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# Effectiveness of Blackburn Exercise on Pain, ROM and Disability in Shoulder Impingement Syndrome among Construction Workers: An Experimental Study

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## ABSTRACT

**Background:** shoulder impingement syndrome (SIS) is one of the most common disorders of affecting the shoulder joint. Approximately 44-46% of general population are affected by shoulder pain due to impingement syndrome. It affects the structure passing through the subacromial space. Construction workers are frequently involved in lifting, pushing, pulling and overhead activities for long period of time during their work. This continuous work in poor posture alters the normal muscle function & biomechanics of shoulder joint and leads to the shoulder impingement syndrome. Therefore, the purpose of this study was to find the effectiveness of blackburn exercise on Pain, ROM & Disability in shoulder impingement syndrome in construction workers.
**Materials and Methods:** 64 construction workers who are routinely involved in overhead activities and having shoulder pain and difficulty in performing overhead activity were included in the study. Neers impingement test, Hawkins Kennedy impingement test & painful arc syndrome was the diagnostic criteria. Visual analogue scale (VAS), Shoulder Pain and disability index (SPADI), universal goniometer were used to assess the individuals. paired t – test was used.
**Result:** There was considerable difference in pre and post score of VAS, SPADI and ROM with the p value of <0.0001.
**Conclusion:** Study concludes that blackburn exercise is effective in reducing the pain and improving the shoulder ROM and functional disability in construction workers.

***Keywords:*** shoulder impingement syndrome, construction workers, blackburn exercise.

## INTRODUCTION

The subacromial space is defined as the space between humeral head inferiorly, the anterior edge and under surface of the anterior third of the acromion, coracoacromial ligament and the acromioclavicular joint superiorly. Shoulder impingement syndrome is a condition where the subacromial space (area directly below the acromion process and above humeral head) has narrowed which causes compression of the structures during humeral elevation [1].

The supraspinatus tendon, subacromial bursa, long head of the biceps brachii tendon, and the capsule of the shoulder joint are the tissues that fill the subacromial gap. Shoulder impingement syndrome can affect any or all of these structures1. Approximately 36% of the general population is thought to be impacted by shoulder problems. Subacromial

impingement syndrome, which accounts for 44-60% of all complaints of shoulder discomfort, is the most typical cause of shoulder pain[1].

The main causes are morphological acromion preconditions or structural acromion alterations. Secondary causes include like rotator cuff tendon and muscle degeneration, inflammation, and strain. A number of complex causes, including bad posture, muscle dysfunction, and capsulo-ligamentous stiffness, can cause changes in the scapular orientation. In patients with subacromial impingement, dysfunctional or weak rotator cuff musculature has been widely characterised.[2]

As the subacromial space is so small, even a little change in dimension could cause the subacromial tissues to compress during glenohumeral elevation. Normal scapular posture and mechanics may change when the scapular musculature is weak or dysfunctional. Inefficient shoulder function can lead to lower neuromuscular performance as well as an increased risk of shoulder injury when the scapula does not carry out its stabilising function.[2]

For normal movement at glenohumeral joint to occur, the scapular muscles should dynamically position the glenoid. During glenohumeral elevation, the scapula exhibits a pattern of upward rotation, external rotation, and posterior tilting. upward rotation of scapula causes elevation of the acromion, and posterior tilting elevates the anterior acromion. To avoid impingement at these acromion-related regions, it seems crucial for both of these scapular motions to occur during glenohumeral elevation[3].

The scapulothoracic articulation is made up of the scapula and thoracic cage. The scapula serves as a steady base from which glenohumeral movement occurs during normal upper-quarter activity. Therefore, scapular posture and motions on the thorax are an essential part of regular GH function and are crucial for enabling the best shoulder movements. The surrounding musculature affects the stability of the scapulothoracic joint. The main scapular stabilisers are the levator scapulae, rhomboid major and minor, serratus anterior, and trapezius. To control the movement, this muscle group collaborates with the rotator cuff in a synergistic manner. [1,8]

Construction workers are exposed to awkward posture, repetitive shoulder movements, overhead work, and reaching up with one or both arms raised above the shoulders because of the nature of their work[14]. Regular overhead workers frequently develop shoulder pain, which in turn gradually leads to functional loss and disability[4].

**Need of study**

- Despite being physically taxing, construction work is essential to the health of our country. They are involved in forceful shoulder exertions and repetitive shoulder movements, reaching up with one or both the arms above shoulder levels are the risk factors for shoulder impingement syndrome.
- This in turn reduces workers capacity to work efficiently and also increases the work related injuries.
- There is dearth in literature focusing on blackburn exercise regimen on shoulder impingement syndrome in construction worker.
- These exercise as a whole can be performed as daily warm up activity by workers which will in turn help to lower the work-related shoulder injuries
- Hence the study was conducted to find the effectiveness of blackburn exercise on Pain, ROM and Disability in shoulder impingement syndrome among construction workers.

## AIMS AND OBJECTIVES

**Aim-** To study the effect of Blackburn exercise on Pain, ROM and Disability in shoulder impingement syndrome among construction workers after 6 weeks of protocol.

**Objectives**

(1) To determine the effect of Blackburn exercise on Pain in shoulder impingement syndrome among construction worker by using Visual Analogue Scale after 6 weeks.

(2) To determine the effect of Blackburn exercise on Range Of Motion in shoulder impingement syndrome among construction worker by using goniometer after 6 weeks.

(3) To determine the effect of Blackburn exercise on disability in shoulder impingement syndrome among construction worker by using Shoulder Pain And Disability Index after 6 weeks.

## MATERIALS AND METHOD

**Materials**

- Visual Analogue Scale [5].
- Shoulder pain and disability index[6].
- Universal goniometer[7].
- Record sheet.

## METHODOLOGY

- Study design: experimental study
- Study type: single group pre test post test study.
- Study setting: in and around the city
- Study population: construction worker
  Sample size :64(calculated by formula - $N = z^2p\ q/\ E^{2)}$
- Sampling technique: convenient Sampling
- Study duration: 1 year

## SELECTION CRITERIA

**Inclusion criteria**

- Both male and females (18 to 40 age).
- At least two of the following test shoulder be positive 1) Neers test 2) Hawkin's test 3) painful arc from 60 - 120 degree during active flexion[8].
- History of shoulder Pain from 4 weeks during overhead activity.
- Pain localizes on anterolateral aspect of shoulder joint
- Full time worker from 3-6 years [4].

**Exclusion criteria**

- Prior history of shoulder dislocation and fracture
- History of any shoulder surgery
- Cervical disc pathology
- Diagnosed for Frozen shoulder, thoracic outlet syndrome
- Pain score >7 on VAS
- Those who receive any physiotherapy treatment in past 3 months.

## METHOD

The study was commenced after getting approval from the ethical committee. Individuals (construction workers) were chosen according to inclusion and exclusion criteria.

A written consent form was taken and entire procedure was explained to the patient in language understood by the patient.

Demographic data of all the subjects was collected including age, work experience, working hours and type of job.

Total duration of intervention is 40 minutes, Warm up – 5 mins, Cool down – 5 mins

Black burn exercise (6 steps) – 3 sets of 10 repetition with 3- 6 sec hold which gradually progress to the 10 secs hold after 2 weeks.

The intervention will be given for 5 days/week for 6 weeks.

Pain, ROM and Disability will be documented of each subject before and at end of 6 weeks of protocol.

## PROCEDURE

**Blackburn exercise protocol:**

**1. Prone horizontal abduction (neutral):**

**2. Prone horizontal abduction (full external rotation):**

**3. Prone horizontal scaption (neutral):**

**4. Prone horizontal scaption (full external rotation):**

**5. Prone horizontal external rotation:**

Position: prone with arms abducted horizontal to side and elbows bent $90^0$.

**6. Prone horizontal extension:**

## DATA ANALYSIS AND RESULT

- Collected data was entered in MS excel spread sheet.
- Statistical data analysis was done by using InStat graph pad software version 3.06.
- Total 61 subjects participated in the study. Various statistical measures such as mean, standard deviation (SD) and test of significance were utilized to analyze the data. 95% confidence interval was taken into consideration. The results were concluded to be statistically significant if, p value was <0.05 and to be statistically insignificant if, p value was >0.05.
- Data of pre and post VAS score did not pass the normality test hence nonparametric test Wilcoxon rank sum was used.
- Pre and post data of SPADI and shoulder ROM passed the normality test hence parametric test was used. For within group analysis paired t test was used.

**Table 1: Gender wise distribution of participants**

| Variable | Groups | No. of subjects | Percentage |
|---|---|---|---|
| Gender | Male | 57 | 93 |
| | Female | 4 | 7 |
| | Total | 61 | 100 |

**INTERPRETATION:** The above table shows that out of total study population 93% were males and 7% were females.

**TABLE 2: Distribution of visual analogue scale.**

| Variable | Groups | Pre | | Post | |
|---|---|---|---|---|---|
| | | No. of subjects | percentage | No. of subjects | Percentage |
| VAS | no pain | 0 | 0.00 | 23 | 17.42 |
| | mild | 43 | 32.58 | 38 | 28.79 |
| | Moderate | 18 | 13.64 | 0 | 0.00 |

**INTERPRETATION:** table no. 2 shows that before intervention 43 subjects were into mild pain and 18 subjects were into moderate pain group. and after intervention 23 subjects were into no pain and 38 subjects were into mild pain group and there were 0 subjects into moderate pain group. indicating a considerable decrease in pain score.

**TABLE 3: Comparison of pre post parameters of VAS.**

| VAS | Mean | SD | p value |
|---|---|---|---|
| Pre | 3.78 | 1.18 | <0.0001 |
| Post | 1.04 | 1 | |
| mean diff | 2.73 | | |

**INTERPRETATION:** table no. 3 shows that mean score of VAS before intervention was 3.78 and after intervention was 1.04. P value is <0.0001 indicating considerable decrease in pain after intervention. Data of VAS did not pass the normality test hence, non-parametric test was used Wilcoxon rank sum.

**TABLE 4: Comparison of pre post SPADI score :**

| SPADI | Mean | SD | p value | t value |
|---|---|---|---|---|
| Pre | 27.89 | 8.46 | <0.0001 | 20.79 |
| Post | 8.92 | 4.85 | | |
| Mean diff. | 18.9 | | | |

**INTERPRETATION:** table no. 4 shows that the mean of SPADI before intervention is 27.89 and after score is 8.92. indicating significant lowering of disability. paired test was use for intra group analysis.

**TABLE 5: Comparison of Pre Post mean ROM**

| ROM | Pre | | Post | | P value | t value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Abduction | 120 | 16.06 | 161 | 12.09 | <0.0001 | 36.25 |
| Flexion | 133.72 | 13.03 | 167.05 | 10.29 | | 33.06 |
| IR | 47.68 | 8.38 | 73.75 | 10.67 | | 30.97 |
| ER | 28.93 | 12.04 | 61.68 | 18.25 | | 25.98 |

**INTERPRETATION:** table no 5 shows mean score of abduction pre exercise is 120 and post exercise is 161. for flexion pre score is 133.72 and post score is 167.05 for ER pre score is28.93 and post score are 12.04. and for IR pre and post score is 47.68& 73.75 respectively.

## DISCUSSION

The present study was conducted to see the effectiveness of blackburn exercise on shoulder impingement syndrome on pain, ROM and disability in construction workers. Shoulder impingement syndrome is the commonest shoulder disorder, resulting in functional loss and disability in the patients that it affects. It affects the structures passing through the suprahumeral space, which are rotator cuff tendons and the subacromial bursa. The upper and lower trapezius have shown increased activity while the serratus anterior has shown decreased activity in construction workers with impingement syndrome, which results in changes to the scapular kinematics of decreased upward rotation and increased anterior tilting and internal rotation during glenohumeral elevation [4,9].

In this study total 61 subjects (3 dropouts), both male and female with mean age of 31.78 were selected using convenient sampling method. Blackburn exercise along with 5 min of warm up and cool down session was explained to the subjects. The outcome measures that is pain, ROM and disability was measured in the beginning of intervention and after 6 weeks that is at the end of intervention.

Present study showed that there was reduction in pain and improvement in functional status post intervention p <0.005. This study is lined with Paula R Camargo,

Melina Haik, et al, in their study found that shoulder strengthening and stretching exercise in workers with shoulder impingement syndrome is effective in decreasing the pain where pain rating index was outcome measure [19] Malarvizhi D, Divya Shivakumar, et al found the similar result in their study effect of home exercise programme on shoulder pain and functional status in construction workers[4].

There was significant difference (p value <0.0001) seen in the pre (3.78± 1.18) and post (1.04 ±1.0) mean score of VAS as mentioned in table no. 4. And in pre (27.89 ± 8.46) and post (8.92 ± 4.85) mean score of SPADI (shoulder pain and disability index). Thus showing significant reduction in disability of workers after 6 weeks.

This study showed that there was considerable difference in post score of all ROM when compared with the pre intervention values p<0.005. study is in lined with Zeliha Baskurta¸ Ferdi Bas¸ Kurta et al in their study, included 27 women and 13 men, mean age 51 (24–71) years old, pain severity, ROM, muscle strength were taken as a outcome measures . there was significant improvement in ROM after scapular stabilization exercise p value <0.005[2] Lamba Dheeraj et al included 30 subjects with rotator cuff injuries and divided them in two groups group A (Blackburn exercise) and group B (conventional exercise). Outcome measures were pain, ROM and strength measure by VAS, Goniometer and 1 RM. exercise was given for 2 weeks 5 times a week. At the end of 2 weeks there was significant reduction in pain, improvement in all shoulder ROM (flexion, abduction, external rotation, internal rotation) and strength with p value <0.005[10].

Usually, it is problematic when movements bring the larger tuberosity closer to the coracoacromial. These movements occur during humeral elevation and involve excessive superior or anterior translations of the humeral head on the glenoid fossa, insufficient lateral (external) rotation of the humerus, decreases in the usual upward rotation of the scapula, and posterior tipping on the thorax[11].

The lateral acromion is elevated by upward rotation, which is required to avoid impingement beneath the lateral acromial edge. The anterior acromion, which is the primary site of impingement, is elevated by posterior tilting. There is more anterior tilting than usual in the participants with shoulder impingement. The participants with shoulder impingement show increased activation of the upper and lower trapezius muscles and decreased activation of the lower serratus anterior muscle[3,11]. The serratus anterior muscle, which not only provides muscular effort to create posterior scapular tipping but also stabilizes the inferior scapular angle against the thorax during shoulder elevation1appears to be the muscle mainly responsible for shoulder impingement [12,13].

These muscles become worn out as a result of prolonged use, which also affects their timing and activity. Studies have shown that the lower trapezius fires even later than the serratus anterior, with a delay in serratus anterior activation of more than three times the typical response time. The lower trapezius activates in healthy people before the upper trapezius[12,13]. Scapular muscles not only work to stabilize the scapula but also contracts to rotate it as the glenohumeral elevation proceeds .The middle and lower serratus anterior are the only scapulothoracic muscles with the capability to both upwardly rotate and posteriorly tilt the scapula on the thorax Their line of action will also directly approximate the scapula to the thorax, which can act as a stable base[3].

Abbey Schory in their systematic review identified optimal positions and exercises for periscapular stability exercises. According to this study, side-lying and prone positions with the elbow flexed to 90° had the better ratios for activating the middle trapezius. prone external rotation with the shoulder abducted to 90 degrees and the elbow flexed showed optimal ratio for lower trapezius[13.]

Lower trapezius activity is more in prone external rotation. Prone scaption with external rotation & prone horizontal external rotation will focus on supraspinatus which will help in glenohumeral stabilization. Prone external rotation will activate the lower trapezius and rhomboids[7]. Maximum activity of serratus anterior is found in prone neutral scaption. Which will help in improving the reduced upward rotation and posterior tilting of scapula during elevation movement. Thus, helps in correcting the altered muscle action during humeral elevation movement [14,18].

Blackburn exercise increases the strength of scapulothoracic and rotator cuff musculature ( upper , middle and lower trapezius, serratus anterior, rhomboid , deltoid infraspinatus , teres major and minor ) and also help to reduce the muscle imbalance .thus will reduce the excessive superior translation of humeral head in glenoid fossa during elevation and increases upward rotation of scapula and posterior tipping on thorax which in turns prevents the impingement of structures in subacromial space. This clears that blackburn exercise will deal with the root cause of the shoulder impingement. And this exercise alone can be added as a routine exercise for the construction worker to reduce the shoulder related problem and help them to lead healthy life.

## CONCLUSION

1. The study concludes that Blackburn exercise is effective in reducing pain, improving functional status and shoulder ROM in construction workers after 6 weeks.

## LIMITATION

1. Limitation of the study is that, the patients are not analyzed according to their dominant extremity involvement.

## CLINICAL IMPLICATION:

1. The study findings are of clinical importance since they indicate an improvement in range of motion, functional status and reduction in pain in workers with shoulder impingement.
2. Hence, Blackburn exercise could be used to improve range of motion, functional status and reduce pain in shoulder impingement syndrome among construction workers.

## Future Scope

1. Future studies need to be done with other outcome measures such as muscle strength.
2. Future studies need to be done with other factors like amount of weight lift and hold overhead

## *Declaration by Authors*

**Ethical Approval:** Approved

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