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Effect of isotonic and isometric strengthening exercises on the endurance and bulk of quadriceps muscle in normal individuals

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Abstract
Back Ground of the Study: Muscle bulk and endurance plays an important role in matching athletes to appropriate sports. From a functional point of view, quadriceps muscle is an extraordinarily important muscle. Strengthening and toning quadriceps muscle can improve the stability of knee, reduce risk of knee injuries, make everyday movements easier to do and improve athletic performance. The aim of the present study is to find and compare the effectiveness of isotonic exercises and isometric exercises on the endurance and bulk of quadriceps muscle in normal individuals.
Methodology: The sample consisting of 30 subjects, were divided randomly into two groups. Group I received isotonic exercises, group II received isometric exercises, all the subjects underwent an initial measurement of quadriceps muscle bulk and endurance. After the initial measurement, the first group was taught isotonic strengthening exercises and the second group underwent isometric resisted exercise. The strengthening program was for a period of 6 weeks for both the groups after which post exercise measurements of thigh circumference and quadriceps endurance were measured by the pre-exercise method.
Conclusion: Both isotonic and isometric exercise program showed significant increase in endurance and muscle bulk. The isotonic exercise group showed better result in improving endurance as compared to isometric exercise. No significant difference in bulk between the two groups.

Keywords: Isotonic exercise, isometric exercise, quadriceps endurance, quadriceps bulk

Introduction
The ultimate goal of any therapeutic exercise program is the achievement of symptom free movements and function [1]. To effectively administer therapeutic exercise to a patient, the therapist must know the basic principles and effect of exercise on the musculoskeletal and neuromuscular systems [2]. The aim of exercise therapy in the presence of muscular weakness is to correct the inefficiency of specific muscle groups, regain normal range of joint movements without delay and achieve efficient functional movements [3]. In order to improve or maintain its strength, various exercises are used, such as isotonic and isometric for obtaining specific physiological changes. Isometric strength is the maximal force that can be exerted against immovable or relatively immovable objects [4]. Isotonic strengthening in most circumstances is a misnomer since it implies that either the torque exerted by the muscle or even the internal tension of the muscle remains the same throughout the arc of movement of the limb [5].

Methodology
The sample consisting of 30 subjects, was divided randomly into two groups. Group I-Isotonic and group II- Isometric. All the subjects underwent an initial measurement of thigh circumference to quantify quadriceps muscle bulk and endurance of the quadriceps.
The thigh circumference was taken at the midpoint between hip and knee with a help of inch tape (cm). The endurance of the subjects in isotonic group was taken as how long (Seconds) the subject can lift a weight of 5 Kgs applied at ankle from 90’ flexion of knee to full extension on a quadriceps table continually. The endurance of the subjects as the Isometric group was taken as the number of seconds the subjects can hold the weight of 5kg applied at the ankle at full extension in quadriceps table [6].

After the initial measurement was taken, the first group was taught isometric resisted exercise using maximum isometric resistance at 90' flexion, 45' flexion and full knee extension. The maximum resistance was constant at 5kg for all subjects. This group practiced these exercises twice daily, with 10 repetitions in each of these positions. The second group underwent isotonic strengthening exercise, 20 lifts with ½ 10 R.M, twice daily [7].

The strengthening program was for a period of 6 weeks for both the groups after which post exercise measurements of thigh circumference and quadriceps endurance were measured by the pre-exercise method. A proforma was formulated to records the pre-exercise and post exercise measurement of thigh bulk and quadriceps endurance for each subject.

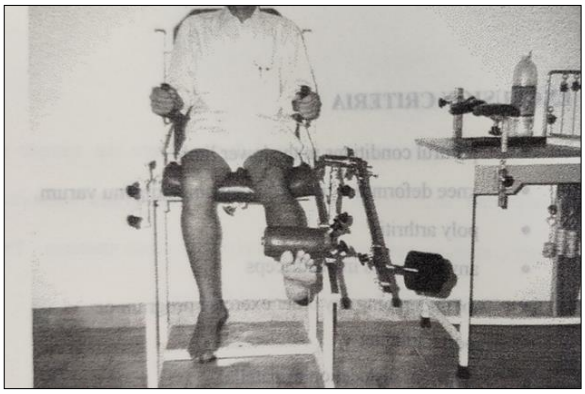

Fig 1: Isotonic contraction exercise training

Fig 2: Isometric contraction exercise training

Fig 3: Quadriceps Muscle Bulk measurement

Data Analysis and Results

The study aims to compare and find the effects of isotonic and isometric strengthening exercises on the endurance and bulk of quadriceps muscle in normal individual.

Table 1: Mean value, mean difference and paired 't' value of quadriceps muscle endurance and bulk in group I and II

Variable	Groups	Pre test	Post test	Mean Difference	Paired 't' value
Endurance	Group I (Isotonic)	67	80	13	7.13
	Group II (Isometric)	66	75	9	4.56
Muscle Bulk	Group I (Isotonic)	49.2	50.3	1.1	5.78
	Group II (Isometric)	48.3	9.4	1.1	3.44

Significant at 0.05 level

In group I for quadriceps muscle endurance and bulk the calculated paired't' values are 7.13 and 5.78 respectively and the 't' table value is 2.145 at 0.005 level. Since all the calculated 't' values are more than the 't' table value, there is significant difference between pre and post test scores of quadriceps muscle endurance and bulk following isotonic strengthening exercises among normal individual.

In group II for quadriceps muscle endurance and bulk the calculated paired't' values are 4.56 and 3.44 respectively and the't' table value is 2.145 at 0.005 level. Since all the calculated 't' values are more than the 't' table value, there is significant difference between pre and post test scores of quadriceps muscle endurance and bulk following isometric strengthening exercises among normal individual.

Table 2: Mean value, mean difference and un paired 't' value of quadriceps muscle endurance and bulk in group I and II

Variable	Group I Mean	Group II Mean	Mean Difference	Un Paired 't' value
Endurance	13	9	4	12.75
Muscle Bulk	1.1	1.1	0	0.53

Significant at 0.05 level

In the between group analysis the calculated unpaired't' values for quadriceps muscle endurance is 12.75 and the 't' table value is 2.048 at 0.005 level. Since all the calculated 't' value is more than the 't' table value there is significant difference between isotonic strengthening exercises and isometric strengthening exercises in improving quadriceps muscle endurance among normal individual. When comparing the mean values of both the groups, group I subjects trained with isotonic strengthening exercises showed more difference in the scores of quadriceps muscle endurance than group II subjects trained with and isometric strengthening exercises.

The calculated unpaired't' values for quadriceps muscle bulk is 0.53 and the 't' table value is 2.048 at 0.005 level. Since all the calculated 't' value is less than the 't' table value there is no significant difference between isotonic strengthening exercises and isometric strengthening exercises on quadriceps muscle bulk in normal individual.

Discussion

This study was done on 30 adult subjects and divided into 2 groups of 15 each. The strengthening program for 6 weeks showed significant increase in bulk and endurance in both groups. This may be due to different muscle fibre types which are representative of the motor unit types that differ not only in muscle metabolic capacities but also nerve conduction, recruitment and contractile function. During muscle endurance exercises, the metabolic capacity of muscle fibres are increased to produce ATP from oxidative phosphorylation[8].

Conclusion

Both isotonic and isometric exercise program showed significant increase in endurance and muscle bulk. The isotonic exercise group showed better result in improving endurance as compared to isometric exercise. No significant difference in bulk between the two groups.

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