Original Article

Efficacy of Low Blood Flow Restricted Exercise on Increasing Muscle Strength in Patients with Knee Osteoarthritis Comparing with Conventional Strength Training

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Abstract

Background: The prevalence of OA knee is diagnosed with radiographic features 15% of patients were symptomatic in one study. OA affects nearly 6% of adults. Female sex is more common. 13% of females and 10% of male in 60 years are affected with OA and in 70 years of population rises to 40%.

Purpose: To find the efficacy of low blood flow restricted resistance exercise on increasing muscle strength in patients with knee OA compared with conventional strength training using NPRS for pain and knee ROM.

Materials and Methods: A total of 60 subjects were assigned in this study. The NPRS and knee ROM were used to calculate pre-and post-test results. Each session included three sets of five repetitions with a ten-second hold in between. The tables were tabulated and statistically evaluated.The entire process was conducted from November 2022 to April 2023.

Result: According to the statistical analysis, both groups had a statistically significant improvement between their pre and post-exercise values ($p<0.0001$). There is also a significant variation in post-exercise results between the two groups ($p<0.0001$), indicating that blood flow restriction with exercises is more effective than conventional strength training with exercises**.**

Conclusion: Blood flow restriction has been shown to be more effective than conventional strength training at relieving pain and increasing knee ROM.

Keywords: Arthritis, Osteoarthritis, Blood flow restriction, Resistance

Introduction

In the anatomical view of OA as a full knee joint of knee. The knee is a wide joint of the human body. It is a synovial joint which contains tibiofemoral and patellofemoral joints . The knee joint performs flexion and extension and some other movements. The anatomical structure and function are depending on muscles, bones, ligaments, cartilage, synovial fluid and tissue. The four ligaments of the knee joint are ACL, PCL, MCL and LCL. The knee had multiple bursae to prevent. The two menisci will separate the fibrocartilage structures attached with tibia and femur. The bursae will prevent the friction between

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the joint surfaces.[1,2] This joint is a common form for arthritis and it is degenerative and characterised by ongoing worsening of cartilage, ligament and joint cavity and the consequences in pain and disability. The OA will affect the biomechanics of the joint.[3] The knee is one of the prominent joints. Osteoarthritis is a degenerative joint disease. It commonly affects the elderly. The OA patients may experience pain, tenderness, stiffness, decreased ROM, downturn of ADL activity.[4] The two aspects of the OA knee are primary. Due to degeneration friction of the joint may increase. The therapy of knee OA disease consists of two essential components: diagnostic and treatment.[5]

The muscles, tendons, and connective tissue around the knee can be strengthened with the aid of resistance bands.[6] Knee band exercises help increase knee mobility and stability while also lowering discomfort and swelling.[7]

Exercise therapy gives pain alleviation that is at least as effective as pharmacological pain drugs while avoiding adverse reactions. In case of mild to moderate OA knee conservative management can be given. Muscle weakness is linked to pain and physical impairment in people with OA of the knee, and it promotes disease progression.[8]

Straight leg raising (SLR) exercises: patient lay in a supine position. A small pillow was put between the knees. They maintain adduction with contraction for seconds.[9] BFR exercise results in enhanced fatigue resistance & improved oxygen consumption when combined with very rigorous training. Blood flow resistance has been performed in samples in low intensity (eg: 25,35%) of1 repetition. Short rest intervals between (eg: 25 seconds). The BFR program will help to restorative the muscle and bone alteration. This study will help us to compare the effectiveness of BFR and conventional strength training in OA knee patients.[10]

Aim

To study the efficacy of low blood flow restricted resistance exercise on increasing muscle strength in patients with knee OA compared with conventional strength training.

Materials and Methods

The Study was conducted on 60 subjects with knee osteoarthritis for ages between 40 and 60 years for 8 weeks from a private physiotherapy clinic. Convenient sampling was used in this study. The entire process was performed from November 2022 to April 2023.

Inclusion criteria:

- Subject of the age group of 40 to 60 years.
- Subjects were selected in both genders.
- Subject with clinically diagnosed osteoarthritis of knee joint.
- Subjects with score below 8 on VAS Scale.
- Subject with stage 2 mild OA knee (knee joints will reveal greater bone spur growth)

Exclusion criteria:

- knee surgeries
- pain more than 10 NPRS scale
- Open wound around knee

Outcome Measure:

Assessment was done before and after the end of 8 weeks of study.

- Numeric pain rating scale (NPRS)
- Range of Motion.

Procedure

Sixty subjects diagnosed with osteoarthritis were screened for inclusion and exclusion criteria. All participants were asked to sign their consent form. The participants were clearly explained about the study. The patients were divided into two groups (Group A-30, Group B-30). The pre and post-test values were measured by visual analog scale, knee range of motion.The entire process was conducted from November 2022 to March 2023.

Group A received blood flow restriction with exercise.

Group B received conventional strength training.

Group A: Blood Flow Restriction:

- Blood flow restriction (BFR) is a technique that involves the application of a specialized

tourniquet or cuff to partially restrict blood flow to a specific area of the body, such as the knee, during exercise or rehabilitation.

- Application of the cuff: A cuff, typically made of an inflatable material, is placed around the upper thigh, proximal to the knee joint. The cuff is then inflated to a specific pressure, which is determined by the healthcare professional based on individual factors such as limb size and tolerance.
- Blood flow restriction: The inflated cuff partially restricts arterial blood flow to the muscles below the cuff, while still allowing venous blood flow to return from the muscles. This restriction creates a temporary ischemic (low-oxygen) environment in the working muscles.
- Exercise or rehabilitation: With the cuff in place, the individual performs exercises specific to their knee rehabilitation program. These exercises typically involve low-intensity resistance training or gentle movements to avoid excessive strain on the knee joint.
- Training parameters: During BFR training, the intensity of exercise is typically lower than traditional training methods, with lighter weights or resistance. This is due to the enhanced muscle response and fatigue that occurs with the restricted blood flow.

Duration and frequency: BFR training sessions are typically shorter in duration compared to regular training sessions, usually lasting around 10-15 minutes.

Safety considerations: BFR should be performed under the supervision of a qualified healthcare professional who is experienced in this technique.

Potential benefits of BFR for knee rehabilitation may include improved muscle strength and size, enhanced recovery, reduced joint stress, and improved functional outcomes.

Duration: BFR training sessions typically last 10-15 minutes.

Intensity: BFR training involves using lower-intensity resistance or performing exercises at around 20-40% of your one-repetition maximum (1RM).

Repetitions and sets: Perform three to four sets of 15-30 repetitions for each exercise.

Rest intervals: Keep rest intervals short, typically ranging from 30 seconds to one min.

Group B: Conventional Strength Training:

Straight leg raises:

Extend one leg straight out in front of you while bending the opposite knee, ensuring the foot stays flat on the ground. Engage the quadriceps muscle in the extended leg by tightening it. Maintain this raised position for a set duration.

Lie on a mat or other solid surface on your back amount of time, usually 2-3 seconds to begin.

Remain in the raised position for the allotted time. Follow your physical therapist's advice and carry out the exercise for the prescribed number of repetitions, such as 10-15. The exercise should be done again on the other side by switching legs.

Calf Raise:

Standing near a wall or other sturdy surface, your feet should be shoulder-width apart for stability. Toes pointed forward, keep your feet parallel to one another. Lift your heels as high off the floor as you can while slowly rising up onto your toes. While maintaining your upright posture, concentrate on tightening your calf muscles. The desired number of times should be done with the movement. It is advised to begin with two to three sets of 10 to 15 repetitions each. As your strength and endurance improves, gradually increase the number of sets and repetitions. Between sets, take a short break of 30 to 60 seconds to allow for recovery.

Quadriceps Isometrics:

Patients were instructed to lie on supine. Underneath the affected knee, A small rolled towel was placed. Ask the patient to push the back of the knee into the rolled towel and encourage them to tense the quadriceps muscle on top of the leg. The patients were told to contract for five seconds, then relax gradually.

Data Analysis

The obtained data was gathered and scrutinized. The mean and standard deviation (SD) were utilized for all parameters. A paired t test was conducted to ascertain whether there were any significant

differences between pre and post-test measurements, and an unpaired t test was conducted to determine between the two groups. A P-value of 0.0001 was utilized as the statistically significant cut off.

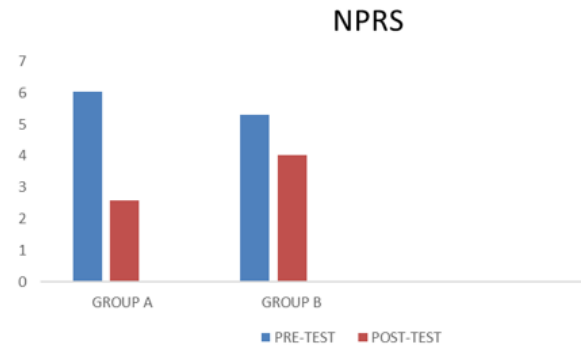

Fig: 1 Comparison of pre and post-test values of NPRS in blood flow restriction and conventional strength training.

Graph No.1:

Graph-1: Comparison of post-test values of NPRS in Blood flow restriction and conventional strength training

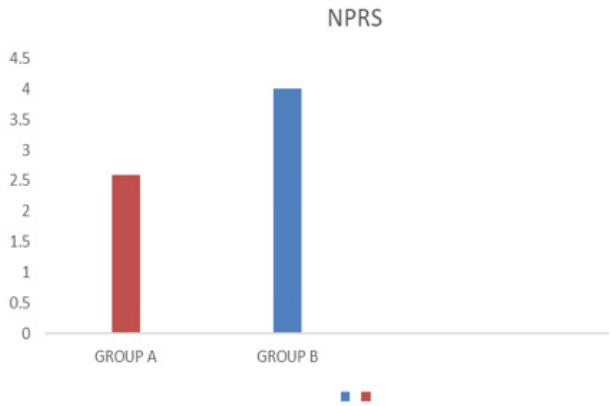

Fig-2: Comparison pre and post-test values of ROM in blood flow restriction and conventional strength training

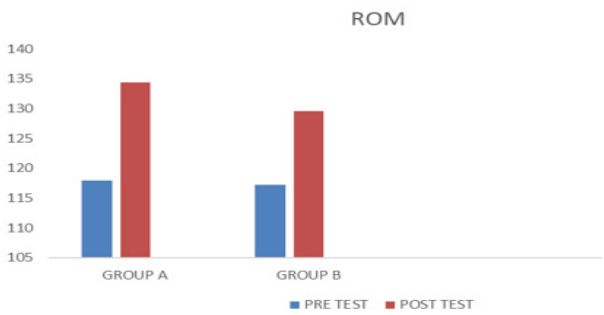

Fig-3: Comparison post-test values of ROM in blood flow restriction and conventional strength training

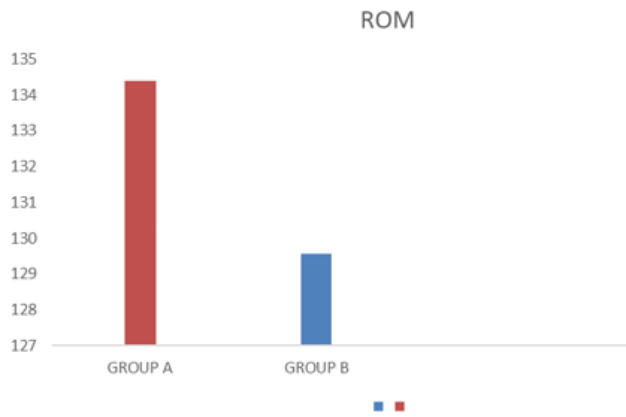

Fig-4: Comparison post test values of ROM in blood flow restriction and conventional strength training

Result

After statistical analysis of data, it was found that there were statistically significant disparities between the values of two groups. Graph 1 contrasts the pre and post test of NPRS and ROM of blood flow restriction with exercise. The pre test mean and SD values of NPRS is 6.04 and 1.55 and post test mean and SD values of NPRS is 2.59 and 0.55. The pre test value of knee flexion was mean and SD 117.97 & 2.71. Whereas the post test value of knee flexion was mean and SD 134.4 and 2.46 with P value <0.0001.

Fig 2 contrasts the pre and post-test of conventional strength training with subjects. The mean and SD value of NPRS is 5.31 and 1.51. Whereas the post test is 4.01 & 1.51 with P value of <0.0006. The pre test value of knee flexion was mean and SD 117.97 & 134.4. Whereas the post test value of knee flexion was mean and SD are 129.57 & 3.00 with P value of < 0.0001.

Fig 3 contrasts of comparison between the blood flow restriction and conventional strength training with exercise. The mean and SD value of blood flow restriction and conventional strength training in NPRS is 2.59 & 0.55 and 4.01 & 1.51. Whereas the mean and SD of shoulder flexion was mean and SD are 134.4 & 129.57 and 2.46 & 3.00.

Fig 4 consist of ROM in blood flow restriction and conventional strength training

As a result, Blood flow restriction with exercise is more significant than conventional strength training

with exercise in patients with osteoarthritis of the knee, which increases the strengthening of the muscle and increases range of motion.

Discussion

The most common type of arthritis in the knee is osteoarthritis. It is a degenerative, "wear and tear" type of arthritis that primarily affects people over the age of 50, though it can affect younger people as well. The cartilage in the knee joint gradually wears away in osteoarthritis.[11,12] The cartilage becomes frayed and rough as it wears away, and the protective space between the bones shrinks. This can cause bone to rub against bone thus resulting in painful bone spurs. Osteoarthritis typically develops gradually, and the pain it causes worsens over time. Walking, aquatic exercise, water jogging, yoga, and Tai Chi have all been found to be effective in OA knee patients to improve their functional status, gait, pain, and aerobic capacity.[13-15]

The purpose of the study is to find the effects of blood flow restriction and resistance training using among OA Knee patients. Research studies also stated that blood flow restriction have shown more effective in OA Knee.[16]

According to the study of Robert W Spitz, et.al (2022) stated that pneumatic cuff or elastic band is used in blood flow restriction exercise to limit arterial inflow into the muscle and block venous return out of the muscle during the exercise bout. It has been demonstrated that the resulting ischemia, when combined with low-load exercise, helps to increase muscle size and strength. The accompanying discomfort from this kind of activity poses a hindrance to using blood flow restriction (BFR).[17-20]

As a result, Blood flow restriction with exercise has been found to be more significant than conventional strength training in osteoarthritis of the knee to reduce pain and to increase range of motion.

Conclusion

This finding led me to the conclusion that blood flow restriction with exercise training was found to be more successful than conventional strength training in reducing pain, increasing muscle strength and restoring function and quality of life in patients with osteoarthritis of the knee. Further research and long term follow up studies are necessary to validate these results and assess the long-lasting effects of blood restriction with exercise in the management of osteoarthritis of the knee.

Ethical Clearance: Taken from Institutional ethical committee. ISRB number: 03/014/ 2022/ ISRB/ SR / SCPT

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Conflict of Interest: Nil

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