

Original Article

EFFECT OF SOCCER TRAINER AND ELASTIC BAND ON QUADRICEPS FEMORIS MUSCLE STRENGTH IN YOUNG HEALTHY INDIVIDUALS: A RANDOMIZED CONTROLLED TRIAL

Santosh Metgud ¹, Pranata Dalal ², Pavan Joshi ^{*3}.

¹ Prof. & Head, Dept. of Orthopaedic Manual Therapy, KLE Institute of Physiotherapy, Belgavi, Karnatak, India.

^{2,*3} KLE Institute of Physiotherapy, Belgavi, Karnatak, India.

ABSTRACT

Introduction: Quadriceps is one of the strongest muscle of the body that is required for knee mobility. Quadriceps plays a crucial role in many daily activities such as walking, twisting, running, jumping, and controlling the movement of knee. Since it's a two joint muscle, they tend to become very tight leading to imbalance, which can give rise to a number of postural problems and common musculoskeletal disorder causing pain in the knee joint. It could be acute, subacute and chronic in its clinical presentation. Hence strengthening of quadriceps femoris is necessary.

Materials and Methods: a total of 90 participants within age of 21 to 29 years and BMI 19.9 to 24.9 having no neurological, cardiopulmonary and musculoskeletal disease were selected. **Results:** of the total 90 subjects, the mean age of the participants in group A 21.67 ± 0.88 the mean age of participants in group B was 22.23 ± 1.33 and the mean age of participants in the group C was 22.03 ± 1.27 . The result showed high significance in the group B.

Conclusion: Study showed increase in the quadriceps muscle strength in group B.

KEY WORDS: Trainer, Elastic Band, Quadriceps femoris, Muscle strength, Musculoskeletal disorders.

Address for correspondence: Dr. Pavan Joshi. PT., KLE Institute of Physiotherapy, Belgavi, Karnatak, India. **E-Mail:** pavanjoshiophysio@gmail.com

Access this Article online

Quick Response code



DOI: 10.16965/ijpr.2015.118

International Journal of Physiotherapy and Research

ISSN 2321- 1822

www.ijmhr.org/ijpr.html

Received: 09-03-2015

Accepted: 21-05-2015

Peer Review: 09-03-2015

Published (O): 11-06-2015

Revised: 16-04-2015

Published (P): 11-06-2015

INTRODUCTION

The supporting structure of an organism is formed by the skeleton [1]. The band or bundle of fibrous tissue in a human or animal body is the muscle. It has the ability to contract, which produces movement and maintains the position of parts of the body [2]. As the strong muscle, tendons, ligaments, and bones decrease the risk of injury, the body is able to respond to falls and extra loads experienced by it [3].

The three general body types are:

Ectomorphic- thin body built; Mesomorphic-

muscular or sturdy body built and endomorphic- this is the fat (heavy) body type [4].

BMI- body mass index is simple index of weight for height that is commonly used to classify underweight, overweight and obesity [5]. Unit for calculation is kg/m^2 .

Quadriceps muscle is in the anterior compartment of thigh. The quadriceps are powerful extensors of the knee joint [6]. They are crucial in squatting, running, jumping and walking.

The ability of muscle or a person to produce or resist a physical force is called as strength [7]. It is a force or moment produced by single maximum voluntary isometric contractions [8]. The greatest measurable force that can be exerted by a muscle or muscle group to overcome resistance during a single maximal effort is the muscle strength [9].

The complex interaction of muscular, mechanical and neural components makes the study of the increase in muscle strength during growth and maturation challenging [10].

The greatest amount of weight a muscle can move through the available range of motion a specific number of times is known as repetition maximum [11].

A static form of exercise in which a muscle contracts and produces force without an appreciable change in the length of the muscle and without visible joint motion is known as isometric contraction. 60% to 80% of intensity of muscle force for developing the capacity to improve strength. An isometric contraction should be held for 6 seconds and no more than 10seconds because muscle develops fatigue develops rapidly [12].

Dynamometer is an instrument used to measure force, strength or torque. Hand held dynamometer has several advantages including low cost, can be used easily and acceptability is high in clinical settings. HHDs measure strength in kilograms, pounds or Newton's. HHDs are superior to MMT for detection of mild to moderate changes in muscle strength [7]. Isotonic muscle contraction involve movement under a constant load throughout the range of motion [7].

THERABAND: is latex resistance band or tube that is used for physical therapy and light strength training exercises a long term exercise plan. According to American physical therapy association the resistance given by the theraband has proved to increase strength mobility and function [13].

Elastic resistance allows free range of motion, allow variable speed of movement and allow progressive resistance. Studies on elastic resistance training have also shown that programme using elastic tubing and elastic band

increase muscle strength and decrease body fat in a similar manner to free weight training program [14].

Soccer trainer is a waist-attached soccer training device that enables the player to practice soccer hands-free without any partner. A sports ball is held in a novel manner within a cradle having multiple arms encircling the ball and attached by Velcro® to a set of strips attached to a flexible tether line fastened to a person's waist. The ball is to be kicked and it returns to the striker in each cycle.

Hauter, U.S. Patent No. 5,443,576 described a soccer training apparatus as a device having a mesh soccer net sized for encapsulating a soccer ball. A cord has a first end and a securing portion is attached. The first end is attached to the mesh soccer net. A waist belt has an inner lapped belt end and an outer lapped belt end. An adjusting lock holds the securing portion of the cord to the inner lapped belt end leaving the mesh soccer net carrying the soccer ball suspended from the waist belt [15].

MATERIALS AND METHODS

Institutional review board approval: the study was approved by the institutional review board and was conducted in conformity with the ethical and humane principles of research.

Participants: A total of 90 subjects were recruited from October 2014 to December 2014 from constituent colleges of KLE University in KLE Campus, Belgaum. The inclusion criteria were

1. Both male and female participants,
2. Subjects willing to participate in the study,
3. Young healthy individuals between the age group 21 to 29,
4. Subjects with BMI between 19.9 to 24.9.

Exclusion criteria were previous and recent traumatic injury to the knee, any recent surgical interventions, Intra-articular steroid injections to knee within 3 months and systemic illness or neurological illness and the subjects who agreed signed an informed consent form and their demographic data and medical history were recorded.

Procedure: The participants were recruited from October to December 2014. The study was conducted in Physiotherapy OPD, Dr. Prabhakar

Kore Hospital and MRC and KLE University's Institute Of Physiotherapy. A brief history was taken about the neurological and musculo-skeletal assessment as per inclusion criteria.

The study protocol explained and a written informed consent was obtained from all the patients. All subjects were screened based on the inclusion and exclusion criteria prior to their enrolment into the study. Baseline values for all the outcome measures in all the patients were noted prior to the beginning of the study. Subjects were randomly selected for collection of data. Prior to strength assessment demographic data was noted, which included age, gender, weight, height, BMI. Height and weight was measured with shoes removed, height and weight were measured using metal tape and weighing scale respectively.

The healthy population were divided into 3 groups:

Group A: Isometric exercises for quadriceps + Isotonic exercises for quadriceps

Group B: Isometric exercises for quadriceps + Isotonic exercises for quadriceps + Theraband exercises for quadriceps

Group C: Isometric exercises for quadriceps + Isotonic exercises for quadriceps + Soccer trainer exercises for quadriceps.

Quadriceps strength was assessed using hand held dynamometer using different positions- sitting, standing.

RESULTS AND TABLES

This study was done to estimate the increase in the strength of the quadriceps femoris muscle using the theraband, soccer trainer, isometric and isotonic exercises. The strength was measured using dynamometer. Out of 90 participants, the mean age of the participants in group A 21.67±0.88 the mean age of participants in group B was 22.23±1.33 and the mean age of participants in the group C was 22.03±1.27. The gender distribution in each group was such that was 7 male and 23 female subjected in soccer trainer, the theraband group included 18 female and 12 male participants and control group there were 11 male and 19 female subjects.

Table 1: Mean and SD of muscle strength scores at pre intervention and post intervention in three groups (A, B, C).

Group	Pre intervention		Post intervention		Difference	
	Means	Std.Dev.	Means	Std.Dev.	Means	Std.Dev.
Group A	7.75	1.794	8.9	1.967	1.15	0.494
Group B	7.883	1.72	9.417	1.717	1.533	0.524
Group C	7.917	1.439	8.967	1.474	1.05	0.331
Total	7.85	1.641	9.094	1.727	1.244	0.499

Table 2: Comparison of three groups (A, B, C) with Muscle strength scores at pre intervention and post intervention by one way ANOVA.

Variable	Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F-value	P-value
Pre intervention	Between groups	2	0.47	0.2333	0.0848	0.9187
	Within groups	87	239.26	2.7501		
	Total	89	239.73			
Post intervention	Between groups	2	4.74	2.3694	0.7907	0.4568
	Within groups	87	260.71	2.9966		
	Total	89	265.45			
Difference	Between groups	2	3.91	1.9528	9.3262	0.0002*
	Within groups	87	18.22	0.2094		
	Total	89	22.12			

*p<0.05

Table 3: Pair wise comparison of three groups (A, B, C) with Muscle strength scores at pre intervention and post intervention by Tukeys multiple posthoc procedures.

Time	Groups	Group A	Group B	Group C
Pre intervention	Mean	7.75	7.8833	7.9167
	Group A	-		
	Group B	p=0.9481	-	
	Group C	p=0.9200	p=0.9968	-
Post intervention	Mean	8.9	9.4167	8.9667
	Group A	-		
	Group B	p=0.4827	-	
	Group C	p=0.9879	p=0.5747	-
Difference	Mean	1.15	1.5333	1.05
	Group A	-		
	Group B	p=0.0048*	-	
	Group C	p=0.6754	p=0.0004*	-

*p<0.05

Fig. 1: Comparison of three groups (A,B,C) with Muscle strength scores at Pre intervention and Post Intervention.

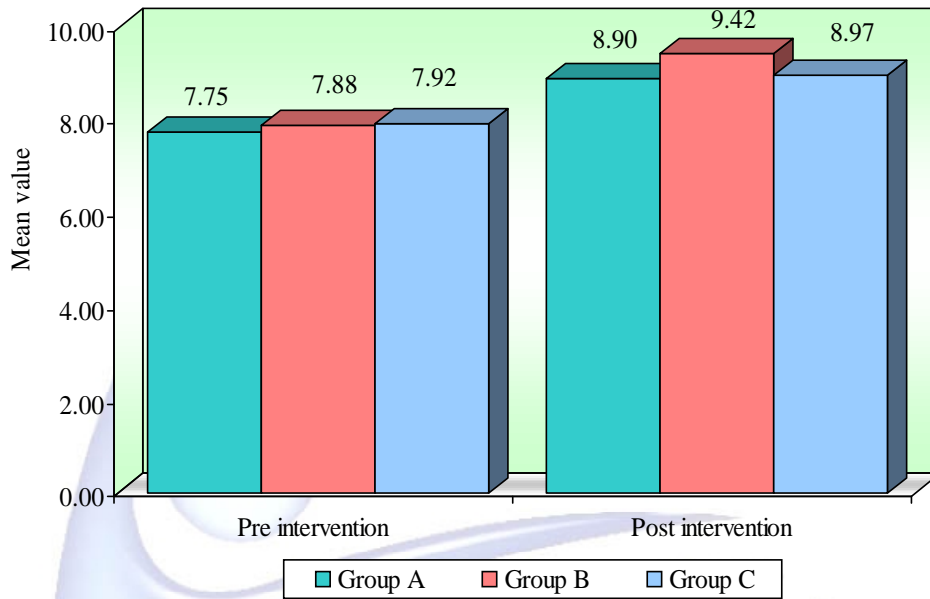
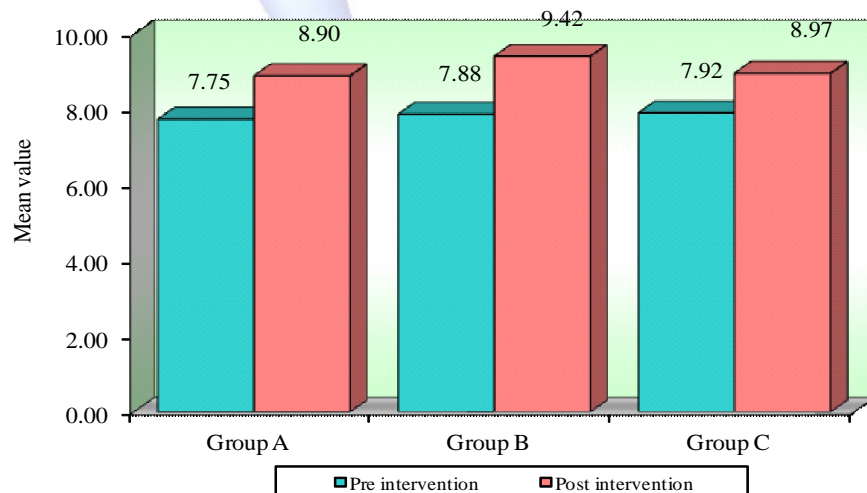


Table 4: Comparison of pre and post intervention with respect to Muscle strength scores in three groups (A, B, C) by paired t test.

Groups	Intervention	Mean	Std.Dv.	Mean Diff.	SD Diff.	% of change	Paired t	p-value
Group A	Pre intervention	7.75	1.79	-1.15	0.49	-14.84	-12.7525	0.00001*
	Post intervention	8.9	1.97					
Group B	Pre intervention	7.88	1.72	-1.53	0.52	-19.45	-16.0235	0.00001*
	Post intervention	9.42	1.72					
Group C	Pre intervention	7.92	1.44	-1.05	0.33	-13.26	-17.3811	0.00001*
	Post intervention	8.97	1.47					

*p<0.05

Fig. 2: Comparison of Pre and Post intervention with respect to Muscle strength scores in three groups (A,B,C).



DISCUSSION

The present study was conducted to compare the effect of 3 weeks training program between soccer trainer, theraband and isometric exercises on quadriceps femoris muscle strength training as to find out which of the three are better method to improve strength.

The band or bundle of fibrous tissue in a human or animal body is the muscle. It has the ability to contract, which produces movement and maintains the position of parts of the body [2].

The myofibril is composed of thick myofilaments composed of protein myosin and thin filaments composed of protein actin the interaction of these two proteins is required for the muscle contraction to occur. The type of muscle contractions is isometric, isotonic and isokinetic VMO stands vastus medialis oblique and is a part of vastus medialis quadriceps muscle at the front of the thigh. The specific role of VMO is to stabilise the patella within the patella groove when the knee is bent and straightened [16].

Till date the gold standard treatment for strengthening of quadriceps femoris muscle were combinations of exercises. Keeping this into consideration all subjects in the present study were given a common set of exercises for a total of 15 sessions which were maintained for a period of 3 weeks of intervention. Similar results were obtained by Thomas Mohr, Barbara Carlson, Cathy Sulentic in a study done on 17 healthy individuals to strengthen the quadriceps femoris muscle for a period of 3 weeks including 15 sessions and was concluded that isometric exercises showed significant increase in strength as compared to high galvanic stimulation [17]. A similar study was done by Ray Marks showing the effect of isometric exercises on quadriceps femoris muscle strength training for osteoarthritis of knee which showed improvement in the strength of quadriceps femoris strength [18]. Another study was performed G. Syme, P. Rowe, D. Martin on disability in patients with chronic patellofemoral pain syndrome where general strengthening of quadriceps femoris muscle was done and selective strengthening of VMO muscle was done. Both the selective strengthening of VMO and general strengthening of quadriceps led to

improvement in the strength of quadriceps muscle however there was no statistically significant difference between the selective and the general groups [19].

According to WHO, body mass index (BMI) is one of the best indicator and a screening tool for obesity. In this study the individuals chosen were between 18.5 – 24.9, as normal individuals are taken. Similar study had been done by Thomas Bohr, Cathy Sulentic on 17 healthy individuals between age group 21 – 29 years, to strengthen quadriceps femoris muscle and resulted in the improvement of strength.¹⁷ Another study on effect of high resistance training on strength and cross sectional area on the quadriceps femoris muscle strength was done by A Young, Stokes on 17 young healthy individuals that improved strength of quadriceps femoris muscle. Similar study was done by Matt Walsworth, Ion Schultz, Raquel, Stephen Allison on 50 healthy individuals and showed improvement in strength of quadriceps femoris muscle [20].

In the present study, a hand held dynamometer was used to measure the strength of the quadriceps femoris muscle before and after the intervention. The test retest reliability of dynamometer was done by Richard Bohannon and he concluded that it is a reliable tool to measure the muscle strength [21]. A study done to check the reliability of hand held dynamometer regarding muscle strength concluded that it had excellent reliability [22].

In the present study a dynamic resistance training in which a constant external load is applied to the contracting muscle by means of quadriceps table. The repetition maximum is used as the basis of progression in the resistance and McQueen protocol was followed. A similar study was done on comparison of elastic tubing and isotonic resistance by Colado Jet al. (2010) in this study resistance was offered to two groups in control group free weights/machine weights were used and theraband was used in the other group [23]. It was concluded in this study that weight machine/free weights and theraband have equivalent improvement in muscle strength in young healthy females.

In the present study, Isotonic exercises for the quadriceps femoris muscle were performed.

Isotonic exercises are known to increase the strength muscle [24]. Another study was done by Charu Eapenet all on the effect of eccentric isotonic quadriceps muscle exercises on patellofemoral pain syndrome which showed improvement in the strength of the quadriceps femoris muscle [25].

In the present study a blue colour theraband was used which offered a resistance of 5.6 pounds (2.54kgs) [26]. The subjects in the theraband group showed improvement in the strength of the quadriceps femoris muscle. The causes: firstly, the elastic resistance provides continuous tension to the muscle being trained. Secondly, it also offers a linear variable resistance, this means as the range of motion of the exercises increases the resistance provided by the elastic band increases as a result of this the number of muscle fibres that are being used in exercising the muscle increases. More are the muscle fibres recruited, there is presumably more increase in strength as adaptation occurs due to the training program. A similar study was performed by researchers that suggested that elastic resistance provides more functional strength, ability to change muscle emphasis and greater power development [27].

In present study the subjects in the soccer trainer was used to check the effects on the strength of the quadriceps femoris muscle. Till date there are no studies, where the effects of the soccer trainer can be seen. In the present study the soccer trainer exercise group showed increase in strength. This can be attributed to strengthening quadriceps femoris muscle that would have improved strength. Isometric and isotonic exercises for quadriceps femoris were given along with soccer trainer. Hence increase of quadriceps muscle strength may have been seen.

According to the review of literature there were no studies where all the three types of exercises have been compared for increase in quadriceps femoris strength. There is paucity in the literature where a comparative study of soccer trainer theraband and isometric and isotonic exercises are done. In the present study when pair wise comparison was done between the groups there is improvement in strength in all the three groups hence the three groups are

effective in improving strength, however the in subjects with theraband group were shown to be more effective in improvement of strength than other two groups.

Limitations: In the present study the sample size was small. Both males and females were taken in the study; hence the mean of the strength may vary due to gender.

Future scope: In the present study both males and females had been taken, in the future this study can be performed using a homogenous group. Also studies can be performed on subjects with conditions of the knee since in this study normal healthy individuals were taken.

CONCLUSION

The study concluded that a 3 week exercise program increased strength of quadriceps femoris in all three groups however the theraband exercises group showed more improvement in the strength.

Conflicts of interest: None

REFERENCES

- [1]. <http://en.wikipedia.org/wiki/Skeleton>, accessed on 12/02/2015, 11:15 pm
- [2]. https://www.google.co.in/?gfe_rd=cr&ei=DaoLVYOEBYPFoAOzgoCwCw&gws_rd=s|l#q=muscle+definition, accessed on 12/02/2015, 11:20 pm
- [3]. Muscular Strength .www. ahealthy philosophy . com. 2002.
- [4]. Orthopedic Physical Assessment, David Magee Elsevier publisher, fourth edition:2006, 480.
- [5]. Davidsons principles ad practice of medicine, 21st edition: 2010, 118.
- [6]. B D Chaurasia, Anatomy 2 volume, chapter no3, 5th edition: 2010, 58.
- [7]. Mosby's medical dictionary, Elsevier, 2009,8th edition
- [8]. Sue Ann Sisto, Trevor Dyson-Hudson, Dynamometry testing in spinal cord injury. Journal of rehabilitation research and development, 2007:123-136.
- [9]. Therapeutic exercises foundations and techniques, Kisner, Jaypee Brother medical publisher. 5th edition:, 148
- [10]. Mark De Ste Criox. Advance in pediatric strength assessment. Journal of sports science and medicine 2007:292-304
- [11]. Therapeutic exercises foundations and techniques, Kisner, Jaypee Brother medical publisher. 5th edition:2007 ,149.
- [12]. Therapeutic exercises foundations and techniques, Kisner, Jaypee Brother medical publisher. 5th edition:2007 ,168.

- [13]. Jim S. Elastic resistance VS Free weights available from http://www.bodylastics.com/articles/elastic_resistance_vs_free_weights
- [14]. Resistance band and tubing instruction manual. The hygiene corporation. 2006;4:2-13 available from http://www.theraband.com/user_files/file/resistance_band_tubing_instruction_manual.pdf.
- [15]. <http://www.google.com/patents/US5358258>
- [16]. www.sportsinjuryclinic.net/rehabilitation-exercises/knee-hamstring-thigh_exercises/vmo-rehab
- [17]. Thomas Mohr, Barbara Carlson, Cathy Sulentic's. comparison of isometric exercise and high volt galvanic stimulation on quadriceps femoris muscle strength; PHYS THER. 1985;65:606-609.
- [18]. Ray Marks, the effects of Isometric quadriceps strength training in midrange for osteoarthritis of the knee. Arthritis & Rheumatism 2005;6(1):52-56.
- [19]. G.Syme, P, Rowe, D Martin, disability in patients with chronic patella femoral pain syndrome: a RCT of VMO selective training vs general quadriceps strengthening: 2008
- [20]. A Young, Stokes, J.M Round. The effect of high-resistance training on the strength and cross-sectional area of the human quadriceps. European Journal of Clinical Investigation. 1983;13(5):411-417.
- [21]. Richard W. Bohannon, Test-Retest Reliability of Hand-Held Dynamometry During a Single Session of Strength Assessment. Phys Ther. 1986;66:206-209.
- [22]. Kobler, Morey J, Cleland, Joshua A. Strength testing using hand held Dynamometry. Physical Therapy. 2005;10(2):99-112.
- [23]. Colado J, Garcia- Masso X, Pellicer M, Alakhdar Y, Benavent J, Cabeza- RuisR. A comparion of elastic tubing and isotonic resistance exercises. International Journal of Sports Medicine. 2010;4:1-7.
- [24]. M. Dena Gardiner, The Principles of Exercise Therapy, 4th edition, 2005, 55
- [25]. Charu et al, Effect of Eccentric Isotonic Quadriceps Muscle Exercises on Patellofemoral Pain Syndrome: Asian Journal of Sports Medicine 2011;2:227-234.
- [26]. http://www.thera-band.com/faqs_consumer.php
- [27]. Theraband academy pro series exercise ball abdominal/core strengthening level1 <http://www.therabandacademy.com/exercise/default.aspx>.

How to cite this article:

Santosh Metgud, Pranata Dalal, Pavan Joshi. EFFECT OF SOCCER TRAINER AND ELASTIC BAND ON QUADRICEPS FEMORIS MUSCLE STRENGTH IN YOUNG HEALTHY INDIVIDUALS- A RANDOMIZED CONTROLLED TRIAL. Int J Physiother Res 2015;3(3):1091-1097. **DOI:** 10.16965/ijpr.2015.118