

COMPARATIVE EFFECTIVENESS OF TRADITIONAL AND FUNCTIONAL EXERCISE PROGRAMS COMBINED WITH AERION ARTHRON CLASS IV LASER THERAPY IN PATIENTS WITH GRADE I AND II SUPRASPINATUS TEARS

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KEYWORDS

Supraspinatus tear, functional exercise, traditional exercise, Class IV laser, VAS, QuickDASH, shoulder rehabilitation.

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Abstract

Background: Partial supraspinatus tears commonly cause shoulder pain, weakness and difficulty with everyday upper-limb activities. Conservative rehabilitation is often advised before surgery, but the type of exercise used may influence the extent of recovery. Class IV laser therapy may support pain relief and tissue healing, while functional exercise may improve the way the shoulder is used during real-life tasks.

Aim: To compare traditional exercises and functional exercises when both are combined with Aerion Arthron Class IV laser therapy in patients with Grade I and II supraspinatus tears.

Methodology: Sixty participants aged 20–60 years with conservatively managed supraspinatus tears were divided into two equal groups. Group A received traditional shoulder exercises with Class IV laser therapy, whereas Group B received functional exercises with the same laser intervention. Pain and upper-limb disability were assessed using the Visual Analogue Scale (VAS) and QuickDASH before and after treatment. Paired t-tests were used for within-group analysis, and independent t-tests were used to compare change scores between groups.

Results: Both groups improved significantly. In Group A, VAS decreased from 7.020 ± 0.511 to 4.763 ± 0.766 , while QuickDASH decreased from 65.741 ± 6.226 to 43.804 ± 6.911 . In Group B, VAS decreased from 7.222 ± 0.585 to 2.812 ± 0.651 , and QuickDASH decreased from 69.267 ± 6.536 to 27.829 ± 7.788 . Between-group analysis favoured Group B for VAS improvement (mean difference 2.154, $p < 0.001$) and QuickDASH improvement (mean difference 19.501, $p < 0.001$).

Conclusion: Traditional and functional exercise programmes were both beneficial when combined with Class IV laser therapy. However, functional exercises produced greater pain relief and functional recovery, suggesting that task-oriented and kinetic-chain-based training may offer additional clinical value in conservative rehabilitation of Grade I and II supraspinatus tears.

Introduction

The supraspinatus is one of the four rotator cuff muscles and plays an important role in initiating shoulder abduction and maintaining the humeral head within the glenoid during arm movement. A partial tear of the supraspinatus tendon can develop following repetitive overhead activity, acute injury, age-related degeneration or prolonged mechanical overload. Patients commonly report pain while lifting the arm, weakness, disturbed sleep and difficulty performing activities such as dressing, reaching overhead or carrying objects.

Grade I and II supraspinatus tears involve partial disruption of the tendon rather than complete loss of continuity. These tears are often managed conservatively, particularly when symptoms are moderate and there is no major loss of function. Exercise-based rehabilitation aims to reduce pain, restore shoulder mobility, improve rotator cuff and scapular muscle performance, and help patients return to meaningful activity without surgery.^{1,2,3}

Traditional shoulder exercise programmes usually progress from pain-free mobility to isolated strengthening of the rotator cuff and scapular muscles. Pendulum exercises, active-assisted range-of-motion work, resisted internal and external rotation, rows, scaption and light dumbbell exercises are commonly used. These methods are valuable for restoring basic strength and movement control, but isolated exercises may not fully reproduce the coordinated demands of daily activities.

Functional exercise follows a different rehabilitation principle. It uses task-oriented, multi-planar and closed-chain movements that combine the shoulder with the scapula, trunk and lower-limb kinetic chain. Wall slides, supported reach-outs, wall push-ups, ball stabilization, resisted reaching, carries and return-to-activity drills may improve proprioception, dynamic stability and movement confidence. Because many daily tasks require coordinated movement rather than isolated muscle contraction, functional exercises may produce

better transfer to activity.

Class IV laser therapy is increasingly used as an adjunct in musculoskeletal rehabilitation. High-power laser energy can penetrate deeper tissues and may influence pain and tissue recovery through photobiomodulation. Proposed effects include improved mitochondrial activity, increased ATP production, modulation of inflammatory mediators, enhanced circulation and support for collagen synthesis. When laser therapy is combined with exercise, pain reduction may allow patients to participate more comfortably in progressive rehabilitation.^{4,5}

Although both traditional and functional exercise approaches are used in clinical practice, direct comparative evidence remains limited when the same Class IV laser therapy is provided to both groups. The present study was therefore undertaken to compare these two exercise strategies in patients with Grade I and II supraspinatus tears.⁶

NEED OF THE STUDY

Partial supraspinatus tears can cause persistent pain and loss of upper-limb function even when surgery is not immediately required. The success of conservative care depends not only on pain-relieving modalities but also on the way therapeutic exercise is selected and progressed.

Traditional strengthening is widely used and remains clinically useful, but patients often need to recover coordinated reaching, pushing, carrying and overhead control. Functional exercises may address these demands more directly by integrating the rotator cuff with scapular control, proprioception, trunk stability and kinetic-chain movement.^{7,8}

As Class IV laser therapy was provided to both study groups, the comparison allowed the effect of exercise strategy to be examined more clearly. Identifying the more effective programme may help physiotherapists design practical and evidence-informed protocols for patients with low-grade supraspinatus tears.⁹

AIM

To compare the effectiveness of traditional exercises and functional exercises combined with Aerion Arthron Class IV laser therapy in patients with Grade I and II supraspinatus tears.

OBJECTIVES

1. To determine the effect of traditional exercises combined with Class IV laser therapy on shoulder pain and upper-limb disability.
2. To determine the effect of functional exercises combined with Class IV laser therapy on shoulder pain and upper-limb disability.
3. To compare the improvement in VAS and QuickDASH scores between the two treatment groups.
4. To identify which exercise strategy provides greater clinical benefit during conservative rehabilitation.

HYPOTHESIS

Null hypothesis: There will be no significant difference between traditional exercises and functional exercises when both are combined with Class IV laser therapy.

Alternative hypothesis: There will be a significant difference between traditional exercises and functional exercises when both are combined with Class IV laser therapy.

MATERIALS AND METHOD

Item	Description
Study design	Comparative interventional study.
Study setting	Pacific Medical College and Hospital, Bedla, Udaipur, Rajasthan.
Sample size	Sixty participants, with 30 participants in each group.
Sampling method	Purposive sampling.

Age range	20–60 years.
Study groups	Group A: traditional exercises with Class IV laser therapy; Group B: functional exercises with Class IV laser therapy.
Outcome measures	Visual Analogue Scale (VAS) and QuickDASH.
Statistical analysis	Paired t-test for within-group comparisons and independent t-test for between-group change-score comparisons. Statistical significance was set at $p < 0.05$.

INCLUSION CRITERIA

1. Patients diagnosed with conservatively managed Grade I or II supraspinatus tear.
2. Age between 20 and 60 years.
3. Diagnosis confirmed under medical supervision.
4. Willingness to participate and provide informed consent.

EXCLUSION CRITERIA

1. High-grade or full-thickness rotator cuff tear.
2. Previous surgical repair of the supraspinatus tendon.
3. Fracture, spinal trauma or amputation.
4. Systemic inflammatory disease or progressive neurological condition.
5. Pregnancy, open wound, high-degree burns or other contraindications to laser therapy.
6. Use of selected medications or conditions requiring medical exclusion.

INTERVENTION PROTOCOL

ETHICAL CONSIDERATION

The study is done after obtaining ethical committee clearance protocol no. PMU/IEC/MPT/2025/04 in the outpatient physiotherapy department of PACIFIC MEDICAL COLLEGE & HOSPITAL, BHILLO KA, NH27, PRATAP PURA, UDAIPUR (313001)

GROUP A: TRADITIONAL EXERCISES WITH CLASS IV LASER

Weeks 1–2: pendulum exercises, passive shoulder flexion, cryotherapy and pain-free scapular retraction.

Weeks 3–4: active-assisted flexion with a stick, resisted internal and external rotation, prone horizontal abduction and light resistance-band rows.

Week 5: side-lying external rotation, prone shoulder extension, horizontal abduction to neutral and scaption with light resistance.

Week 6: progressed resistance-band rotation, seated shoulder press and lateral raises. Resistance was advanced only when symptoms remained controlled.

GROUP B: FUNCTIONAL EXERCISES WITH CLASS IV LASER

Weeks 1–2: supported wall slides, scapular clocks, ball-assisted reach-outs and quadruped rocking.

Weeks 3–4: wall push-ups, ball stabilization on the wall, diagonal band pull-aparts and light farmer's carries.

Week 5: dynamic wall pushes, medicine-ball wall dribbles, band-resisted reach-outs and progressed carrying tasks.

Week 6: push-up progression, ball throws against a wall, closed-chain stability drills and kinetic-chain integration using a lunge with overhead reach.

Class IV laser therapy was administered to both groups according to the treatment protocol. Exercise progression was based on pain response, movement quality and the absence of a next-day symptom flare.

OUTCOME MEASURES

Visual Analogue Scale (VAS): Pain intensity was recorded on a numerical visual scale, with higher scores indicating greater pain.

QuickDASH: The 11-item QuickDASH questionnaire was used to measure upper-limb symptoms and disability. Higher scores indicate greater functional limitation.

RESULTS

A total of 60 participants completed the study. Thirty participants received traditional exercises with Class IV laser therapy, and 30 received functional exercises with the same laser intervention. Both groups demonstrated statistically significant improvement, but the magnitude of change was consistently greater in the functional exercise group.

DEMOGRAPHIC PROFILE

Group	Mean age $\pm$ SD	Male	Female
Group A: Traditional + Laser	40.97 $\pm$ 11.01	13	17
Group B: Functional + Laser	37.07 $\pm$ 12.56	19	11

The average age of both groups fell within the adult working-age population. Although the sex distribution differed slightly, both groups included male and female participants and were clinically suitable for comparison.

WITHIN-GROUP COMPARISON

Group	Outcome	Pre Mean $\pm$ SD	Post Mean $\pm$ SD	Mean change $\pm$ SD	t-value	p-value	Effect size d
A	VAS	7.020 $\pm$ 0.511	4.763 $\pm$ 0.766	2.257 $\pm$ 0.910	13.580	<0.001	2.479
A	Quick DASH	65.741 $\pm$ 6.226	43.804 $\pm$ 6.911	21.937 $\pm$ 8.410	14.288	<0.001	2.609
B	VAS	7.222 $\pm$ 0.585	2.812 $\pm$ 0.651	4.410 $\pm$ 0.779	30.995	<0.001	5.659
B	Quick DASH	69.267 $\pm$ 6.536	27.829 $\pm$ 7.788	41.438 $\pm$ 7.629	29.751	<0.001	5.432

Group A showed meaningful reductions in pain and disability after treatment. Group B also improved significantly, but the larger mean changes and effect sizes indicate a stronger response to the functional exercise programme.

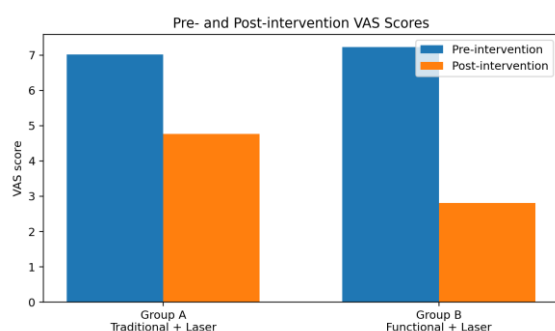


Figure 1. Mean VAS scores before and after intervention in both groups.

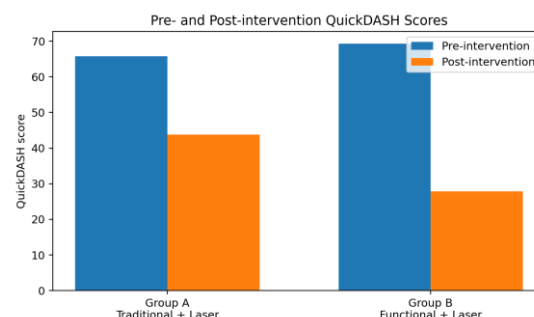


Figure 2. Mean QuickDASH scores before and after intervention in both groups.

BETWEEN-GROUP COMPARISON OF CHANGE SCORES

Outcome	Change Group A	Change Group B	Mean difference (B-A)	t-value	p-value	Effect size g
VAS	2.257 $\pm$ 0.910	4.410 $\pm$ 0.779	2.154	-9.844	<0.001	2.509
QuickDASH	21.937 $\pm$ 8.410	41.438 $\pm$ 7.629	19.501	-9.407	<0.001	2.397

The between-group analysis showed a clear advantage for functional exercises. Participants in Group B experienced approximately twice the mean reduction in VAS and almost twice the mean improvement in QuickDASH compared with Group A. The very large effect sizes suggest that the differences were clinically important as well as statistically significant.

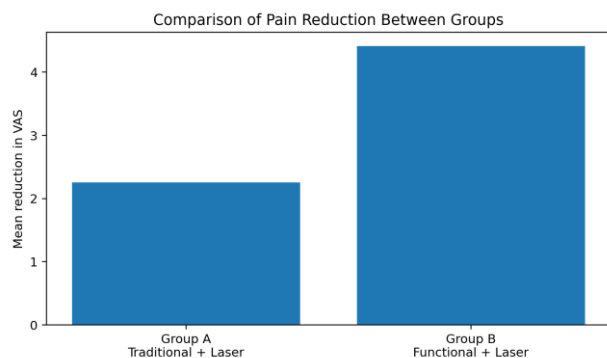


Figure 3. Comparison of mean pain reduction between Group A and Group B.

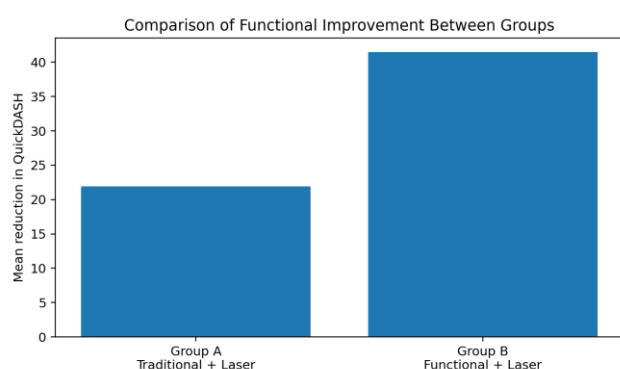


Figure 4. Comparison of mean functional improvement between Group A and Group B.

RELATIONSHIP BETWEEN PAIN AND DISABILITY

The thesis reported a positive correlation of $r = 0.58$ between pain reduction and functional improvement. Participants who experienced greater relief from pain generally showed greater improvement in upper-limb function. This finding supports the clinical relationship between symptom control and participation in activity.

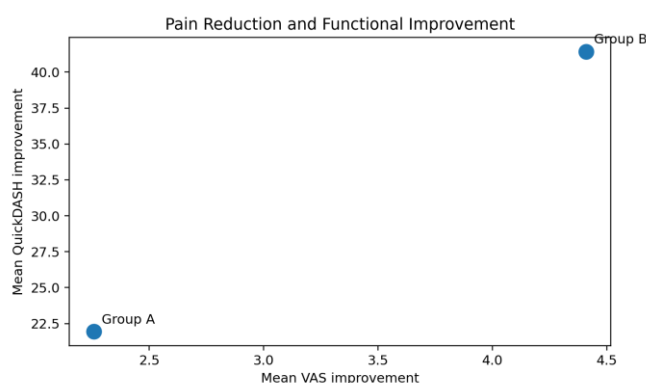


Figure 5. Group-level relationship between pain reduction and functional improvement.

SUMMARY OF FINDINGS

- Both treatment programmes significantly reduced shoulder pain.
- Both programmes significantly improved QuickDASH scores.
- Functional exercises with Class IV laser produced greater pain reduction than traditional exercises with laser.
- Functional exercises produced greater improvement in upper-limb function.
- The null hypothesis was rejected and the alternative hypothesis was accepted.

DISCUSSION

The present study compared two conservative rehabilitation approaches for Grade I and II supraspinatus tears. Both groups received Aerion Arthron Class IV laser therapy, allowing the exercise component to remain the main difference between the programmes. The findings showed that both traditional and functional exercises were effective, but functional exercise produced a substantially greater improvement in pain and disability.¹⁰

The improvement in Group A confirms that conventional rehabilitation remains useful. Pain-free mobility, scapular retraction, resisted rotation, rows, scaption and progressive strengthening may reduce guarding, improve circulation, restore rotator cuff capacity and increase confidence in shoulder movement. These changes were reflected in significant reductions in both VAS and QuickDASH scores.¹¹

Group B achieved a larger reduction in pain. Functional exercises use supported weight bearing, closed-chain control, reaching patterns and task-based progression. These movements may distribute load across the shoulder complex more effectively and improve coordination between the rotator cuff, scapular stabilizers and trunk. Better

movement control may reduce repeated irritation of the supraspinatus tendon during daily activity.

The greater QuickDASH improvement in Group B is particularly relevant. QuickDASH measures the patient's ability to perform real-life upper-limb tasks. Functional exercises resemble these tasks more closely than isolated strengthening. Wall push-ups, carries, ball stabilization, resisted reaching and kinetic-chain drills may therefore provide stronger transfer from the treatment area to daily activity.^{12,13}

The shoulder does not function in isolation. During reaching, lifting and overhead movement, force is transferred through the lower limbs, pelvis, trunk, scapula and humerus. Functional exercise incorporates this kinetic chain, which may decrease compensatory shoulder loading. Improved trunk and scapular control can provide a more stable base for humeral movement and reduce unnecessary strain on the supraspinatus tendon.¹⁴

Class IV laser therapy may have supported improvement in both groups by reducing pain and helping participants tolerate exercise progression. Photobiomodulation has been associated with improved cellular energy production, modulation of inflammatory activity and support for soft-tissue repair. Because both groups received the laser intervention, however, the superior result in Group B is more reasonably linked to the difference in exercise strategy than to laser therapy alone.

The positive association between pain reduction and functional improvement is clinically understandable. Pain can lead to fear, guarding and avoidance of movement. As pain decreases, patients are more willing to move the arm and participate in rehabilitation. At the same time, improved movement control can reduce mechanical irritation and further decrease pain. Recovery is therefore likely to involve a two-way relationship between symptom relief and functional restoration.

The large effect sizes reported in the study suggest that the observed differences were not minor. Functional exercise may be particularly helpful for patients whose goals include returning

to work, household activity, carrying, pushing or overhead tasks. Traditional exercises may still be valuable during the early and irritable stages, while functional tasks can be introduced progressively as pain and control improve.

The findings support a staged approach rather than a complete rejection of traditional exercise. Basic mobility and isolated strengthening may prepare the shoulder for more demanding functional work. Once tolerated, task-oriented and kinetic-chain exercises may provide the additional stimulus needed for better recovery in daily life.

CLINICAL IMPLICATIONS

- Conservative rehabilitation can produce meaningful improvement in patients with Grade I and II supraspinatus tears.
- Class IV laser therapy may be used as an adjunct to support pain control, but exercise selection remains important.
- Functional tasks should be introduced progressively after basic mobility and muscle activation are established.
- Rehabilitation should include scapular control, closed-chain stability, reaching, carrying and kinetic-chain integration.
- Progression should be guided by pain response, next-day symptoms, movement quality and the patient's functional goals.

CONCLUSION

Both traditional exercises and functional exercises were effective when combined with Aerion Arthron Class IV laser therapy in patients with Grade I and II supraspinatus tears. Participants in both groups experienced significant reductions in shoulder pain and upper-limb disability.

The functional exercise group, however, achieved substantially greater improvement in VAS and QuickDASH scores. Task-oriented, closed-chain and kinetic-chain-based movements appear to provide better transfer to everyday

activity than isolated strengthening alone. Within the limits of this study, functional exercise combined with Class IV laser therapy may therefore be considered the more effective conservative rehabilitation approach for low-grade supraspinatus tears.^{19,20}

LIMITATIONS

1. The sample was limited to 60 participants from a single clinical setting.
2. The study did not include a no-laser control group, so the independent contribution of Class IV laser therapy could not be determined.
3. Only VAS and QuickDASH were used; objective strength, range of motion, scapular kinematics and imaging outcomes were not included.
4. Participant and therapist blinding was not possible because the exercise programmes were visibly different.
5. The study included a broad age range and did not perform subgroup analysis by age, activity level or tear grade.
6. Long-term follow-up was not available to determine whether the benefits were maintained.
7. Adherence outside supervised treatment could not be monitored with complete accuracy.

RECOMMENDATIONS

1. Future studies should use larger, multicentre samples and randomized allocation.
2. A third group receiving exercise without laser therapy should be included to clarify the added value of Class IV laser.
3. Long-term follow-up should be performed to assess recurrence, sustained function and later need for surgery.
4. Future research should include range of motion, dynamometer strength, scapular motion, tendon imaging and patient satisfaction.

5. Subgroup analysis should examine the influence of tear grade, age, occupation and symptom duration.
6. Clinical protocols may combine early traditional exercises with later functional and kinetic-chain progression.
7. Different Class IV laser doses and treatment schedules should be compared to establish optimal parameters.

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