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Original Research Article

High Resistance Verses Low Resistance Training on Pain in Patients with Knee Osteoarthritis

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ABSTRACT

Aim: "To compare the effects of high resistance training and low resistance training on pain in patients with knee osteoarthritis."
Objective : To study the effects of High resistance training on pain in patients with knee osteoarthritis, To study the effects of Low resistance training on pain in patients with knee osteoarthritis & to compare the effects of high resistance training and low resistance training on pain in patients with knee osteoarthritis.
Procedure: 38 subjects were collected according to the inclusion and exclusion criteria. Among which 5 subjects were excluded according to the exclusion criteria.2 subjects were not co-operative and 1 subject was not regular for the treatment. So 30 subjects underwent the physiotherapy intervention .Written consent were taken from the respected subjects for study. Participants were divided into Group A and group B by purposive convenient sampling technique for 6 weeks. Group Received low resistance exercise training and Group B received high resistance exercise training. Each group received 40 minutes individual training sessions 4 times a week. Numerical pain rating scale score was the outcome measure taken before and after the treatment protocol. Statistical test used for analysis were: One way Annova test and unpaired t-test.
Result: After 6 weeks, Group A showed more improvement in reduction of pain (p value<0.0001) considered extremely significant than Group B.
Conclusion: This study concludes that low resistance exercise training is more effective in improving pain than high resistance exercise training in patients with knee osteoarthritis

Key words: Osteoarthritis, high resistance training, low resistance training, numerical pain rating scale, and weight cuffs.

INTRODUCTION

Knee OA is a wide spread and well known degenerative disease of joint under common musculo-skeletal disorder, occurrence of which progresses with age. [(1,2)] Individuals with knee OA present with knee pain, joint stiffness, deficits in proprioception and decreased muscle strength (force-generating capacity). [(3,4)] The complicated biomechanics of the knee impact of the muscle group surrounding the joint which affects the Quadriceps femoris muscle group more than surrounding muscle group thus resulting in muscle weakness and pain impacting the quality of life of the patient and thus increasing the functional disability resulting in difficulty to perform activities of daily living especially stair climbing and descending, crossed leg sitting, getting up and sitting on chair. The Steultjens et al analyzed that the force generating capacity of the Quadriceps femoris muscle reduced by around 15% to 20% functional capacity of the lower

extremity and for 5% of the knee pain associated with OA. Therefore, one aim of physical therapy intervention for patients with OA is to increase the strength of the musculature surrounding the knee joint.

It is well known that muscle performance diminishes with age, [5, 6] and the deficits in muscle strength, power and endurance are associated with a higher incidence of activity limitation and participation restriction (functional limitation and disability). [7,8] The extent to which decreasing muscle strength is caused by the normal aging process versus a sedentary lifestyle or an increasing incidence of age relating diseases , such as hypertension and osteoarthritis , is not clear.

A major goal of resistance training in older adults is to maintain or improve their levels of functional independence [9-12] and reduce the risk of age – related diseases. [12-14] As with young and middle – aged adults, older adults benefit from regular physical activity that includes aerobic exercises, flexibility exercises and resistance training. Even in previously sedentary older adults or frail elderly patients , a program of weight training has resulted in training – induced gains in muscle strength .Resistance training also has been shown to improve other parameters of physical function , such as balance ,speed of walking , and the ability to rise from chair and minimize the incidence of falls.

Several guidelines for resistance training for adults have to be followed:

1. Prior to resistance training, perform warm – up activities followed by flexibility exercises.
2. Include both concentric (lifting) and eccentric muscle actions.
3. Perform moderate intensity (60 % to 80% of 1 R.M) exercises that allow 8 to 12 repetitions of each exercise per set.
4. Increase intensity gradually (increments of approximately 5%) to progress the program as strength and muscular endurance to improve.
5. 2 set progressing to 4 sets of each exercise.
6. 2 to 3 minutes Rest between sets.
7. Frequency of two to four times per week.
8. Use slow to moderate speeds of movement.
9. Use rhythmic, controlled, non –ballistic movements.
10. Exercise should not interfere with normal breathing.
11. Whenever possible, train with a partner for feedback and assistance.
12. Cool down after completion of exercise.
13. After a lay-off of more than 1 to 2 weeks, reduce the resistance and volume when reinitiating training weight. [15]

Some authors [10,16] have reported the clinical effectiveness of muscle strengthening exercises in patients with knee OA and have suggested that the exercise should not include high joint load .If the knee joint is overloaded , patients with knee OA may aggravate symptoms such as pain, swelling ,and inflammation. [17,18] However, other authors [19,20] have declared that strength training of a vigorous intensity (50%-80% of 1 RM)does not appear to induce or exacerbate joint symptoms in older adults. Thus, at the present time, it is not clear what level of strength training weight or resistance is optimal to facilitate symptomatic improvement or functional gains in individuals with knee OA.

Pain is the main symptom in the patients with knee osteoarthritis which can cause weakness or locking of the knee joint which is the most discomforting sensation and hindering patients' functional activities. [21,22] Therefore increasing strength in primary knee extensors and flexors by resistance exercises can be beneficial to reduce pain in patients with knee osteoarthritis. Many studies have been done to find the effect of high resistance training and low resistance training on knee osteoarthritis but less have been proved to compare the effect of high resistance

training and low resistance training on pain in patients with knee osteoarthritis. The goal of this study is to determine if increasing strength in primary knee extensors and flexors would directly affect net knee joint pain in patients with knee OA. Hence there is need for further research to compare the effect of high resistance training and low resistance training on pain in knee osteoarthritis.

The purpose of this study was to investigate differences in knee pain following high- and low-resistance strength training. We hypothesized that subjects who received either high- or low-resistance strength training would exhibit greater functional improvement. [(23)] Symptomatic improvement or functional gains in individuals often leads to disability and loss of independence. (Aagard, Suetta, Caserotti, Magnusson, & Kjaer, 2010)

In this study the inclusion are as follows:

1. History of knee pain longer than 6 months.
2. Age is more than 40 years and less than 60 years.
3. Mild to moderate arthritic deformity with reference to classification by S.BENT BROADZMANN.
4. NPRS was taken as a baseline and was between 3 to 5
5. Males and females both were included.
6. With or without involvement of patella.

The exclusion criteria of the study are as follows:

1. Patients who had received knee physical therapy during the preceding 3 months.
2. Have other systemic illness or musculo-skeletal problems associated with the knee joint (such as tendon or ligament tears).
3. Subjects who are on analgesics, supplements.
4. Deformities present.

In this study the outcome measure is numerical pain rating scale. This scale is used because the NPRS is a 11 – point scale which scores from 0 to 10 in which "0"means no pain whereas "10" denotes the maximum imaginable pain. This scale uses less than 3 minutes to administer with only one item in the structure. We teach the patient to select the number in this scale according to pain perception from 0-10. The NPRS is proving to have more than 0.95 test retest reliability and the construct validity ranging from 0.86-0.95. These psychometric properties of NPRS proves that this scale is reliable and is easy in administrating with the patient reduces the barrier in language so we have included NPRS as an outcome measure in osteoarthritis patient. [(24,25)]

PROCEDURE

In this study 38 participants were selected among which 5 patients were excluded on the basis of inclusion and exclusion criteria , 2 patients were non - cooperative and 1 patient was not regular for the treatment so the intervention was performed on 30 subjects and were divided into two groups including both males and females. A detailed explanation of procedure was given to the patient after which consent was signed .A pre and post experimental study was conducted at the outpatient department of the Late Shree Fakirbhai Pansare Education Foundation and yashwantrao chavan memorial hospital were participants of age 40-60 years were included . Total 15 samples were randomly allocated in respective groups i.e. Group A (low resistance training) and Group B (High resistance training). They were all trained by same coach. Respective protocol was followed for group 1 and group 2; and protocol was programmed for 6weeks. Participants were evaluated before and after the training program by using NPRS .The initial evaluation was done before and after 2 weeks, 4 weeks and 6 weeks. It included pain assessment using numerical pain rating scale.

Warm up phase for 5 to 7 minutes was given to both the groups which included activities such as AROM exs of B/L lower extremities and spot marching.

After treatment both the group, i.e; group A and group B were given Cool Down for a period of 5 to 7 minutes which includes activities like hamstring stretching, calf is stretching. During the training, a passive break of 1 to 3 minutes was given between two consecutive activities. Training occurred using 4 separate training stations each with a certified instructor so that 4 participants are treated simultaneously. Training is being given for 4 days in a week for 6 weeks.

Quadriceps drill with 10% of 10 R.M2 sets of 15 reps 2nd station

Partial squats 2 sets of 15 reps 3rd station

Hamstring curl with 10% of 10 R.M 2 sets of 15 rep1st station

Calf strengthening with 10% of 10 R.M 2 sets of 15 reps 4th station

FIGURE 1.1: GROUP A LOW RESISTANCE TRAINING

Quadriceps drill with 80% of 10 R.M 2 Sets of 7-10 reps 1st station

Hamstring curl with 80% of 10 R.M 2 Sets of 7-10 reps 2nd station

Partial squats 2 sets of 7-10 reps of 10 R.M 3rd station

Calf strengthening with 80% 2 sets of 7-10 reps 4th station

FIGURE 1.2: GROUP B HIGH RESISTANCE TRAINING

Materials Used

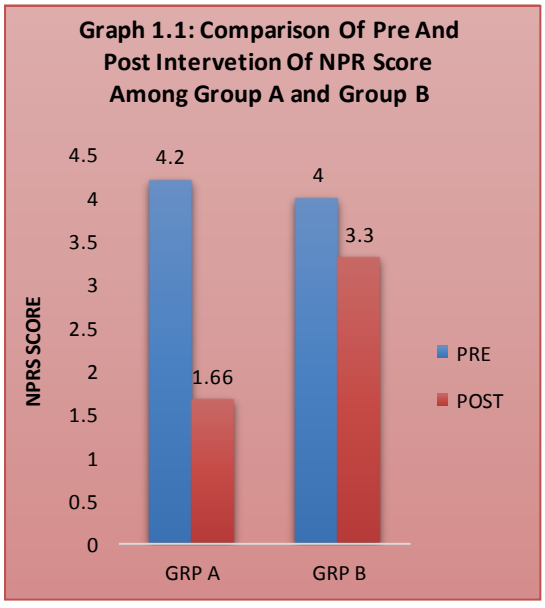
- Numerical pain rating scale
- Data collection sheet
- Consent form
- Weight cuffs

RESULT

The data was managed on excel spread sheet and was analyzed using a 1 – way ANOVA for continuous variables to check the results after 2nd, 4th and 6th weeks. One way analysis of variance was used to analyze the difference among the pain improvement in group A and B. Paired t-test was used to analyze difference between pre and post values of numerical pain rating scale on group A and group B. Unpaired test was used to analyze the difference between the balance improvement between group A and group B. A significant level of p value ($p<0.0001$) was fixed.

GRAPH 1.1 & TABLE 1.1 :SHOWING THE PRE AND POST VALUES OF NUMERICAL PAIN RATING SCALE AT REST IN GROUP A AND GROUP B

	PRE	POST	T VALUE	P VALUE
GRP A	4.2	1.66	15.332	<0.0001
GRP B	4	3.3	5.292	<0.0003



GRAPH 1.2 & TABLE 1.2: SHOWING THE POST AND POST VALUES OF NPRS SCALE AT REST AMONG GROUP A AND GROUP B

	POST	T VALUE	P VALUE
GRP A	2.53	6.07	<0.0001
GRP B	1.2		

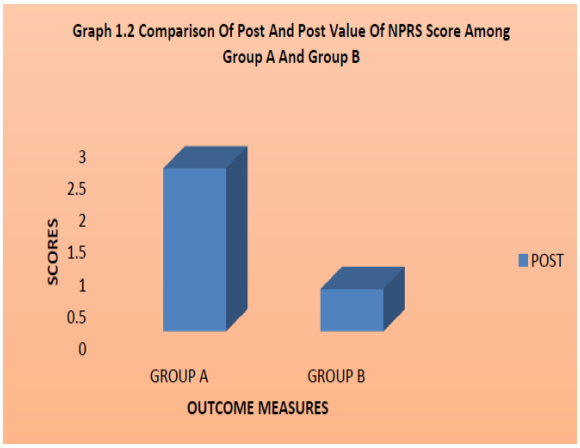
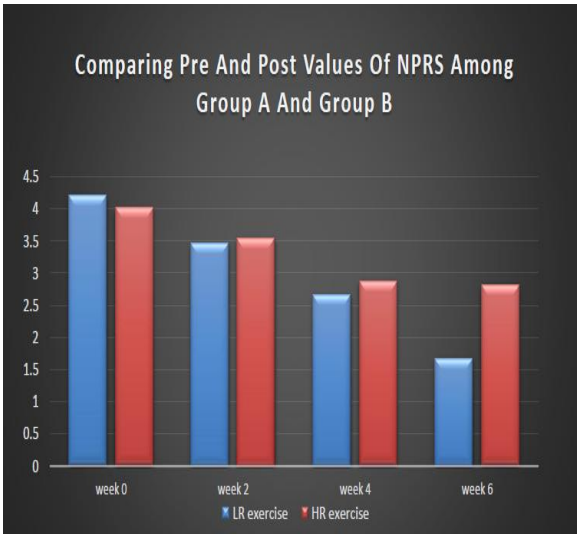


TABLE 1.3 AND GRAPH 1.3 COMPARING PRE AD POST VALUES OF NPRS AMONG GROUP B

	LR exercise	HR exercise
week 0	4.2	4
week 2	3.46	3.53
week 4	2.66	2.86
week 6	1.66	2.8



DISCUSSION

Individuals with knee osteoarthritis, who undertook a program involving a similar volume of mechanical work strength training for 6 weeks displayed significant improvements in knee pain, function of lower extremity and a knee muscular torque following either high resistance training or low resistance training exercise. However, low resistance exercise training appears to have a larger effect than high-resistance exercise training on pain component in patients with knee osteoarthritis.

The results of the study have revealed that subjects in group A (Low

resistance training) and group B (High resistance training) both are benefited from resistance training intervention with a significant improvement in post intervention pain scores on numerical pain rating scale score. We found that participants who received low resistance training demonstrated greater improvements on pain as with low resistance training there is increase in oxidative and metabolic capacities which allows better delivery and use of oxygen as it works on aerobic energy system. The improvement of the muscles ability to use energy is a direct result of increased levels of oxidative enzymes in the muscles, increased mitochondrial density and size, and an increased muscle fibre capillary supply which reduces the activation of nociceptors in knee joint therefore reducing pain

For patients in group A with impaired muscle performance, low resistance training has a more positive impact on improving function than high resistance strength training. In Group A with low resistance training there is improvement in the outcome measures within 2 weeks post intervention with significant improvement after 6 weeks post intervention. The predominant fibre type found in the hamstring and quadriceps muscles and the adequacy of blood supply, which transports oxygen and nutrients to muscle and removes waste products; affect the tension-producing capacity of a muscle and its resistance to fatigue. The removal of waste products from the tension producing muscle results in reduction of pain in the muscles

In addition, using low levels of resistance in an exercise program minimizes adverse forces on joints, produces less irritation to soft tissues and is more comfortable than heavy resistance exercise.Increases in both flexor and extensor muscle strength have been shown to increase general knee stability. Enhanced knee stability results in better functional performance of the lower extremity. Therefore, an essential aim of exercise therapy in patients with knee O.A should be to increase both extensor and flexor muscle strength. Deyle et al examined the frequency of knee arthroplasty in patients with knee OA who undertook an 8 week strength training. They found that 20% of the subjects in the placebo group had undergone arthroplasty at the 1-year follow-up, whereas only 5% of the subjects who underwent the exercise intervention required surgery. This is further evidence supporting the notion that strength training is beneficial for patients with knee OA. Reference taken from Mei-hwajan, jiu-jeng Lin, jiann –jong Liau, Yeong-Fwuliu, Da-Hon Lin

In this study, we have used 10 R.M as a baseline measurement as the use of 1 R.M as a baseline measurement of dynamic strength is inappropriate for some patient populations because it requires one maximum effort. It is not safe for patients, for example, with joint impairments, patients who are recovering from or who are at risk for soft tissue injury, or patients with known or at risk for osteoporosis or cardio-vascular pathology .To avoid the trial and error associated with establishing a 1 R.M or to eliminate the need for an at-risk patient to exert a single, maximal effort the baseline of 10 R.M has been used. Reference taken from Carolyn kisner and Lynn Allen Colby chapter 6 pg no.172

The impact of exercise was evaluated especially in relation to aspects of pain. All the studies that analyzed the pain component, observed a reduction after the resistance exercise program. Two studies analyzed interventions of high and low intensity, and found pain reduction in both cases; although more pronounced in the subjects that practiced more intense exercises. This study proves pain reduction in patients who practiced low intensity exercises.

The pain reduction in patients with knee OA submitted to resistance exercises has been attributed to increased muscle strength and stability in the afflicted joint, as

well as to the joints consequent load reduction. However, the pain reduction witnessed in the short duration programs may be attributed to the frequent contact with the health professional and to the reduction in anxiety and depression provided by participation. With reference from Resistance exercise in osteoarthritis by Nataliacristina de oliveria, Fabio Macron Alfeiri pg.no-145

The effect of 6weeks of resistance training in older adults have been proved in a article stating that 6 weeks of resistance exercise significantly improved lower body strength (1 R.M) by 35% and function (CHAIR) by 20%.There were also beneficial improvements in the delay of neuromuscular fatigue (PWCft) by 14% and gait speed (WALK) by 15%.The results of this study indicate 6 weeks of resistance exercise has a beneficial effect on improving strength and functionality and possibly beneficial at delaying the onset of neuromuscular fatigue in older adults With reference The effect of 6-weeks of resistance training on the neuromuscular fatighue threshold in older adults.

CONCLUSION

Both high-resistance and low resistance strength training reduced pain and improved function in patients with knee Osteoarthritis. Although low-resistance strength training demonstrated effect sizes that consistently were slightly greater than those achieved with high-resistance strength training, the differences in improvement between the high resistance group and low resistance group were significant.

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