



**Research Article**

**IMMEDIATE AND DELAYED EFFECT OF CRYOTHERAPY ON QUADRICEPS MUSCLE STRENGTH USING MODIFIED SPHYGMOMANOMETER IN HEALTHY INDIVIDUAL**

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**Key words:**

Cryotherapy, quadriceps muscle strength, modified sphygmomanometer, healthy individual.

**ABSTRACT**

**Objective:** To study the immediate and delayed effect of cryotherapy on quadriceps muscle strength using modified sphygmomanometer in healthy individual.

**Background:** Cryotherapy is therapeutic application of any substance to the body that removes heat from the body resulting in decreased tissue temperature. Various methods are used such as crushed ice, ice towel, ice pack, ice massage, refrigerant gases etc. Both superficial and deep temperature changes depend on application method, time, temperature. The physiological and biological effects are due to the reduction in temperature in various tissues. Depending on the duration of the intervention and the timing of measurement, cryotherapy has been associated with both increases and decreases in muscle strength.

**Methodology:** An experimental study of 60 healthy individual aged 18-28yrs was done. They were instructed to perform isometric contraction of quadriceps with a hold time of 5-8secs and strength was assessed. Then for 10 minutes cryotherapy was applied and similarly strength was assessed immediately after cryotherapy, 10minutes, 20minutes and 30 minutes after cryotherapy.

**Result and Conclusion:** Data was analysed and the results were interpreted. There was significant difference in quadriceps muscle strength immediate after cryotherapy and 30mins after cryotherapy. There was no such significant difference was observed in the strength of quadriceps muscle after 10mins and 20mins of cryotherapy as compared to pre assessed strength. We conclude that the strength of quadricep muscle is increased immediately after and 30 mins following 10 mins cryotherapy (crushed ice) whereas, the strength of quadriceps muscle was observed to be decreased 10 mins and 20 mins following cryotherapy.

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**INTRODUCTION**

Cryotherapy is defined as the therapeutic application of any substance to the body that removes heat from the body resulting in decreased tissue temperature<sup>11</sup>. The use of cryotherapy i.e. the application of cold for the treatment of injury or disease is widespread in sports medicine today. It is an established method when treating acute soft tissue injuries, but there is a discrepancy between the scientific basis for cryotherapy and clinical studies. Various methods such as ice packs, ice towels, ice massage, gel packs, refrigerant gases etc are used<sup>14</sup>. Cryotherapy induces effects both locally and at the spinal cord via neurologic and vascular mechanisms<sup>11</sup>. Both superficial and deep temperature changes depend on the method of application, initial temperature and application time. The physiological and biological effects are due to the reduction in temperature in the various tissues, together with the neuromuscular action and relaxation of the muscle

produced by the application of cold. Cold appears to be effective and harmless and few complication or side effects after the use of cold therapy are reported. Prolonged application at very low temperatures should however be avoided as this may cause serious side effects such as frost bite and nerve injuries<sup>14</sup>.

Depending on the duration of the intervention and the timing of measurement, cryotherapy has been associated with both increases and decreases in muscle strength. Isometric muscle strength has been found to increase directly after the application of ice massage for 5 minutes or less; however the duration of this effect has not been documented. In contrast, after cooling for 30minutes or longer, isometric muscle strength has been found to decrease initially and then to increase an hour later, to reach greater than precooling strength for the following 3 hours or longer. It is important to be aware of these changes in muscle strength in response to the application of cryotherapy because they can obscure accurate, objective assessment of muscle strength and patient progress<sup>7</sup>. The quadriceps is a group of muscles located in the front of thigh. The Latin translation of "quadriceps" is four headed as

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the group contains four separate muscles: the vastus lateralis, vastus medialis, vastus intermedius and the rectus femoris. Each of the vastus muscles are also partially covered by the rectus femoris, which also attaches to the kneecap. However, unlike the vastus muscles, the rectus femoris inserts into the hip bone<sup>1</sup>. All four quadriceps muscles powerfully combine working in tandem primarily as extensors of the knee joint. They are extremely crucial muscles aiding in important actions such as walking, running, jumping and squatting in addition to stabilizing the patella<sup>10</sup>.

A modified sphygmomanometer was utilized in measuring the strength of shoulder and hip manually and was found to be a very liable measuring device. It provides an easy understanding of the quality and magnitude of the exercise<sup>9</sup>. The modified sphygmomanometer provides objective measures and involves the use of an aneroid sphygmomanometer, a low cost, portable device widely used by health professionals<sup>2,5</sup>.

The quadriceps are critical to dynamic knee joint stability and weakness of this muscle group is related to poor functional outcome.

It is important to be aware of the changes in muscle strength in response to the application of cryotherapy. So the purpose of this study is to focus on immediate and delayed effect of cryotherapy on muscle strength so that it can further be used for clinical purpose.

**MATERIAL AND METHOD**

**Study Design**

**Type of study:** experimental study.

**Duration of study:** 1 year.

**Place of study:** metropolitan city.

**Study Design**

**Sample size:** 60

**Sample population:** - 18-28yrs healthy individuals.

**Sampling:** Random.

**Selection Criteria**

**Inclusion criteria**

- 18-28year healthy individuals who are willing to participate.
- Asymptomatic individuals with no underlying disorder

**Exclusion criteria**

- Recent fracture less than 6 months.
- Knee surgery less than 6 months.
- Allergy to cold.
- Sensory loss.
- Hypersensitive skin.
- Non co-operative persons.
- Soft tissue injury.

**Material Used**

- Ice-crushed
- Towel
- Bottle(500ml)
- Plinth
- Modified sphygmomanometer
- Test tube

**Procedure**

Screening of the subject will be done as per the inclusion criteria. The procedure will be explained to the subject in detail. A written informed consent will be taken from the subject in the language best understood by them.

A thermal sensitivity test will be performed. Two test tubes with stoppers will be required. One filled with warm water and other with crushed ice. Ideal temperature for cold will be 5-10 degree and for warmth 40-45 degree<sup>13</sup>. The subject will be asked to close his/her eye and the side of the test tube will be placed in contact with the skin. The subject will then be asked to sense it and reply what he/she will be feeling.

The individual will be made to sit on a plinth in a long sitting position with hand supported and ipsilateral knee placed approximately in 10-15 degree of flexion angle. Strength of quadriceps muscle will be measured by modified sphygmomanometer.

A conventional sphygmomanometer will be used with cuff wrapped tightly over a 500ml bottle. The cuff will be inflated to about 100mm Hg. The individuals will be instructed to perform isometric contraction of quadriceps muscle with a hold time of 5-8 seconds under the therapist supervision to avoid potential compensation patterns like hip hiking, excessive hamstring and gluteus muscle activity. The base pressure will be fixed and maintained at about 100mm Hg in the sphygmomanometer and the pressure difference will be noted following isometric quadriceps contraction<sup>9</sup>.

Check that the part where the ice will be applied is exposed properly and the crushed ice will now be applied over the quadriceps muscle for 10 minutes. The strength of quadriceps muscle will be measured immediate after the cryotherapy. Similarly the strength of quadriceps will be measured 10 minute, 20 minute and 30 minute after cryotherapy.

**RESULTS**

Effect of cryotherapy on quadricep muscle before application, immediate after, 10mins after, 20mins after and 30mins after cryotherapy

TABLE A	Strength Pre-cryotherapy	Strength post cryotherapy(immediate after)
Mean	27.10	32.40
Standard deviation	13.51	13.00

**Inference:** P value is less than 0.0001 thus it is considered to be statistically significant.

Table B	Strength pre-cryotherapy	Strength post cryotherapy(10mins after)
Mean	27.10	28.65
Standard deviation	13.51	12.79

**Inference:** P value equals 0.1336 thus it is considered to be not statistically significant

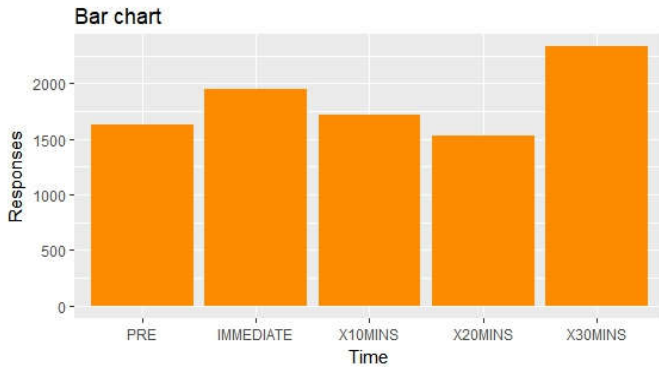
TABLE C	Strength pre-cryotherapy	Strength post cryotherapy(20mins after)
Mean	27.10	25.52
Standard deviation	13.51	13.40

**Inference:** P value equals 0.0899 thus it is considered to be not statistically significant

TABLE D	Strength pre-cryotherapy	Strength post cryotherapy(30 mins after)
Mean	27.10	38.88
Standard deviation	13.51	14.90

**Inference:** P value is less than 0.0001 thus it is considered to be statistically significant

**Graph: Immediate and Delayed of Cryotherapy on Quadriceps Muscle Using Modified Sphygmomanometer In Healthy Individual**



**Inference:** There was significant difference in quadriceps muscle strength immediate after cryotherapy and 30mins after cryotherapy. There was no such significant difference observed in the strength of quadriceps muscle after 10mins and 20mins of cryotherapy as compared to pre assessed strength.

**DISCUSSION**

This study investigated immediate and delayed effect of cryotherapy on quadricep strength using modified sphygmomanometer in healthy individual.

Cryotherapy is the fundamental modality of physical therapy. Depending on duration of the intervention, cryotherapy has been associated with both increase and decrease in muscle strength.

60 samples of healthy individual were selected among the age group of 18-28years as per the inclusion and exclusion criteria. The data was collected using crushed ice and modified sphygmomanometer. The collected data was statistically analyzed using paired 't' test.

Table and graphs were interpreted and the results clearly indicate that application of the cryotherapy improves the strength immediately after and 30mins post cryotherapy. The proposed mechanism for this response includes motor nerve excitability and increased psychological motivation to perform<sup>4,7</sup>.

Oliver et al put the leg in 10 degree celcius water for 30minutes. A definite relationship was found between intramuscular temperature and plantar flexion strength. It steadily increased, beginning at 30minutes post treatment and reached 133% of pretreatment levels at 180 minutes posttreatment<sup>6</sup>.

The strength was observed to be decreased up to 20mins. Mechanism behind this reduction is the alteration in muscle temperature which influence metabolic rate, enzyme activity, nerve conduction velocity, impaired calcium and acetylcholine release<sup>4</sup>.

Cryotherapy is commonly used for treatment of acute injuries and following a rehabilitation session. However cryotherapy could be equally useful prior to atheletic competition and rehabilitation of patients with injuries. Our data indicate that motor function is enhanced following cooling on normal subjects.

**CONCLUSION**

This study conclude that the strength of quadricep muscle is increased immediately after cryotherapy and 30 mins following cryotherapy(crushed ice) whereas, strength of quadriceps muscle was observed to be decreased 10 mins and 20 mins following cryotherapy.

**Limitations**

1. Small sample size
2. Gender ratio was not mentioned

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**Abbreviation**

- Mins-minutes
- Secs-second
- Yrs-years

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