Original article

"THE INFLUENCE OF ISOMETRIC, ISOTONIC AND ISOKINETIC STRENGTHENING EXERCISE ON FUNCTIONAL PERFORMANCE OF QUADRICEPS IN NORMAL MALE INDIVIDUALS"

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ABSTRACT

Background- Strengthening exercise has become an integral part of many training and rehabilitation programs. Many studies had measured the torque relationship between isometric and isokinetic and also between isometric and isotonic strengthening exercise but no study has been done to assess the effectiveness between isometric, isotonic and isokinetic strengthening exerciseson quadriceps.The aim of this study, was to find out the influence of isometric, isotonic and isokinetic strengthening on isotonic strength of quadriceps in normal male individuals. **Materials & Methods** -This Experimental study was conducted in the Department of Physiotherapy, Rama Institute of Paramedical Sciences during a period of 2 weeks during may 2016 at Kanpur by using the following machines, Humac Norm Isokinetic Dynamometer, Static Cycle, Stair Case for Step Test and Stop Watch(Runner 2000 Digital). **Results**- Subjects of age groups between 18-30 years of having weight 53-65 kg and height of 160-175 cm were included in the subject.They are equally divided into 3 Groups and they did 20 cycles/minute for 5 minutes before the functional performance to get a warming-up effect. Oneway ANOVA was done to compare step test and agility run test between the group in 0 days, 1st week and 2nd week. Results showed no statistical significant difference. **Conclusion**-The study reveals that all the strengthening exercises (isokinetic, isometric and isotonic) are equally effective on improving the functional performance.

Key words: Isometric, Isotonic, Isokinetic Strengthening Exercise, Quadriceps

INTRODUCTION

Strengthening exercise has become an integral part of many training and rehabilitation programs. The ability to enhance the physiological and mechanical function of muscle is dependent upon training stimulus[1]. According to Delore "High resistance, low repetions build powerful muscle, whereas low resistance, High repetion exercise produces the quality

of endurance"[2]. Isometric exercise is conducted at 0/sec speed without observable joint movement. Isokinetic exercise includes con/ecn muscle loading through the application of constant or variable resistance. It involves a fixed speed with a variable resistance that is totally accommodating to the individual and facilitates maximal dynamic loading throughout the entire range of motion[3]. Human muscular strength can be operationally defined as the ability of a muscle or muscle group to exert maximal force in a single voluntary effort. This can be measured isometrically. Isotonically or Isokinetically[4]. Isotonic training has been reported to be equal to or more effective than isokinetic training in which muscle contraction are similar to functional movement[5].

METHODS

This study was conducted in the Department of Physiotherapy, Rama Institute of Paramedical Sciences during a period of 2 week during may 2016 at Kanpur by using the following machines, Humac Norm Isokinetic Dynamometer **[Fig 1]**, Static Cycle, Stair Case for Step Test and Stop Watch(Runner 2000 Digital).

Thirty nine normal male individuals were participated in this study. The subjects were divided into three groups. [1] Group A(Isokinetic exercise), [2]Group B(Isometric exercise),[3]Group C(Isotonic exercise),They were recruited randomly from Dolphin (PG) institute of medical and natural sciences and local community on the basis of inclusion and exclusion criteria. The subjects in all groups did 20 cycles per minute for 5 minutes before the functional performance to get a warming-up effect for two Weeks[6].

Each subject performed the following two functional performances:

1) Step test- Step test performed on a step stair (20 high, 30deep, 60wide). Participants were asked to perform 20 two-step cycles (step-step-up, step-step-down) at their natural pace and time to completion was recorded in see by stop watch[7].

2) Agility run test- each subject ran a multiple, figure-eight course around cones set 10 yards apart, subjects were timed to the nearest 0.01 sec for the run using a mat switch to start and stop the timer. Subjects were given one practice run and two trials with a minimum of 5 min rest between two trials. The best time for the run was recorded[8].

After that participants were positioned on the cybex chair with stabilization support. Isometric strengthening exercises were given at an angle of 60 degree and isotonic strengthening exercises were given at an angular velocity 60 degree/sec. Isokinetic strengthening exercises were given at an angular velocity 60 degree/sec. It was a two week study having 6 sessions (3 sessions per week). All the exercises were given in a progressive manner. An increasing dose program in second to six sessions were applied that is, in the first session only one 1 set of exercise is given and in the next session 2 sets are given and likewise it goes on increasing on every session and finally a dose of 6 sets were applied on 6th sessions.

For Group A and Group C each set consisted of 5 repetitions of (con/con) contraction in angular velocity of 60 degree/sec between 0-120 degrees extensions. Participants were given rest interval at 5 seconds in between sets for group B a set of 6 maximal contractions with duration of 6 sec followed by 20 sec of rest interval.

Data analysis - ANOVA test was done within and between the groups (A, B and C). Post Hoc test were applied for multiple comparison between the 0 day, 1st week and 2nd week session within and between the group A, B and C.

RESULTS

All the three training groups demonstrated an increase the functional performance following 2 weeks of training protocol. All the strengthening exercise improved to the functional performance, but Isokinetic strengthening exercise significantly improved to the functional performance(Step test p=0.0001 and Agility run test p=0.008).

Fig 1: Humac Norm Isokinetic Dynamometer

DISCUSSION

The result of our study showed that the functional performance improved after isometric strengthening exercises but

significant difference was not found in the functional performance after two weeks of isometric strengthening exercises. The study by Bishop et al supports our result who reported that isometric strength gains at 5% per week occurs when healthy subjects performs single near maximal isometric contraction over six weeks[9].Milner Brown et al and Komi et al are in support of our result who reported that static isometric training can increase the number of motor fibers recruited but can hardly improve the synchronous firing of motor unit[10].

Regarding isometric strengthening exercises in our subjects and its effect on functional performance it was seen that after 2 weeks of isotonic strengthening exercises, functional performance did not improve significantly in our subjects. Alexander et al indicated that during isotonic contraction when a fixed weight is lifted vertically or a dynamometer regulates resistance to maintain a constant external load to our subject's knee. The internal muscle forces that are needed to move the load change substantially as the mechanically advantage of the skeletal lever system changes over the range of motion of the joint[11].Mitchell et al when made a composition of isotonic and Isokinetic predictions of a functional task, it was suggested isotonic weight lifted in a not weight bearing, closed kinetic chain could not directly translate into a force production during functional activity. These studies are support of our finding regarding the effect of isotonic strengthening exercise on functional performance[12].

The result of present study implicated that functional performance improves significantly only after two weeks of isokinetic strengthening exercises.Shunh-Swa Wei et al proved that quadriceps musculature can be maximally strengthen by using isokinetic knee extension exercises which is in support of our results effective strengthening or quadriceps occur through isokinetic strengthening and improve the functional performance[13]

CONCLUSION

It was clear that all the strengthening exercise (Isokinetic, Isometric and Isotonic) are equally effective on improving the functional performance.

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