

Pragmatic posterior capsular stretch and its effects on shoulder joint range of motion

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ABSTRACT

Objective To evaluate the immediate effects of pragmatic posterior capsular stretch (PPCS) on shoulder joint range of motion (ROM).

Method A quasi-experimental design was used to recruit healthy subjects of age 21.43 (\pm 1.960) years, height 165.8 (\pm 2.1069) cm and weight 63.90 (\pm 13.187) kg. Inclusion criteria were grade 1 and grade 2 of the shoulder mobility test of functional movement screening. Preintervention and postintervention measurement of flexion, abduction, internal rotation (IR), external rotation (ER), reaching up behind the back (RUBTB) and reaching down behind the neck (RDBTN) were compared. A therapist-administered PPCS was the only intervention applied.

Results Paired t-test statistics showed improvement (mean \pm SD) in shoulder flexion (13.5 \pm 8.11), abduction (11 \pm 8.35), IR (8.5 \pm 10.27), ER (7.83 \pm 7.15), RUBTB (17.34 \pm 13.81) inches and RDBTN (2.93 \pm 1.52) inches. The changes in these ROM and functional movements were statistically significant (p <0.05).

Conclusion PPCS can effectively improve the functional movement of RUBTB and shoulder ROM in healthy subjects. It is recommended for the trials on prevention and rehabilitation of shoulder pathologies.

Trial registration number NCT04242888.

INTRODUCTION

The mechanism of indirect shoulder injuries is under debate in the literature. Asymptomatic changes in the thoracic spine and shoulder girdle are considered the precursors of specific diagnoses such as subacromial impingements.^{1 2} One of the most prominent changes reported in this regard is scapular dyskinesia.² The opinion of the researchers on shoulder pathology is gradually drifting towards posterior capsular tightness as a major culprit in relation to scapular dyskinesia and subsequent pathology.^{3–5} A cohort study reported a strong association of scapular dyskinesia and glenohumeral rotation deficits with the shoulder pain.⁶ Another study reported the presence of scapular dyskinesia for 9–24 months increases the risk of shoulder pain by 43% in an athletic population.^{7 8} It is theorised that glenohumeral internal rotation deficit is a result of posterior capsular

What are the new findings

- ▶ A novel posterior capsular stretch can effectively loosen the posterior capsule.
- ▶ Posterior capsular tightness is the precursor of indirect shoulder pathology.
- ▶ It can be used for prevention as well as rehabilitation of shoulder pathology especially in overhead athletes.

tightness, and scapular dyskinesia is its manifestation.^{7 8}

It is observed that the repetitive overload during the deceleration phase of throwing leads to the hypertrophy of the posterior capsule, which forces the greater tuberosity of the humerus to translate superiorly—a useful observation that explains the mechanism of subacromial impingement.⁹ Therefore, a lax capsule is necessary for the optimum function of the shoulder.

To loosen the posterior capsule, a cross-body stretch, sleeper's stretch and modified stretches are used. The application of a cross-body stretch and a sleeper's stretch has been reported with an increase in range of internal rotation (IR) and external rotation (ER) in healthy subjects.^{5 10 11} However, the scapula remains unstable during these stretches and therefore a modified stretch had been proposed and reported with better outcomes of IR and ER.¹² All three stretches fail to address the torsional stress on the posterior capsule, which is mandatory in functional movements of reaching up behind the back (RUBTB) and reaching down behind the neck (RDBTN).⁸

Objective

A pragmatic posterior capsular stretch (PPCS) is designed to stretch the posterior capsule when it is in torsion. The purpose of this study is, therefore, to evaluate the effects of this novel technique on the shoulder range of motion (ROM) and its functional movements.



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METHODOLOGY

Study design

This single-group study of quasi-experimental design recruited 30 subjects in an equal proportion of males and females from a convenient sample of 18–30-year students of Helping Hand Institute of Rehabilitation Sciences. A sample size of 30 was deemed appropriate after a pilot trial on five healthy subjects with restricted shoulder mobility, which produced a meaningful difference of 15-degree change in abduction, and 3 cm difference in RUBTB, using SD estimates from previous studies.^{13 14} The primitive study design on healthy subjects was deemed appropriate since the intervention was novel and exploratory in nature. The sample included subjects of grade 1 or 2 on the shoulder mobility test of functional movement screening (FMS).¹⁵ Both the grades indicate restriction in functional movement and shoulder ROM. Subjects with any pathology of the shoulder and with scores of Grade 0 (unable to bring arm behind the back) and Grade 3 (no restriction in shoulder mobility) on the same scale were excluded. An approved informed consent form was signed by each subject. This study design was approved by the Board of Advanced Study and Research of Isra International University Islamabad. This study represents one of the four arms of novel interventions registered on ClinicalTrials.gov (NCT04242888).

Data collection and instruments

The shoulder mobility tests of FMS were used to assess the RUBTB and RDBTN.¹⁵ Distance between the close bony

prominences in each fist was measured before and after the intervention.

A digital inclinometer installed on a smartphone was used for measuring shoulder flexion, abduction, IR and ER. This method is reported with excellent reliability and concurrent validity.^{16 17} Abduction was measured with the shoulder in the ER and flexion with the shoulder in IR. This method was used for better visibility of the inclinometer. The phone was strapped to the wrist and the reading on the inclinometer was set to zero at 90° shoulder abduction in a supine position on a Bobath's plinth for IR and ER, while abduction was measured in standing. All the ROM and functional movements were active in nature. This procedure for measuring each variable was repeated after the intervention.

Intervention: PPCS

PPCS was the only intervention used during the study. The subject is positioned in side-lying as shown in [figure 1](#). Label 1 shows the position of the thumb and fingers. The therapist stabilises the scapula in protraction through one hand and uses his/her other hand for longitudinal traction (label 2), medial rotation (Label 3) and extension (label 4) simultaneously. The semi-flexed elbow provides the necessary leverage, and the manoeuvre is performed in a way to mimic the active RUBTB. The stretch is maintained for 30 s combined with at least three deep breaths, and each breath is held in deep inspiration for around 8–10 s. Three repetitions are performed. Intervention was given by well-trained and experienced male and female physiotherapists for their respective genders.

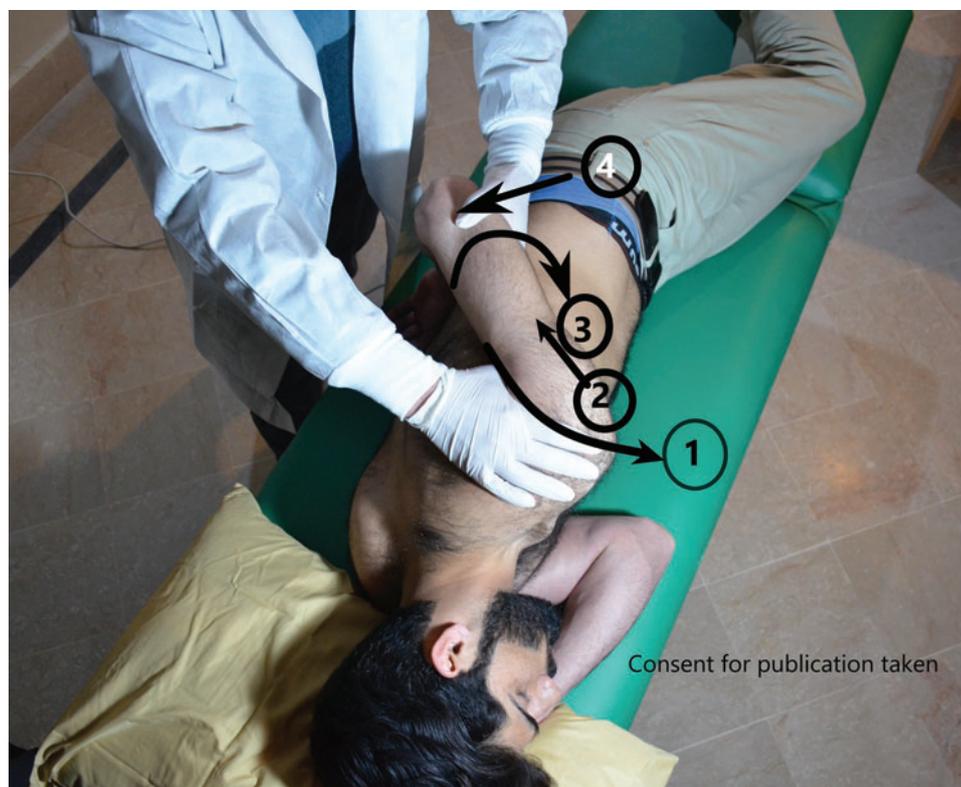


Figure 1 Novel posterior capsular stretch techniques.

The principal investigator was not involved in the data collection and administration of the intervention. The intervention was given by senior physiotherapists. The data were collected by two male and two female undergraduate students before and after the intervention, for their respective genders under the supervision of senior physiotherapists. Mutual consensus for each measurement was reached by taking the mean value.

Data analyses

Descriptive statistics were computed for all variables. The normal distribution of the change in all dependent variables was computed through Kolmogorov-Smirnova and Shapiro-Wilk test. The mean and SD values of the pretest scores, posttest scores and the mean change in between each of the dependent variables were calculated using a paired t-test. Percentage change from the initial scores was calculated to show the amount of improvement in addition to the significant value. The effect size was calculated for each variable as the sample size appeared small.

RESULTS

The mean (SD) values for age, weight and height were 21.43 (± 1.960) years, 63.90 (± 13.187) kg and 165.8 (± 2.1069) cm, respectively. The dominant shoulder in 28 participants was the right, which was treated with the pragmatic stretch. Among the male participants; eight played cricket, five played volleyball and two played both; while eight females played badminton, two went to the gym and the remainder did not participate in any sport, though did carry out household chores such as putting objects on high shelves and hanging clothes for drying.

Data showed normal distribution on all the ROM ($p > 0.05$). Baseline statistics of shoulder ROM revealed limitation in almost all the mean values of ER, IR, flexion and abduction compared to the normative ROM values. Similarly, all values improved after improvement in RUBTB following an intervention. Detailed statistics are given in table 1. Paired t-test statistics revealed profound and significant improvements in all ranges. The effect size was calculated by dividing the mean change through the

respective SD and through all the ROMs, a very large effect of more than 1 was found.

DISCUSSION

Effects of PPSC and its analogy

The results of this study reveal that a single session of PPSC can significantly and profoundly increase the shoulder ROM in healthy subjects. The improvement in each ROM was close to normal values.¹⁸ It is further observed that posterior capsular tightness has a direct relationship with rotation, abduction, flexion and RUBTB. Restriction in shoulder ROM was observed in association with the restriction in RUBTB at baseline and, once RUBTB improved due to PPSC, simultaneous improvement occurred in all the shoulder ROMs. These observations are consistent with the findings reported by Rosa *et al* in relation to the posterior capsular tightness.⁴

Improvement in shoulder ROM is also reported with the intervention of the cross-body stretch, sleeper's stretch and modified stretch. The improvement associated with these stretches is less pronounced and required a longer duration of 4–8 weeks.^{11 14 19} However, the current study lacks follow-up measurements of ROM, which need to be explored.

PPSC and RUBTB

RUBTB requires extensibility of the posterior capsule in torsion, a factor which is lacking in the other forms of stretches which are aimed at lengthening the capsule in a longitudinal direction. PPSC is more specific to RUBTB and addresses the rotatory aspect of the posterior capsule, which makes it an effective intervention. In addition, sleeper's stretch and cross-body stretch do not accentuate the stability of the scapula, which is required because of greater tubercle adjustment and superior translation around 90° of arm elevation as observed by McClure *et al*.²⁰ Therefore, the stability of the scapula during the cross-body stretch and sleeper's stretch has been questioned and the modified stretch had been proposed.²¹ For this very reason, the PPSC emphasises the passive stability of the scapula.

Table 1 Range of motion before and after PPSC

Range of motion	Preintervention Mean (\pm SD)	Postintervention Mean (\pm SD)	Mean change X (\pm SD)	Per cent improvement	P value	Cohen's d value
Flexion	152.67° (12.71°)	166.17° (10.31°)	13.5° (8.11)	8.9%	≤ 0.001	1.66
Abduction	151.33° (11.81°)	162.33° (9.62°)	11° (8.35)	7.2%	≤ 0.001	1.31
Internal rotation	53.67° (13.38°)	62.17° (12.57°)	8.5° (10.27)	15.9%	≤ 0.001	0.82
External rotation	71.67° (9.67°)	79.50° (11.01°)	7.83° (7.15)	11.0%	≤ 0.001	1.09
Total rotation	124.33° (17.75°)	141.67° (19.13°)	17.34° (13.81)	14.0%	≤ 0.001	1.25
RUBTB (cm)	24.10 (3.81)	17.20 (3.80)	6.90 (2.80)	28.6%	≤ 0.001	2.45
RDBTN (cm)	24.10 (5)	16.70 (35)	7.40 (3.85)	31%	≤ 0.001	1.92

NPCS; RDBTN, reaching down behind the neck; RUBTB, reaching up behind the back.

The PPCS resembles Mulligan's mobilisation with movement (MWM) for hand behind the back.²² Unlike Mulligan's MWM for hand behind the back movement, the PPCS includes stabilisation of the scapula in end range protraction, passive medial rotation, passive extension, the position of the therapist behind the back and patient position in side-lying—all combined with the deep breathing and administration duration of at least 30 s.

Recommendations and limitation

The current report does not have a control group, and the results cannot be generalised. Therefore, the future studies on PPCS should be of multiple treatment sessions on multiple occasions, with a control group in both healthy subjects and subjects with shoulder pathology.

CONCLUSION

PPCS can effectively improve the functional movements (RUBTB, RDBTN) and shoulder ROM of healthy young adults, and is recommended for the trials on prevention and rehabilitation of shoulder pathology.

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