Journal of Athletic Training 2014;49(1):95–96
doi: 10.4085/1062-6050-48.3.13

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Should Athletes Return to Activity After Cryotherapy?

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Reference/Citation: Bleakley CM, Costello JT, Glasgow PD. Should athletes return to sport after applying ice? A systematic review of the effect of local cooling on functional performance. *Sports Med*. 2012; 42(1):69–87.

Clinical Question: Does local tissue cooling affect immediate functional performance outcomes in a sport situation?

Data Sources: Studies were identified by searching MEDLINE, the Cochrane Central Register of Controlled Trials, and EMBASE, each from the earliest available record through April 2011. Combinations of 18 medical subheadings or key words were used to complete the search.

Study Selection: This systematic review included only randomized controlled trials and crossover studies published in English that examined human participants who were treated with a local cooling intervention. At least 1 functional performance outcome that was measured before and after a cooling intervention had to be reported. Excluded were studies using whole-body cryotherapy or cold-water immersion above the waist and studies that measured strength or force production during evoked muscle contraction.

Data Extraction: Data were extracted by 2 authors using a customized form to evaluate relevant data on study design, eligibility criteria, detailed characteristics of cooling protocols, comparisons, and outcome measures. Disagreement was resolved by consensus or third-party adjudication. To perform an intent-to-treat analysis when possible, data were extracted according to the original allocation groups, and losses to follow-up were noted. The review authors were not blinded to the study author, institution, or journal. For each study, mean differences or standardized mean differences and 95% confidence intervals were calculated for continuous outcomes using RevMan (version 5.1; The Nordic Cochrane Centre, Copenhagen, Denmark). Treatment effects were based on between-groups comparisons (cryotherapy versus control) using postintervention outcomes or within-group comparisons (precryotherapy versus postcryotherapy). If continuous data were missing standard deviations, other statistics including confidence intervals, standard error, t values, *P* values, or *F* values were used to calculate the standard deviation. The Cochrane risk-of-bias tool was used to assess the methodologic quality of included studies. Each study was evaluated for sequence generation, allocation concealment, assessor blinding, and incomplete outcome data. Studies were graded as low or high based on the criteria met, but the risk of bias across the studies was consistently high, so meaningful subgroup classifications were not possible. Differences in study quality and intervention details, including duration of cryotherapy interventions and time periods after intervention before follow-up, were potential sources of bias and considered for a subgroup analysis.

Main Results: Using the search criteria, the authors originally identified 1449 studies. Of these, after title and abstract review, 99 studies were deemed potentially relevant and kept for further analysis (1350 studies were excluded). Of the 99 potentially relevant studies, 35 were included in the final review (64 studies were excluded), with relevant outcomes of strength, power, vertical jump, endurance, agility, speed, performance accuracy, and dexterity reported. The 64 excluded studies were rejected due to intervention relevancy, outcome relevancy, and non-English language. In the 35 studies meeting the inclusion criteria, 665 healthy participants were assessed. Muscle strength (using an isokinetic dynamometer, cable tensiometer, strain-gauge device, or load cell) was assessed in 25 studies, whole-body exercise (vertical jump height, power, timed hop test, sprint time, and time taken to complete running-based agility tests, including carioca runs, shuttle sprints, T-shuttle, and cocontraction tests) was assessed in 6, performance accuracy (throwing or shooting) was assessed in 2, and hand dexterity was assessed in 2. Outcomes before and immediately after cryotherapy intervention were reported in all studies; additional outcome assessments at times ranging from 5 to 180 minutes postintervention were recorded in 11 studies. The review authors reported a high risk of bias: selection bias (poor randomization and concealment of group allocation), performance and detection bias (poor blinding of assessors), and attrition bias (incomplete data). Because of the diversity of studies, particularly with respect to cryotherapy protocols and the potential for rewarming before the posttest, the effects of cryotherapy on functional performance were mixed. From the included studies, the authors concluded that cryotherapy treatment reduced upper and lower extremity muscle strength immediately after cryotherapy. However, increases in force output after cryotherapy were reported in 5 studies. Regardless of the effect of cryotherapy on strength, the clinical meaningfulness of most of the data may not be important due to variability and small effects. Studies reporting outcomes of muscle endurance resulted in conflicting evidence: endurance increased immediately after cryotherapy in 6, whereas muscle endurance decreased in 3 . These conflicting results limit the ability to draw clinically relevant conclusions about the effect of cryotherapy on muscle endurance. The majority of studies evaluating whole-body exercise demonstrated decreases in performance after cryotherapy; these outcomes included vertical jump, sprint, and agility, even when cryotherapy was applied only to a body part. Additionally, cryotherapy appeared to decrease hand dexterity and throwing accuracy immediately after intervention, although an increase in shooting performance postintervention was reported in 1 study .

Conclusions: The authors suggested that the available evidence indicates that athletic performance may be adversely affected when athletes return to play immediately after cryotherapy treatments. Many of the included studies used variable cooling protocols, reflecting differences in time, temperature, and mode of cryotherapy. The majority of the included studies used cryotherapy for at least 20 minutes. However, when considering an immediate return to activity, this cooling duration may not be clinically relevant because cryotherapy applications during practice and competitions usually last less than 20 minutes. When immediate return to activity occurs after cryotherapy, short-duration cold applications or progressive warm-ups should be implemented to prevent a deleterious effect on functional performance.

Key Words: cold modalities, functional performance, strength, endurance

COMMENTARY

Topical cooling is a common treatment for acute athletic injuries and is often used to provide cold-induced analgesia before therapeutic exercise or before athletes return to play. In their title, the authors of this recent systematic review imply that athletes may be participating at a functional deficit when returning to activity during the cooled state. Although evidence supports a decrement in function after cooling, the data are not conclusive. Functional performance within groups (precryotherapy versus postcryotherapy) and between groups (cryotherapy versus control) was evaluated using standardized mean differences (SMDs) and 95% confidence intervals (CIs). Most of the SMD values were small, and many CIs crossed zero, indicating inconclusive data. Therefore, although many SMDs indicated that cryotherapy decreased performance, those outcomes could only be considered meaningful if the CI was conclusive. The purpose of the study was not to evaluate the effect of cold as a recovery modality or to measure the effect of cooling on pain, because all participants were healthy and likely did not exercise at a level similar to that in athletic competition, but rather to examine functional performance outcomes immediately after cryotherapy treatment.

The systematic review highlighted some common inconsistencies of cryotherapy treatment. Of the 35 included studies, cold-water immersion was used in 23, ice bags (4 with compression, 2 without) were used in 6, ice towels and cold packs were used in 2, Cryo/Cuff (DJO, LLC, Vista, CA) was used in 1, and ice massage was used in 1. To further demonstrate the variability of applications, of the 23 studies using cold-water immersion, only 2 sets of researchers followed identical time and temperature protocols; otherwise, various combinations of time and temperature, ranging from 30 seconds to 45 minutes, with water temperatures ranging from 1°C to 20°C, were used. Because few guidelines exist for cryotherapy application, many clinicians and athletes follow the 20-minute prescription, regardless of the desired physiologic outcome, without considering the potential negative effects of returning to play while still cold. Cold-induced analgesia can be attained in about 10 minutes, so if the goal of cryotherapy is to temporarily reduce pain, a longer treatment may not be appropriate.[1] If the goal of cryotherapy treatment is to decrease muscle temperature, longer-duration treatments are necessary, but treatment times do not differ between common cryotherapy modalities of ice bag and cold-water immersion.[2] Clinicians should think critically about the timeframe after injury, the patient's body composition, and the treatment goals before prescribing a cryotherapy treatment, whether on the field or in the clinic. We should also begin to consider different mechanisms by which cryotherapy may be acting to create a successful treatment, such as changes in cutaneous sensation, providing a counterirritant to pain through diffuse noxious inhibitory control, the pain gate theory, or suppressed nociceptive receptor sensitivity.[3]

During athletic competitions, cryotherapy may be applied during short breaks in play or during half-time, but its effects on proprioception remain unclear.[4] In one of the included studies,[5] short (3-minute) cryotherapy applications did not affect vertical jump, agility, or sprint performance. These results, combined with those of the current systematic review, may indicate that clinicians should avoid using cryotherapy for longer periods of time during competitions to limit performance declines. The results of this systematic review do not suggest that cryotherapy before competition places the athlete at an increased risk of injury or that short-duration cryotherapy treatments will have the same negative performance implications as long-duration cryotherapy treatments. More research needs to be conducted using better-developed cryotherapy prescriptions to understand the effects of muscle or joint cooling on functional performance. Until then, when precompetition cryotherapy is appropriate, a proper rewarming period before play or limiting the cooling effects to minimize potential functional decrements is recommended.

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