

## To Compare the Effects of Isometric and Eccentric Training on Quadriceps Muscle Strength in Collegiate Football Players

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**ABSTRACT:** This study is an experimental design of comparative pre and post-test type. The study was at outpatient physiotherapy department, faculty of physiotherapy, Dr M G R Educational and Research Institute. 30 subjects were randomly divided in to two groups. The duration of the study was 4 weeks. Subjects were age group between 18-25 years. Only male subjects are included. Subjects with recent surgery, Deep Vein Thrombosis , recent fracture in lower limb were excluded from the study. 30 male subjects fulfilling inclusion criteria were selected in this study and were divided into two groups. Group A received the isometric contractions. Group B received the eccentric contractions. The result of this study shows that it can be concluded that the superiority of eccentric training over isometric concentric training is particularly significant on improvement in quadriceps muscle in collegiate male shot put players in quadriceps strength. Hence, this study reveals that eccentric training can significantly increase player's muscular performance in terms of strength and power.

**KEYWORDS:** Football players, isometric exercise, eccentric exercise, quadriceps training.

### I. INTRODUCTION

Football is one of the most popular games in the world. It is a team sports that involve to varying degree kicking a ball to score a goal. Quadriceps injury is common in football, baseball, running<sup>(1)</sup>. Sudden twist can also cause a tear in the quadriceps the other factor like muscle fatigue tightness and muscle imbalance can predispose to quadriceps tear.<sup>(1,2)</sup>

Injury to the quadriceps muscle group can be painful and debilitating<sup>(3)</sup>. Strains and contusions of the quadriceps are common in

athletics and result in lost time from training and competition.

The quadriceps muscle group is composed of the rectus femoris, vastusmedialis, vastuslateralis, and vastusintermedius. The rectus femoris originates at the Ilium, thus crossing both the hip and knee joint along its course. This anatomy allows for hip flexion and knee extension<sup>(3)</sup>. The remaining muscles originate on the femur and function solely as knee extensors. Innervation of these muscles is by the femoral nerve. The quadricepses are primarily active in kicking, jumping, and running<sup>(4)</sup>.

Acute strain injuries of the quadriceps commonly occur in athletic competitions such as soccer, rugby, and football<sup>(1, 5)</sup>. These sports regularly require sudden forceful eccentric contraction of the quadriceps during regulation of knee flexion and hip extension. Higher forces across the muscle-tendon units with eccentric contraction can lead to strain injury. Excessive passive stretching or activation of a maximally stretched muscle can also cause strains. Of the quadriceps muscles, the rectus femoris is most frequently strained<sup>(6)</sup>. Several factors predispose this muscle and others to more frequent strain injury. These include muscles crossing two joints, those with a high percentage of Type II fibers, and muscles with complex musculotendinous architecture. Muscle fatigue has also been shown to play a role in acute muscle injury<sup>(7)</sup>.

Eccentric exercise refers to tension being applied to a muscle as it lengthens. Eccentric contraction exercise are important a often overlooked component of strength training. Muscles act like shock-absorbing structures and springs when they absorb mechanical work while eccentrically lengthening<sup>(5,8)</sup>. The forces resulting

from these eccentric muscle contractions produce negative work. During a stretch-shorten contraction (SSC), muscles are actively lengthened prior to a subsequent shortening phase. The stretched components of the muscle-tendon unit store elastic recoil potential energy (or elastic strain energy), a portion of which may be subsequently recovered<sup>(9)</sup>.

An isometric exercise is a form of exercise involving a static contraction of muscle without any visible movement in the angle of the joint. It lengthens the muscle and angle of the joint does not change, though contraction and strength may be varied. It is ideal exercise for football players<sup>(10)</sup>.

## II. METHODOLOGY

Experimental design was done with the comparative study type. The experiment was done in the A.C.S medical college and hospital, playground with 30 subjects who were selected with random sampling method. The subjects were asked to attend 2 sessions per week for 4 weeks. The subjects were included considering the criteria as: Age group between 18- 25 years, Only males are included, Subjects with quadriceps weakness, Subjects willing to participate in the study. The subjects with recent surgery on the lower limb, recent fracture on lower limb, musculoskeletal injury, DVT, nerve lesion, skin infection were excluded.

The outcome measures used were maximum isometric voluntary contraction (MIVC)

Quadriceps muscles using push pull dynamometer for measuring muscle strength. The Baseline push-pull dynamometer can be used for both muscle strength testing and functional workplace evaluations. It is ideal for a wide range of individual muscle

## III. PROCEDURE

Before doing the following exercise, warm up for 5 to 10 minutes of low impact activity like walking or riding a stationary bicycle

### GROUP A:

15 subjects will be given the isometric exercise for quadriceps, contract the quadriceps muscles hold for a few seconds and relax. Ask the subject to sit with the back supported or in supine position bend one knee and straighten the knee and straighten the other knee ,place the towel roll under the straighten knee . Tighten the Quadriceps hold for 10 seconds with rest period of 20 seconds (Alternate days).

### QUAD SETS

Sit on the floor with injured leg straight out in front of you. Tighten the muscles on top of your thigh by pressing the back of your knee flat down to the floor. Hold it for about 6 seconds, then rest up to 10 seconds. 3 set of 10 repetitions, 3 times a day.



QUAD SET

### STRAIGHT LEG

Lie on the floor with elbows directly under your shoulders to support your upper body .Keep your one leg straight and bend your other leg so that your foot is flat on the floor .Tighten the

thigh muscle of your leg and slowly raise it 6 to 10 inches of the floor .Hold this position for 5 seconds and then relax and then bring your leg to the floor .Repeat it for 3 sets of 10 repetitions.



### STRAIGHT LEG RAISE

#### QUADRICEPS STRETCH

Hold on to the back of a chair or a wall for a balance .Bend your knee and bring up your heel up toward your buttock. Grasp your ankle with your hand and gently pull your heel closer to your body .Hold this position for 30 to 60 seconds, 2 to

3 times of repetition, 3 times a day. Repeat with the opposite leg .Patients lay in a supine position. A rolled up towel was put beneath the knee. They were instructed to maximally activate their thigh muscles in order to straighten their knee and hold the contractions for 5 seconds.



### QUADRICEPS STRETCH

**HIP ADDUCTION** :Patient lay in a supine position .A small pillow was put between the knees .They were instructed to perform isometric hip adduction exercise while pressing the pillow

between the knees and to maintain the adduction with contractions for 5 seconds .



**HIP ADDUCTION**

**GROUP B**

15 subjects will receive the eccentric exercise performed by squatting down very slowly and more quickly up .when performing single leg eccentric squats both leg eccentric exercise are given . The eccentric squat exercise can be performed on a slant board or with a half foam roller to raise the leg begin with 3 sets and 10 repetition in alternate days and increase to 3 sets and 15 repetition.

**HALFSQUATS**

Stand with your feet shoulder distance apart. Your hands can rest on the front of your thighs or reach in front of you. If needed hold on to the back of your chair or wall for balance.

Keep your chest lifted and slowly lower your hips about 10 inches, as if your sitting down to your chair. Plant your weight on your heels and hold the squat for 5 seconds .Push through your heels and bring your body back up to standing .3 sets of 10 repetitions in alternate days.



**HALF SQUATS**

**LEG EXTENSION**

Sit up straight on a chair or bench. Tighten your thigh muscles and slowly straighten and raise your leg as high as possible .Squeeze your thigh

muscles and hold this position for 5 seconds .Relax and bring your foot to the floor .Repeat it for 3 sets of 10 repetitions in alternate days.

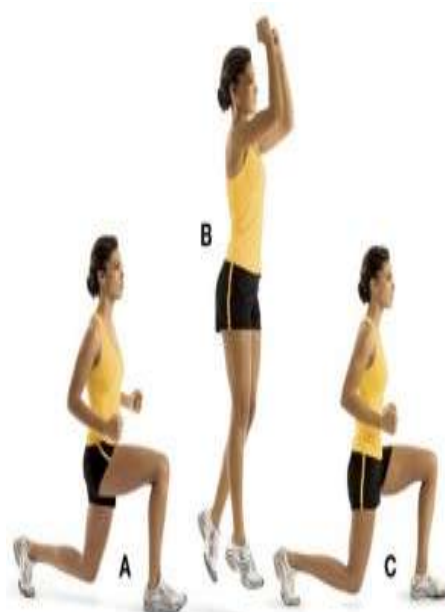


**LEG EXTENSION**

**SPLIT JUMPS**

Stand tall with your feet hip distance apart .Hands are in front of the chest hand on fist .Take a large step forward with one feet and lower your body toward the floor .Both legs should be bent at a 90 degree angle at the bottom of the lunge .Lower

the back knee slightly and jump to switch the feet .While in the air front foot comes back and back foot comes to the front .Land in a bent knee lunge .Repeat it for 3 sets of 10 repetitions in alternate days.



**SPLIT JUMPS**

**SINGLE LEG BOUND**

Balance on your right leg .Jump upwards and forward as for as you can .Land on the same

foot you jumped from and as soon as you land jump again .Repeat this motion for 3 sets of 10 repetitions and then switch legs.



**SINGLE LEG BOUND**

**IV. DATA ANALYSIS**

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS

version 24. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find the statistical difference between the group.

**TABLE- 1**  
**COMPARISON OF MAXIMUM ISOMETRIC VOLUNTARY CONTRACTION (MIVC) OF QUADRICEPS MUSCLES BETWEEN GROUP – A AND GROUP - B IN PRE & POST TEST**

#MUSCLE STRENGTH (POUNDS)	#GROUP - A		#GROUP - B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	20.53	.553	20.60	.492	-.348	28	.730*
POST TEST	24.05	.502	26.54	.593	-12.37	28	.000** *

(\* -  $P > 0.05$ ), (\*\* -  $P \leq 0.001$ )

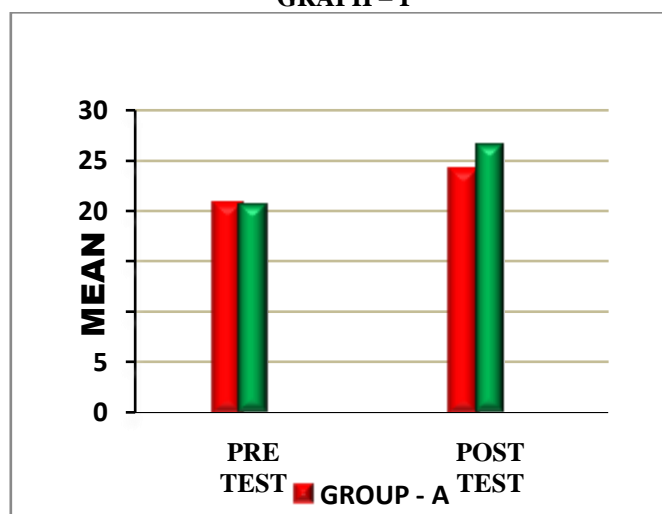
The above table reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom(df) and p-value of the Maximum Isometric Voluntary Contraction (MIVC) between (Group A) & (Group B) in pre-test and post-test.

This table shows that there is no significant difference in pre-test values of the Maximum

Isometric Voluntary Contraction (MIVC) of Quadriceps Muscles between Group A & Group B (\* $P > 0.05$ ).

This table shows that there is a significant difference in post-test values of the Maximum Isometric Voluntary Contraction (MIVC) of Quadriceps Muscles between Group A & Group B (\*\* -  $P \leq 0.001$ )

**GRAPH – I**



**COMPARISON OF MAXIMUM ISOMETRIC VOLUNTARY CONTRACTION (MIVC) OF QUADRICEPS MUSCLES BETWEEN GROUP – A AND GROUP - B IN PRE & POST TEST**

**TABLE - 2**

**COMPARISON OF MAXIMUM ISOMETRIC VOLUNTARY CONTRACTION (MIVC) OF QUADRICEPS MUSCLES WITHIN GROUP – A & GROUP – B BETWEEN PRE & POST TEST VALUES**

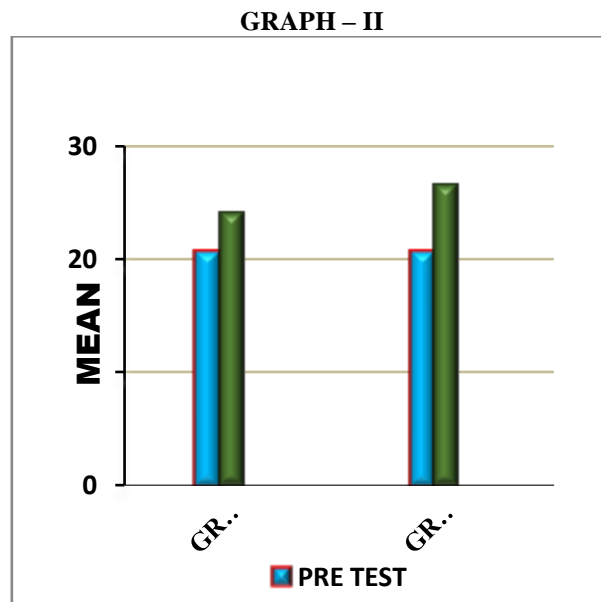
#MIVC	PRE TEST		POST TEST		t TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
<b>GROUP-A</b>	20.53	.553	24.05	.502	-21.35	.000***
<b>GROUP-B</b>	20.60	.492	26.54	.593	-68.56	.000***

(\*\* -  $P \leq 0.001$ )

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value between pre-test and post-test within Group – A & Group – B



There is a statistically highly significant difference between the pre-test and post-test values within Group A and Group B (\*\*\*)-  $P \leq 0.001$ )



### COMPARISON OF MAXIMUM ISOMETRIC VOLUNTARY CONTRACTION (MIVC) OF QUADRICEPS MUSCLES WITHIN GROUP – A & GROUP – B BETWEEN PRE & POST TEST VALUES

#### V. RESULTS

On comparing the Mean values of Group A & Group B on Muscle Strength Measurement in terms of Maximum Isometric Voluntary Contraction (MIVC) Score using Push Pull Dynamometer, both the groups shows significant Increase in the post test mean values, but (Group B - Eccentric Training) Quadriceps 26.54 pounds which has the higher mean value in Quadriceps Muscle Strength is effective than (Group A - Isometric Training) Quadriceps 24.05 pounds at  $P \leq 0.001$  Hence Null Hypothesis is rejected.

On comparing Pre-test and Post-test within Group A & Group B on Maximum Isometric Voluntary Contraction (MIVC) on quadriceps muscle strength shows highly significant difference in Mean values at  $P \leq 0.001$

#### VI. DISCUSSION

The study evaluated the selective effect of 4weeks strength training program on quadriceps muscle strength in collegiate football players. The results of the study were associated with the

strength training induced changes in dynamic athletic upper body performance.

Another interesting finding was that the eccentric training represents an optimal stimulus to induce significant neuromuscular adaptations. So the training environment can be modified to increase the training efficiency of strength training program.

**MICHAEL VOGT et al 2014**, Eccentric exercise: Mechanism and effects when used as tanning regime or training adjunct Concluded that eccentric exercises offers a promising training modality to enhance performance and to prevent injuries in athletes.

In this regard, although the Maximum Isometric Voluntary Contraction show a significant and Almost identical increase in explosive reactive strength during training, the training efficiency was superior in the eccentric training **SHAHNAWAZ ANWAR et al 2014**, Concluded that 5 week isometric quadriceps exercise program showed beneficial effect on quadriceps muscle strength. Previous studies corroborate that a larger volume may result in less training efficiency. It seems that



when an optimal training load is achieved, further increases in volume do not offer additional benefits, and may even negatively affect performance. The stretch load, storage of elastic energy, pre contraction activation state and activation of the stretch – reflex can be influenced by the type of surface used during strength training.

**CHETAN D NAYAK et al** 2011, Concluded that eccentric training of quadriceps muscle was found to be effective and improve and also **JOHN P TOMBERL et al**1991, Concluded eccentric training group demonstrates the most significant increase in eccentric torque and work.

On comparing the Mean values of **Group A & Group B** on Muscle Strength Measurement in terms of Maximum Isometric Voluntary Contraction (MIVC) Score using Push Pull Dynamometer, both the groups shows significant Increase in the post test mean values, but (**Group B - Eccentric Training**) Quadriceps 26.54 pounds which has the higher mean value in Quadriceps Muscle Strength is effective than (**Group A - Isometric Training**) Quadriceps 24.05 pounds at  $P \leq 0.001$  Hence Null Hypothesis is rejected.

On comparing Pre-test and Post-test within Group A & Group B on Maximum Isometric Voluntary Contraction (MIVC) on quadriceps muscle strength shows highly significant difference in Mean values at  $P \leq 0.001$

## VII. CONCLUSION

The present study concluded that a 4week eccentric training program of two different strength training program yielded significant improvement on quadriceps muscle strength in collegiate male shot put players. Superiority of eccentric training over isometric concentric training is particularly evident in quadriceps strength measurement using push pull dynamometer. The most important finding in this study is that eccentric training can significantly increase player's muscular performance in terms of strength and power. This is important for coaches who only have a brief period of time to train their athletes or sports players before competition, can choose the design which best suits their schedule or available resources.

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