

## COMPARING DIFFERENT ANKLE POSITIONS DURING ISOMETRIC STRENGTHENING OF QUADRICEPS IN KNEE OSTEOARTHRITIC PATIENTS BY USING HAND HELD DYNAMOMETER.

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### ABSTRACT:

**Background:** Osteoarthritis (wearing and tearing of joints) is the most common problem in older adults where it particularly affects the knee joints. Affected people normally complaint of having pain and tenderness around the knee joints.

**Objective:** Physiotherapists have been performing isometric strengthening for quads from decades on the people suffering from knee OA and the results were quite satisfactory in improving functioning and relieving pain along with quads strengthening of knee joint. The chief aim of this study was to rule out that which ankle position can provide enhanced effects on the strengthening of quadriceps when comparing by using Hand held dynamometer along with the gain of functional activity in these positions using WOMAC scale.

**Material Methodology:** It was a quasi-experimental study. Subjects suffered from knee osteoarthritis and had visited different physiotherapy setups (public or private) of Faisalabad were included in this study using the selection criteria after they signed their consent forms. Some of the data was also collected from our surroundings such as from neighbors and relatives. Data was collected by convenient sampling technique through using different data collection tool like already diagnosed patients, physical examination and available X-Rays while weekly follow up was measured by using Hand held dynamometer (isometric strengthening of quads). Duration of this study was of three weeks including 45 subjects ranging from 40-65 years of age.

**Results:** The end results of this research clearly pointed out the fact that the dorsiflexion in terms of specified ankle position offered enhanced effects rather than other ankle positions. Hand held dynamometer was used for measuring to compare quadriceps strength in all three groups. While comparing the effect of functional activity in these positions, no significant difference was found.

**Conclusion:** This research concluded that the subjects who were placed in the dorsiflexion group during the whole procedure of strengthening regime reaped more benefits in terms of quadriceps strength comparing to other groups and functional activity improved equally in all three groups.

**Key words:** Hand held dynamometer, isometric strengthening, isometric strengthening of quadriceps, quadriceps, knee osteoarthritis, ankle positions, KOA.

## BACKGROUND:

Osteoarthritis (wear and tear of joint) is the most common form of injury found in knee joint specifically in old age. It can create difficulties in every day normal (activities) life of an individual. The percentage of people that might develop it during their lifetimes is 46%. The prevalence rate is high in woman with the ratio of 13 % than in men with the ratio of 10%. People having knee osteoarthritis suffer from different sign and symptoms starting from pain to swelling, tenderness, and increase in temperature and decrease in functional activity. Radio graphical representation mostly show cartilage loss, bony spurs while its severity depends in which grade the OA is. (Hunter et al., 2020, Wieland et al., 2005, Zhang, Jordan et al., 2010)

(Muraki et al., 2013) (Centers for Disease Control and Prevention et al., 2020; Diseases et al., 2019; Staff et al., 2021) (Higuer et al., 2021) (David et al., 2020)

Sign and Symptoms of knee joint are the main reasons people mostly approach a physician. Medications and physical therapy both hold a specific importance in treating knee osteoarthritis but in the recent years, due to all the positive findings physical therapy is gaining more importance. The most commonly recommend exercise for the strengthening of quadriceps in knee osteoarthritis is isometric setting exercise. A lot of literature supports the idea of using an exercise regime rather than loads of medication to treat knee osteoarthritis. Like the study conducted by Lan Feng in 2018 about comparing the effects of NSAIDs and isometric strengthening in two groups respectively concluded that the patients who received isometric strengthening of quadriceps showed significant improvement. (professional, Selderslaghs et al., 2019)) (Higuer et al., 2021, professional et al., 2019.) (David et al. 2020) (Palmieri-Smith et al., 2010; Sharma et al., 2003) (Huang et al., 2018)

Another study conducted by Anwar in 2014 found that individuals with knee osteoarthritis benefitted from a 5 week isometric quadriceps training program in terms of quadriceps strength, pain relief and functional improvement. While another research that was conducted by Bennell showed the same kind of results. He used quadriceps strengthening activities along with neuromuscular training to treat the patients suffering from moderate to severe type of knee osteoarthritis. The outcomes of using quadriceps strengthening exercises are mostly related to increase in functional status, decrease in discomfort and preventing further injury. (Anwer, Alghadir et al., 2014)

So, a lot of research has already been conducted to indicate that the isometric setting exercises are indeed helpful in regaining normal ADLs. But a new dispute had arose i.e. which ankle position will benefit the already existing isometric strengthening regime. A lot of researches are being carried out to determine a single ankle position for quads strengthening exercises. Our research is also based to find out the fact which ankle position is superior to others in terms of increasing strength and functional activity.

## MATERIAL AND METHODOLOGY:

### Selection criteria:

**Inclusion criteria;** The inclusion criteria of the study involved both genders ranging from age 40-65 suffering from unilateral or bilateral knee osteoarthritis probably in grade 2 or less than that and were having symptoms of pain, swelling, tenderness and functional loss.

**Exclusion criteria;** While the subjects who had any kind of injury such ACL injury, soft tissue injury, radiating pain to leg, CNS involvement, bursitis, tendonitis or knee fracture/ dislocation

were not involved in this study. Other subjects like who had limitation in ankle ROMs, history of metallic implant or mentally unstable were also excluded from this study.

### **Procedure:**

It was a quasi-experimental study. Subjects suffered from knee osteoarthritis and had visited different physiotherapy setups (public or private) of Faisalabad were included in this study using the selection criteria after they signed their consent forms. Some of the data was also collected from our surroundings such as from neighbors and relatives. Data was collected by convenient sampling technique through using different data collection tool like already diagnosed patients, physical examination and available X-Rays while weekly follow up was measured by using Hand held dynamometer (isometric strengthening of quads). Duration of this study was of three weeks including 45 subjects ranging from 40-65 years of age. 15 patients were added in each group dorsiflexion, plantar flexion and neutral.

Group A: Short arc quads along with dorsiflexion ankle position.

Group B: Short arc quads along with plantar flexion ankle position.

Group C: Short arc quads along with neutral ankle position.

### **Measurement of variables:**

Data was first collected before starting any treatment as the baseline value. Exercise were guided to the subjects as a follow up to perform for the whole week until the next measurement that was conducted at the end of first week. Following to the end of 2<sup>nd</sup> and then the end of 3<sup>rd</sup> week.

#### **1- Quadriceps strength:**

For measuring quadriceps strength, hand held dynamometer was used. Subjects were made to sit on a chair and their thighs were made stabilized by using physio belts. Subjects were told to flex their knees to 60 degrees at the start of the measurement. Inelastic straps were used to bind the dynamometer. Dynamometer was tied from one side to the rear leg of the chair and other side to the distal leg of the subject. Finally, subjects were told to extend their knees to the fullest. Dynamometer gave the readings in kilograms and pounds. It represented as the strength of the quadriceps.

#### **2- functional activity:**

For measuring functional activity of participants from baseline value up to the follow up for three weeks, WOMAC scale was used. Every week participants were asked to fill out the forms as they were guided about the written question in them. In the end, total score was calculated to find out the end results.

### **Intervention:**

Subjects were made to lie supine and then placed a rolled towel behind their knees. They were told to extend their knees while lying in supine position. 20 repetitions were done at the time of treatment. They were guided further for a home program. Subjects were told to perform short arc quads with 15-20 repetitions twice a day.

### Results and Statistical Analysis:

After intervention, for results pre value and post value that was calculated at the end of 3<sup>rd</sup> week were compared. The results showed that there is a difference in the mean values of all three groups. But the significant difference was found in the pre and post value of the dorsiflexion group.

One way ANOVA test was used to compare the mean and standard deviation of all three groups before and after treatment to elicit a comprehended result.

#### 1- Quadriceps strength:

**Table 4.9:**

**Comparing mean and standard deviation between all three groups before and after treatment.**

		N	Mean	Std. Deviation	Std. Error
What was the strength before treatment?	planter flexion group	15	8.1133	6.34799	1.63904
	dorsiflexion group	15	11.1533	7.32275	1.89073
	neutral group	15	5.9067	4.63118	1.19577
	Total	45	8.3911	6.43735	.95962
What was the strength after treatment?	planter flexion group	15	10.0600	6.98609	1.80380
	dorsiflexion group	15	15.0800	7.68553	1.98440
	neutral group	15	7.9267	4.97041	1.28335
	Total	45	11.0222	7.16795	1.06853

ANOVA

		Sum Squares	df	Mean Square	F	Sig.
What was the strength before treatment?	Between Groups	208.192	2	104.096	2.707	.078
	Within Groups	1615.144	42	38.456		
	Total	1823.336	44			
What was the strength after treatment?	Between Groups	404.608	2	202.304	4.578	.016
	Within Groups	1856.089	42	44.193		
	Total	2260.698	44			

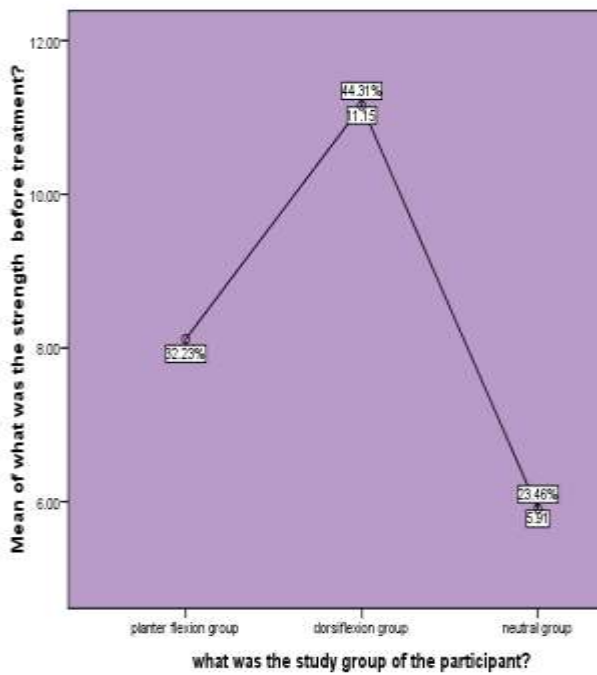


Figure 4.9 (a) Comparing the percentage quadriceps strength in all three groups before treatment.

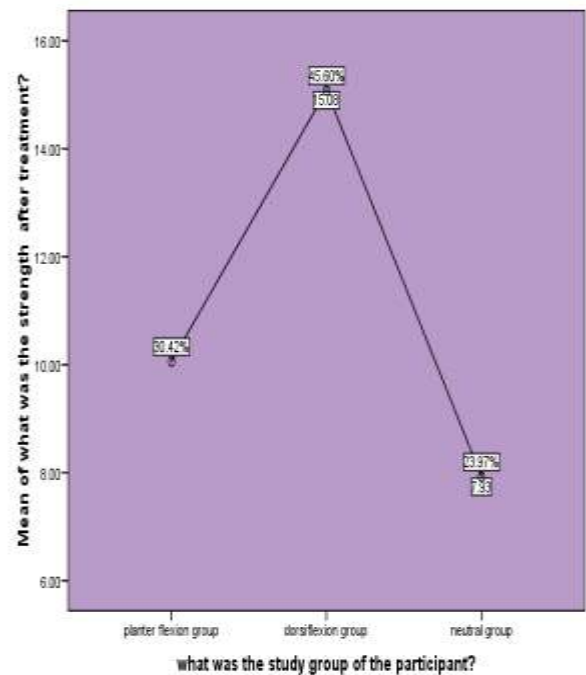


Figure 4.9 (b) Comparing the percentage of quadriceps strength in all three groups after treatment.

## 2- Functional activity:

Table 4.8

## Comparison of functional index between three groups:

	N	Mean	Std. Deviation	Std. Error
What was the functional activity before planter flexion treatment?	15	53.6667	9.64118	2.48934
group				
dorsiflexion group	15	48.5333	11.52554	2.97588
neutral group	15	63.4667	12.72717	3.28614
Total	45	55.2222	12.75270	1.90106
What was the functional activity after planter flexion treatment?	15	27.4667	6.49029	1.67578
group				
dorsiflexion group	15	21.8667	6.58859	1.70117
neutral group	15	31.0000	5.59336	1.44420
Total	45	26.7778	7.18549	1.07115

## ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
What was the functional activity before treatment?	Between Groups	1726.978	2	863.489	6.680	.003
	Within Groups	5428.800	42	129.257		
	Total	7155.778	44			
What was the functional activity after treatment?	Between Groups	636.311	2	318.156	8.170	.001
	Within Groups	1635.467	42	38.940		
	Total	2271.778	44			

## Discussion:

This study was conducted to compare the difference between different ankle positions (plantarflexion, dorsiflexion and neutral position) when same exercise was used along with different ankle positions to strengthen the quadriceps.

All treatment recommendations for knee osteoarthritis promote exercise as one of the most significant non-pharmacological treatment alternatives for pain alleviation and enhancement of physical function (Zhang et al. associates, 2008). Like in a paper published in 2020, Raghava et al. thoroughly synthesized the most recent research on the effects of hip strengthening on knee pain, lower limb function, and biomechanical measurements of the knee joint in individuals with osteoarthritis of the knee. The analysis found compelling, high-quality data supporting the recommendation of hip strengthening in the conservative care of persons with knee osteoarthritis, according to the study's findings. (Neelapala et al., 2020) The experimental group employed isometric quadriceps to treat knee osteoarthritis whereas the control group received physical therapy and NSAIDs. At the 1 and 3 month follow-ups, several scales were employed to compare the results before and after the therapy. Significant improvements in knee function and pain alleviation were seen in the experimental group. (Huang et al., 2018)

All these literature and the results of this study are highly correlated with each other. They prove the point that the exercises are not only the best alternate to the pharmacological treatment but can provide much better effects than some medications. Secondly, which ankle position is superior to others well few literature supports our results while other literature had found some quite different results that are opposite to ours. In 2010, Shveta et al. conducted an experimental study to find out the effect of different ankle position doing isometrics for quadriceps strengthening in KOA. At the end of the 3<sup>rd</sup> week, result showed a significant increase in isometric strength during dorsiflexion compared to others. Teppermen et al. conducted a prospected study on 20 normal clients to find out the effect of different ankle positions (plantarflexion, dorsiflexion and rest) on facilitation and comfort of isometric contraction of quadriceps strengthening in spine positions with knee and hip fully extended. At the end of the research, results showed that both plantarflexion and dorsiflexion were superior in enhancing facilitation rather than knee being in neutral position and next choice can be made based on the patient's comfort level. (Shveta et al., 2010)

**Conclusion:**

At the end of this study, it is finally concluded that the subjects who were placed in the dorsiflexion group during the whole procedure of strengthening regime reaped more benefits in terms of quadriceps strength comparing to other groups. While no significant difference was found in terms of functional activity in all three groups. Other groups who were involved in this study i.e. subjects in plantar flexion group or the subjects who were in neutral group were also found quite happy at the end of the treatment. Even though, the time period was small and the only way the only they can strengthen their quadriceps was through the use of exercise rather than use of any physical therapy instrument like PCM. Continues exercise for three weeks did benefit them a lot.

**Limitations:**

- A specific measurement tools for measuring quadriceps strength *microfet 2 hand held dynamometer* was not available in Pakistan and it was quite expensive. Even though, several literature have proved as a reliable source of information for the use of hand held dynamometer in measuring quadriceps strength. Still a complete practice is required of its positioning to value reading before using it for clinical purpose.
- Only quadriceps setting exercise was used to treat the patients.
- Patients suffering from grade 2 were involved in this study.

**Recommendations:**

- Clinically, more accurate modalities or instruments can be used for the purpose of quadriceps strengthening. Such as use isometric resistance training chair as they are not portable that easily. Having them in clinics for use is much easy than carrying it around. While other modalities can also be used in conjunction with the quadriceps setting exercise like the use Shortwave Diathermy to produce effects more early and more enhanced.
- If possible, then use of a most reliable instrument to measure quadriceps strength should be used. As it will be much easier for the beginners to use it and extracting some accurate results. Practicing hand held dynamometer will utilize some time and might not be that easy for the beginners to use.
- Finally, it is necessary to have some kind of information about the use of quadriceps setting exercise in grade 3 of knee osteoarthritis. As it is necessary to know that whether applying only quadriceps setting exercise can help the subjects of grade 3 or not without the use of any other modality.



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