

CLINICAL APPLICATIONS OF CRYOTHERAPY AMONG SPORTS PHYSICAL THERAPISTS

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ABSTRACT

Background: Therapeutic modalities (TM) are used by sports physical therapists (SPT) but how they are used is unknown.

Purpose: To identify the current clinical use patterns for cryotherapy among SPT.

Study Design: Cross-sectional survey.

Methods: All members (7283) of the Sports Physical Therapy Section of the APTA were recruited. A scenario-based survey using pre-participation management of an acute or sub-acute ankle sprain was developed. A Select Survey link was distributed via email to participants. Respondents selected a treatment approach based upon options provided. Follow-up questions were asked. The survey was available for two weeks with a follow-up email sent after one week. Question answers were the main outcome measures.

Results: Reliability: Cronbach's alpha = >0.9. The SPT response rate = 6.9% (503); responses came from 48 states. Survey results indicated great variability in respondents' approaches to the treatment of an acute and sub-acute ankle sprain.

Conclusions and Clinical Relevance: SPT applied cryotherapy with great variability and not always in accordance to the limited research on the TM. Continuing education, application of current research, and additional outcomes based research needs to remain a focus for clinicians.

Level of Evidence: 3

Key Words: Best practice, cryotherapy, injury management

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INTRODUCTION

Cryotherapy, the therapeutic application of cold, has been recognized “as an integral part of physical medicine, physical therapy, athletic therapy, and sports medicine”^{1(p. 96)} for several decades. Despite the common application of cryotherapy, the evidence for its usage is lacking. Bleakley et al.² concluded in their systematic review that insufficient evidence exists to support the use of cryotherapy clinically, and Hubbard and Denegar state that “the exact effect of cryotherapy on more frequently treated acute injuries has not been fully elucidated.”^{3(p. 279)}

Numerous attempts have been made to supply proof for the use of cryotherapy, but studies have failed to either provide concrete evidence to support cryotherapy usage and/or fully dispel misconceptions about its application. For example, Selkow et al. observed no decrease in blood flow and blood volume of the calf during the application of an ice bag, even though intramuscular temperature did decrease.⁴ Otte et al.⁵ observed cooling times associated with cryotherapy application were affected by adipose tissue thickness. More recent data suggests that target tissue depth may be another explanation for the results of Otte et al.⁶ Ideal cryotherapy applications have also been debated. When seeking the most rapid anesthesia, ice massage appears to be most effective, but cold water immersion may have longer lasting effects.^{7,8} The nature of these “longer lasting effects” is also under scrutiny. Bleakley and Hopkins report that within animal models, target tissue (e.g. the tissue in the immediate proximity to the injury) temperatures must reach 5 – 15 °C in order to decrease metabolic function. It should be noted that no studies on humans exist that address this same issue. Bleakley and Hopkins did not find a single study that reported superficial muscle temperatures being changed to less than 21 °C, meaning that the tissues targeted with the cryotherapy likely do not become cold enough for a decrease in metabolism.⁹ It is apparent from the references cited that a great deal of confusion exists with respect to utilization of cryotherapy and the parameters for application of cold modalities.

From this perspective, one might question whether clinicians are practicing according to evidence (or the lack thereof) or if decisions are being made

based on historical factors, such as therapeutic modality availability, ease of application, familiarity with a given modality, and tradition. Therefore, the purpose of this research was to identify the current clinical use patterns for cryotherapy among sports physical therapists (SPT). It was hypothesized that there would be a general consensus amongst the respondents as to how to treat each condition. It was also anticipated that different approaches would be selected depending on the scenario provided. To the authors knowledge, this is the first study of this type to ascertain how SPT would approach these type of injuries.

METHODS

An survey was developed based on available therapeutic modality research.^{5,6,11-17} The authors of this study wrote the survey, drawing upon greater than two decades of clinical experience and several research studies conducted on therapeutic modalities. The authors received feedback concerning the content of each scenario, treatment options, and the specific parameters of each treatment from five physical therapists (all practicing in the clinical setting at the time of survey development, two trained in master's programs and three via doctoral programs) and five certified athletic trainers (all with previous clinical athletic training experience teaching at the time of survey development) within an athletic training curriculum (three with PhDs, one with an EdD, and one working towards an EdD).

The survey was sent via a blast email to SPT that are part of the Sports Physical Therapy Section of the American Physical Therapy Association. This section was selected because of it being the section that has members who participate in “a specialized practice that focuses on the prevention, evaluation, treatment, rehabilitation, and performance enhancement of the physically-active individual.”¹⁰ Utilizing the blast email method, all members of the Sports Physical Therapist section (7,283 – included physical therapists, physical therapist assistants, and physical therapy students) received an email with a request to participate in the study and a link to the survey. This group received a follow-up reminder email one week after the initial survey request for participation had been sent. The study was approved by the Institutional Review Board at Illinois State

University and informed consent was obtained prior to data collection. The instructions within the email stated that by clicking on the link to the survey the respondents were providing their consent to participate in the study.

Based upon available research and the feedback received, the survey was scaled back from five scenarios to the two included. The number of treatment options and specific parameters were also decreased, with the ones selected chosen based upon regularity of use and availability to the population to whom the survey would be distributed. These ten individuals also took the survey. The feedback received at each stage (during development and after actually having taken the survey) served as the development of content validity for the survey. The reliability of the survey was determined by evaluating the internal consistency of answers between similar questions among the study participants. A frequency analysis was used to assess the number and percent of responses for each question. Pearson correlation coefficients were also computed to see whether relationships existed between the participants and their answers.

The survey focused on the treatment of acute (Scenario 1) and sub-acute (Scenario 2) ankle sprains. The treatment options included ice packs, ice immersion, and Game Ready (CoolSystems, Inc., Concord, CA). Cryokinetics (the use of cold to facilitate exercise) was also included as an option for ice immersion in both scenarios and as an additional option with ice packs and Game Ready in Scenario 2. Respondents were asked to describe their treatment approach, including parameters for their application, for the following scenarios:

- **Scenario 1:** The center on the men's basketball team went up for a rebound and landed awkwardly during practice. An initial evaluation was performed and it was determined that he suffered a Grade II lateral ankle sprain. He was pulled from practice to begin treatment. Which treatment do you perform?
- **Scenario 2:** The basketball player with a Grade II lateral ankle sprain has moved past the acute care phase (0 – 4 days) and is now moving into the sub-acute phase (4 – 14 days). You begin

a before practice rehabilitation protocol to remove any swelling that is left over from the injury and to facilitate range of motion exercises. The athlete is full weight bearing and is able to walk unassisted. Which cryotherapy modality would you choose for the rehab?

These two scenarios and the treatment options identified were selected based on their common occurrence and typical usage in sports medicine clinics, allowing for a common reference point for data collection concerning evidence based therapeutic modality selection.

If the SPT would not use one of the approaches provided in survey, they had the option to input their own approach or to select "none of the above." Descriptive demographic information (sex, age, years practicing, route to practice, where therapeutic modality knowledge was gained, how often therapeutic modalities were used each day) was also sought from each respondent as well as an overview of the equipment available for their use in their given clinical setting.

RESULTS

The reliability of the survey was calculated as being good¹⁸ (Cronbach's alpha > 0.9 for each question assessed). Five hundred and three members of the Sports Physical Therapy section (6.9% response rate) responded to the survey. The majority of respondents were male, 52% had a doctorate degree, and 77% gained their therapeutic modality experience as a combination of classroom education and clinical experience (Table 1). Additionally, 71% of respondents had an ice machine, and 92% had hydrocollator packs and an ultrasound machine. Other common therapeutic modalities available in their clinics are listed on Table 2.

The predominant choice demonstrated great variability in both cryotherapy selection and parameters of application for the treatment of an acute ankle sprain, where 42% selected RICES with an ice pack, 35% selected Game Ready, 14% selected ice immersion with cryokinetics, and 9% selected "other" (Table 3) and a sub-acute ankle sprain where 24% selected ice pack, 23% selected Game Ready, 14% selected "other", and 12% selected Game Ready

Table 1. Participant demographics (# (% of total)) for the sports physical therapists who responded to the survey.

Demographic Category	# (% of total)
Sex	
Female	157 (39)
Male	247 (61)
Age (years)	
≤ 25	14 (3)
26 – 35	165 (41)
36 – 45	128 (31)
> 45	99 (24)
Years Practicing (years)	
≤ 5	125 (31)
6 – 10	79 (20)
11 – 15	67 (17)
16 – 20	47 (12)
> 20	87 (21)
Route to Practice	
Bachelors	83 (20)
Masters	110 (27)
Doctorate	212 (52)
Where therapeutic modality knowledge gained	
Classroom	66 (16)
Working clinically	28 (7)
Combination	311 (77)
How often therapeutic modalities used each day	
With every patient	14 (3)
With most patients	198 (49)
With few patients	142 (35)
Rarely	53 (13)

Table 2. Therapeutic modalities present in the sports physical therapy clinics surveyed (# (% of total)).

Therapeutic Modalities	# (% of total)
Ice machine	291 (71)
Whirlpool (cold)	64 (16)
Whirlpool (warm)	78 (19)
Game Ready	154 (37)
Other cryocompression device	137 (33)
Hydrocollator packs	381 (92)
Ultrasound	381 (92)
Diathermy	11 (3)
Paraffin	187 (45)
Fluidotherapy	79 (19)
Laser	88 (21)

+ cryokinetics (Table 4). There was no correlation between degree type (Scenario 1 = .000; Scenario 2 = -.010), years practicing (Scenario 1 = -.020; Scenario 2 = .027), or for where the respondents gained their therapeutic modality knowledge (Scenario 1 = -.009; Scenario 2 = .015) and the treatment selected for either scenario. The choices selected for the two scenarios exhibited a medium strength of correlation however (Pearson correlation = .321, significant at the .01 level).

DISCUSSION

The purpose of this study was to determine the current clinical use patterns with regards to cryotherapy by SPT in the treatment of an acute and sub-acute ankle sprain. Variability was observed in the selected cryotherapy methods and parameters (Tables 3 & 4), but the selection for Scenario 1 was moderately correlated with the selection for Scenario 2. The variability of treatment approaches may be attributed to a lack of available research associated with cryotherapy and its therapeutic application. Since evidence based practice guidelines do not exist with respect to the use of cryotherapy to treat acute and sub-acute ankle sprains, the results obtained will be compared to research available concerning aspects of cryotherapy usage. Adjustments to practice are recommended where appropriate.

Scenario 1

Scenario 1 queried the respondents' approach to the treatment of an acute ankle sprain. This scenario was written to determine how a SPT would choose to cool the tissue in order to limit pain and secondary

Table 3. Management strategy of sports physical therapists of an acute ankle sprain (# (% of total)).

Treatment Option	# (% of total)
RICEs with an ice pack	160 (42)
How long initially iced	
≤ 10 min	10 (7)
11 – 15 min	73 (49)
16 – 20 min	56 (38)
> 20 min/Until numb	5 (3)/5 (3)
What ice applied with	
Elastic wrap	85 (57)
Plastic film	45 (30)
Other/Nothing	10 (7)/8 (5)
Barrier present	
Yes	115 (78)
No	33 (22)
Ice immersion with cryokinetics	54 (14)
Toe Cap	
Yes	15 (33)
No	30 (67)
How long initially iced	
≤ 10 min	27 (58)
11 – 15 min	10 (22)
> 15 min/Until numb	5 (11)/ 4 (9)
Game Ready	136 (35)
How long initially iced	
≤ 10 min	8 (6)
11 – 15 min	53 (42)
16 – 20 min	51 (40)
> 20 min/Until numb	11 (9)/3 (2)
Pressure of the machine	
No pressure	1 (1)
Low	25 (20)
Medium	86 (68)
High	15 (12)
How many “snow flakes”*	
1	7 (6)
Between 1 & 3	51 (41)
3	67 (54)
Other	35 (9)

*Game Ready indicates how cold a treatment is based on the number of “snow flakes” selected – one snow flake is not as cold as three.

Table 4. Management strategy of sports physical therapists of a sub-acute ankle sprain (# (% of total)).

Treatment Option	# (% of total)
Ice pack	78 (24)
Ice pack + Cryokinetics	23 (7)
Ice immersion	9 (3)
Ice immersion + Cryokinetics	25 (8)
Game Ready	74 (23)
Game Ready + Cryokinetics	41 (12)
Other	45 (14)
None of the above	34 (10)

tissue injury. Of note, the SPT picked what they would do, not necessarily what they thought was the best thing to do, from the available treatment options presented in the survey. As mentioned previously,

42% of respondents chose to accomplish this goal using RICEs while 35% of respondents chose to use a Game Ready (Table 3). Marketing for the use of Cold/compression devices (e.g., Game Ready) base their performance claims on the notion that they can do what an ice pack and an elastic wrap can do, but do it better. This claim is made due to the added benefit of being able to provide intermittent compression to the body part, something that cannot be done with an elastic wrap.¹⁹ Not only did roughly one third of the respondents select the Game Ready to manage an acute ankle sprain (Table 3), but approximately one quarter selected it for the management of a sub-acute ankle sprain (Table 4) as well. The

propensity for this use is not supported by data. In a 2012 study, Hawkins et al.¹¹ observed that an ice pack with an elastic wrap and ice immersion both cooled the sinus tarsi area of the ankle to a greater extent than a Game Ready machine on medium setting, and maintained that cooling longer. Again, if cooling is the goal, the use of a Game Ready machine may not be best practice. If this is indeed the case, less than half of respondents in this case appear to be practicing accordingly.

Beyond determining the most appropriate cooling modality it is also important to discuss treatment parameters, in particular: treatment time, the use of a barrier, and how the selected method of cryotherapy is to be held in place (elastic wrap vs. plastic film). Forty-nine percent of respondents chose to apply RICEs for 11-15 minutes while 38% chose 16-20 minutes. These were the two most popular responses. Generally speaking, it is unknown how long is sufficient to apply cryotherapy in an acute situation. However, based on the work of Otte et al.⁵ the respondents treated the acute ankle sprain for an adequate amount of time to see a 7° C decrease in temperature (12 minutes). Jutte et al.¹² have added further clarity to this issue by applying the Otte et al recommendations to commonly treated body parts. The results of their study indicated that an ankle should be treated for 15 minutes.

In the clinical environment, the use of reusable cryotherapy approaches (e.g., chemical gel packs) is common. Should a non-reusable approach be taken, ice packs made from crushed ice are safe to be applied directly to the skin.²⁰ Chemical gel packs are generally considered to be unsafe for application directly to the skin as they can actually maintain a temperature that is several degrees below zero, increasing the risk of frostbite.^{21,22} Applying a non-reusable ice pack made of crushed ice directly to the skin is supported by available research since including a barrier (elastic wrap or towel) will insulate the treatment area, decreasing the effectiveness of the cryotherapy treatment.^{13,14} As noted in Table 3, the majority of respondents (78%) selected to use a barrier during the application of an ice pack. If the respondents were using a chemical gel pack as their “ice pack”, this response is appropriate. Whether they were using a chemical gel pack or not cannot be ascertained from the data however.

When ice was selected for application, it was applied with an elastic wrap 57% of the time (Table 3). This is supported by available research. Tomchuk, et al.¹⁵ compared the difference between an elastic wrap and flexi wrap (plastic film) on tissue cooling. Both held the ice pack in place, but the elastic wrap facilitated a decrease in temperature that the flexi wrap did not. The elastic wrap does this by compressing the underlying tissue closer together. Tissues that are closer together more readily conduct heat, or in this case, the removal of heat from the body part. As such, if the goal is to decrease tissue temperature, applying the ice pack under an elastic wrap is optimal.

It bears noting that no data from randomized clinical trials exist to suggest that decreasing temperature change after injury causes a change in outcomes in actual patients with respect to limiting pain and secondary injury. Furthermore, the rationale for use of cryotherapy in the specific manner provided above is based on the results from a few papers. Ideally there would be multiple papers that have established good evidence. This fact is highlighted to emphasize the need to gather further evidence with respect to the acute management of musculoskeletal conditions before definitive statements can be made regarding the correct choice, application strategies, and duration and regarding the treatment effectiveness of any given intervention on athletes with injury.

Scenario 2

Scenario 2 queried the respondents' approach in treating a sub-acute ankle sprain. A common goal of cryotherapy in a scenario such as this is to cool the area to the point of numbness which will in turn facilitate pain free range of motion exercises and allow for active muscle pumping to assist with removal of residual swelling. This is known as cryokinetics.^{21,22} Numbness has been reported to occur in 15 – 20 minutes with various methods of ice application.¹⁶ Longer applications, meaning applications beyond numbness, are not believed to be any more beneficial.^{21,22} As such, selecting either “16 – 20 minutes” or “until numb” appears to be the best response to this question, making sure to take into account adiposity^{5,17} as well as target tissue depth.⁶ The respondents most commonly selected an ice pack (24%) and Game Ready (23%) to accomplish this

goal (Table 4). The use of cryokinetics was not commonly chosen (7%-ice pack + cryokinetics, 8%-ice immersion + cryokinetics, and 12% -Game Ready + cryokinetics) by the respondents.

The parameters associated with the cryotherapy selections outlined in Table 4 (sub-acute ankle sprain) were purposefully not reported. Since no one treatment approach had greater than 24% of the total responses it was believed that this fact was more telling than any specific aspect of the treatment. Once a patient moves out of the acute phase where a decrease in temperature may help with pain and secondary injury, movement and mobility via exercise is the key. The approach a therapist takes to get their patient cold to facilitate exercise (if needed) may be less important than the fact the patient is able to exercise. This appears to be the case with the responses reported in Table 4, and there is no evidence to support the use of one treatment approach over the other.

The need for additional study of cryotherapy interventions is further substantiated in the number of "Other" selections made in both scenarios. The question was open ended, allowing for the 35 "Other" responses (9%) for Scenario 1 and the 45 (14%) for Scenario 2 unique in their own way. The responses were most commonly a combination of the answer options provided in the surveys but also included different methods of manual therapy, notably massage and the use of instrument assisted soft tissue mobilization. It was clear that personal preference or experience guided these answers; and some responses have more evidence for their use than others.

Limitations

A major limitation of this study is the low response rate. The data received is enlightening and does shed light on how cryotherapy is used, but may not represent fully the SPT group due to the lack of participants. A second limitation is the fact that the entire SPT section received the survey. As the section also includes sports physical therapy assistants and sports physical therapy students who are not decision makers, the results may not fully represent the SPT group. Ideally only practicing SPT would have received the survey, but the Sports Physical Therapy section would not distribute the survey that way. A third limitation is associated with the survey responses themselves.

From the number of "other" responses it is clear that the respondents would have deemed numerous other approaches appropriate. Although the provided survey responses were deemed appropriate by the authors and ten reviewers of the survey, they apparently did not encompass the possibilities of treatment. Fourth, the survey scenarios themselves, as well as the specific wording, could have influenced the choices made by the respondents. Finally, there is a lack of research evidence to support the use of cryotherapy as well as the parameters for application of the types of cryotherapy offered as interventions, as referenced throughout this manuscript. Without clear evidence it is nearly impossible to determine what an appropriate "correct" choice would be.

Clinical Implications

Within the two scenarios presented in this article lies the primary uses of cryotherapy clinically, to treat acute and subacute injuries. The most common methods of cryotherapy application are also highlighted, with the exception being ice massage. Ice massage was purposefully left off of the list due to the boney nature of the ankle. Regardless of the specific form of cryotherapy used or the injury it is applied on, efforts need to be made to substantiate the evidence beyond cryotherapy application.

Conclusions

A great deal of variability existed in the approaches that were selected by SPT for treatment of an acute and sub-acute ankle pathology using cryotherapy. These results demonstrate the lack of clear consensus for choices or treatment guidelines for cryotherapy. The greatest implication of this study is that the data to substantiate the use of cryotherapy and create treatment guidelines exists and needs to be gathered, quantified, and disseminated so evidence-based guidelines for cryotherapy can be created. Further, it is evident that certain aspects of the application of cryotherapy (creation of a therapeutic goal and how to best accomplish it, treatment time, use of barrier, and how the modality is held in place) should also be further studied.

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