

A COMPARATIVE STUDY TO ANALYZE THE EFFECTS OF CONVENTIONAL RESISTANCE TECHNIQUE VERSUS ELASTIC RESISTANCE TECHNIQUE ON IMPAIRMENTS OF OLDER ADULTS WITH OSTEOARTHRITIS OF KNEE

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ABSTRACT

Background: Osteoarthritis (OA) is a chronic joint disorder in which symptoms and signs like Pain, swelling, loss of range of motion, joint stiffness and bony deformity take place gradually. It is the one of the most common musculoskeletal disorders which affects 5.3% males & 4.8% females in Older adults population (>55 years of age) of India and comprises the leading cause of disability particularly when the knees are affected (a large weight bearing joint) since the ability to walk, to rise from chair & to use stairs are limited. Physical activity programs directed toward older adults with OA have consisted of aerobic modes as well as resistance training has significant positive effect on impairments.

Purpose: To evaluate the effectiveness of elastic resistance training as an intervention to improve arthritis-related pain (VAS), effects on leg strength (RM), performance-based and self-reported physical function, symptoms of depression outcomes (SF36) and to compare elastic resistance technique with conventional technique & derive benefits of it.

Result: Each of the outcomes compared pre and post exercise in both the groups and the differences are statistically significant at 95% CI ($p < 0.05$). And finally the comparison between post data of both the group showed the difference which was insignificant at 95% CI and $p > 0.05$. Paired and unpaired t-test was used.

Conclusion: The result on the bases of the statistical analysis proved the effectiveness of elastic resistance training and conventional training for the Osteoarthritis patients of old age; both treatments are significantly effective. But, Elastic bands are inexpensive, easy to store, convenient for transport and able to provide resistance in multiple directions.

KEY WORDS: Osteoarthritis of Knee, Older adults, Conventional resistance, Elastic resistance.

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BACKGROUND

Osteoarthritis (OA) is a chronic joint disorder in which there is progressive softening & disintegration of articular cartilage occurs. The term 'Osteoarthritis' was coined by John Spendon [1]. This progressive degenerative

diseases is known to affect various changes in articular cartilage, bone, synovium, and joint capsule. Consequently these structures have been studied widely [2]. It is particularly disabling when the knees are affected (a large weight bearing joint) since the ability to walk,

to rise from chair & to use stairs are limited. Clinically a diagnosis is often made on the basis of symptoms and signs which are Pain, swelling, loss of range of motion, joint stiffness and bony deformity [3].

It is the one of the most common musculo-skeletal disorder. It is characterized by pain, articular cartilage deterioration and joint space narrowing and reduced muscle strength. It is a slowly progressive non-inflammatory disorder of the synovial joints. It is so common in the developed world.

Osteoarthritis (OA) affects 5.3% males & 4.8% females in Older adults population (>55 years of age) of India and comprises the leading cause of disability [4]. The Osteoarthritis of Knee being a common problem in India, seen with the view point of lifestyle and household conditions in the country is creating more clinical concern especially for Physiotherapists who are encountering many of these cases [5].

Osteoarthritis is no longer considered to be a normal part of the aging process, but growing older continues to be consistently identified as one risk factor for disease development. Cartilage destruction can actually begin between ages 20 and 30, and the most common of adults are affected by age 40 [6]. Risk factors that directly shows relationship to Osteoarthritis are obesity, weakness of quadriceps muscle, joint impacts, twisting and some occupational activities which require kneeling and squatting movements.

The most common symptom older adults with OA report is joint pain related to everyday activities (e.g. walking, climbing stairs). The resultant cycle that tends to occur is initiated by joint pain which leads to avoidance of activity followed by additional periarticular muscular weakness from disuse [5-11].

Muscle weakness accelerates the OA disease process in that the joint protective mechanism of shock absorption is diminished. In essence, the lack of muscle protective actions leads to increase stress to joint cartilage leading to further deterioration and pain [12-13].

Physical activity programs directed toward older adults with OA have typically consisted of aerobic modes such as walking. However,

aerobic programs are not intended to target periarticular muscle weakness. A better approach to using exercise may be to implement a resistance training program either prior to, or in conjunction with, walking programs to address the associated factors of lower extremity joint pain and muscle weakness. Standard of care noted in patients typically consists of some low intensity resistance training with more emphasis placed on aerobic activities. Unfortunately, the older adult patient commonly will stop the resistance training, but may continue walking simply due to convenience. It has been suggested that both general (aerobic fitness training) and local (strengthening) exercises are essential to hip or knee OA management [12].

There is strong evidence that conventional resistance training has positive effects on physical function. Resistance training has beneficial effects on musculoskeletal function and body composition, cardiovascular disease, Insulin action, bone health, energy metabolism, psychological health, functional status. These adaptations to resistance training are potentially very relevant to knee OA because quadriceps weakness, obesity, and abnormal mechanical joint forces have been related to the development and progression of knee OA and are potentially modifiable by resistance training [13].

However, it is believed that the positive effects of conventional resistance training may be lost over time due to diminishing compliance related to accessibility or exercise adherence issues. Home-based programs with simple tools may address this compliance issue regarding long-term resistance training. A small number of studies targeting older adults with OA support elastic resistance training programs conducted in the individual's home [14].

Thera band is recognized as the original system of progressive resistance for over 25 years, Thera-Band elastic resistance has been proven to increase strength, mobility and function, as well as reduce joint pain [15].

According to the patient's response to the elastic resistance training, amount of resistance can be progressed by increasing initial length of band and then by color of the band [15].

Identified gaps in the current literature specific to elastic resistance training and OA are methodological in nature.

A review of the literature has revealed:

- 1) A lack of attention to the use of a valid method for quantifying intensity.
- 2) A poorly defined protocol for progression of resistance.
- 3) Outcome measures that lack sensitivity to small but important changes.

If these gaps are addressed, the effects of this potentially useful method of resistance training could be evaluated with confidence in older adults diagnosed with OA.

The importance of this study is to create new knowledge by establishing a valid method of delivering resistance training with elastic bands and then comparing with sandbag as an exercise intervention tool for older adult diagnosed with OA. In addition, this study will explore evidence to support the already established theorized casual relationships between impairment and functional limitation, but need to be further explored in samples of older adults with OA [14].

Purpose of the study: To evaluate the effectiveness of elastic resistance training as an intervention to improve arthritis-related pain.

To evaluate the leg strength, performance-based and self-reported physical function, symptoms of depression outcomes.

To assess Comparison of elastic resistance technique with conventional technique & benefits of it.

MATERIALS AND METHODS

Present study carried at Shree B.G.Patel college of physiotherapy, Anand Anand dham old age home, Lambhvel, with sample size of 30 (Patients with OA Knee), subjects were selected by convenient sampling method and designed as a comparative study for 6 weeks duration.

Materials used for this study were Plinth, Thera band, Sand bags, Chair / stool.

Inclusive Criteria:

Old age group 55 to 75 year
Both, Males & females
Primary Osteoarthritis of Knee joint, unilateral & bilateral

Exclusion Criteria:

Patients with recent surgery
Patients with Neurological disorder
Patients with severe Cardio-Pulmonary disorder
Patients with any Musculoskeletal disorder of Lower extremity except OA knee

Collection of data: The subject were taken for this experiments referred to Shree B. G. Patel college of physiotherapy, Anand and Anand dham old age home, Lambhvel. After that patients were chosen according to the inclusion and exclusion criterions. 30 subjects were taken with osteoarthritis of knee.

The written informed consent was obtained from each subject after explaining the details of training to be conducted.

Then subjects were randomised in experimental groups, 15 subjects in each group.

Procedure: Thirty patients with OA of knee were selected based on the inclusion and exclusion criterions. A brief explanation of the procedure was given to prepare the subjects after obtaining the informed consent, all the subjects were clearly instructed about the purpose of the study. Before the treatment all subjects were assessed thoroughly and also assessed for the pain status using Visual Analogue Scale, 1RM and SF36.

15 patients were randomly assigned for each group. The duration of the treatment program was 6 weeks.

Treatment regime:

1. Knee Extension in high sitting (100-0°), 6 to 8 repetitions at 80% of 1RM.
2. Knee flexion exercise (0-120°) in prone position with sand bag, 6 to 8 repetitions at 80% of 1RM.

This protocol is followed daily for 5 days /week for 6 weeks for both the groups.

Progression of the amount of resistance is done by re checking the strength at the end of every week.

For the Group A: Elastic band group, amount of resistance is increased by reducing the initial length of the band.

For the Group B: Sandbag group, it is done by increasing amount of weight of the sandbag [38].

At the end of 6 weeks, each patient's all outcomes are re checked and recorded.

Outcome measure:

Visual analogue scale (VAS): It is a psychometric response scale which can be used in questionnaires. It is a measurement for subjective characteristics or attitudes that cannot be directly measured, like Pain. When responding to a VAS item, respondents specify their level of pain by indicating a position along a continuous line between two end-points. A 100 mm long line is put [22].

The Short Form (36) Health Survey: It is a patient-reported survey of patient health. The SF-36 is a measure of health status and an abbreviated variant of it. The SF-36 consists of eight scaled scores,. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight.

Here 8 components are included,

1. PF (Physical function)
2. RP (Role of Physical function)
3. BP (Bodily pain)
4. GH (General health)
5. VT (Vitality)
6. SF (Social functioning)
7. RE (Role of emotional function)
8. MH (Mental health)

These all are summarised in two components

1. PCS (Physical Component Summary)
2. MCS (Mental Component Summary)

For interpretation total 60% in both summaries is considered as excellent health status.

For the age group >55 years, 40% above is considered as a good health status.

1 RM (one repetition maximum): In weight training is the maximum amount of force that can be generated in one maximal contraction. One repetition maximum can be used for determining an individual's maximum strength.

Here it is evaluated by sub maximal load formula

$$1RM = \text{Weight} \times (36 / (37 - R)) [19]$$

Data Analysis: This study was aimed to compare the effect of the Elastic resistance technique and the conventional resistance technique (sand-bag) in the older adults with Osteoarthritis of

knee by using the VAS for pain, 1RM for strength and SF36 for Overall health status.

Unpaired t tests were used to compare the outcome measurement data between two groups.

Paired t tests were used to determine whether VAS, 1RM and SF36 were significantly different before and after the intervention.

Each calculated t value is compared with t-table value to test hypothesis at 0.05 level of significance. Data analysis software Graph pad prism version 6 has been used for the data analysis of the study.

Descriptive analysis of data: All the descriptive data was analysed to see homogeneity of two groups for all the possible confounding factors.

Mean \pm SD of age for the study population was 62.53 ± 5.63 .

Mean \pm SD of age for Group A (Elastic resistance) was 64.2 ± 4.79 .

Mean \pm SD of age for Group B (Sand bag resistance) was 60.86 ± 6.05 .

Total 30 patients were taken, among them 21 were females and 9 were males. In Elastic resistance group 12 were females and 3 were males, in Sandbag resistance group 9 were females and 6 were males.

RESULTS

Results of outcome measures in both the group:

Group A: Elastic resistance group

Data analysis of pain with VAS:

Pre test Mean \pm SD for Group A was 73.40 ± 15.13 and

Post test Mean \pm SD for Group A was 32.00 ± 10.65 .

Table 1: Showing the Group A: Elastic resistance group.

VAS		
	Pre	Post
Mean	73.4	32
SD	15.13	10.65
t-calculated	t = 12.13	
df	df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of strength with 1RM:

Table 2: Showing the strength with 1RM.

	Knee Flexion(kg)		Knee Extension(kg)	
	Pre	Post	Pre	Post
Mean	1.7	2.2	1.5	2.18
SD	0.24	0.33	0.29	0.28
t-calculated	t = 9.31		t = 9.10	
Df	df = 14		df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of Overall health status with SF36:

Table 3: Results of Overall health status with SF36.

	Physical Component Summary		Mental Component Summary	
	Pre	Post	Pre	Post
Mean	33.05	45.67	34.49	47.97
SD	3.7	4.85	6.47	5.06
t-calculated	t = 7.98		t = 12.40	
Df	df = 14		df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Group B: Sandbag resistance group :

Results of pain with VAS:

Pre test Mean ± SD for group B was 69.6 ± 9.71 and Post test Mean ± SD for group B was 31.86 ± 9.24.

Table 4: Showing the Results of pain with VAS.

	VAS	
	Pre	Post
Mean	69.6	31.86
SD	15.13	10.65
t-calculated	t = 14.09	
df	df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of strength with 1RM:

Table 5: Showing the Results of strength with 1RM.

	Knee Flexion(kg)		Knee Extension(kg)	
	Pre	Post	Pre	Post
Mean	1.6	2.07	1.65	2.36
SD	0.3	0.34	0.28	0.32
t-calculated	t = 9.082		t = 11.68	
Df	df = 14		df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of Overall health status with SF36:

Table 6: Results of Overall health status with SF36.

	Physical Component Summary		Mental Component Summary	
	Pre	Post	Pre	Post
Mean	34.47	46.36	37.21	49.8
SD	4.69	5	8.39	5.96
t-calculated	t = 9.705		t = 9.288	
Df	df = 14		df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of outcome measures Between the groups:

Data analysis of pain with VAS:

Table 7: Results of outcome measures Between the groups.

	VAS	
	Group A	Group B
Mean	32	31.86
SD	10.65	10.65
t-calculated	t = 0.03662	
df	df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of strength with 1RM:

Table 8: Showing the Results of strength with 1RM.

	Knee Flexion(kg)		Knee Extension(kg)	
	Group A	Group B	Group A	Group B
Mean	2.2	2.07	2.18	2.36
SD	0.33	0.34	0.29	0.32
t-calculated	t = 1.06		t = 1.61	
Df	df = 14		df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

Results of Overall health status with SF36:

Table 9: Showing Results of Overall health status with SF36.

	Physical Component Summary		Mental Component Summary	
	Elastic group	Sandbag group	Elastic group	Sandbag group
Mean	45.67	46.36	47.97	49.8
SD	4.85	5	5.06	5.96
t-calculated	t = 0.385		t = 0.904	
Df	df = 14		df = 14	

Here the t-calc > t-table, 95% CI. So it is statistically significant.

DISCUSSION

In this study 30 subjects of Osteoarthritis of knee with mean age of 62.53 year were participated. Both genders were included in this study. Participants were randomly divided into two groups; group A and group B. following 6 week intervention both the group showed significant improvement in pain intensity (VAS), strength (1RM), and overall health status (SF36).

In group A the mean difference of VAS is 41.4mm, for 1RM is 0.5 kg & 0.68 kg for the flexion & extension consequently and 12.62% & 13.48% for the physical & mental components of SF36. Where as in group B the mean difference of VAS is 37.74mm, for 1RM is 0.47 kg & 0.71 kg for the flexion & extension respectively and 11.89% & 12.59% for the physical & mental components of SF36. These results are statistically significant at 95% CI ($p < 0.05$).

Now the comparison between post data of both the group showed mean difference of only 0.14mm for the VAS, 0.13 kg & 0.18 kg for the flexion & extension the 1RM, and finally 0.69% & 1.83% for the physical & mental components of SF36. These values are statistically insignificant at 95% CI and $p > 0.05$.

The primary finding derived from this study, leg strength mediates the relation between arthritis-related pain and physical function, illustrates a plausible explanation as to how arthritis-related pain leads to decrements in physical function. It was noted in this sample that almost half (47.2%) reported an under physical activity level suggesting the adoption of a sedentary lifestyle. This study provides evidence that arthritis-related pain is associated with lower muscular strength, which in turn is associated with lower daily physical function

It is difficult to directly compare our results to those results published previously because we used different dependent variables. Moreover, this study is the first to show that the participation in a training program using elastic tubing is as effective as a training program using free weights in improving isometric strength in older adults. One of the few studies that used a young healthy subject population was Kraemer et al. [14] This study also developed a training methodology using medium high exercise

intensity & concluded the both methods as of same effectiveness. One another study by J.C. Colado, who compared the difference between elastic resistance and free weights and weight machines on normal young individuals. He found the effects of both training same.

On the other hand, Dawn M Hayes had done a Randomised controlled trial on older women patients and found elastic training beneficial in his 8 week training program.

Our work confirmed the effectiveness of these elastic devices in improving the muscular performance in older adults with Osteoarthritis. However the comparison did not show any difference, other benefits of using elastic training are studied by Jim Stoppani (2010) and he gave the benefits which are as follows Inexpensive, Easy to store, Easy to transport, Provides resistance in multiple directions (gravity free), Provides variable resistance, Provides constant tension.

CONCLUSION

As the results shows that the elastic resistance training and conventional training for the Osteoarthritis patients of old age, both treatments are significantly effective, After the comparison we found, there is no statistically significant difference Between Elastic resistance technique and Conventional resistance technique ($p > 0.1$). But Elastic bands are inexpensive, easy to store, convenient for transport and able to provide resistance in multiple directions.

ABBREVIATIONS

OA - Osteoarthritis

1 RM - 1 Repetition Maximum

VAS - Visual Analogue Scale

Conflicts of interest: None

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