



EFFECT OF COLD WATER IMMERSION ON ANKLE JOINT POSITION SENSE IN HEALTHY INDIVIDUALS – AN EXPERIMENTAL STUDY

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Abstract:

Purpose of the study- To find out the effect of cold water immersion on ankle joint position sense in healthy individuals.

Method- An experimental study was conducted on 78 individuals between 18-30 years of age for testing of Joint Position Sense after 15 minutes immersion in cold water of ($15\pm 1^{\circ}\text{C}$). Ankle JPS was measured using Range of motion by goniometer.

Result- In this study the result analysis was taken into 2 stages which is Before and After cold water immersion. All the result based on the performance of the volunteers regarding the effect of the cold water immersion which divided into 2 groups by gathering the data collection of active plantar flexion and dorsi flexion for JPS. The result has been analyzed by using the paired T-Test it was found that cold water immersion has significant effect on ankle joint position sense ($P < 0.0001$).

Conclusion- These findings suggest that a 15-minute cryotherapy ($15\pm 1^{\circ}\text{C}$) is deleterious to JPS.

Index terms – Joint Position sense (JPS), cryotherapy, Proprioception, Ankle.

INTRODUCTION:

Proprioception is essential in coordinating body segments and controlling muscles to perform movements. Proprioception is defined as afferent information travelling to the central nervous system (CNS) which encompasses a number of different components including kinesthesia, somatosensation, balance, reflexive joint stability, and Joint position sense.¹

Joint position sense is the ability to sense the position of joint with vision occluded.²

Angular measurements have been used by researchers to assess joint position sense (JPS) as one of the submodalities of proprioception. JPS in the ankle has been investigated in several experiments, the apparatus used in each case varies.³⁻⁸

Cryotherapy or cold therapy refers to the lowering of tissue temperature by the withdrawal of heat from the body to achieve a therapeutic objective. Cryotherapy is commonly used to reduce tissue temperature, metabolism, inflammation, pain, circulation, tissue stiffness, muscle spasm, and symptoms of delayed-onset muscle soreness.⁹⁻¹⁰

Cryotherapy, or icing and/or submersion of the foot and ankle in cold water, is a very popular treatment method for both acute and chronic athletic injuries because of its ability to reduce pain, inflammation, and muscle spasm.¹¹

Moreover, cryotherapy influences neuromuscular properties including nerve conduction velocity and muscle contraction.¹² Hence it is very important to study the effects cryotherapy has on joint position sense.

When an injury occurs in a sports setting, vigorous attempts are often made to return athletes to competition as quickly and safely as possible. Athletic trainers, sports therapists, and physicians working in sports medicine settings have realized the successful potential of ice as an effective treatment modality for many years. Clinical and empirical evidence appears to demonstrate that early and frequent cold application during the acute and rehabilitative phases can result in more successful management of the injury.¹³

The ankle is the most frequently injured joint of the weight bearing sports in athletes. Typically, the ankle is most vulnerable in a position of plantar flexion and inversion. A history of recurrent ankle injuries and the absence of structural instability of the joint a deficit in proprioception is often implicated as a significant factor in recurrent ankle injuries. Ankle injuries are invariably

treated with an immediate care or rehabilitation regimes in which cryotherapy plays a major role.¹⁴ The aim of cooling the tissues in such situation is to reduce the total amount of tissue damage, muscle spasm, swelling, pain and to reduce the disability time and allow faster rehabilitation of the injury.¹⁵

MATERIALS AND METHODOLOGY:

Sample size: 78

Study design: Experimental study.

Target population: Young adults (18-30years)

Sampling method: Random Sampling.

Study duration: 6 months.

Inclusion criteria: 18-30 years of age, Healthy individuals irrespective of gender

Exclusion criteria: Hypersensitive or Hyposensitive to cold, Recent injury or fracture of ankle joint, Vascular problems, Peripheral nerve injury, Skin conditions

Outcome measures: Joint position sense :Ankle range of motion - Dorsiflexion and plantarflexion were measured using universal Goniometer.

PROCEDURE:

To conduct the following study permission was taken from the ethical committee of the institution. Subjects were taken as per the inclusion and exclusion criteria. The procedure was explained and a written consent was obtained from the subjects. Initially the demographic data that is Name, age, gender, dominance was recorded.

They were then asked to remove shoes and socks were seated in high sitting position on a stool so that their feet don't touch the ground.

Then they were asked to close their eyes and their testing foot was passively plantar flexed or dorsiflexed and they were asked if the foot was up or down.

After that their active ranges of motion were measured for plantar flexion and dorsiflexion with goniometer: The subject is seated in sitting position with knees flexed and ankle in neutral position. The fulcrum of the goniometer is over the lateral aspect of the lateral malleolus. The proximal arm is aligned with the lateral midline of the fibula, using the head of the fibula for reference. The distal arm is aligned parallel to the lateral aspect of the fifth metatarsal.¹¹

They were then seated on a chair in a comfortable position and their foot was immersed in cold water with temperature ($15 \pm 1^\circ\text{C}$) for 15 minutes.

The cold water was measured using a digital water thermometer.

After that there were again sitting on a high chair and checked for JPS passively with their eyes closed and Active ranges of motion i.e plantarflexion and dorsiflexion were recorded.

STATISTICAL ANALYSIS:

The data was collected, analyzed and was entered in excel sheet and statistical analysis was done using SPSS statistical package of social sciences version 19.0.

The statistical analysis was done using paired t-test for statistical hypothesis to compare pre and post experiment values.

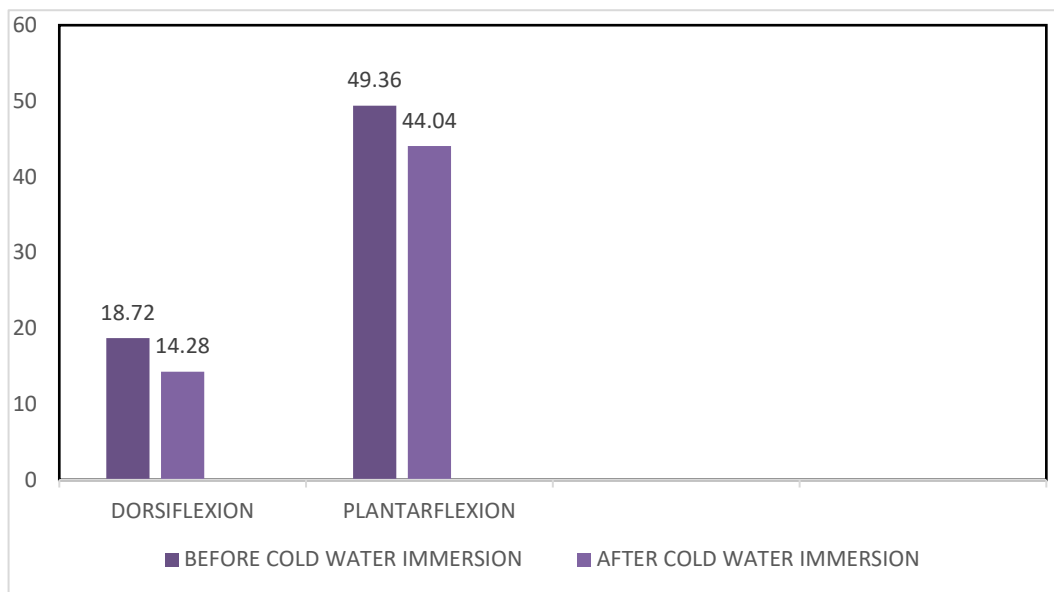
Statistical significance was set at $p \leq 0.05$.

RESULT:

The result show significant changes on the Joint Position Sense after the cold water immersion therapy as the p value is less than 0.0001. The result analysis was taken into 2 stages which is before and after cold water immersion. The result is divided into 2 groups by gathering the data collection of active plantar flexion and dorsi flexion for joint position sense.

	BEFORE IMMERSION	AFTER IMMERSION	DIFFERENCE	P
JPS DORSIFLEXION	18.72 ± 1.34	14.28 ± 2.04	4.44	<0.0001
JPS PLANTARFLEXION	49.36 ± 3.20	44.04 ± 3.26	5.32	<0.0001

TABLE 1.1 JPS Before Water Immersion & After Water Immersion



Comparison of JPS before water immersion and after water immersion

DISCUSSION:

This study was designed to investigate whether cold water immersion has any effect on joint position sense of ankle joint as cryotherapy is used as the immediate management in acute soft tissue injuries and sport players have recurrent injuries so cryotherapy is used and they sometimes return immediately to continue the sport activities, so it is important to check if cryotherapy affects JPS as it should not worsen the injury.

It was found that cold water immersion for 15 Min at (15±1°C) reduces ankle Ranges of motion and has effect on JPS. The Ranges of motion reduced as the temperature of water causes Vaso constriction and contraction of muscles exposed to cold.

Olson and Stravino²⁰ suggested that cold may produce a temporary limited anesthesia due to decreased nerve conduction velocity. Dejong et al¹⁷ similarly demonstrated an effect on nerve conduction velocity caused by cold. He showed a linear association between conduction velocity and temperature above 25 °C.

Edwards and Burton¹⁸ noted that cold increases blood viscosity, which also helps to decrease blood flow into the injured area. Additional vasoconstriction is achieved because of slower blood flow into the injured area. This initial response of vasoconstriction produced by cold application is considered to be the principal mechanism to reduce swelling and bleeding after trauma and to decrease edema in inflammatory reactions.¹²

Hopper¹⁵ conducted a study on effect of cryotherapy on ankle joint in which significant difference in ankle JPS (p<0.049) following fifteen minutes of ice immersion was found. It stated that cryotherapy has negative effect on JPS.

Uchio et al⁷ indicated that applying cooling pad to the knee for 15 minutes under the circulating medium at 4°C increases inaccuracy of position sense by 1.7 as pain receptors are very fired at this temperature. Hence, this matter may have negative effect on the proprioception. Uchio et al identified decreases in nerve conduction velocity after cryotherapy as the culprit for altered proprioception⁷.

Surenkok et al²¹ were the only investigators who employed proprioceptive tests (JPS and static balance) after 2 separate cryotherapy interventions in a crossover study design. In this research, significant differences were found before and after cold pack application and also before and after cold spray application. In other words, both methods affected JPS after treatment negatively.

A study conducted by Rajan Balakrishnan²² conclude that a 15-minute cryotherapy ($18\pm 1^{\circ}\text{C}$) is deleterious to JPS and alteration of the temperature. The P value $< 0.0001/ < 0.0005$ in this study was found similar to this study.

Roya khan Mohammadi¹ found no significant difference in JPS at the middle range of active plantar flexion. LaRiviere and Osternig²³ concluded that an ice treatment had no effect on JPS at the ankle joint.

Different cooling techniques may produce different degrees of joint cooling. Hence, it can be believed that the modality of cooling ice-water immersion, a cooling pad, or ice application may be critical in governing the effect on joint position sense. This study has been done on the ankle joint. However, this point should be regarded that mechanism of proprioception in various joints ankle, knee and shoulder is different¹.

Furthermore, differences between the results may be related to the various methods of studies because soft tissue thickness, type of modality, contact time, primary temperature of tissue and modality are very important in cooling process and can influence the results.

CONCLUSION:

The present study concludes that a 10 min immersion in cold water is deleterious to Ankle Joint Position Sense. Hence there must be caution following cryotherapy to avoid further complications or injury.

LIMITATIONS:

All subjects participating in this study had uninjured ankles. The findings of the present study are not applicable to an injured population as the injury or acute inflammatory processes may affect the results. Cutaneous fat thickness and changes in intramuscular and joint temperature were not measured.

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