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Evaluation of shoulder pain, disability, mobility, and quality of life in patients with adhesive capsulitis following suprascapular nerve block combined with low-intensity laser therapy

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Abstract. – OBJECTIVE: Adhesive capsulitis is a common health concern affecting shoulder mobility, which targets around 5% of populations worldwide, consequently affecting their quality of life. The aim of this study was to ascertain the effects of combining suprascapular nerve block and low-power laser therapy on pain intensity, mobility, disability, and quality of life in adhesive capsulitis.

PATIENTS AND METHODS: Between December 2021 and June 2022, 60 patients with adhesive capsulitis were enrolled in the study. They were randomly allocated into three groups, 20 each. The first group was employed for laser therapy 3 sessions a week for 8 weeks (LT group). The second group was employed for nerve block one time (NB group). The third group was recruited for nerve block intervention one time in addition to laser therapy 3 sessions a week for 8 weeks (LT+NB group). VAS, SPADI, SF-36, and shoulder range of motion were assessed pre- and post-8-week intervention.

RESULTS: Of 60 patients that started the study, 55 patients have completed the study program. No significant differences were noticed between LT, NB, and LT+NB groups before intervention (VAS at rest, $p = 0.818$, VAS at motion, $p = 0.878$, SPADI, $p = 0.919$, SF-36 (PCS), $p = 0.731$, SF-36 (MCS), $p = 0.936$, shoulder flexion, $p = 0.441$, shoulder abduction, $p = 0.722$, shoulder internal rotation, $p = 0.396$, and shoulder external rotation, $p = 0.263$). However, noteworthy differences were identified between LT, NB, and LT+NB groups (VAS at rest, $p < 0.001$, VAS at motion, $p < 0.001$, SPADI, $p = 0.011$, SF-36 (PCS), $p = 0.033$, SF-36 (MCS), $p = 0.007$, shoulder flexion, $p < 0.001$, shoulder abduction, $p < 0.001$, shoulder internal rotation, $p < 0.001$, and shoulder external rotation, $p < 0.001$).

CONCLUSIONS: Both treatment modalities whether low-power laser therapy or suprascapular nerve block have beneficial effects in the treatment of adhesive capsulitis. The combination of both interventional modalities has beneficial effects in the treatment of adhesive capsulitis more than laser therapy or suprascapular nerve block alone. Accordingly, this combination should be recommended in pain management of musculoskeletal disorders, particularly adhesive capsulitis.

Key Words:
Adhesive capsulitis, Suprascapular nerve block, Laser therapy, Shoulder pain, Quality of life.

Introduction

Adhesive capsulitis is a common health concern affecting shoulder mobility which influences around 5% of populations worldwide[1,2]. Frozen shoulder starts with capsulitis and ends consequently with fibrosis[3]. Initially, a marked vascularity combined with synovial hyperplasia occurs in the shoulder joint and develops to synovial inflammation and capsular fibrosis as a result of immune reactions[4]. Microscopic and macroscopic characteristics of decreased capsular space are clearly observed[5].

Nocturnal pain of the shoulder joint commonly affects sleep quality in patients suffering from shoulder disorders[6]. Prior studies[7,8] have found that insomnia, nocturnal shoulder pain, and sleep

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disturbance occur characteristically with pathological process of the shoulder joint. Medical documents have reported that sleep disturbance associated with adhesive capsulitis has negative effects on psychological status and quality of life[9,10]. Both pain severity and interrupted sleep may affect patients' biological and social well-being[7]. Sleep quality and activity of daily living may be negatively affected by painful complaints. Contrariwise, proper management of adhesive capsulitis may cause relief of shoulder pain and improve sleep quality that, in turn, improves the physiological condition[11].

Priorly, it has been stated that laser therapy is widely used for rehabilitating the musculoskeletal disorders. Laser therapy application is identified as a safe and successful modality[12].

In addition, laser therapy is greatly applied in combination with exercise interventions for controlling joint pain and restoring mobility functions in musculoskeletal rehabilitation[13]. Although prior documents[14] have recommended the use of laser therapy in managing musculoskeletal disorders, particularly shoulder joint problems, it is still unclear whether laser therapy moderates pain and improves joint function due to inefficient data.

Recently, another efficient and safe interventional modality has been documented for relieving chronic pain in the shoulder joint, identified in an ultrasound-guided suprascapular nerve block, both using corticosteroids or not[15]. The suprascapular nerve block is effectively used for controlling shoulder pain caused around or in the shoulder joint because it supplies about 70% of the shoulder area[16].

No previous studies have assessed the combination of laser therapy with nerve block in patients with adhesive capsulitis. To the best of our knowledge, this is the first study to determine the combination of laser therapy and nerve block for those patients by hypothesizing that the nerve block enhances active and passive shoulder mobilization without pain; additionally, nerve block combined with laser therapy may have a better effect than each alone.

Patients and Methods

Study Design and Ethics

This randomized control study was ethically accepted by the localized Research Ethics Committee of physiotherapy and health rehabilitation department at Prince Sattam University (No.: RHPT/21/020). All procedures followed the Helsinki Declaration. Reporting followed CONSORT and randomized trial standards. With an informative interview, each participant was detailly informed with benefits and possible side effects of the therapeutic modalities used in the study and was instructed to sign a consent form before starting study procedures.

Participants

Between December 2021 and June 2022, 60 patients with adhesive capsulitis were enrolled in the study after their diagnosis and referral from professional orthopedists. They were randomly allocated into three groups, 20 per each. The first group was employed for laser therapy 3 sessions a week for 8 weeks without nerve block intervention (LT group). The second group was employed for nerve block one time without laser therapy (NB group). The third group was recruited for nerve block intervention one time in addition to laser therapy 3 sessions a week for 8 weeks (LT+NB group). All patients received their traditional physiotherapy exercise 3 sessions a week for 8 weeks.

Sample Size

The trial's sample size and statistical power were determined with the use of the G*Power software (V. 3.1.9.2, Dusseldorf, Germany). Based on results from a pilot study, we determined that 18 individuals would be needed to detect a standard mean difference of 40% with a standard deviation of 0.5 in visual analogue scale (VAS) scores as a primary outcome measure for each group. The result was derived by using the power of 80% and alpha error of 0.05 for statistical significance. A total of 20 individuals were needed for each group after allowing for a 20% attrition rate (60 for total).

Blinding and Randomization

Sixty people who were considered for inclusion in the study have signed up to take part. After screening sixty-six patients for eligibility, we found that 4 participants did not match the research's requirements, and 2 others flat-out declined to take part in the study. Using a computer-generated random table, a blinded investigator who was not involved in the intervention programs randomly assigned 60 individuals to three groups of 20 each. One set of people got LT, another set got NB, and a third set got both LT and NB. The CONSORT flow diagram shows that the entire trial took place over the course of 8 consecutive weeks (Figure 1).

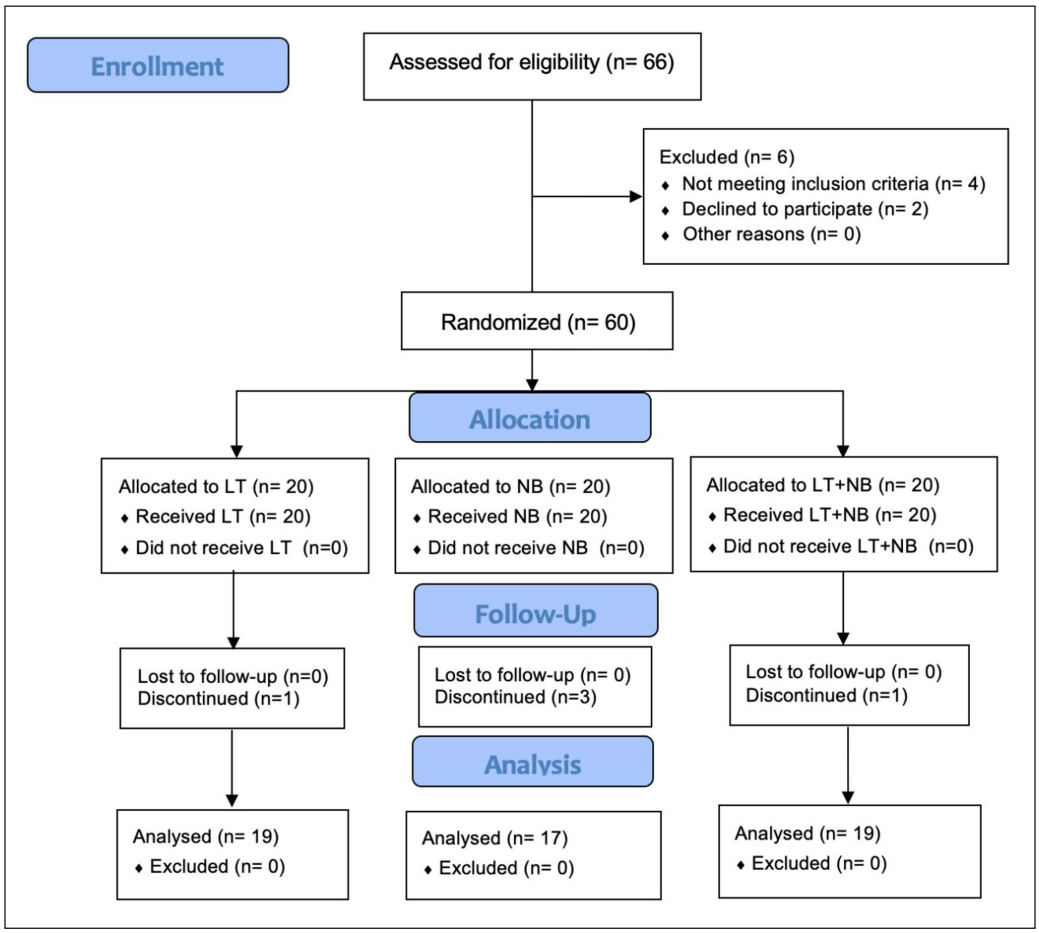

Figure 1. The consort flowchart of the study.

Intervention

Exercise intervention

Mobilization exercise including stretching, range of motion, and strengthening exercises were performed for all participants by professional manual therapists for all shoulder joints 10 to 15 minutes after 5 minutes warming up and same duration was done for calling down 3 sessions per week for 8 weeks.

Suprascapular Nerve Block

The participant was situated in a sitting position. After sterilizing the procedure area, a protected 6-13 MHz linear ultrasound probe with a sterile sheath was parallelly situated to the spine of the scapula to identify the suprascapular notch, and the suprascapular nerve was consequently detected. The injection was done using a 50-mm 21 G needle with a long axis to visualize the whole length of the needle. A local anesthetic (10 ml of bupivacaine 0.5%) was injected around the suprascapular nerve one time before starting physiotherapy program. The analgesic effect of the block was ranged between 14 and 18 hours. Nerve block intervention was done by professional anesthesiologists.

Laser Therapy Protocol

Laser therapy was applied with low energy pulsed infrared laser, a wavelength of 850 nanometers, a power of 800 milliwatts, a spot size of 1 centimeter, 60-80% duty cycle, and 50 Joules per meter square energy density for 20 minutes a session in a setting position, 3 sessions per week for supervisory 8 weeks.

Outcome Measures

The primary variable was pain intensity that was assessed at rest and during activity in two occasions, pre- and post-treatment group using a validated visual analog scale (VAS) score. The

secondary variables were shoulder range of motion (ROM) including, flexion, abduction, internal rotation, and external rotation, shoulder pain and disability index (SPADI), and short-form 36 quality of life (SF-36) that were assessed pre- and post-treatment program.

Statistical Analysis

Data was curated at baseline and after completing the study program. Data was analyzed using SPSS for windows v. 25 (IBM, Armonk, NY, USA). Descriptive analysis was performed using means and standard deviation in continuous data with *t*-test and one-way ANOVA for repeated measures. However, categorical data were analyzed using Mann–Whitney U and Chi-square tests. The statistical significance level was set at $p<0.05$.

Results

Of 60 patients started the study, 5 patients discontinued the study program without any definitive reasons (1 in LT group, 3 in NB group, and 1 in LT+NB group). Analyzing baseline demographics and clinical features showed non-significant differences in all measured variables between LT, NB, and LT+NB groups (age, $p = 0.892$; gender, $p = 0.836$; BMI, $p = 0.822$; symptoms duration, $p = 0.654$; diabetics, $p = 0.941$; symptomatic arm, $p = 0.724$; dominant arm, $p = 0.478$) as detailed in Table I.

Post-treatment, all variables were significantly improved in LT, NB, and LT+NB groups when compared with pre-treatment values (VAS at rest, VAS at motion, SPADI, SF-36 (PCS), SF-36 (MCS), shoulder flexion, shoulder abduction, shoulder internal rotation, and shoulder external rotation, $p < 0.001$) as shown in Table II. As detailed in Table II, no significant differences were noticed between LT, NB, and LT+NB groups before intervention (VAS at rest, $p = 0.818$, VAS at motion, $p = 0.878$, SPADI, $p = 0.919$, SF-36 (PCS), $p = 0.731$, SF-36 (MCS), $p = 0.936$, shoulder flexion, $p = 0.441$, shoulder abduction, $p = 0.722$, shoulder internal rotation, $p = 0.396$, and shoulder external rotation, $p = 0.263$). However, noteworthy differences were identified between LT, NB, and LT+NB groups (VAS at rest, $p < 0.001$, VAS at motion, $p < 0.001$, SPADI, $p = 0.011$, SF-36 (PCS), $p = 0.033$, SF-36 (MCS), $p = 0.007$, shoulder flexion, $p < 0.001$, shoulder abduction, $p < 0.001$, shoulder internal rotation, $p < 0.001$, and shoulder external rotation, $p < 0.001$).

Comparison between LT and NB groups showed no differences post-treatment (VAS at rest, VAS at motion, SPADI, SF-36 (PCS), SF-36 (MCS), shoulder flexion, shoulder abduction, shoulder internal rotation, and shoulder external rotation, $p > 0.05$) as shown in Table II.

Discussion

This study aimed at assessing the combination of laser therapy and nerve block for patients with adhesive capsulitis hypothesizing that the nerve block enhances active and passive shoulder mobilization without pain and additionally, nerve block combined with laser therapy may have better effect than each alone.

The study results confirmed our hypothesis that both treatments laser therapy and suprascapular nerve block have positive therapeutic effects in improving the symptoms of adhesive capsulitis. In addition, the study findings approved that the combination of laser therapy and suprascapular

Table I. Baseline demographics and clinical features of the participants.

	LT group (n=19)	NB group (n=17)	LT+NB group (n=19)	*p*-value
Age (yrs)	55.4 ± 7.8	55.8 ± 8.6	56.7 ± 9.2	0.892
Gender (males/females)	13/6	12/5	14/5	0.836
BMI (Kg/m^2)	28.4 ± 3.1	29.2 ± 4.4	28.9 ± 4.1	0.822
Symptoms duration (mon)	4.9 ± 1.2	5.2 ± 0.82	5.1 ± 0.91	0.654
Diabetes (n, %)	12(63.16%)	11(64.7%)	11(57.9%)	0.941
Symptomatic arm (Rt/Lt), n	6/13	3/14	4/15	0.724
Dominant arm (Rt/Lt), n	15/4	16/1	17/2	0.478

Significant level at $p \leq 0.05$. All data are presented as mean ± standard deviation. LT: laser therapy; NB: nerve block; BMI: body mass index; mon: months; Lt: left; Rt: right.

Table I. Baseline demographics and clinical features of the participants.

	LT group (n=19)	NB group (n=17)	LT+NB group (n=19)	*p*-value
VAS at rest				
Pre-TTT	6.4 ± 1.3	6.2 ± 1.5	6.5 ± 1.5	0.818
Post-TTT	4.1 ± 0.91	3.9 ± 0.9	2.4 ± 0.5	<0.001
p-value	<0.001	<0.001	<0.001	
VAS at motion				
Pre-TTT	7.6 ± 1.72	7.5 ± 1.81	7.8 ± 1.88	0.878
Post-TTT	4.5 ± 1.1	4.6 ± 1.3	2.7 ± 0.7	<0.001
p-value	<0.001	<0.001	<0.001	
Total SPADI				
Pre-TTT	78.4 ± 18.5	77.8 ± 19.2	80.2 ± 17.4	0.919
Post-TTT	38.5 ± 11.2	39.7 ± 11.8	29.14 ± 10.5	0.011
p-value	<0.001	<0.001	<0.001	
SF-36, PCS				
Pre-TTT	36.5 ± 13.4	38.7 ± 12.6	35.4 ± 11.8	0.731
Post-TTT	61.6 ± 15.7	60.8 ± 15.2	72.3 ± 12.4	0.033
p-value	<0.001	<0.001	<0.001	
SF-36, MCS				
Pre-TTT	41.4 ± 11.3	42.5 ± 10.8	41.3 ± 10.5	0.936
Post-TTT	66.7 ± 12.9	66.2 ± 12.5	77.8 ± 10.8	0.007
p-value	<0.001	<0.001	<0.001	
Shoulder flexion ROM				
Pre-TTT	81.6 ± 11.8	84.5 ± 12.2	79.4 ± 11.6	0.441
Post-TTT	112.5 ± 13.5	110.7 ± 14.3	134.7 ± 16.3	<0.001
p-value	<0.001	<0.001	<0.001	
Shoulder abduction ROM				
Pre-TTT	75.3 ± 15.2	76.6 ± 14.1	72.8 ± 13.8	0.722
	108.6 ± 16.7	107.4 ± 16.4	129.7 ± 14.5	<0.001
p-value	<0.001	<0.001	<0.001	
Shoulder Int. Rotation ROM				
Pre-TTT	41.4 ± 5.6	43.3 ± 6.1	40.7 ± 5.8	0.396
Post-TTT	63.1 ± 7.7	62.5 ± 7.2	72.8 ± 6.4	<0.001
p-value	<0.001	<0.001	<0.001	
Shoulder Ext. Rotation ROM				
Pre-TTT	34.5 ± 5.4	35.2 ± 5.5	32.3 ± 5.7	0.263
Post-TTT	58.8 ± 6.5	57.6 ± 6.1	68.5 ± 7.1	<0.001
p-value	<0.001	<0.001	<0.001	

Significant level at $p \leq 0.05$. All data are presented as mean ± standard deviation. LT: laser therapy; NB: nerve block; VAS: visual analogue scale; SPADI: shoulder pain and disability index; TTT: treatment; SF: short form; PCS: physical component summary; MCS: mental component summary; ROM: range of motion.

nerve block produces more significant improvements in all outcome measures than each alone. It has been observed that no adverse effects were detected in the patients of the three study groups.

Consistent with our findings, prior documents[17-19] explained that low-power laser therapy with a wavelength of 810 nm significantly reduces pain and increases shoulder range of motion in adhesive capsulitis patients, consequently decreasing shoulder disability and improving the quality of life in those patients. Previous clinical studies[20,21] of laser therapy focused more on shoulder impingement syndrome than on frozen shoulder, however, the reported positive effects appeared only short-lived, as claimed by a recent Cochrane systematic review.

The anti-inflammatory and sedative influences of low-power laser therapy are accompanied by an elevation of pain threshold and an inhibition of the transmission of A-δ and C fibers. This is combined with a suppression of peripheral nociceptors, an increase in hydroxyindoleacetics, a

decrease in inflammatory cytokines such as IL-1, IL-8, and TNF-, and a reduction in prostaglandin levels[22]. In addition, low-level laser therapy reduces pain by promoting the secretion of endogenous opioids in the body's periphery[23].

Regarding suprascapular nerve block, previous study provided that using 10 mL injection was more enough in blocking suprascapular nerve[24]. In line with our study results, a recent study[25] has evaluated the combination between suprascapular nerve block with physiotherapy exercise in patients experiencing adhesive capsulitis and found that this combination was a safe protocol that provided pain relief and functional performance improvement. Furthermore, before the usage of suprascapular nerve block, around ninety-three percent of patients needed opioid medications despite their side effects to overcome shoulder pain. Also, the usage of suprascapular nerve block and reducing opioids and its adverse effects could relieve pain and improve quality of life in those individuals[26]. Moreover, the main advantage of nerve block before rehabilitative exercise is that the analgesic effect facilitates the painless full range of shoulder mobility in all movement planes.

In conclusion, we selected combination of low-power laser therapy and suprascapular nerve block because they are safe, effective, and well-tolerated by the patients. In contrast, nonsteroidal anti-inflammatory, opioid drugs, and conventional physiotherapy techniques are typically used to treat aching shoulders in patients with adhesive capsulitis.

Limitations

The main limitation in the current study is that we did not include one more group with exercise intervention alone without laser therapy and suprascapular nerve block. The second limitation is the shortage of local anesthetic duration. Further studies are recommended to increase the sample size to explore the effect of each interventional modality alone and nullifying the effect of other combination. Moreover, long-term following-up assessment need to conduct in future studies.

Conclusions

Both treatment modalities whether low-level laser therapy or suprascapular nerve block have beneficial effects in the treatment of adhesive capsulitis. The combination between low-level laser therapy and suprascapular nerve block has beneficial effects in the treatment of adhesive capsulitis more than laser therapy or suprascapular nerve block alone. Accordingly, this combination should be recommended in pain management, particularly adhesive capsulitis.

Authors' Contribution

The authors equally contributed to the concept, design, study procedures, and data analysis. The authors declare that they wrote and reviewed the final version of the submitted manuscript.

Conflict of Interest

No potential conflict of interest was reported.

Ethics Approval

The study was ethically accepted by the localized Research Ethics Committee of Physiotherapy and Health Rehabilitation Department at Prince Sattam bin Abdulaziz University (No.: RHPT/21/020).

Informed Consent

With an informative interview, each participant was detailly informed with benefits and possible side effects of the therapeutic modalities used in the study and was instructed to sign a consent form before starting study procedures.

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