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Correspondence
✉ Sarwat Mehmood,
sarwatmehmood1@gmail.com

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Effect of Gongs Mobilization with Neuromuscular Electrical Stimulation vs Shockwave Therapy Among Patients with Rotator Cuff Tendinopathy

Sarwat Mehmood[1], Qurrat Ul Ain[2], Anum Saeed[3], Ayesha Malik[4], Areesha Anwar[5], Sundus Riaz[6], Syeda Warisha Shakil[6], Hafiza Mufaz ul Swaba Zanjani[7]

[1] Faisal Hospital, Faisalabad, Pakistan
[2] Independent Researcher, Pakistan
[3] Masters in Global Public Health From Canterbury Christ Church University
[4] University of Management and Technology (UMT), Lahore, Pakistan
[5] Dow Institute of Physical Medicine & Rehabilitation (DIPMR), Dow University of Health Sciences (DUHS), Karachi, Pakistan
[6] Noor Care Clinic, Pakistan
[7] The University of Lahore, Lahore, Pakistan

ABSTRACT

Background: Rotator cuff tendinopathy is a common cause of shoulder pain and functional limitation, and optimal conservative management remains debated. Gong's mobilization combined with neuromuscular electrical stimulation (NMES) and extracorporeal shockwave therapy (ESWT) are used clinically, but comparative evidence is limited. Objective: To compare the effectiveness of Gong's mobilization + NMES versus ESWT in reducing pain and improving disability and shoulder range of motion (ROM) in patients with chronic rotator cuff tendinopathy. Methods: A randomized controlled trial enrolled 60 participants (35–65 years) with ultrasound-confirmed rotator cuff tendinopathy (>3 months). Participants were randomized to Gong's mobilization + NMES (10 minutes mobilization plus 15 minutes NMES, 35–50 Hz, three sessions weekly) or ESWT (2000 shocks/session at 0.18 mJ/mm², weekly) for eight weeks. Outcomes were assessed at baseline, Week 4, and Week 8 using VAS (primary endpoint: Week 8), SPADI, and goniometric ROM. Results: Both groups improved significantly over time. At Week 8, pain was lower in the Gong's mobilization + NMES group than ESWT (VAS 2.5 ± 0.8 vs 3.8 ± 1.0; p = 0.002). ROM gains favored Gong's mobilization + NMES for flexion (152° ± 10 vs 140° ± 12; p = 0.004), abduction (148° ± 11 vs 138° ± 13; p = 0.009), and external rotation (66° ± 7 vs 60° ± 8; p = 0.010), while SPADI improvement was comparable (30.4 ± 6.5 vs 33.8 ± 7.0; p = 0.15). Conclusion: Both interventions were effective, but Gong's mobilization + NMES produced superior pain reduction and ROM improvement at eight weeks

Keywords

Rotator cuff tendinopathy; Gong's mobilization; neuromuscular electrical stimulation; extracorporeal shockwave therapy; shoulder pain; SPADI; range of motion.

INTRODUCTION

Rotator cuff tendinopathy is among the most prevalent causes of chronic shoulder pain and functional limitation, particularly in adults exposed to repetitive overhead activity or sustained shoulder loading. The condition is characterized by tendon degeneration and impaired load tolerance rather than purely inflammatory pathology, often leading to persistent pain, restricted active range of motion (ROM), and progressive disability in daily activities. Despite widespread use of conservative interventions, optimal non-surgical management remains contested because different modalities target distinct mechanisms such as neuromuscular control deficits, capsular stiffness, and tendon mechanobiology. Extracorporeal shockwave therapy (ESWT), for example, has been increasingly used for rotator cuff tendinopathy because it may stimulate tendon healing through mechanotransduction and pain modulation, and systematic evidence supports its effectiveness in improving pain and function in rotator cuff-related disorders. (1) Contemporary tendinopathy evidence syntheses also suggest that shockwave-based approaches can yield clinically meaningful improvements across multiple tendinopathy sites, although comparative effectiveness varies depending on dosing parameters and the type of tendinopathy. (3)

Alongside tendon-focused biological stimulation, clinical recovery in rotator cuff tendinopathy frequently requires restoration of joint mechanics and muscle activation patterns. Manual therapy approaches are commonly applied to address pain-related movement inhibition and joint mobility restrictions through graded glides and traction aimed at optimizing glenohumeral arthrokinematics. Gong's mobilization is a structured mobilization method designed to improve shoulder mobility and reduce pain by targeting glenohumeral joint play, and it has shown favorable clinical effects in shoulder conditions characterized by painful stiffness and restricted mobility. (7) Because rotator cuff tendinopathy often involves neuromuscular inhibition of the rotator cuff musculature, the addition of neuromuscular electrical stimulation (NMES) may plausibly augment clinical benefit by improving motor unit recruitment, enhancing muscle activation, and supporting functional control of the shoulder complex. Evidence in rotator cuff tendinopathy populations indicates that NMES can improve pain, function, and muscular performance outcomes, supporting its role as an adjunct intervention. (5) Broader physiotherapy evidence across shoulder stiffness and pain-related conditions further supports that multi-modal rehabilitation approaches combining manual therapy and adjunct modalities often outperform isolated treatments when pain and mobility impairment coexist. (9)

Although ESWT is supported as an effective intervention for rotator cuff tendinopathy, it does not directly address joint mobility limitations or neuromuscular activation deficits, both of which may contribute to persistent pain and movement restriction. Conversely, combining Gong's

mobilization with NMES may offer a dual-mechanism benefit by simultaneously improving glenohumeral mobility and enhancing rotator cuff activation. Current clinical guidelines for non-surgical shoulder disorders emphasize individualized conservative management and support the integration of manual therapy and adjunct rehabilitation interventions when functional deficits persist. (10) However, direct randomized comparative evidence between a combined manual-electrotherapy approach and ESWT in rotator cuff tendinopathy remains limited, particularly over an 8-week treatment window using standardized outcomes. Therefore, this randomized controlled trial aimed to compare Gong's mobilization combined with NMES versus ESWT in patients with chronic rotator cuff tendinopathy, hypothesizing that the combined approach would produce superior improvement in pain intensity (primary outcome: VAS at Week 8) and greater gains in ROM, while both interventions would improve disability measured by SPADI. (1)

MATERIALS AND METHODS

A randomized controlled trial was conducted in outpatient physiotherapy clinics, enrolling 60 participants with chronic rotator cuff tendinopathy defined as shoulder pain persisting for more than three months, exacerbated by shoulder abduction and/or external rotation, accompanied by positive clinical impingement signs and ultrasound-confirmed tendinopathy without evidence of full-thickness rotator cuff tear. Participants were eligible if aged 35–65 years and were excluded if they had prior shoulder surgery, corticosteroid injection within the preceding three months, systemic inflammatory disease, or neurological impairment affecting the upper limb. All participants provided informed consent before participation. Evidence supporting ESWT effectiveness in rotator cuff tendinopathy and broader tendinopathy contexts informed selection of the comparator intervention and dosing structure. (3)

Participants were randomly allocated in a 1:1 ratio to either Gong's mobilization combined with NMES (Group A) or ESWT (Group B) using a computer-generated random sequence. Allocation was implemented by an independent administrator not involved in treatment delivery or outcome assessment, and outcomes were collected by an assessor blinded to group assignment. Because of the nature of the interventions, blinding of therapists and participants was not feasible; to reduce performance bias, treatment delivery followed standardized protocols and scheduled frequencies. The prespecified primary outcome was pain intensity measured by a 10-point Visual Analogue Scale (VAS) at Week 8, and secondary outcomes included shoulder disability using the Shoulder Pain and Disability Index (SPADI; 0–100, higher scores indicating worse disability) and active ROM measured using a goniometer for shoulder flexion, abduction, and external rotation.

In Group A, participants received Gong's mobilization focusing on glenohumeral distraction and graded anterior and posterior glides applied for approximately 10 minutes per session, followed immediately by NMES delivered to the supraspinatus and infraspinatus muscle regions for 15 minutes at 35–50 Hz, three sessions per week for eight weeks. The selection of NMES as an adjunct modality was supported by evidence indicating benefits for pain, strength, and function in rotator cuff tendinopathy populations. (5) In Group B, participants received ESWT using a radial shockwave protocol (2000 shocks per session at 0.18 mJ/mm²), applied over the rotator cuff tendon insertion region once weekly for eight weeks, reflecting contemporary therapeutic dosing patterns used across tendinopathy care pathways. (1) Outcomes were recorded at baseline, Week 4, and Week 8 to characterize temporal change trajectories and to support repeated-measures analysis.

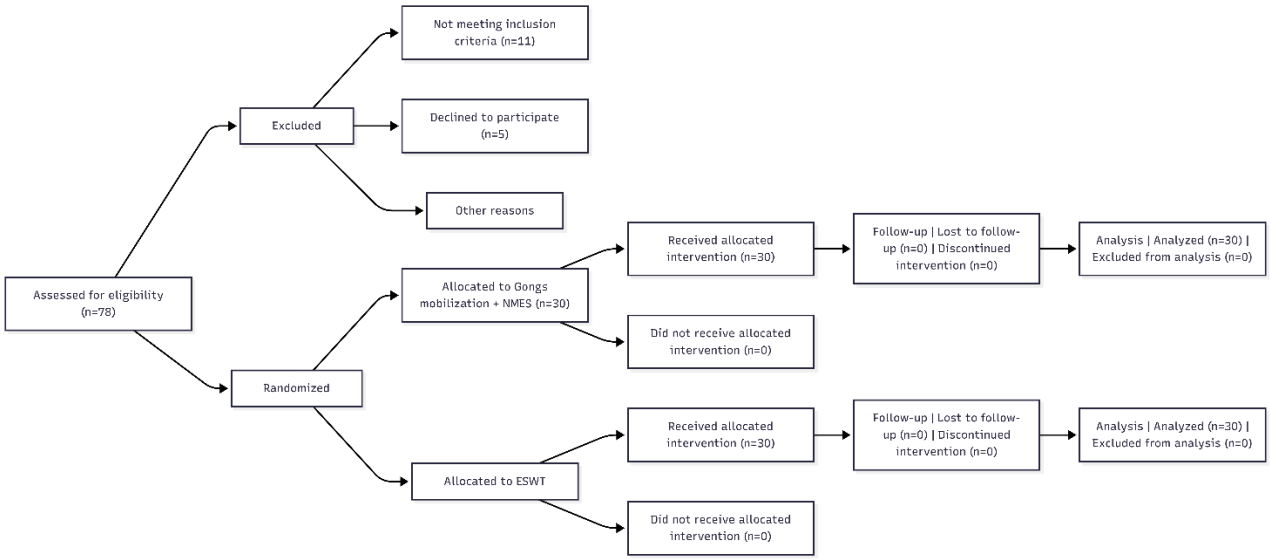

Figure 1 CONSORT Flowchart

Statistical analysis was performed using repeated measures analysis of variance to assess within-group changes over time and between-group differences across timepoints, with independent-samples t-tests used for between-group comparisons at each timepoint. Statistical significance was set at $p < 0.05$. In addition to p-values, between-group mean differences at Week 8 were quantified with 95% confidence intervals (CIs) and standardized effect sizes (Cohen's d) for interpretability. Baseline group comparability was evaluated for demographic and clinical variables using appropriate parametric and categorical comparisons. The methodological approach and conservative management framework were aligned with contemporary guidance for non-surgical shoulder rehabilitation emphasizing standardized assessment and structured conservative interventions. (10)

RESULTS

The two groups were comparable at baseline across demographic and clinical variables, including pain severity (VAS 6.8 ± 1.1 vs 6.5 ± 1.2; $p = 0.42$), disability (SPADI 58.2 ± 9.5 vs 56.9 ± 8.8; $p = 0.58$), and ROM values for flexion, abduction, and external rotation (all $p > 0.05$), supporting adequate randomization and baseline balance for primary and secondary outcomes.

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Table 1. Baseline Demographic and Clinical Characteristics (n = 60)

Characteristic	Group A: Gong's Mobilization + NMES (n = 30)	Group B: ESWT (n = 30)	p-value
Age (years), mean ± SD	49.2 ± 7.5	50.1 ± 6.8	0.62
Gender (M/F)	12/18	11/19	0.79
Symptom duration (months), mean ± SD	8.3 ± 3.1	8.7 ± 3.4	0.68
VAS pain (0–10), mean ± SD	6.8 ± 1.1	6.5 ± 1.2	0.42
SPADI total (0–100), mean ± SD	58.2 ± 9.5	56.9 ± 8.8	0.58
ROM flexion (°), mean ± SD	120 ± 12	118 ± 14	0.58
ROM abduction (°), mean ± SD	115 ± 13	116 ± 12	0.77
ROM external rotation (°), mean ± SD	48 ± 8	50 ± 9	0.36

Table 2. Outcomes Across Timepoints (Baseline, Week 4, Week 8)

Outcome	Timepoint	Group A (mean ± SD)	Group B (mean ± SD)	Between-group p-value
VAS pain (0–10)	Baseline	6.8 ± 1.1	6.5 ± 1.2	0.42
	Week 4	4.2 ± 1.0	4.6 ± 1.1	0.23
	Week 8	2.5 ± 0.8	3.8 ± 1.0	0.002
SPADI total (0–100)	Baseline	58.2 ± 9.5	56.9 ± 8.8	0.58
	Week 4	43.0 ± 7.8	44.5 ± 8.2	0.51
	Week 8	30.4 ± 6.5	33.8 ± 7.0	0.15
ROM flexion (°)	Baseline	120 ± 12	118 ± 14	0.58
	Week 8	152 ± 10	140 ± 12	0.004
ROM abduction (°)	Baseline	115 ± 13	116 ± 12	0.77
	Week 8	148 ± 11	138 ± 13	0.009
ROM external rotation (°)	Baseline	48 ± 8	50 ± 9	0.36
	Week 8	66 ± 7	60 ± 8	0.010

Table 3. Week 8 Between-Group Effect Estimates (Group A – Group B), with 95% CIs and Effect Sizes

Outcome (Week 8)	Mean Difference (A − B)	95% CI	Cohen's d	Interpretation
VAS pain (0–10)	−1.30	−1.76 to −0.84	−1.44	Large pain reduction favoring Group A
SPADI total (0–100)	−3.40	−6.82 to 0.02	−0.50	Moderate effect; not statistically significant
ROM flexion (°)	+12.0	6.41 to 17.59	+1.09	Large mobility gain favoring Group A
ROM abduction (°)	+10.0	3.91 to 16.09	+0.83	Moderate-to-large mobility gain favoring Group A
ROM external rotation (°)	+6.0	2.20 to 9.80	+0.80	Moderate-to-large mobility gain favoring Group A

Both interventions produced clinically meaningful improvements over time in pain, disability, and ROM. Pain intensity decreased in both groups from baseline to Week 8, with Group A improving from 6.8 ± 1.1 to 2.5 ± 0.8 (absolute change −4.3 points), and Group B improving from 6.5 ± 1.2 to 3.8 ± 1.0 (absolute change −2.7 points).

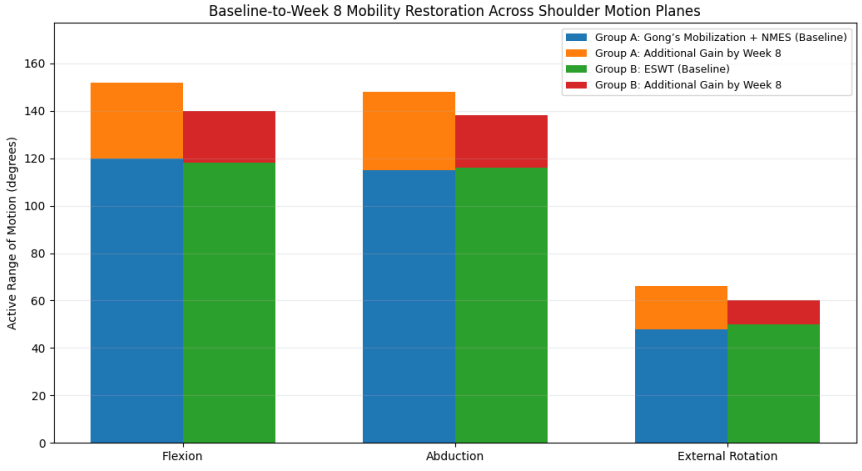

Figure 2 Gong's mobilization + NMES group across all shoulder motion planes over 8 weeks compared with ESWT

While Week 4 pain scores did not differ significantly between groups (p = 0.23), Group A demonstrated significantly lower pain at Week 8 compared with Group B (2.5 ± 0.8 vs 3.8 ± 1.0; p = 0.002). Disability measured by SPADI improved substantially in both groups by Week 8 (Group A: 58.2 ± 9.5 to 30.4 ± 6.5; Group B: 56.9 ± 8.8 to 33.8 ± 7.0), with not statistically significant between-group difference in SPADI at Week 8 (p = 0.15), indicating that both interventions improved self-reported disability similarly. ROM gains were consistently greater in Group A at Week 8, including flexion (152° ± 10 vs 140° ± 12; p = 0.004), abduction (148° ± 11 vs 138° ± 13; p = 0.009), and external rotation (66° ± 7 vs 60° ± 8; p = 0.010), supporting superior mobility recovery with Gong's mobilization combined with NMES.

At Week 8, Group A demonstrated statistically and clinically stronger improvements in pain and ROM compared with ESWT alone. The between-group pain difference was −1.30 points on the VAS (95% CI −1.76 to −0.84) with a large standardized effect (d = −1.44), confirming superior analgesic benefit. ROM differences favored Group A with large effects for flexion (+12°, 95% CI 6.41 to 17.59; d = 1.09), and moderate-to-large

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effects for abduction (+10°, 95% CI 3.91 to 16.09; d = 0.83) and external rotation (+6°, 95% CI 2.20 to 9.80; d = 0.80). In contrast, SPADI improvement at Week 8 showed a moderate effect size (d = −0.50) but did not reach statistical significance based on the confidence interval crossing zero and the corresponding p-value (p = 0.15), indicating comparable disability outcomes between groups despite superior pain and mobility benefits in the combined intervention group.

Figure 1 demonstrates a consistently greater mobility restoration in the Gong's mobilization + NMES group across all shoulder motion planes over 8 weeks compared with ESWT. In shoulder flexion, Group A improved from 120° to 152° (+32°) versus Group B from 118° to 140° (+22°), corresponding to a +10° advantage in total gain for Group A (between-group Week 8 difference +12°, p = 0.004). A similar pattern is evident for abduction, where Group A improved from 115° to 148° (+33°) compared with Group B from 116° to 138° (+22°), yielding an 11° greater gain in Group A (Week 8 difference +10°, p = 0.009). For external rotation, Group A increased from 48° to 66° (+18°) whereas Group B improved from 50° to 60° (+10°), reflecting an 8° superior gain in Group A (Week 8 difference +6°, p = 0.010). Collectively, the stacked structure highlights that while baseline ROM values were comparable between groups, the incremental rehabilitation-driven mobility gain was systematically larger with Gong's mobilization + NMES, supporting superior restoration of functional shoulder mechanics by Week 8.

DISCUSSION

This randomized controlled trial compared Gong's mobilization combined with neuromuscular electrical stimulation (NMES) versus extracorporeal shockwave therapy (ESWT) in patients with chronic rotator cuff tendinopathy and demonstrated that both interventions produced statistically significant within-group improvements in pain, disability, and shoulder range of motion over eight weeks. However, the combined manual–electrotherapy intervention yielded superior outcomes for the primary endpoint, with significantly greater pain reduction at Week 8 and consistently larger gains in shoulder ROM than ESWT. These findings support the clinical proposition that interventions targeting both joint mechanics and neuromuscular activation may generate greater analgesic and mobility benefits than tendon-focused biological stimulation alone in a tendinopathy population. Systematic evidence supports ESWT as an effective conservative therapy for rotator cuff tendinopathy, particularly for pain and functional improvement, and the within-group improvement observed in the ESWT arm aligns with this broader literature. (1) Similarly, tendinopathy-wide syntheses have suggested that shockwave-based interventions can meaningfully improve symptoms, although outcomes depend on protocol selection and clinical phenotype, which may partially explain the comparatively smaller ROM gains observed in the ESWT group in the present study. (3)

The magnitude and pattern of improvement in the Gong's mobilization + NMES group are consistent with the mechanistic advantages of combining joint mobilization with augmented rotator cuff activation. Gong's mobilization may reduce capsular stiffness and pain-related movement inhibition through traction and gliding approaches that improve glenohumeral arthrokinematics, while NMES likely increases motor unit recruitment and neuromuscular control of the rotator cuff musculature, supporting functional stabilization during movement and allowing safer progression of active ROM. Evidence indicates that NMES can improve pain and function and influence neuromuscular outcomes in rotator cuff tendinopathy populations, supporting its role as a meaningful adjunct in shoulder rehabilitation programs. (5) Moreover, physiotherapy evidence across painful shoulder conditions supports that structured manual therapy can improve mobility and pain outcomes, particularly when stiffness, guarding, and movement restriction coexist, which is clinically consistent with the larger ROM differences observed across flexion, abduction, and external rotation in the combined intervention group. (7,9) In practical terms, the observed Week 8 differences favoring Gong's mobilization + NMES suggest that integrating a mobility-restoration strategy with neuromuscular activation may accelerate recovery in patients whose tendinopathy presentation includes joint motion restriction and rotator cuff inhibition.

Importantly, disability measured by SPADI improved substantially in both groups but did not differ statistically between interventions at Week 8, indicating that improvements in self-reported function may be achievable through either modality over an eight-week course. This finding is clinically meaningful because pain and ROM improvements do not always translate proportionally to disability scores over short follow-up periods, particularly when disability is influenced by occupational demands, activity modification, behavioral adaptation, and psychosocial factors. Given that contemporary clinical practice guidance emphasizes multimodal, individualized conservative care for shoulder disorders, the present results support the feasibility of both approaches while highlighting that the combined intervention offers a clearer advantage for pain reduction and mobility restoration. (10) Clinically, these findings suggest a reasonable treatment-selection framework: Gong's mobilization + NMES may be preferred when substantial ROM limitation or neuromuscular inhibition is present, while ESWT may remain valuable when manual therapy is contraindicated, poorly tolerated, or when tendon pain predominates and a tendon-focused stimulus is desired. (1)

This study has limitations that should be considered when interpreting the findings. The follow-up period was limited to eight weeks; therefore, long-term maintenance of improvements and recurrence patterns remain unknown. Participant and therapist blinding was not feasible, which may have introduced expectancy effects despite assessor blinding and protocol standardization. The trial did not incorporate imaging follow-up, so structural tendon changes could not be evaluated alongside clinical improvement. Additionally, the study did not report cost-effectiveness or treatment adherence metrics, which are important for implementation decisions in outpatient rehabilitation. Future trials should evaluate longer-term outcomes, include prespecified minimal clinically important difference interpretation, and explore stratified treatment effects based on baseline ROM restriction, symptom chronicity, occupational overhead activity exposure, and ultrasound severity grading to identify phenotypes most likely to benefit from combined joint-mechanical and neuromuscular interventions versus tendon-focused stimulation strategies. (3)

CONCLUSION

Both Gong's mobilization combined with neuromuscular electrical stimulation and extracorporeal shockwave therapy were effective in reducing pain, improving disability, and increasing shoulder range of motion in patients with chronic rotator cuff tendinopathy over eight weeks; however, Gong's mobilization with NMES produced significantly greater pain reduction and superior gains in flexion, abduction, and external rotation compared with ESWT, while disability improvement measured by SPADI was comparable between interventions, indicating that the combined manual–electrotherapy approach may provide an added advantage for patients presenting with marked pain and mobility limitations.

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