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Research Article

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Effect Of Eccentric Training And Isolytic Contraction To Improve Flexibility Of Quadriceps In Recreational Marathoners.

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Abstract: In the field of athletics, running is one of the most popular activities having beneficial health effects as well as negative effects during sports injury. Not only elite marathoners, but recreational marathoners have various lower limb musculoskeletal injuries that occur quite frequently which produces an adverse effect over the performance of the marathoners. Studies have suggested that the most common muscles that were affected were quadriceps group of muscles as well as the hamstrings muscles. The main mechanism behind the injury to the quadriceps muscles is the strong contraction of the muscle against the forced flexion action of the knee joint which is commonly seen in runners in a downhill marathon. Some of the risk factors that are responsible for the quadriceps muscle strains are inadequate stretching, muscle imbalance of the lower extremity and inadequate warm-up before vigorous exercise. Objective of this study was to find out the effect of eccentric training and whether isolytic contraction helps to improve the flexibility of the quadriceps muscle and joint range of motion of knee as well as hip joint. A total of 30 subjects were selected for the study from Krishna College of Physiotherapy. The subjects were divided into two groups namely, group A and group B consisting of 15 subjects each. Demographic data, assent and consent was taken from the marathoners that were selected according to the inclusion criteria. Pre and post assessment was taken on the basis of both active range of motion of the hip joint, active range of motion of knee joint, Manual Muscle Test of the quadriceps and Ely's test for quadriceps before and after 6 weeks (total 16 sessions) of the treatment respectively. The session lasted for a time period of 45 mins. After the data was collected, evaluation and interpretation of collected data was done thoroughly. The subjects under the eccentric training protocol were found to have more effect compared to the ones in the group consisting of isolytic contraction protocol. The conclusion of this study was that significant effect of eccentric training and isolytic contraction helps to improve the flexibility of the quadriceps muscle and joint range of motion.

Keywords: Eccentric, isolytic, Ely's, flexibility, marathoners, quadriceps, range, knee, hip, manual muscle test.

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1. INTRODUCTION

The quadriceps muscles is a large group of major muscles which lie anteriorly consisting of vastus lateralis, vastus medialis , vastus intermedialis, rectus femoris originating from the lateral, medial and front of the femur respectively.[1] These muscles insert into the tuberosity of the tibia via patella, in which the tendon of the quadriceps converts into the patellar ligament[2]. This group of muscles is supplied by the femoral nerve (L2,L3, L4) and is further supplied by the femoral artery.[1] These muscles are considered as the primary muscle group for extension of the knee and also recognized as the flexors of the hip[2]. While running a downhill marathon, quadriceps are activated the most due to which these muscles tend to fatigue soon. Strengthening of these muscle reduces the stress on the knee joint and helps to absorb the shock. Stretching the muscle after strengthening is important for restoring the range of motion and preventing injury. Flexibility is defined as the ability of a muscle to lengthen and allow one joint to move through a full range of motion[3]. In the field of athletics, running is considered as one of the most popular activities for the beneficial health effects as well as negative effects in terms of sports injury[4]. Not only elite marathoners but recreational marathoners have various lower limb musculoskeletal injuries that occur quite frequently which produces an adverse effect over the performance of the marathoners[5]. Studies have suggested that the most common muscles that were affected was quadriceps group of muscles as well as the hamstrings[6]. The main mechanism behind the injury to the quadriceps muscles is a strong contraction of the muscle against the forced flexion action of the knee joint which is commonly seen in runners in a downhill marathon[7]. Some of the risk factors that are responsible for the quadriceps muscle strain are inadequate stretching, muscle imbalance of the lower extremity and inadequate warm-up before vigorous exercise[8]. It is also suggested that there is a relationship between the quadriceps angle (Q-angle) and knee disorders[9]. Runners with abnormal Quadriceps- angle were found to have more sustained knee injuries[10]. Muscle energy technique (MET) is considered as a class of soft tissue osteopathic manipulation method that incorporates directed and controlled, patient initiated isometric and/or isotonic contractions to improve the musculoskeletal function and to reduce pain[11]. In eccentric muscle work, the muscles become longer and thinner as they allow their attachments to be drawn apart by the force producing the movement[12]. Eccentric training is an essential component of rehabilitation programs following musculoskeletal injury and in conditioning programs to reduce the risk of injury or re-injury associated with activities that involve high intensity deceleration, quick changes of direction, or repetitive eccentric muscle contraction.[6] Eccentric training involves dynamic loading of a muscle beyond its force-producing capacity, causing physical lengthening of the muscle as it attempts to control the load when lowering a weight[6]. In a conditioning program, aerobic conditioning strength training and flexibility is considered better for athletes[3]. When a rapid direct contraction is resisted and overcome by the practitioner, it is termed as isolytic contraction which involves stretching, and sometimes breaking down of the fibrotic tissue that are present in the affected muscles[11]. It has been found that during the early stage of postoperative rehabilitation, isolytic contraction plays an important role by the virtue of its two main important properties namely pain free mobilization and relative mobilization within patients' capacity to bear pain[13].Aim of our study is to determine the flexibility of the muscle using the Ely's test and the range of motion of the quadriceps will be noted in recreational marathoners participating in the Krishna Marathon

2. METHODOLOGY

Total 30 subjects, using the simple random sampling method, were selected for the study according to the inclusion and exclusion criteria. The subjects were divided into two groups namely, group A and group B consisting of 15 subjects each. Inclusion criteria consisted of both male and female recreational marathoners , aged between 20-35 years, who participated in the Krishna Marathon and the exclusion criteria were subjects with previous surgery or pain in the lower limbs, recent trauma or any muscle injury. It was found that among 30 subjects, 23 subjects belonged to 20-25 years of age group and remaining 7 belonged to 25-30 years of age group. In group A, there were altogether 15 subjects out of which 13 were males and 2 were females. In group B, of the 15 subjects, 11 were males and 4 were females. Necessary and required consent was taken from the participating individuals . Demographic data and assent and consent form was taken from the marathoners. Pre and post assessment was taken on the basis of both active and passive joint range of motion on the hip joint, active and passive range of motion of knee joint, Manual Muscle Test of the quadriceps and Ely's test for quadriceps before and after 6 weeks (total 16 sessions) of the treatment taken respectively. Both the groups were given a common set of warm-up exercises that included quadriceps stretching, upper limb low intensity exercise. The warm up exercises included 5-minutes of light jogging and short (15s) and long (45s) of static stretching exercises of the main muscles which are quadriceps, hamstrings and triceps surae[14]. Group A was considered under the protocol of lunges on the wedge where the subject was asked to keep his foot over the wedge and perform an anterior lunge[15]. Group B received isolytic contraction where the patient was positioned supine with hip maintained in neutral position after which the knee was taken into the range where the first resistance was felt and the subject was instructed to use 20-25% of his knee extensor force in resistance to the therapist's flexion force; knee was taken to a new range until a second resistance was felt and was held for 15 seconds and was brought back to the neutral position[16]

2.1 Ethical clearance

This study has undergone and received ethical clearance through the Institutional ethical committee of Krishna institute of medical sciences, deemed to be University, Karad with Protocol number 0105/2019-2021.

3. STATISTICAL ANALYSIS

Statistical analysis of the recorded data was done by using the software SPSS version 2.0. The paired test and one way ANOVA test were used for analysis of data.

Table 1. Active flexion of knee joint.

	Group A				Group B			
	Right		Left		Right		Left	
	Mean±SD	P	Mean±SD	P	Mean±SD	P	Mean±SD	P
Pre	136.2±1.934646516	<0.0005	136.2±1.934647	0.0005	136.2±1.934647	0.3125	136.2±1.934647	0.0572
Post	139.1333±1.63994		139.1333±1.63994		136.6±1.764734		136.8±2.00713	

According to table 1, for group A the mean and standard deviation of active flexion of the knee joint was 136.2±1.9346 , whereas post-interventional mean±SD was 139.133±1.6399. It was concluded that p value was 0.0005 and interference was considered extremely significant. For group B mean and standard deviation was 136.2±1.93, whereas post-interventional mean±SD was 136.6±01.764. It was concluded that p value was 0.3125 and interference was considered not quite significant.

3.1 *Active flexion of hip joint*

Table 2. Active flexion of hip joint

	Group A				Group B			
	Right		Left		Right		Left	
	Mean±SD	P	Mean±SD	P	Mean±SD	P	Mean±SD	P
Pre	122.1333±1.187234	0.0001	122.1333±1.187234	0.0001	122.6±1.183216	0.0406	122.2667±1.279881	0.0335
Post	124.4±0.736788		124.4±0.736788		122.8667±1.187234		122.8667±1.187234	

According to table 2, for group A, the mean and standard deviation of active flexion of hip joint was 122.133±0.7303, whereas post- interventional mean ± SD was 124.4±0.7367. It concluded that p value was 0.0001 and interference was considered extremely significant. For group B, the mean and standard deviation was 122.6±1.183, whereas post-interventional mean ± SD was 122.866±1.1872. It was concluded that p value was 0.0406 and interference was considered significant.

3.2 Manual Muscle Test

Table 3. Group A : Manual Muscle Test

Group A	Right		left	
	Mean±SD	p	Mean±SD	p
Pre	3.6±0.507092553	<0.0001	3.733333±0.457738	<0.0001
Post	4.666667±0.48795		4.733333±0.457738	

According to table 3, the pre interventional mean and standard deviation of group A manual muscle test was 3.6±0.507, whereas post- interventional mean ± SD was 4.66±0.487. It concluded that p value was <0.0001 and interference was considered extremely significant.

Table 4. Group B- Manual Muscle Test

Group B	Right		left	
	Mean±SD	p	Mean±SD	p
Pre	3.666667±0.48795	0.0005	4.2±0.414039	>0.9999
Post	4.466667±0.516398		4.266667±0.457738	

Table 4 shows that, in this , pre interventional mean and standard deviation of group B manual muscle test joint was 3.666±0.487, whereas post- interventional mean ± SD was 4.66±0.516. It was concluded that p value was 0.0005 and interference was considered extremely significant.

3.3 Ely's Test

Table 5. Group A: Ely's Test

Group A	Right		left	
	Mean±SD	p	Mean±SD	p
Pre	0.666667±0.48795	0.0313	0.666667±0.48795	0.0313
Post	0.266667±0.457738		0.266667±0.457738	

In this study pre interventional mean and standard deviation of group A Ely's test (Table 5) was 0.666±0.487, whereas post- interventional mean ± SD was 0.266±0.4577. It was concluded that p value was 0. 0313 and interference was considered significant.

Table 6. Group B: Ely's Test				
Group B	Right		left	
	Mean±SD	p	Mean±SD	p
Pre	0.733333±0.457738	0.5469	0.8±0.414039	>0.9999
Post	0.6±0.507093		0.733333±0.457738	

In this study pre interventional mean and standard deviation of group B Ely's test (Table 6) was 0.7333±0.457, whereas post- interventional mean ± SD was 0.6±0.507. It concluded that p value was 0.5469 and interference was considered not significant.

4. DISCUSSION

Flexibility is defined as the ability of a muscle to lengthen and allow one joint to move through a full range of motion[3]. In the field of athletics, running is considered as one of the most popular activities having beneficial health effects as well as negative effects in terms of sports injury[4]. Not only for elite marathoners, but various lower limb musculoskeletal injuries also occur quite frequently in recreational marathoners which has an adverse effect over the performance of the runners[5]. This research was undertaken with the aim to study the effect of eccentric training and isolytic contraction which helps to improve the flexibility of the quadriceps muscle and joint range of motion of knee as well as hip joint. The study was carried out by the outcome measures, GONIOMETER, MANUAL MUSCLE TEST and ELY'S TEST. Group A subjects showed changes in the range of motion of the hip as well as knee joint, while there were no visible changes in the range of motion of subjects in Group B. In the present study, pre interventional mean and standard deviation of active flexion of the knee joint was 136.2±1.9346 , whereas post-interventional mean±SD was 139.133±1.6399. It was concluded that p value was 0.0005 and interference was considered extremely significant. For the individuals in the Group B, the strength of the muscle was evaluated and the results declared that the individuals had a remarkable change in their strength of the muscle. In the present study, pre interventional mean and standard deviation of Active flexion of hip joint was 3.6±0.507, whereas post-interventional mean ± SD was 4.66±0.487. It was concluded that p value was <0.0001 and interference was considered extremely significant. The flexibility of the muscle was checked using the Ely's test which indicated that the subjects in Group A were found to have more improved flexibility of the quadriceps muscle compared to the subjects in Group B. In the present study pre interventional mean and standard deviation of Active flexion of hip joint was 0.666±0.487, whereas post- interventional mean ± SD was 0.266±0.4577. It was concluded that p value was 0. 0313 and interference was considered significant.

5. CONCLUSION

On the basis of the results of our study, it can be concluded that the effect of eccentric training and isolytic contraction helps to improve the flexibility of the quadriceps muscle and joint range of motion of knee as well as hip joint. The effect of exercises allotted to group A which consisted of warm up exercise along with lunges over the wedge were found to be more significant effective compared to those of Group B.

6. AUTHORS CONTRIBUTION STATEMENT

Dr. Namrata Kadam derived the concept and guided this study and revised the manuscript. Ms. Sharvari Wagh, carried out the research study evaluated the results and drafted the manuscript and contributed to the design and implementation of the research to the analysis of the results and to the writing of the manuscript.

7. CONFLICTS OF INTEREST

Conflict of interests declared none.

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