0482$). Future studies should explore additional predictors (e.g., psychosocial factors, physical therapy adherence, etc).
4. Generalizability – Our findings may not be generalizable to different populations, settings, or ethnic groups, as the study was conducted at a single tertiary care center.

Addressing these limitations in future research will help establish optimal patient selection criteria and refine treatment protocols for fluoroscopy-guided articular branch blocks. Future studies should assess whether fluoroscopy or ultrasound guided articular branch blocks provide sustained pain relief beyond 12 weeks or require repeated interventions for long-term efficacy. Additionally, further research is needed to determine whether articular branch-specific RFA offers a longer-lasting alternative to corticosteroid-based blocks, while maintaining safety and minimizing motor deficits.

6. Conclusions

Fluoroscopy guided articular branch block of suprascapular, subscapular nerves is an effective treatment modality for chronic shoulder pain for middle aged patients. Patients reported significant improvement in pain, disability and range of motion after the procedure. The procedure is safe and well tolerated by the patients.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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