AWARENESS OF BLOOD FLOW RESTRICTION TECHNIQUE AS STRENGTH TRAINING OF QUADRICEPS MUSCLE IN POST TKR PATIENTS AMONG PHYSIOTHERAPISTS

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Abstract : Quadriceps weakness is a typical postoperative complication of Total Knee Replacement (TKR) that is likely to impair recovery and functional outcomes. Blood Flow Restriction (BFR) is a safe and effective method of muscle strength training that induces high muscle strength when combined with low-intensity exercise and partial vascular occlusion. This study aimed to evaluate the perception and awareness of physiotherapists regarding the application of BFR training in strengthening the quadriceps muscles in post-TKR patients. An observational cross-sectional survey was conducted on 104 licensed physiotherapists using a self-structured and validated questionnaire. The outcome established that participants were well informed about the BFR technique, with 82% of them agreeing that the technique should be incorporated in post-TKR rehabilitation and 94% of them confirming that the technique was effective, but only 8% of them said they frequently used it clinically. The conclusion of the study is that BFR training has a high level of awareness and positive attitudes among physiotherapists, yet it is not used in practice enough, which stresses the necessity to educate and train physiotherapists clinically.

Index Terms- Blood Flow Restriction Technique, Awareness, Physiotherapists, Total knee replacement, Quadriceps muscle

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I. INTRODUCTION

Knee osteoarthritis is a clinically more prevalent musculoskeletal disorder that may greatly restrict the functional condition of an individual, and decrease quality of life.6 It is predominantly due to population aging.14 Total knee replacement, also called total knee arthroplasty, is a widely performed procedure for advanced knee joint pathologies , including osteoarthritis and rheumatoid arthritis.[7]

TKR involves the replacement of a damaged or arthritic knee joint with artificial components. The femoral and tibial components are always replaced, whereas the replacement of patellar components depends on the condition of its articular surface and therefore may not be replaced.[7] The prosthesis consist of a tibial component which has a metallic base plate and a high-molecular-weight polyethylene (HMWPE) ,a metallic femoral component and a HMWPE button for the articular surface of patella.[7] The general objective of TKR is to soothe pain and allow sufficient mobility, correct the deformity and enhances quality of life.[7] TKR improves symptoms and function but postoperative impairments that follow the operations are prevalent.4 However postoperative recovery after TKR is often associated with persistent muscular weakness .[13]

Quadriceps weakness is significant in approximately 40-80 percent of patients postoperatively.60 percent of patients were found to have quadriceps weakness at 6 weeks post-TKR, and 40 percent of patients had persistent weakness at 6 months post-TKR. Thus ,managing quadriceps weakness is vital in recovery.[6]

Following hospitalization, each patient participated in a three-week rehabilitation program, either inpatient or outpatient. This program included daily supervised resistance training, proprioceptive exercises, and endurance sessions designed for individual recovery goals.[13] High-load resistance training is known to be the most effective for improving muscular strength and achieving muscle growth. However, older adults, postoperative patients, and individuals with chronic pain often cannot tolerate it.

BFR therapy is one of the physical rehabilitation techniques that emerged recently and has shown promising results in improving strength.[3] BFR after knee surgery may be a viable modality to incorporate into a postoperative rehabilitation protocol for patient who require extra assistance in building muscle strength.[12] By using specific tourniquets around the proximal part of the lower extremities, BFR training is able to improve muscle strength to a similar extent to high load mechanical resistance training.[13] It combines low intensity exercise with blood flow occlusion which generate the same outcomes as high intensity training.[1] Blood flow restriction training has gained significant attention over the last few years as a novel approach to enhance muscle strength while utilizing lower intensities of resistance exercise.[1] The application of passive blood flow restriction training could be a safe, low-threshold approach to cure muscle atrophy in the initial stages.[13]

BFR training started in 1966 in Japan and was called KAATSU training.[1]

It uses a tourniquet proximally to the muscle that is being trained to restrict partial arterial and complete venous blood flow while performing resistance training thereby creating a hypoxic environment that encourage muscle growth.[1]

Mechanism of BFR

Muscular changes from exercise occur due to the combined effects of mechanical tension and metabolic stress.[2] A variety of physiological processes are believed to lead to the increased muscular size and strength observed with BFR training, although the exact process is not clear.[2] BFR involves using tourniquet or elastic band around the proximal limb.[2] This restrict venous flow (the flow of blood away from the muscle), but it does not completely stop the arterial blood flow.[2] Occlusion of venous return results in increased metabolic stress and hypoxic (low oxygen level) in the muscle tissue and decreased intramuscular pH seen during BFR training stimulates group 3 and 4 afferent fibres , thereby causing earlier neuromuscular fatigue than seen in non BFR exercise at the same load. [2] The reduced blood flow causes a accumulation of metabolites (eg. Lactate and hydrogen ions) and other byproducts of anaerobic metabolism.[2] The hypoxic environment causes more fatigue and reduced force production. This leads to buildup of metabolites like lactate and hydrogen ions, which activates muscle fiber recruitment.[2] The increase in metabolites also contributes to a higher release of anabolic hormones, such as growth hormone, and promotes an inflammatory response. This response increases the production of myokines (such as interleukins 6), which helps to activate muscle satellite cells..[2] This process also improves muscle protein synthesis .[2] Even when using lighter weights, BFR training helps to build muscle and improves strength by increasing muscle fatigue, swelling in the cell, and protein synthesis. [2]

II. NEED OF THE STUDY

To study the awareness of BFR technique as strength training of quadriceps muscle in post TKR patients among physiotherapists.

Weakness in the quadriceps post-TKR can cause poor functional outcomes, increased risk of falling, and prolonged rehabilitation time. It is important to use effective strength training methods. Elderly population may not be able to tolerate high resistance exercises post TKR because of severe pain and muscle weakness.

Physiotherapists play a crucial role in rehabilitation; their knowledge and application of BFR can greatly affect the patients' outcomes.

As this technique becomes more widespread ,it is important for healthcare providers to understand the current application , its limitations, and safety considerations so they can use it properly to help strengthen the quadriceps muscle in patients who undergo total knee replacement surgery.

III. RESEARCH AND METHODOLOGY

A study was done to check how aware physiotherapists are about using blood flow restriction (BFR) as a way to build strength in the quadriceps muscles after total knee replacement (TKR). The study took six months and involved 104 participants who were working in hospitals, private clinics, and schools. The researchers used a questionnaire they made themselves, with eight questions, which was sent out online through Google Forms and also on paper. Before taking part, all the physiotherapists were told about the study and signed a consent form. Only those who were licensed and had experience treating people who had TKR were included, and people who were still studying, not practicing, or not officially licensed were not allowed to take part. The things used in the study were pens, paper, consent forms, and the questionnaire. The main thing they looked at was how much the physiotherapists knew and understood about using BFR for strengthening the quadriceps after knee replacement surgery

Procedure

1. Firstly, permission will be taken from the institutional ethical committee of TILAK MAHARASHTRA VIDYAPEETH, department of Physiotherapy and Ethical clearance will be taken from the institutional ethical committee of Tilak Maharashtra Vidyapeeth – College of Physiotherapy.
2. The aims and objectives of the research will be explained to the participants and those who fulfill the inclusion criteria will be included in the study.
3. Then a self made questionnaire will be made consisting of 2 sections and participants have to answer either yes or no.
4. The questionnaire will be validated by the experienced physiotherapists in the field of rehabilitation.
5. The review and rating to examine and evaluate each survey question for its relevance, clarity, sequence, and concept will be taken from the physiotherapist.
6. Each Physiotherapist's comments will be thoroughly reviewed to improve accuracy, quality and validity of the survey questions.
7. Before conducting the survey consent of the physiotherapist participating in the survey will be taken.
8. An electronic survey will be conducted and distributed via WhatsApp , and E- mail.

9. In addition the physiotherapists which will be contacted will be requested to forward the survey among the physiotherapists they know.
10. The Physiotherapists will be asked to select an appropriate option from the questionnaire.
11. The data will be collected and analyzed and appropriate results will be found out.

IV. RESULT

A total of 104 physiotherapists completed the questionnaire, with 44% male and 56% female respondents. It should be noted that the largest portion of participants (44%) reported having 1 to 5 years of professional experience, indicating that most were early in their careers.The participants who were between the age of 21-25 years old consisted of 37.5% (n=39) of the study, while the 26-30 years old age group made up 37.5% (n=39) of the study. The 31-35 years old age group comprised 12.5%(n=13) of the study, while the 36-40 years old age range comprised 8.6% (n=9) of the study. Lastly, the age group of 40+ years old made up 3.8% (n=4) of the study.

All respondents (100%) were familiar with the concept of Blood Flow Restriction (BFR) training, showing a high level of awareness. About 82% agreed or strongly agreed that BFR therapy should be included in post-TKR rehabilitation to improve quadriceps muscle strength.

With regard to perceived benefits, 94% reported that BFR could increase muscle strength similar to high-load resistance training, and 82% agreed that it can accelerate recovery in post-TKR patients. However, only 8% of physiotherapists reported using BFR frequently, while 92% used it rarely, showing a gap between awareness and actual implementation.

The majority of physiotherapists (96%) believed BFR to be beneficial or very beneficial for quadriceps strengthening. Additionally, 94% were aware of its precautions and contraindications. This reflects a good understanding but also highlights the need for more practical training opportunities.

To assess the current level of awareness and understanding of BFR technique among physiotherapists working with post TKR patients.

- Do you feel that BFR therapy should be included in treatment to strengthen the quadriceps muscle in post TKR patients?

Table 1 - Are you familiar with the concept of blood flow restriction (BFR) technique?

Responses	No. of responses given by Physiotherapists
Yes	104
No	0

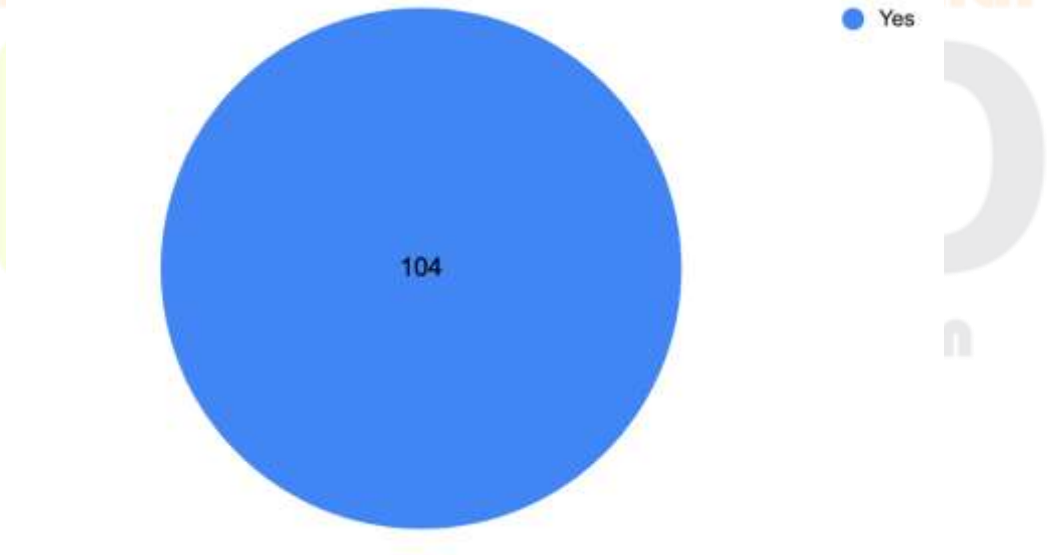

Figure 1 - Are yo familiar with the concept of blood flow restriction (BFR) technique

Interpretation – According to the data, all 104 physiotherapists (100%) responded "Yes," indicating that they are familiar with the concept of the Blood Flow Restriction (BFR) technique. This shows a high level of awareness and understanding of the BFR technique among physiotherapists working with post-TKR patients.

- Do you feel that BFR therapy should be included in treatment to strengthen the quadriceps muscle in post TKR patients?

Table 2 - Do you feel that BFR therapy should be included in treatment to strengthen the quadriceps muscle in post TKR patients?

Responses	No. of responses given by Physiotherapists
Strongly agree	17
Agree	66
Maybe	16
Disagree	2
Strongly disagree	3

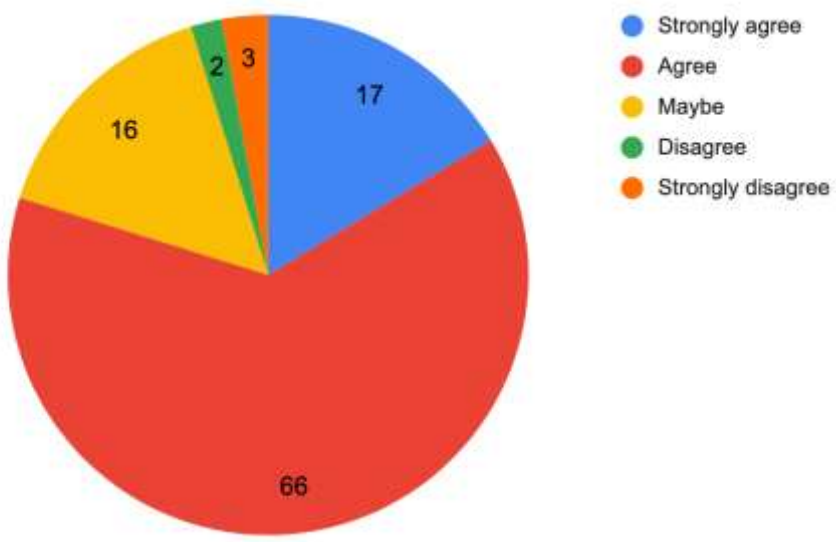

Figure 2 - Do you feel that BFR therapy should be included in treatment to strengthen the quadriceps muscle in post TKR patients?

Interpretation – According to the data, 3 physiotherapists strongly disagreed, 2 disagreed, 16 remained neutral, 66 agreed, and 17 strongly agreed that BFR therapy should be included in treatment to strengthen the quadriceps muscle in post-TKR patients. This shows that the majority of physiotherapists (82%) agree or strongly agree with including BFR therapy as part of quadriceps strengthening in post-TKR rehabilitation, reflecting a high level of positive awareness and acceptance of the technique.

- To what extent have you used BFRT to strengthen the quadriceps muscle?

Table 3 - To what extent have you used BFRT to strengthen the quadriceps muscle?

Responses	No. of responses given by Physiotherapists
Very frequently	3
Frequently	5
Moderately	16
Somewhat rarely	31
Rarely	49

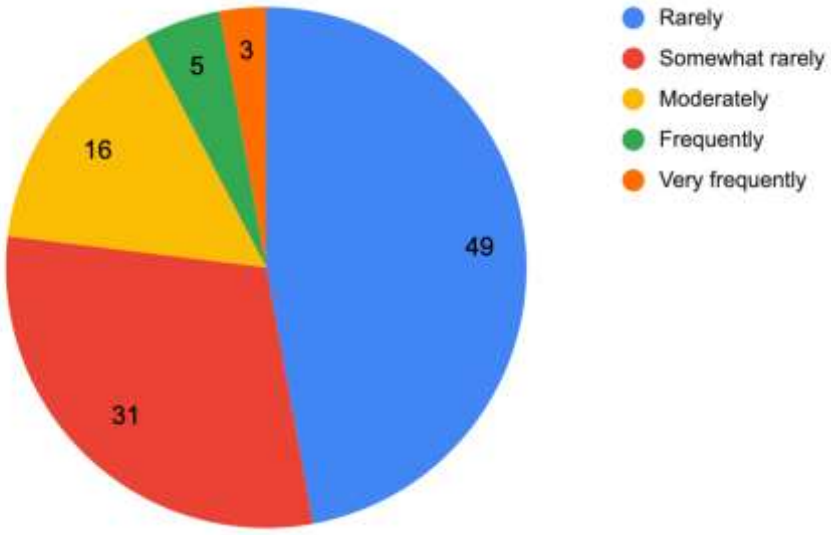

Figure. 3 - To what extent have you used BFRT to strengthen the quadriceps muscle?

Interpretation – According to the data, 3 physiotherapists reported using BFRT very frequently, 5 frequently, 16 moderately, 31 somewhat rarely, and 49 rarely to strengthen the quadriceps muscle in post-TKR patients. This shows that the most of physiotherapists (79%) use BFRT rarely or somewhat rarely, suggesting that while awareness of the technique exists, its actual implementation in clinical practice is still limited.

- Do you believe BFR is an effective strength training method to improve quadriceps muscle in post TKR patients?

Table 4 - Do you believe BFR is an effective strength training method to improve quadriceps muscle in post TKR patients?

Responses	**No. of responses given by Physiotherapists**
Very beneficial	22
Beneficial	76
Less effective	2
No effect	4

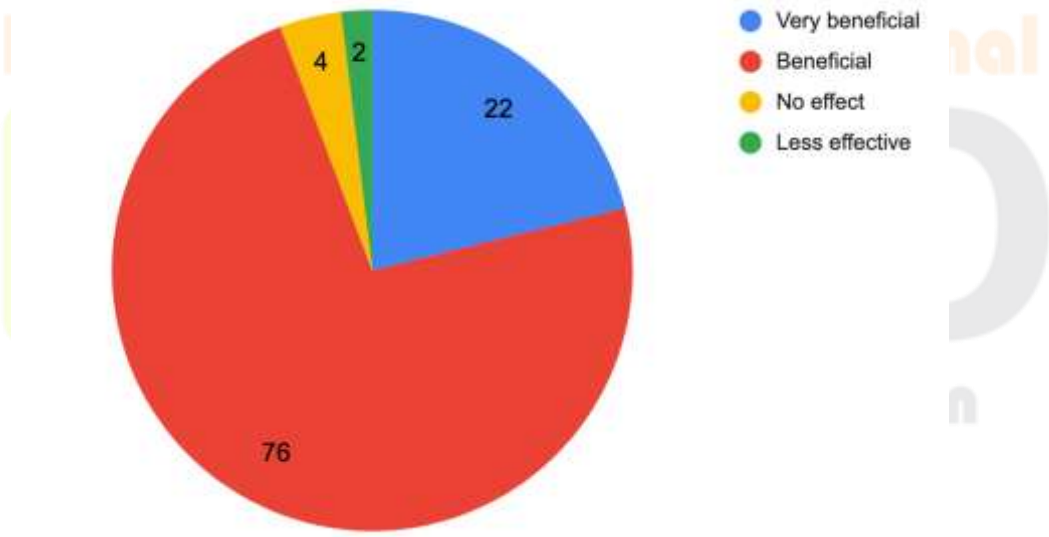

Figure 4 - Do you believe BFR is an effective strength training method to improve quadriceps muscle in post TKR patients?

Interpretation – According to the data, 22 physiotherapists considered BFR training to be very beneficial, 76 considered it beneficial, 2 thought it was less effective, and 4 believed it had no effect on quadriceps strengthening in post-TKR patients. This indicates that an overwhelming majority (approximately 96%) of physiotherapists perceive BFR as an effective method for improving quadriceps strength, reflecting a highly positive attitude toward its use in post-TKRrehabilitation, with only a very small proportion viewing it as less effective or ineffective.

- Can BFR training stimulate muscle strength gains similar to HLRT without the need for high loads?

Table 5 - Can BFR training stimulate muscle strength gains similar to HLRT without the need for high loads?

Responses	No. of responses given by Physiotherapists
Yes	95
No	9

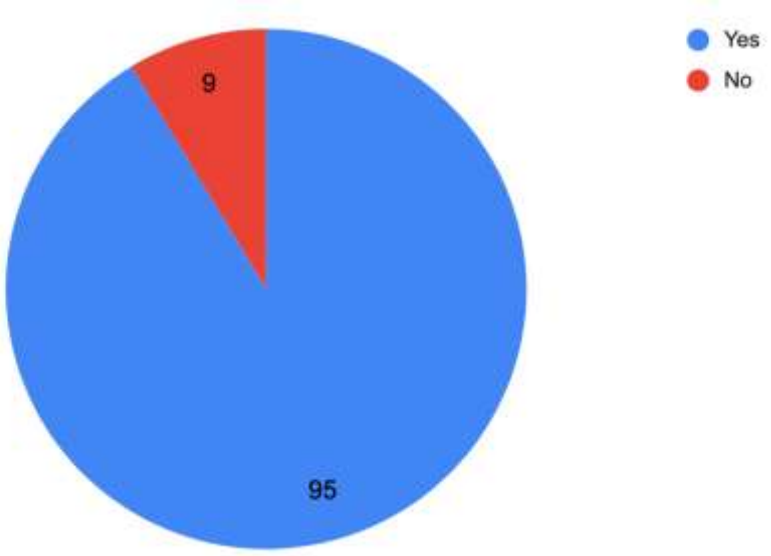

Figure 5 - Can BFR training stimulate muscle strength gains similar to HLRT without the need for high loads?

Interpretation – According to the data, 95 physiotherapists (94%) believe that Blood Flow Restriction (BFR) training can stimulate muscle strength gains similar to High Load Resistance Training (HLRT) without the need for high loads, while only 9 physiotherapists (6%) disagreed. This shows that the most of physiotherapists perceive BFR training as an effective and beneficial alternative to HLRT, especially in situations where high-load exercises may not be suitable, such as post-TKR rehabilitation.

- Do you feel that BFR training can speed up the recovery process in post TKR patients?

Table no. 6 - Do you feel that BFR training can speed up the recovery process in post TKR patients?

Responses	No. of responses given by Physiotherapists
Strongly agree	16
Agree	61
Neutral	24
Disagree	3
Strongly disagree	0

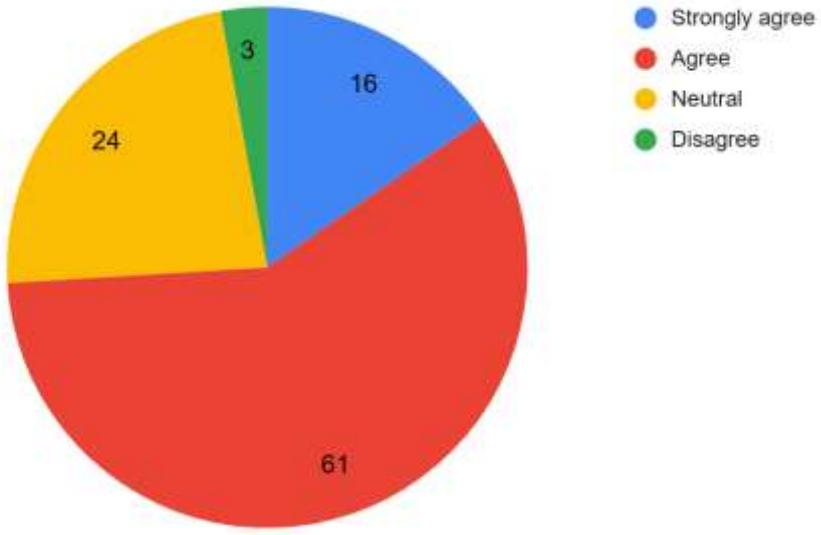

Figure. 6 - Do you feel that BFR training can speed up the recovery process in post TKR patients?

Interpretation – According to the data, 0 physiotherapists strongly disagreed, 3 disagreed, 24 were neutral, 61 agreed, and 16 strongly agreed that BFR training can speed up the recovery process in post-TKR patients. This shows that a large majority (77%) of physiotherapists agree or strongly agree that BFR training contributes to faster recovery, indicating a positive perception of its benefits in post-TKR rehabilitation, with only a small portion remaining uncertain.

- Do you believe BFR is a safe technique to use in post TKR rehabilitation?

Table 7 - Do you believe BFR is a safe technique to use in post TKR rehabilitation?

Responses	**No. of responses given by Physiotherapists**
Strongly agree	5
Agree	58
Neutral	38
Disagree	2
Strongly disagree	1

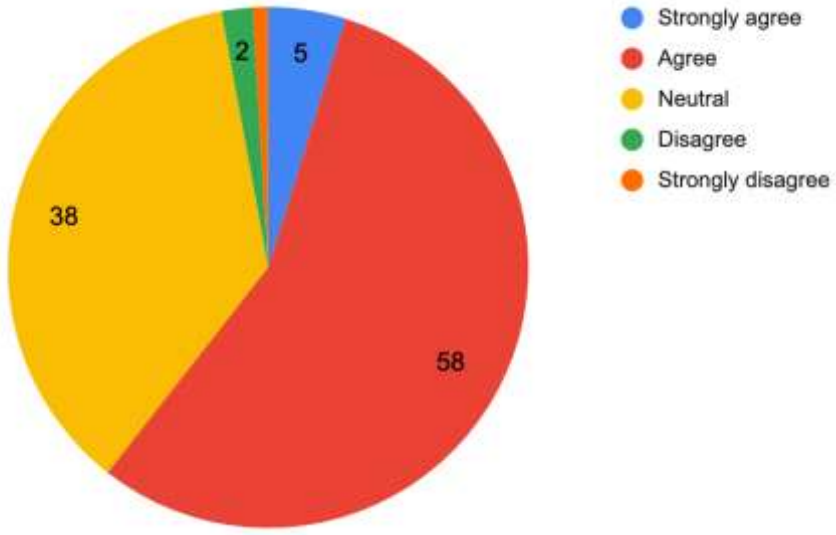

Figure 7 - Do you believe BFR is a safe technique to use in post TKR rehabilitation?

Interpretation – According to the data, 1 physiotherapist strongly disagreed, 2 disagreed, 38 were neutral, 58 agreed, and 5 strongly agreed that BFR is a safe technique to use in post TKR rehabilitation. This shows that a large majority (63%) of physiotherapists agree or strongly agree that BFR is a safe technique to use in post TKR rehabilitation.

- Are you aware about precautions and contraindications for using BFR training with post TKR patients?

Table 8 - Are you aware about precautions and contraindications for using BFR training with post TKR patients?

Responses	No. of responses given by Physiotherapists
Yes	94
No	10

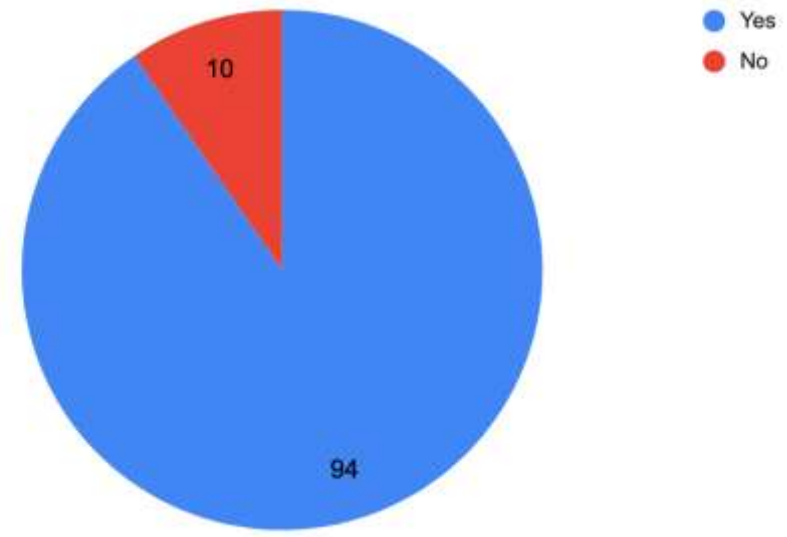

Figure 8 - Are you aware about precautions and contraindications for using BFR training with post TKR patients?

Image

Interpretation – According to the data, 94 physiotherapists reported being aware of the precautions and contraindications for using BFR training with post-TKR patients. In contrast, 10 physiotherapists indicated they were not aware. This shows that most physiotherapists understand how to safely apply BFR in post-TKR rehabilitation. However, a small portion still lacks awareness. This highlights a potential need for targeted educational resources and training to ensure the technique is implemented safely and effectively.

V. DISCUSSION

The purpose of the study was to assess awareness and perception of physiotherapists regarding the use of Blood Flow Restriction (BFR) training as a strengthening technique for the quadriceps muscle in post–total knee replacement(TKR) patients. The main findings from this study are that most physiotherapists have a high level of awareness and positive attitude toward the use of BFR technique as strength training of quadriceps muscle in post TKR patients. Almost all PTs were familiar with the concept of BFR training. From these findings, it can be suggested that this technique has gained substantial recognition within the physiotherapy community.

The majority of participants in this study (82%) agreed or strongly agreed that BFR should be included in the post-TKR rehabilitation program. This may suggest that BFR therapy has positive effects on muscle strength and functional outcomes after knee arthroplasty. Additionally, 94% of participants believed that BFR could achieve strength gains similar to those from high-load training is consistent with previous literature, which shows that low-load BFR training can produce similar muscle growth and strength improvements as traditional high-load resistance exercises to boost quadriceps strength.

Despite this high level of awareness and positive perception, only 8% of physiotherapists reported using BFR frequently. In contrast, 92% used it rarely. This shows a large discrepancy between physical therapists' knowledge of BFRT and how often they actually use this rehabilitation technology. This gap suggests that while physiotherapists grasp the theoretical benefits of BFR, practical use is limited by external factors such as access to resources and specialized training.

94% of participants were aware of the precautions and contraindications associated with BFR use. This shows a good grasp of its safety profile. BFR therapy is safe and effective for patients recovering from knee surgery as long as the tourniquet fits correctly and the procedure is done under supervision. This oversight helps avoid complications such as vascular or nerve injury.

However, the limited clinical use seen in this study might suggest that if provided the resources such as structured educational programs and hands-on workshops, equipment ,etc. most PT's would be willing to adopt new techniques. Overall, the findings indicate that physiotherapists hold favourable views toward the integration of BFR into post-TKR rehabilitation but face practical challenges that restrict its widespread use.

VI. Conclusion

The study concludes that physiotherapists have a high level of awareness and a positive attitude toward Blood Flow Restriction (BFR) training for strengthening the quadriceps in post-TKR patients. They recognize its effectiveness and safety, but its clinical use remains limited due to barriers such as lack of training and resources .

Overall, the findings show how important educational workshops, clinical exposure, and support from institutions are for promoting wider and safer implementation of BFR techniques in post-TKR rehabilitation. Incorporating BFRT education in PT programs could improve utilization of BFRT potentially improving healthcare outcomes in physical therapy.

VII. Limitation

The study's cross-sectional design and reliance on self-reported data limited its findings and may have introduced response bias. Additionally, the sample was confined to a one region, which may limit the generalizability of findings.

VIII. Future scope

Future studies should be investigated in physiotherapists' practical competence, patient outcomes, and institutional factors affecting BFR adoption by using larger and more heterogeneous samples.

Comparative experimental studies with BFR based and conventional post-TKR rehabilitation protocols, can also confirm its clinical efficiency.

IX. Acknowledgment

The success and result of this project required a lot of guidance and assistance, and I am extremely privileged to have got this all along the completion of my project. I owe my deepest gratitude to my project guide Dr. Venkataseshan (PT) , who took keen interest in our project work and guided me along till the completion by providing all the necessary information throughout numerous consultations. I will forever be grateful for the knowledge and skills that I have gained working under you. Thank you! I respect and thank our principal who gave me the opportunity to do this wonderful project
on the topic: "AWARENESS OF BLOOD FLOW RESTRICTION TECHNIQUE AS STRENGTH TRAINING OF QUADRICEPS MUSCLE IN POST TKR PATIENT AMONG PHYSIOTHERAPISTS" I am thankful to and fortunate enough to get constant encouragement, support and guidance from all teaching staff of the Department of Physiotherapy, which helped me in successfully completing my project work.

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