Cryotherapy and its effects on shoulder proprioception

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Introduction

Proprioception, or the relative sense of body position in space, is accomplished by a complex integration of multiple sensory receptors within the skin, muscle, joints, ligaments, and tendons. These proprioceptors continually send afferent neural impulses to the central nervous system regarding peripheral joint stability and movement and are typically stimulated (excited) with tissue deformation via stretching or compression. However, when an athlete sustains an injury to a joint during competition, the joint is most commonly treated with a desensitizing treatment like cryotherapy. Ice application is used to interrupt pain sensation by decreasing nerve conduction velocity, inflammatory mediators, and metabolic byproducts. Although pain and other negative factors are minimized with ice, the efficacy of proprioception may also be inhibited thereby leaving the athlete at a greater risk of injury if he/she returns to play too soon. Previous research has demonstrated a decrease of proprioceptive ability in several joints after cryotherapy, but little is known on the time dependent effects of cryotherapy on the complex glenohumeral joint.

Purpose

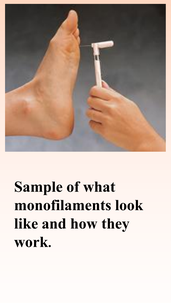
The purpose of this study was to determine the time dependent effects of a 30-minute cryotherapy treatment on shoulder proprioception and skin sensation.

Methods

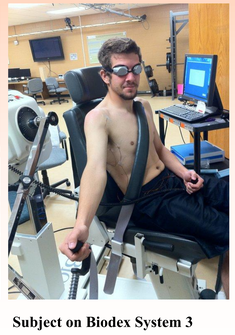
Study design was a within subjects design with three levels of time (time zero (pre), time 20-minutes (post1), and time 30-minutes (post2). Five healthy subjects (age 22 ± 0.8 yrs, ht 177 ± 10 cm, mass 76 ± 13 kg) with no recent history of shoulder surgery or injury. Subjects were tested for skin sensation, skin temperature, and accuracy of joint positioning both actively and passively. The pre test was performed at thermal neutral and post1 and post2 were performed after the subject had iced. Skin sensation (grams of pressure) was tested using graded Semmes–Weinstein Monofilaments and skin temperature was continuously monitored using three copper-constant thermocouples and the Isothermex®. Proprioception was assessed on the Biodex System 3 machine using 30, 60, and 90 degrees for detection of passive motion and active repositioning to 90 degrees. Blacked out goggles were worn for all measurements to eliminate cues. Two ice bags were wrapped with an Ace bandage around the shoulder joint. After 20 minutes, ice bags were removed and sensation and proprioception data were collected, then ice was re-applied and the same procedures performed at 30 minutes.

Methods (cont'd)

Subject with ice bags on shoulder.



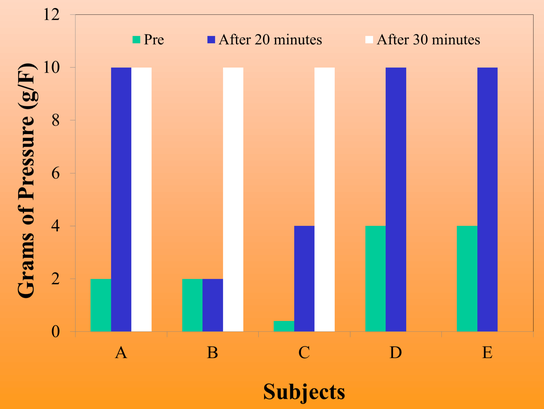
Sample of what monofilaments look like and how they work.



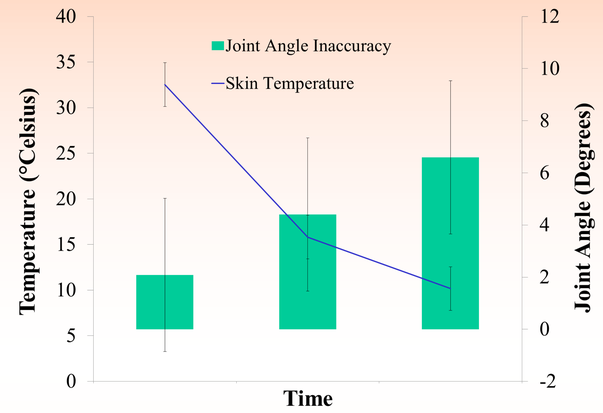
Subject on Biodex System 3

Results

Both temperature (Pre: 32.53±1.4; 20min:15.82±2.9) and sensation (Pre: 2.48±.68; 20min: 7.2±1.7) decreased significantly from the pre test to 20 minutes ($p < 0.05$); however, there were no significant changes in passive or active joint repositioning tasks. At 30 minutes, no changes were detected in passive joint repositioning tasks at 30°or 60° or with the active 90° test, but the accuracy (degrees above or below 90°) of passive joint repositioning to 90° was significantly different from the pre test (Pre: 2.08±.18 and 30-min:6.5±1.74)($p < 0.05$). At 30-minutes both skin temperature (10.17±1.2˚C) and sensation (10±0) remained below pre test values ($p < 0.05$). Two outliers were removed for sensation data.



Results (cont'd)



Conclusions

It is evident that cryotherapy at 20 minutes application and 30 minutes application causes a loss of skin sensation and decreased skin temperature. However, only the 90° passive repositioning task demonstrated a significant decline in accuracy from pre ice to after 30 minutes of ice. Therefore, temperature reduction and loss of sensation are only two of the multiple proprioceptive contributors to shoulder motion; deeper joint proprioceptors that were not sufficiently cooled must still be sending sensory information to the brain and spinal cord. It is interesting to note that the only change was at the greatest shoulder angle tested. Therefore, as the shoulder progressively increases in its range of motion to 90°, the skin must be playing a larger role because the skins' decreased temperature and sensation may have affected subject accuracy. This may or may not affect overall sport performance and accuracy. It is further projected that cryotherapy treatment would need more intensity or time to induce changes that would alter return to play performance.