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A Comparative Study to Evaluate the Effect of Blood Flow Restriction Therapy and Retro Walking on Pain, Strength of Muscles and WOMAC Score in Patients of Osteoarthritis of Knee

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: To assess the impact of blood flow restriction and retro walking in knee osteoarthritis subjects.
Study Design: It was a comparative study. All the participants who meet inclusion criteria gave a written consent and were allocated to Group A or Group B randomly by chit method and the pre and post test scores were derived. The scores obtained in the two groups were compared and the results were derived.
Place and Duration of the Study: This study was conducted in musculoskeletal sciences division, RNPC Sawangi, Wardha, for 12 months
Methodology: A total of 150 samples were chosen. Using the chit method, they were divided into two groups at random, Group A and Group B. Blood Flow Restriction Training was given to Group A, while retro walking training was given to Group B. The training lasted 15 days. After 15 days, the pain, strength, and WOMAC score were tested again.

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Result: Out of 150 patients 75 were placed in each group, where p=.0001. Significant increase was seen in mean of group I and II in pre ad post-test NPRS score, Quadricep and hamstrings muscle strength and WOMAC score. Analysis showed significant improvement in both the groups.
Conclusion: Both the interventions included in this study, have been shown to help individuals with osteoarthritis reduce pain, enhance strength, and improve their WOMAC score. Both the interventions are easy to practice and can be easily performed by the older population. When these two interventions were compared blood flow restriction therapy was proved to be better than retro walking.

Keywords: Knee osteoarthritis; Blood Flow Restriction Therapy; Retro walking; WOMAC score.

1. INTRODUCTION

The most frequent kind of arthritis is osteoarthritis (OA).In this form of arthritis women are more likely affected than males and one in every three adults over the age of 65 years is affected. It mostly affects the hips, knees, hands, feet and spine, with a high incidence of polyarticular involvement [1]. It is a main reason of pain, disability, and socioeconomic cost across the globe [2]. More likely, OA has multiple etiologies and are also joint specific [3]. Obesity, physical inactivity, and joint injury are all common OA risk factors. The World Health Organization has recognized OA as a "priority disease" since it is the primary cause of persistent disability in those over the age of 70. (WHO). In developed countries, OA is amongst the 10 most disabling diseases. Hip and knee degenerative diseases were labelled as the eleventh biggest contributor to worldwide disability in a study by Global Burden of Disease. The incidence of KOA is in the range of 13.8% to 71.1% across the Asian people. The prevalence in female and males are 31.6% and 28.1%, respectively. Occurrence of OA is 22% to 39% in India [4].

Pathological changes like softening, ulceration, and localized disintegration of the articular cartilage are signs of advanced OA. Inflammation of synovium can also occur. There are many changes inaffected joint's bone. Subchondral cysts, sclerosis, and osteophyte production are all signs of advanced OA [2]. It sometimes presents as a bone disorder, affecting the structure of bone and remodeling.The major symptoms of this disease are Joint pain, stiffness, and gait disturbance. Weakness of muscles, balance issues, and comorbidities such as fibromyalgia are other symptoms seen in OA knee patients. These common clinical symptoms, may decrease productivity and quality of life among the patients. Most cases of OA are idiopathic, hence are referred to as primary OA. Localized, generalized, or as erosive OA are the types of presentation of primary OA. Osteoarthritis occurring due to another disease or condition is called as secondary OA [5].

A number of interventions were tested for their ability in treating OA of the knee have demonstrated short term advantageous factors for knee ache and activities. Except of weight loss, agility training, and all-purpose exercise programs, some interventions are assessed to check their long-term benefits. Numerous treatments have been introduced for treating osteoarthritis of knee is treated by Electrotherapy modalities like involves use of thermal agents, Transcutaneous Electrical Nerve Stimulation (TENS), Short Wave Diathermy (SWD), Interferential therapy (IFT), Traditional Chinese Acupuncture, Tai chi programs, Manual mobilization/manipulation therapy, aquatic exercises, Obesity programs. Cryotherapy, Hydro collateral packs, contrast bath and in Recent advances includes various Taping techniques, Dry needling, Cup therapy, Laser therapy [6]. All the physiotherapy treatments are very beneficial and provides symptomatic relief to patients of osteoarthritis of knee. Research also proves that some recent advances like blood flow restriction therapy and retro walking are easy to practice and may be beneficial to the patients if added to their rehabilitation protocol.

Yoshiaki Sato Japan originally invented and evolved BFR training in Japan in the late 1960's. Kaatsu training is a new intervention that has become popular in the last fifteen years. It entails exercising while the blood supply to the muscle is reduced using an inflatable cuff or tourniquet placed close to the muscle to be exercised. Low intensity aerobic and light-load intensity training in combination of BFR therapy leads in favorable strength of muscle, mass, and endurance adaptations and the vasculature,and is well-supported in clinical and elderly populations, healthy athletic populations. BFR resistance exercise creates the exercise-induced

hypoalgesia response in the exercising limb. The association between exercise and hypoalgesia is partly mediated by endogenous opioid production activation and a conditioned pain modulation effect. Furthermore, muscles exercising with BFR quickly run out of oxygen and can't get rid of accumulating waste, resulting in metabolic stress or acidosis. Metabolic stress is one of the most important factors in muscle growth. Despite using loads that are frequently considered too low to achieve considerable hypertrophy, BFR exercise activates anabolic signaling and muscle protein synthesis and significantly increases muscular growth, according to the body of literature [7]. In this way improvement in pain and strength parameters is seen in subjects practicing BFR which as a result improves the functional abilities of the subject. As this is a new technique studies and further investigations are still going on.

Humans learn to stroll and race ahead with ease. As our field of view is in the forward direction, this is essentially reasonable. Backward walking engages the quadriceps femoris muscle in both isometric and concentric activity, whereas forward walking primarily engages the muscle in eccentric motion. Backward walking produces joint kinematic patterns that are different from those experienced when walking ahead. It is clear that both backward and forward walking are useful in recovery. Backward walking, on the other hand, may provide some benefits in addition to those gained from forward walking alone. Strolling backwards appears to produce "greater muscle activation in proportion to effort" than strolling in forward direction, according to Gray. This assumption is supported by research that demonstrate that energy consumption during retro-walking is much greater than that of forward walking [8]. The purpose of the study is to assess the impact of blood flow restriction and retro walking in knee osteoarthritis subjects.

2. METHODS

2.1 Study Design

This study was conducted in musculoskeletal sciences division, RNPC Sawangi, Wardha after endorsement from institutional ethic advisory group of DMIMS, deemed to be university. Before including, entire procedure was explained to all the subjects. Written consent was submitted by the participants who met the inclusion criteria and were allocated to group A or Group B randomly by chit method. They were enrolled for the study and were called to the OPD for treatment daily for two weeks. Data was collected after two weeks and statistically analyzed. It was single blinded study and different personnel were used to carry out different steps of the study that is for providing treatment, recording the outcome measures and statistically analyzing the data who were unaware about the hypothesis of this study. Entire procedure described in the flow chart.

2.1.1 Inclusion criteria

150 men and women of the age group 50 to 70 years participated in the study. All the participants were diagnosed patients of OA knee depending on the American College of Rheumatology criteria (unilateral). They were having symptomatic knee OA and were graded from 1 -3 on Kellengren and Lawrence scale [9,10].

2.1.2 Exclusion criteria

Participants undergone any knee surgery to either knee in last three months in which any sort of foundational ligament condition, some other solid, joint or neurological condition influencing capacity of lower appendage, experienced active recuperation treatment or taken intra-articular joint injections for knee joint for last previous three months were excluded. Also, participants with fringe vascular illness, systolic pulse more prominent than 160 or under 100 mm Hg, diastolic circulatory strain more noteworthy than 100 mm Hg, profound vein apoplexy, previous myocardial localized necrosis, paralysis in the earlier year, or previous malignant growth which created confinements for work out were excluded to avoid further complications [10,11].

2.2 Sample Size Consideration

Total 150 participants were included in the Study.The sample size was calculated with the use of a basic sample size calculation algorithm. The article cited as a reference was Osteoarthritis in India: An Epidemiologic Aspect, which was published in October 2017 in an international journal of recent scientific research.Participants were randomly classified into two groups by chit method.

Sample size formula with desired error of margin was used.

$$n = \frac{Z\ \alpha/2^2.\ P.\ (1-P)}{d^2}$$

Where,
Z α/2 is the level of significance at 5% that is 95% confidence. Interval = 1.96
P = prevalence of osteoarthritis = 22% = 0.22
d = desired error of margin = 7% = 0.07
$n = 1.96^2 \times 0.22 \times (1 – 0.22) / 0.07^2$
= 134.53
= 150

Formula reference: VK Chadha, sample size determination, in health studies, NIT bulletin, 2006, 42/3 and 4, 55-62

2.3 Intervention Design

2.3.1 Group A – Blood flow restriction therapy

All the participants will undergo 5 mins of warm up session followed by conventional physiotherapy exercises. Then patient will undergo strength training using blood flow restriction therapy, followed by a 5 mins of cool down session.

Warm up session -

1. Ankle toe movements
2. Heel slides

Conventional physiotherapy exercises –

3. Static quadriceps (10 sec holds with 10repetitions)
4. Active hip movements (10 repetitions of each)

Strength training session - In the blood flow restriction therapy, resistance exercises will be done at twenty per cent of 1RM with external pressure on each leg's upper thigh.

Exercises which will be performed-

1. Dynamic quads
2. Hamstring curls

In each set counts of reps will be as follows

In first sitting = 30 reps with rest of 20 seconds
In second sitting = 20-30 reps with rest of 20 seconds
In third sitting = 10-20 reps with rest of 20 seconds

Pressure of the cuff is set according to [pressure= 0.5 (systolic blood pressure) + 2(thigh circumference) + 5]

Cool down session –

1. Hamstring stretching
2. Calf stretching
3. Heel raises

2.3.2 Group B – Retro walking

All the participants will undergo 5 mins of warm up session followed by conventional physiotherapy exercises. Then patient will undergo 10 mins of retro walking session, followed by a 5 mins of cool down session.

Warm up session –

1. Ankle toe movements
2. Heel slides

Conventional physiotherapy exercises –

3. Static quadriceps (10 sec holds with 10 repetitions)
4. Active hip movement (10 repetitions of each)

Strength training session -1: -10 mins of retro walking

Cool down session –

1. Hamstring stretching
2. Calf stretch
3. Heel raises

2.4 Statistical Analysis

The data was recorded and entered into Microsoft excel spreadsheet. Descriptive statistics included computation of means and standard deviation. Inferential statistics using student's paired 't' test (for the quantitative data to compare pre and post observation), unpaired t test (for quantitative data to compare within two groups) were used for comparison of all clinical indicators and Chi square test (for testing relationships between categorical variables). The software used in the analysis were SPSS 24.0 and Graph Pad Prism 7.0 version and $p< 0.01$ is considered as level of significance.

3. RESULTS

In total, 150 subjects participated in this 2-week interventional study. Participants were divided into two groups where group a consisted of 75 participants each. Group A received blood flow restriction therapy and group B received retro

walking. Outcome measures which were used pain, muscle strength and WOMAC score.

Image 1 and 2. Dynamic quads with blood flow restriction therapy

Image 3 and 4. Hamstring curl with blood flow restriction therapy

Image 5. Retro-walking

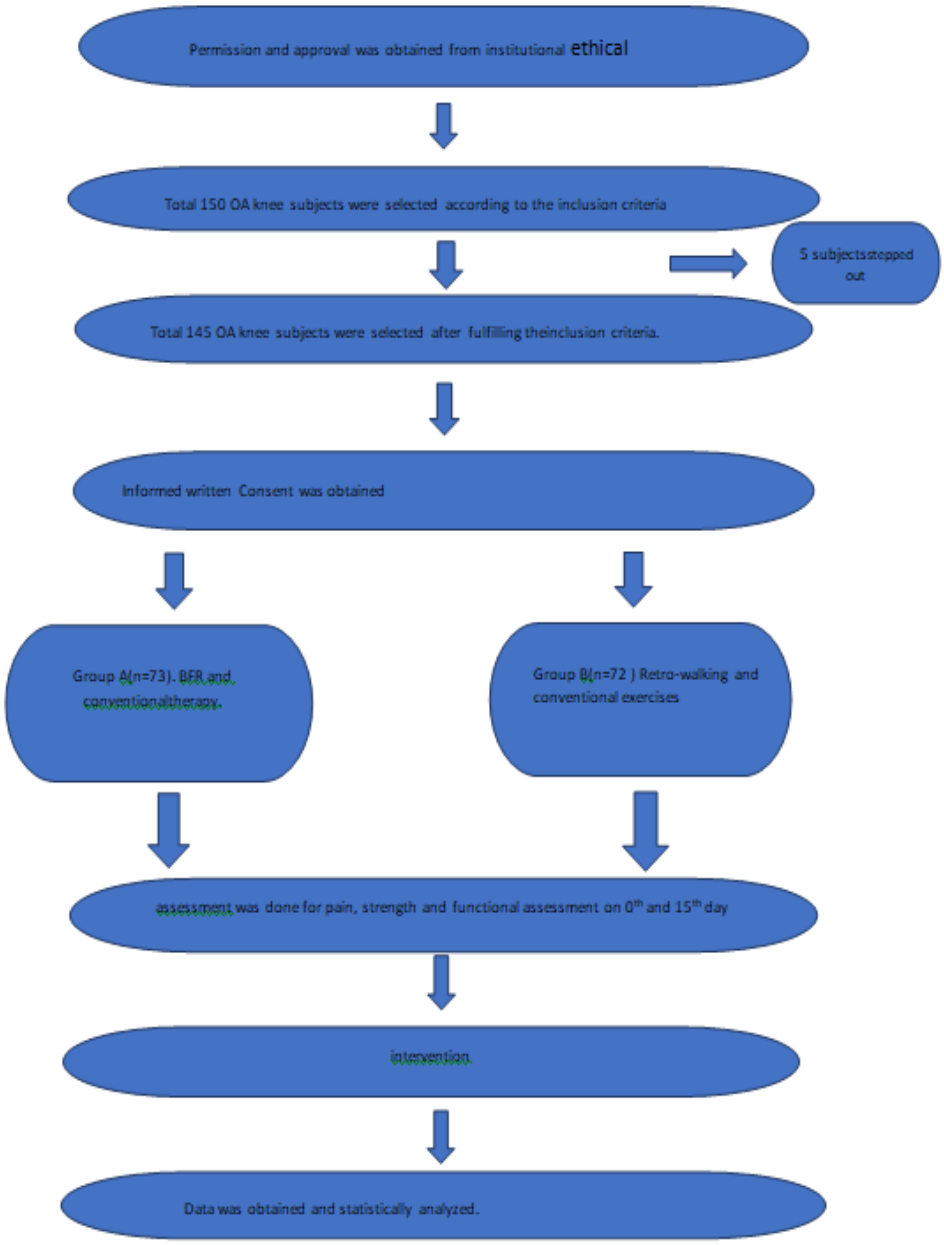


Fig. 1. Flow Chart

Table 1. Participant's characteristics at baseline

Demographic data and Outcome measures	Blood flow restriction Therapy (Group A)	Retro walking (Group B)	P-value
Age (in years)	60.40	60.14	0.87
Gender	75	75	0.86
NPRS	8	8.09	0.43
Quadriceps strength (in mm/Hg)	120.73	119.82	0.080
Hamstrings strength (in mm/Hg)	119.78	120.78	0.67
WOMAC score	73.83	73.21	0.042

Baseline scores of all outcome measures and the demographic data among the two groups showed non-significant differences except the WOMAC score. Baseline scores for WOMAC score was significant (Table 1).

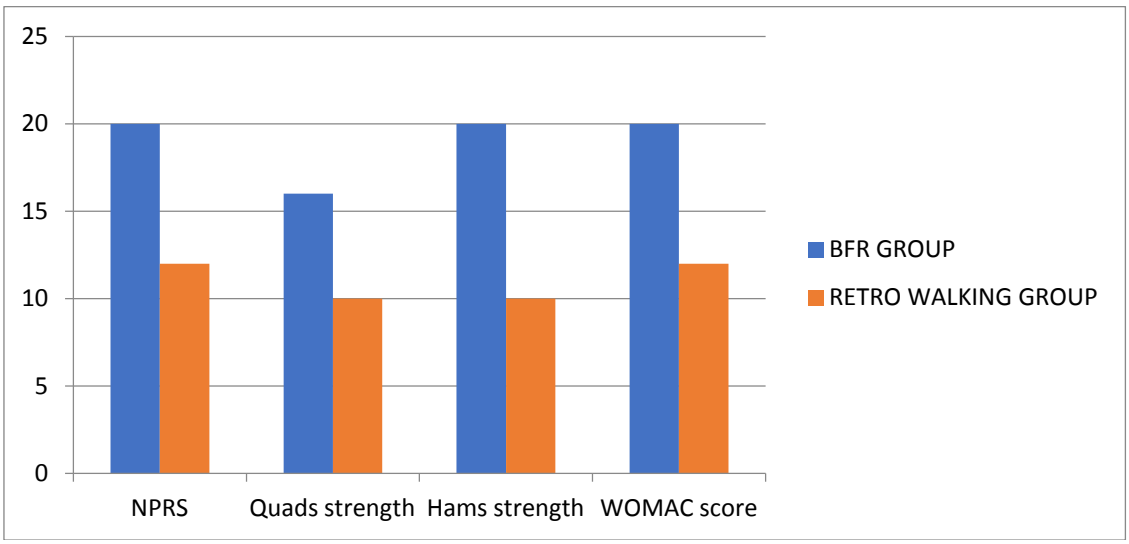
Detail outcome assessment was done at the end of second week. NPRS scale was used to measure pain; modified sphygmomanometer was used to measure strength and WOMAC score to assess functional activities of the subjects. BFR group showed significant reduction in pain when compared to retro walking group (p value - 0.0001). Also, BFR group was proved to be more effective in strengthening muscles as compared to that of retro walking group (P value for quadriceps strength and hamstrings strength – 0.0001). WOMAC score also improved significantly in BFR group than the retro walking group (p value -0.0001).Shown in Table 2 and Graph 1

4. DISCUSSION

The present study was undertaken because OA is a rapidly growing disease. Also, it is one of the 10 diseases which cause disability in geriatric population. The disease which was very common in developed countries is rapidly growing in developing countries also. Nur Aimi Asyrani Zamri et. al. conducted a study and revealed that the overall occurrence of Osteoarthritis is in a range of 20.5% to 68.0%. Most of the Asian populations stated to have knee OA in a range of 13.1% to 71.1% in various countries of Asian. Looking at the prevalence of the disease and the growing elderly population in India, this study was conducted in Indian population. Also, No longer this disease is limited to geriatric population. Due to increasing ligament tears, meniscal injuries and other traumatic injuries, post traumatic OA is also becoming common and such cases are being identified in younger population as well. Adam G Culvenor et al. conducted a study on 63 subjects in which a conclusion was drawn that MRI OA feature occurrence in symptomless undamaged knees were 4% - 14% in adults aged < 40 years to 19% to 43% in older adult aging more or equal to 43 years of age. As knee is one of the most common joints to sustain injuries in sports as well as in our day-to-day activities, osteoarthritis can be easily seen in this joint as a post injury complication [12].

Table 2. Outcome measures at the end of second week in Group A and Group B

Outcome measures	Blood flow restriction Therapy (Group A)	Retro walking (Group B)	P-value
NPRS	2.86	3.84	0.0001
Quadriceps strength	159.20	144.62	0.0001
Hamstrings strength	158.26	145.06	0.0001
WOMAC score	51.08	57.24	0.0001



Graph 1. shows the improvement in outcome measures in post test of the two groups
Y axis - mean score

Arthritis is a very common disease and OA is most commonly occurring subtype of arthritis. But the sad situation is that there is no definitive treatment protocol. Many times, there is a conflict of opinion about the prescription of exercises in this disease in medical practitioners. A.P. Verhagen et al. conducted a study and revealed that in OA knee patient exercise is efficient and clinically useful in pain reduction immediately after the treatment compared to no or minimal treatment and adding new data will unlikely change this conclusion [13]. Exercise being a broad term, specific intervention which is easy for the patient to practice without aggravating his/her pain was to be found out. So, according to our study both BFR and retro walking were effective in reduction of pain, strengthening of muscles and improving WOMAC score.

Ferraz et al. concluded that Blood Flow Resistance In knee OA patients, both training and HI-RT were equally helpful in enhancing strength of muscle, quadriceps muscle mass, and functioning. Importantly, BFRT improved pain while reducing joint stress, making it a viable and effective therapeutic adjuvant in the treatment of OA. As osteoarthritis is a painful disease, excessive collision of the joint structure can aggravate the pain. So, in BFR training minimal resistance can be applied with partial blood flow restriction which helps to strengthen the hamstrings and quadriceps muscle, reduction of pain and improving functional activities of the patient. It is well tolerated by the osteoarthritis patients [14]. In BFR training resistance applied is actually minimal and only with application of 20% – 30 % of 1RM we can obtain same results as that of high intensity resistance training. Neil Segal et al. conducted a study in which he reported that when compared to the same program without BFR, adding BFR to a 30 percent 1RM resistance training program increased leg press and knee extensor strength in women at risk for knee OA [15]. As per all the above studies, inference can be drawn that BFR is one of the beneficial intervention which can be easily practiced by the elderly population and it is well supported by the results obtained in this study. Significant improvement was seen in all the outcome measures. Hence it was proved that this intervention helps to build up muscle strength by causing muscle hypertrophy and pain reduction. Pain reduction occurs by the mechanism of by exercise induced hypoalgesia which is partly mediated by endogenous opioid production activation and a conditioned pain modulation effect. Furthermore, muscles exercising with BFR quickly run out of oxygen and can't get rid of accumulating waste, resulting in metabolic stress or acidosis. Metabolic stress is one of the most important factors in muscle growth. Despite using loads that are frequently considered too low to achieve considerable hypertrophy, BFR exercise activates anabolic signaling and muscle protein synthesis and significantly increases muscular growth, according to the body of literature. Also it improves the functional activities of the patients due to pain reduction and building up of muscle strength

As retro-walking is one of the easiest interventions for the treatment of osteoarthritis of knee, it was included in the study to investigate its effectiveness. In our study we found out that this intervention was effective in pain reduction, strength improvement and improving functional status of the patient. Ahmad H. Alghadir et al. conducted a studyand concluded that in those with knee OA, a 6-week retro walking program reduced pain and functional disability and increased quadriceps muscle strength and presentation when compared to strolling ahead or control groups. We believe that, because backward-walking has number of benefits over forward walking, Public will perform such types of exercise into their daily lives to elevate their standard of living. After some initial practice, subjects will be able to perform the retro-walking in the community gardens [9]. Excessive forces leading to degeneration of the soft tissues is predisposing factors of this disability causing disease. Hence, we must aim towards such interventions which may reduce the excessive forces on the joints and reduce the stress placed on them. K. Hrishikesh Yadav et. al. after conducting a study stated that Retro Walking has an advantage over Forward Walking in terms of reducing the compressive strain on the knee and boosting muscle strength in the functional range [16].

Both these interventions are new, few numbers of studies exist which investigate its effectiveness. BFR is mainly used in fitness and gym training, but its clinical application needs to be considered and evaluated. Positive results were obtained during our study which states that BFR is a new upcoming intervention. Retro walking one of the easiest interventions of all times is a simple closed chain exercise which decreases the excessive forces on patella femoral joint and also causes strengthening of thigh muscles by the dynamic strengthening

method. During retro -walking isometric and concentric activities of quadricep muscle is preserved. As the thigh muscles grow strong, there is reduction in the forces exerted on medial compartment and the cartilage. Hence the symptoms of osteoarthritis are relieved and there is reduction in pain. Both the interventions are helpful in strength improvement and hence they enhance the functional performance of the patient showed. In our study while analyzing it was found out that significant improvement was seen in both interventions. Hence we tried to find out that which among the two was more beneficial and which among them should be added to the rehabilitation protocol of osteoarthritis. So, according to our study it was found that BFR was more efficient in pain reduction, strengthening of the muscles and improving functional status of the patient.

5. CONCLUSION

The present study concluded that both Blood Flow Restriction Therapy and Retro walking are effective in pain reduction, muscle strengthening and improvement of functional activities. When these two interventions were compared, it was found out that Blood flow restriction therapy is more effective than Retro-walking.

6. LIMITATION OF STUDY

1. It was difficult to convince the subjects for continuing the session oftreatment.
2. Long term follow up was not taken.

CONFIDENTIALITY

Specific patient's information was kept separate from the central dataset, and was not exchanged. All personal data was stored securely before, during and after the court to preserve the confidentiality.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The trial was performed in accordance with the Declaration of Helsinki. CTRI registration number is CTRI/2021/08/035413.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hawker GA. Osteoarthritis is a serious disease. Clin Exp Rheumatol. 2019;37(Suppl 120):3–6.
2. Chow YY, Chin K-Y. The Role of Inflammation in the Pathogenesis of Osteoarthritis. Mediators of Inflammation. 2020;2020:e8293921.
3. Glyn-Jones S, Palmer AJR, Agricola R, Price AJ, Vincent TL, Weinans H, et al. Osteoarthritis. The Lancet. 2015;386(9991):376–87.
4. Zamri NAA, Harith S, Yusoff NAM, Hassan NM, Ong YQ. Prevalence, Risk Factors and Primary Prevention of Osteoarthritis in Asia: A Scoping Review. Elderly Health Journal; 2019
[cited 2021 Apr 7];
Available:https://publish.kne-publishing.com/index.php/EHJ/article/view/1196
5. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. Indian J Orthop. 2016;50(5):518–22.
6. Dixit M, Samal S, Ramteke S. Efficacy of Maitland Mobilization and Myofascial Trigger Point Release in Patients of Osteoarthritis of Knee. Indian Journal of Public Health Research & Development. 2020;11(5).
7. Vanwye WR, Weatherholt AM, Mikesky AE. Blood Flow Restriction Training: Implementation into Clinical Practice. Int J Exerc Sci. 2017;10(5):649–54.
8. Logde A, Borkar P. Effect of retro walking on hamstring flexibility in normal healthy individual. Int J Phys Educ Sports Health. 2018;5:71–3.
9. Alghadir A, Anwer S. Effect of retro and forward walking on quadriceps muscle strength, pain, function, and mobility in patients with knee osteoarthritis: a protocol for a randomized controlled trial. BMC musculoskeletal disorders. 2016;17(1):161.
10. Buford TW, Fillingim RB, Manini TM, Sibille KT, Vincent KR, Wu SS. Kaatsu training to enhance physical function of older adults with knee osteoarthritis: Design of a randomized controlled trial. Contemporary clinical trials. 2015;43:217–22.
11. Cerqueira MS, de Brito Vieira WH. Effects of blood flow restriction exercise with very low load and low volume in patients with knee osteoarthritis: protocol for a randomized trial. Trials. 2019; 20(1):135.

12. Culvenor AG, Øiestad BE, Hart HF, Stefanik JJ, Guermazi A, Crossley KM. Prevalence of knee osteoarthritis features on magnetic resonance imaging in asymptomatic uninjured adults: a systematic review and meta-analysis. Br J Sports Med. 2019;53(20):1268–78.
13. Verhagen AP, Ferreira M, Reijneveld-van de Vendel EAE, Teirlinck CH, Runhaar J, van Middelkoop M, et al. Do we need another trial on exercise in patients with knee osteoarthritis?: No new trials on exercise in knee OA. Osteoarthritis and Cartilage. 2019;27(9):1266–9.
14. Ferraz RB, Gualano B, Rodrigues R, Kurimori CO, Fuller R, Lima FR, et al. Benefits of resistance training with blood flow restriction in knee osteoarthritis. Med Sci Sports Exerc. 2018;50(5):897–905.
15. Segal NA, Williams GN, Davis MC, Wallace RB, Mikesky AE. Efficacy of blood flow–restricted, low-load resistance training in women with risk factors for symptomatic knee osteoarthritis. PM&R. 2015;7(4):376–84.
16. Yadav KH, Shashidharan S. Effectiveness Of Retrowalking In Osteoarthritis Of Knee–A Review Article. International Journal of Advanced Research. 2016;4(2):215–20.

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