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# Effectiveness Of Blood Flow Restriction Therapy In Construction Workers With Impingement Syndrome

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## ABSTRACT

**Background:** Shoulder impingement syndrome is a leading cause of shoulder-related morbidity, particularly in construction workers who perform repetitive overhead movements. Blood Flow Restriction Therapy (BFRT) has emerged as a potential intervention to enhance muscle strength and reduce pain in affected individuals.

**Objective:** This study evaluates the effectiveness of BFRT in improving pain levels and muscle strength in construction workers diagnosed with impingement syndrome.

**Methods:** A total of 10 participants (aged 30–60) diagnosed with impingement syndrome were included in this interventional study. Participants underwent a structured physiotherapy protocol, including BFRT, three times a week for four weeks. Pre- and post-treatment assessments were conducted using the Visual Analog Scale (VAS) for pain and a handheld dynamometer for muscle strength measurement. Data analysis was performed using paired t-tests.

**Results:** A significant reduction in pain was observed (VAS score decreased from $7 \pm 1.491$ to $2.2 \pm 1.033$, $p < 0.0001$). Additionally, there was a statistically significant increase in muscle strength across key shoulder muscles, including the supraspinatus ($p < 0.0001$), infraspinatus and teres minor ($p < 0.0001$), and subscapularis ($p = 0.0002$).

**Conclusion:** BFRT is an effective intervention for reducing pain and improving muscle strength in construction workers with impingement syndrome. Its ability to enhance neuromuscular function and promote recovery suggests that it may be a valuable addition to occupational rehabilitation programs. However, further research is needed to optimize treatment protocols and assess long-term outcomes.

***Keywords:*** *blood flow restriction therapy, shoulder impingement*

## 1. INTRODUCTION

36% of shoulder illnesses are caused by shoulder impingement syndrome, which has the highest frequency. Injuries to the subacromial region, including bursitis, partial thickness cuts of the rotator cuff, and tendinosis, are together referred to as shoulder impingement syndrome. There is ongoing discussion over the cause of rotator cuff injuries and how they relate to subacromial impingement, or the encroachment of the associated tissues. Shoulder impingement syndrome frequently results in discomfort and disability, diminished quality of life, and disturbed sleep[1].

When performing repetitive, high-velocity overhead movements, the shoulder needs to be mobile while also remaining functionally stable to prevent damage. Stated differently, when carrying out high-speed movements, the shoulder needs to remain stable at its end ranges of motion. A disruption of this delicate equilibrium frequently leads to a variety of shoulder diseases. For these professionals to return to work safely and avoid recurrence injury, it is crucial that they develop sufficient shoulder stability strength and mobility[2].

There are a number of theories as to why exercise helps people with nonspecific shoulder pain, but the most commonly cited neuromuscular theory contends that strengthening the rotator cuff muscles reduces pain. Therapeutic exercise loading is the cornerstone of conservative treatment and seems to be a potent tool in the hands of clinicians to improve pain, mobility, and shoulder function in patients with nonspecific shoulder pain[3].

BFRT was first introduced in Japan as KAATSU training in the 1970s and has since been widely studied for its ability to enhance muscle strength and hypertrophy using low-load exercises. This method involves applying a specialized tourniquet to the proximal limb to partially restrict venous blood flow while maintaining arterial inflow. The resulting hypoxic environment triggers metabolic stress, promotes the recruitment of fast-twitch muscle fibers, and stimulates the release of growth factors such as insulin-like growth factor-1 (IGF-1) and growth hormone (GH)[4].

A tourniquet applied to the proximal upper or lower extremities causes arterial blockage, which results in metabolic stress. This creates a hypoxic environment that promotes anaerobic metabolism by blocking venous outflow while preserving arterial inflow[4].

In rehabilitation, grip strength measurement is frequently used to assess dominant and nondominant limb strength or to compare against normative values. Alizadehkhaiyat et al. discovered that the supraspinatus and infraspinatus were engaged by a standardized hand grip task performed in a neutral position. It has been demonstrated that grip strength is an objective indicator of upper extremity function and is connected with both upper extremity strength and overall body strength[5]. A statistically significant and positive correlation between isometric hand grip strength and isokinetic peak torque and work assessments of the shoulder stabilizing muscles was discovered by Nascimento, Manadlidis, and O'Brien. Because of the force conveyed down the myofascial pathways and the need for a stable proximal shoulder girdle to facilitate effective recruitment of the distal muscles, the link has been hypothesized. It has been demonstrated that hand grip dynamometers are a simple and accurate way to measure grip strength[6]. A statistically significant and positive correlation between isometric hand grip strength and isokinetic peak torque and work assessments of the shoulder stabilizing muscles was discovered by Nascimento et al. and Manadlidis and O'Brien. It has been demonstrated that grip strength serves as an objective indicator of the upper extremity's functional integrity and may be objectively assessed with a hand dynamometer. Comparatively speaking, hand grip dynamometry is less expensive than traditional isokinetic dynamometers, and there has been a moderate correlation found between the two[6].

## 2. MATERIALS & METHODOLOGY

The Ethical Committee and Protocol Committee authorized the research investigation (protocol number - 2024). The research is a interventional study involving 10 participants including both genders from the Karad, Maharashtra, India. This research recorded the pre- and post-treatment values between the same group that lasted for a duration of 6 months. The goal of this study was to find effectiveness of blood flow restriction therapy in construction workers with impingement syndrome. And to explore the experiences and perceptions of patients and health care providers regarding physiotherapy interventions.

This study was conducted as per inclusion and exclusion criteria. Participants were briefed on the study's nature, duration, and intervention in their language of choice. The subjects of this study were adult patients diagnosed with advanced stage illness with age range: 30 to 60 yrs, Patients with a pain score of >4 (vas) obtained during 1st visit, Patients with Diagnose impingement syndrome And Patients who are able to provide informed consent or have a legally authorized representative were included. And Patients who have recently undergone surgery or experienced trauma were excluded from this study. This study was conducted on 10 patients .Informed consent was taken from the study participants & baseline data was collected. Pre-assessment was done regarding pain, and strength . They were assessed with Visual Analog Scale (VAS) and Handheld dynamometer. The individuals taking part in the research were assigned to a group, who received a preset structured physiotherapy protocol for 3 times a week for 30 mins; for 4 weeks duration.

BFR Protocol:- The Arterial occlusion pressure needed for the complete occlusion of the upper extremity blood flow will be measured at rest, with the participant relaxed in the standing position, by placing a 6 cm wide and 60 cm long cuff on the more proximal part of the affected upper limb using an automatic personalised tourniquet system designed to automatically calculate limb occlusion with clinically acceptable accuracy and high reliability. The limb occlusion pressure will be set at 50–60% of the complete occlusion pressure for the intervention group.

## 3. OUTCOME MEASURES

### 1.Visual Analog Scale (VAS)[7]

It is a measurement tool that seeks to measure a characteristic that believed to range across a continuum of values and cannot easily be directly measured. VAS is a uni-dimensional measure of pain intensity, which has been extensively used in various adult people.

The Visual Analog Scale is typically a straight line that is 10 cm (or sometimes 100 mm) in length. The scale has two endpoints, each representing the extremes of the experience being measured:

Left Endpoint (0 or 0%): Represents the absence of the symptom or condition (for instance, "no pain" for pain assessments).

Right Endpoint (10 or 100%): Represents the worst possible level of the symptom or condition (e.g., "worst pain imaginable" for pain assessments).

**2. Handheld dynamometer**[8]

A handheld dynamometer is a portable device used to measure force, particularly in the context of muscle strength or physical function. It is often used in clinical and rehabilitation settings to assess the strength of specific muscle groups in patients or individuals undergoing therapy. The device consists of a handle, a gauge, or a sensor that measures the force exerted when a person pushes or pulls against it.

A handheld dynamometer measures the force exerted by the hand muscles. The unit typically used for this type of measurement is kilograms (kg) or pounds (lb), depending on the design of the device.

Kilograms (kg): Common in regions using the metric system. The force is measured in kg, indicating how much weight the subject is able to grip or lift.

## 4. TREATMENT

**Structured Protocol: 3 Times a week for 30 minutes; for 4 weeks duration.**

This rehabilitation protocol is designed to help individuals recover from a shoulder injury or surgery over the course of four weeks, with a focus on relieving pain, restoring range of motion (ROM), and progressively strengthening the muscles. In Week 1, the primary goals are to relieve pain, decrease swelling, and prevent muscle atrophy. Treatments include pendulum exercises for gentle joint mobility, active-assisted ROM to help with controlled movement, and cryotherapy to reduce inflammation. Isometric exercises are introduced for the external rotation, internal rotation, biceps, and deltoid to maintain muscle engagement without joint movement[9].

In Week 2, the focus shifts towards reducing pain and increasing ROM. Rope and pulley exercises are incorporated for flexion and abduction movements, along with anterior and posterior capsular stretching to enhance shoulder mobility. Cryotherapy continues to address inflammation, while isometric exercises remain to maintain muscle strength. By Week 3, the goal is to normalize ROM and enable symptom-free movement during normal activities. Isotonic dumbbell exercises are added, with side-lying, prone, and standing exercises targeting various movements such as internal and external rotations, extension, and horizontal abduction. Serratus anterior strengthening is introduced through wall push-ups, and blood flow restriction training is used to boost muscle strengthening[9].

In the final Week 4, the emphasis is on increasing strength, endurance, and power. The self-capsular stretching continues, serratus exercises progress, and blood flow restriction training is maintained. This structured approach, progressing from pain management to strength-building, ensures a well-rounded recovery by gradually enhancing shoulder function and muscle performance.

## 5. RESULTS

For data analysis, the data was entered into an Excel spreadsheet, and statistical analysis was performed using the Instat app. Descriptive statistics were utilized, and paired t-tests were employed to ascertain significant differences between pre- and post-interventional group across (VAS Tool & Handheld dyanmometer ) outcome measures.

**Table No.1: Comparison of Mean, SD, P Value & t value of VAS SCALE**

| VAS SCALE | PRE | POST | p-value | t-value |
|---|---|---|---|---|
| | 7±1.491 | 2.2 ±1.033 | <0.0001 | 19.243 |

**Interpretation**:

The results indicate a significant reduction in the measured parameter (likely pain or discomfort) following the intervention, with the average score decreasing from 7 ± 1.491 pre-treatment to 2.2 ± 1.033 post-treatment.

The p-value of <0.0001 and the t-value of 19.243 both suggest that the difference is not only statistically significant but also large in magnitude, emphasizing the effectiveness of the intervention.

**Table No.2: Comparison of Mean, SD, Value & t value of SUPRASPINATUS MUSCLE**

| SUPRASPINATUS MUSCLE | PRE | POST | p-value | t-value |
|---|---|---|---|---|
| | 39±2 | 43.4 ±2.22 | <0.0001 | 12.944 |

**Interpretation**:

The results indicate that there was a significant improvement in whatever parameter was measured for the supraspinatus muscle after the intervention. The p-value of <0.0001 confirms that the improvement is highly statistically significant. The t-value of 12.944 further supports this, indicating a substantial and meaningful difference between the pre- and post-intervention measurements. The intervention had a strong positive effect on the supraspinatus muscle.

**Table No.3: Comparison of Mean, SD, P Value & t value of INFRASPINATUS and TERES MINOR**

| INFRASPINATUS and TERES MINOR MUSCLE | PRE | POST | p-value | t-value |
|---|---|---|---|---|
| | 39.1±2.132 | 43.2 ±2.150 | <0.0001 | 11.781 |

**Interpretation**:

The results indicate that there was a significant improvement in whatever parameter was measured for the infraspinatus muscle and teres minor muscle after the intervention. The p-value of <0.0001 confirms that the improvement is highly statistically significant. The t-value of 11.781 further supports this, indicating a substantial and meaningful difference between the pre- and post-intervention measurements.

The intervention had a strong positive effect on the infraspinatus muscle and teres minor muscle.

**Table No.4: Comparison of Mean, SD, P Value & t value of SUBSCAPULARIS MUSCLE**

| SUBSCAPULARIS MUSCLE | PRE | POST | p-value | t-value |
|---|---|---|---|---|
| | 38.5±3.0280 | 41.9 ±3.479 | 0.0002 | 6.053 |

**Interpretation**:

The mean measurement for the subscapularis muscle increased from 38.5 to 41.9, suggesting a positive effect of the intervention. This could be an increase in muscle strength, size, function, or some other relevant parameter.

The p-value of 0.0002 indicates that the change observed between the PRE and POST measurements is highly statistically significant.

The t-value is a statistic that measures the difference between the groups (PRE and POST) in relation to the variability of the data. A high t-value (like 6.053) indicates that the difference between the two groups is much larger than the variability in the measurements.

## 6. DISCUSSION

This study shows how Blood Flow Restriction Therapy (BFRT) might reduce discomfort and improve muscle strength in construction workers suffering from impingement syndrome. The considerable drop in VAS ratings (7 ± 1.491 to 2.2 ± 1.033) indicates that BFRT efficiently alleviates pain, possibly by lowering inflammation and modifying pain perception through endorphin release. Furthermore, enhanced muscle strength in the supraspinatus, infraspinatus, teres minor, and subscapularis muscles indicate that BFRT improves neuromuscular function and shoulder stability. These data suggest BFRT as a helpful solution for workers who perform repetitive overhead jobs, allowing them to regain function and lower their risk of additional injury.

BFRT causes several critical physiological changes. External occlusion pressure lowers venous return while preserving arterial inflow, resulting in a hypoxic environment that promotes metabolic stress. This hypoxia promotes Type II muscle fiber recruitment, resulting in increased muscular growth and strength even at modest resistance levels. Furthermore, BFRT stimulates the production of anabolic hormones such as growth hormone and insulin-like growth factor-1 (IGF-1), which aids muscle repair and regeneration. Angiogenesis, or the development of new blood vessels, also occurs, increasing oxygen delivery and endurance. Increased lactate accumulation causes a shift to anaerobic metabolism, which is critical for muscle adaptation and resilience. Furthermore, improved proprioception and neuromuscular coordination promote joint stability, lowering the risk of re-injury[10].

Another difficulty was applying BFRT correctly since different limb sizes necessitated exact occlusion pressure calibration

to prevent excessive discomfort or circulation problems. The tourniquet's tightness caused some participants to initially feel anxious and slightly uncomfortable, therefore patient education and reassurance were necessary. The comparatively brief research period (4 weeks) was another drawback, which might not adequately account for the possible hazards and long-term advantages of BFRT[11].

Additionally, some participants found it difficult to attend regular sessions because of work obligations, making it difficult to follow the planned physiotherapy regimen. This is indicative of a larger problem in rehabilitation settings, where time constraints may make it difficult for labor-intensive professionals to comply with treatment. Future research should examine more adaptable rehabilitation plans, perhaps including at-home BFRT activities, to increase adherence[11].

## 7. CONCLUSION

This study highlights the effectiveness of Blood Flow Restriction Therapy (BFRT) in reducing pain and improving muscle strength in construction workers suffering from impingement syndrome. The significant decrease in pain scores and enhancement in shoulder muscle function suggest that BFRT can serve as a valuable rehabilitation approach for individuals engaged in repetitive overhead activities. By inducing physiological adaptations, such as improved neuromuscular activation and muscle hypertrophy, BFRT aids in functional recovery while minimizing the risk of reinjury. Despite its benefits, challenges related to treatment adherence and individualized occlusion pressures necessitate further research to refine protocols and assess its long-term applicability in occupational rehabilitation.

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