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Effect of duration of cryotherapy on ankle proprioception

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Abstract

Objective: The study was done a) to correlate the effect of time of application of cryotherapy on ankle proprioception. b) to assess ankle joint, reposition sense before and after application of cryotherapy. and c) to assess the single leg stance time before and after application of cryotherapy

Method: Twenty-six healthy subjects participated in the experiment as per the inclusion and exclusion criteria. Dominant leg was chosen as the treatment leg in the study. Subjects single leg stance and joint position sense was evaluated pre and post cryotherapy.

Then ice gel application to the dominant ankle and foot was applied for 10/15/20 mins.

Results: A comparative analysis between the duration of application of cryotherapy to the ankle joint at 0min (ie pretest) and after 10, 15 and 20 mins of application for Active Joint Repositioning Sense at 10 deg Dorsiflexion, 20 deg Plantarflexion and through unipedal stance time.

There was a significant difference in AJRS and SLS time-pre application and post 20 mins after ice application (p value <0.05)

Conclusion: 20 mins of cryotherapy application to the ankle affects proprioception significantly.

Keywords: Joint repositioning sense, single leg stance time, proprioception, cryotherapy

Introduction

Proprioception is the sense of the body's position in space and kinesthesia refers to the sense of movement. Proprioception is the ability to detect stimuli arising within the body regarding position, motion, equilibrium. Even a person is blindfolded, he or she knows through proprioception if the arm is above the head or hanging by the side of the body. Proprioception is essential in coordinating body segments and controlling muscles to perform movements.

The term cryotherapy refers to the lowering of the tissue temperature by withdrawal of heat from the body to reduce the total amount of tissue damage, muscle spasm, swelling, pain and to reduce the disability time and allow faster rehabilitation after injury. There are various techniques of cryotherapy application as follows; Ice towels, Ice pack, Immersion, Ice cube, massage, quick ice.

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. Results from previous research suggest a linear relationship between the rate of muscle spindle discharge and muscle temperature.

The proprioceptive effects of cryotherapy may be explained neurophysiologically by reference to the reduction of nerve conduction velocity (NCV) and the eventual blocking of conduction.

The slowing of nerve conduction is commonly a desired effect of cryotherapy, it may be undesirable before therapeutic exercise or training [25]. Cryotherapy before exercise may result in inadequate peripheral feedback on the position sense and may change biomechanical properties of the ankle joint and may reduce the sports performance. Afferent input from the dynamic stabilizer muscles surrounding the ankle joint may play a critical role in the prevention of ankle sprains

Aim: To study the effect of cryotherapy on ankle proprioception

Objectives

- To study the effect of time of application of cryotherapy on ankle proprioception
- To assess ankle joint reposition sense before and after application of cryotherapy.
- To assess the single leg stance time before and after application of cryotherapy.

Hypothesis

Null Hypothesis

Cryotherapy will not have an effect on proprioception of ankle joint.

Alternate Hypothesis

Cryotherapy will have an effect on proprioception of ankle joint.

Need for Study

In acute traumatic cases we use cryotherapy as a measure to lower the effects of injury. But, lowering of the body temperature reduces the nerve conduction velocity and directly affects the proprioception. The purpose of this study is to present data on the position sense of healthy ankle after cryotherapy to clarify the effectiveness and safety of this therapy

Research Question

Does cryotherapy affect ankle proprioception?

At what time of application: 10mins/15mins/20mins of ice is ankle proprioception significantly affected?

Review of Literature

- Topic:** Effect of cryotherapy in the Normal Ankle Joint Position sense
Author: Roya khanmohammadi Phd, Marjan Someh Bsc, Farahnaze Ghafarinejad Msc
Conclusion: These findings suggest that a 15 min cryotherapy session at (6+/-1 deg C) is not deleterious to JPS and can be safely used without fear of reinjury due to decreased proprioception.
- Topic:** To investigate "the effects of functional performance following an ice immersion to lower extremity" published in the journal of Athletic training.
Author: Kelvin Cross and Rick Wilson.
Conclusion: Findings suggested that 20 min ice water immersion at 13 deg C produced a significant decline in the athletic performance
- Topic:** Immediate effects of ankle and foot ice water immersion on static and dynamic balance.
Author: Matthew Douglas, DPT1 Serena Bivens, DPT1 Jennifer Pesterfi eld, DPT1 Nathan Clemson, DPT1 Whitney Castle, DPT1 Gisela Sole, BSc (Physio), MSc (Med), Craig A. Wassinger, PT, PhD1

Conclusion

The results suggest that cryotherapy to the ankle has a negative effect on the ML component of dynamic balance following ice water immersion.

- Topic:** To study the effects of cryotherapy on ankle proprioception and balance in subjects with chronic ankle instability

Author: Chang, Yi-WenWu, Hong

Conclusion: The affected ankle showed a significantly greater proprioceptive error than the unaffected ankle.

- Topic:** Reliability and Concurrent Validity of the Goniometer-Pro App vs a Universal Goniometer in determining Passive Flexion of Knee.

Author: Alberto Melian Ortiz, Alberto Melian Ortiz, David Varillas Delgado

Conclusion: The results presented of the mobile application were slightly more accurate than those of traditional goniometry, which seems to indicate that the G-Pro app is a useful tool to measure the arc of movement

Study Design

Type of study- Comparative study

Place of study- KJ Somaiya College of Physiotherapy

Study period- 6 months

Materials required-

- Stop watch
- Gel pack
- G pro app to measure ROM

Sample Size-20

Data collected through convenient sampling.

Inclusion Criteria-

Normal or asymptomatic individuals, male or female of the age 18 to 25 years.

Exclusion Criteria

History of fracture or any other orthopedic trauma to the hip, knee, ankle and foot.

Skin Hypersensitivity, defective skin sensation.

Diabetes.

Peripheral vascular diseases (Raynauds, Buergers, arteriosclerosis)

Outcome Measures

Single leg stance test (moderate to high validity and reliability of 0.657-0.998 and 0.84-0.97) Subject was instructed to stand on the dominant leg without the support of the upper extremities or bracing of the non weightbearing leg against the stance leg. The time subject maintained this posture was used as a measure of balance.

Test was considered complete if,

- The foot touches the support leg,
- Hopping occurs,
- The foot touches the floor or
- The arms touch something for support.

The G pro I phone based application is used to assess ankle joint position sense

Ankle ROM measured through the G pro app (in degrees) has moderate to high inter and intra rater reliability with an ICC= 0.662-0.956



Fig: Ankle in neutral



Fig 2: Active joint position sense with ankle at 10° Dorsiflexion

Methodology

Twenty-six healthy subjects participated in the experiment as per the inclusion and exclusion criteria. Prior to participation, all subjects signed an informed consent form. Dominant leg was chosen as the treatment leg in the study (The dominant leg was defined as the leg that the subject would choose to kick a ball.) Subjects skin temperature, single leg stance and joint position sense was evaluated pre and post cryotherapy.

Then ice gel application to the dominant ankle and foot was applied for 10/15/20 mins.

First Stage

Evaluate the patient thoroughly for any contraindications.

Assessment of single leg stance

Subject is instructed to stand on the dominant leg without the support of the upper extremities or bracing of the non-weightbearing leg against the stance leg. The time subject maintained this posture was used as a measure of balance.

Test was considered complete if 1) the foot touches the support leg, 2) hopping occurs, 3) the foot touches the floor or 4) the arms touch something for support.

Assessment of Joint position sense

Dominant leg was chosen (the leg chosen for kicking is the dominant leg) Subject will be in a high sitting position with thigh fully supported, knee flexed to 90 degree and foot off the ground. Subject will be blind folded. Foot will then be positioned in zero degree of inversion, eversion, plantarflexion, dorsiflexion.

The iphone will be placed on dorsal aspect of foot along third metatarsal as shown in the figure. Therapist will bring

the patients foot to neutral and readjust the reading on the app to zero degrees and then foot will be moved to 20° of plantarflexion. This position will be held for 5 seconds and then foot will be passively moved into varying degrees of plantar and dorsiflexion and now subject will be asked to actively position the foot in the previous test position (ie. 20° of plantarflexion) Three readings will be taken and difference between initial and final angle will be noted and relative error of these three readings will be taken for analysis.

The same procedure is repeated by this time the test involves active joint repositioning at 10° of dorsiflexion

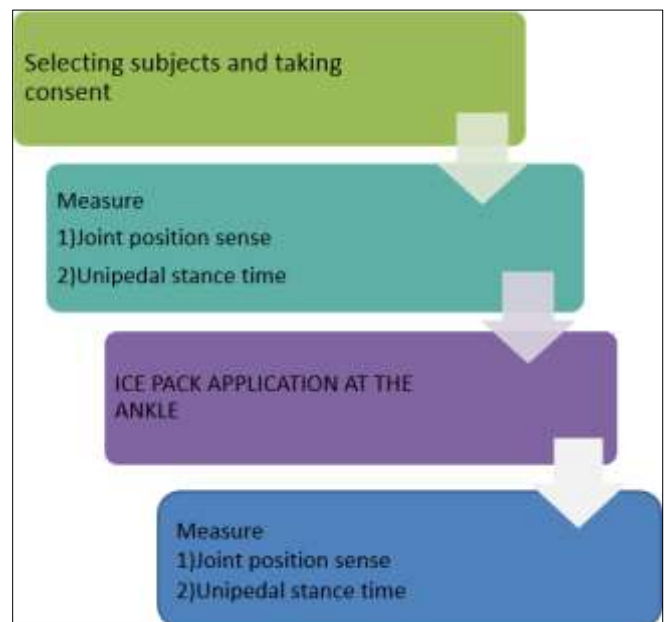
Second Stage

The therapist applies a cold gel pack around the dominant ankle for the required time duration. Each of the 26 subject undergoes ice pack application around the ankle for 10mins, 15 mins and 20 mins. The wash out period between the sessions should be more than 2 to 3 hours.

The gel pack molds easily to the contour of the ankle. The pack is held in place with a Velcro strap for the required time. In case the pack doesn't feel sufficiently cold it must be replaced by a new cold pack. Some Vegetable oil is applied over the skin on the ankle to prevent an ice burn. The therapist needs to keep asking the patient if he feels excessively cold and evaluates the colour of the foot and the distal pulses (Dorsalis pedis) at regular intervals.

Third Stage

After the treatment time, the one leg stance time and joint position sense are reevaluated and the data is entered into the data record sheet.



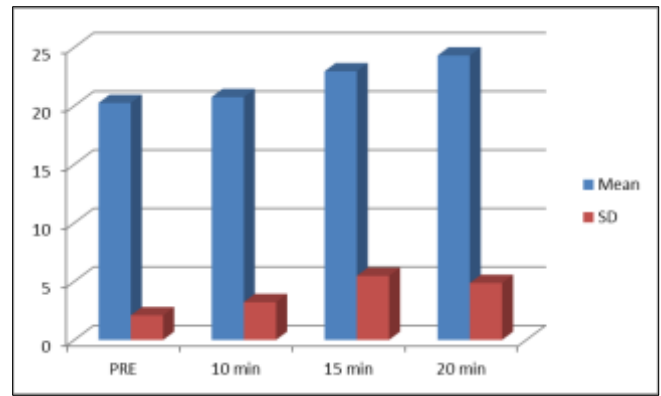
Result and Analysis

The data that was collected was analysed with the help of statistical tests

A comparative analysis between the duration of application of cryotherapy to the ankle joint at 0min (ie pretest) and after 10, 15 and 20 mins of application for Active Joint Repositioning Sense at 10 deg Dorsiflexion, 20 deg Plantarflexion and through unipedal stance time.

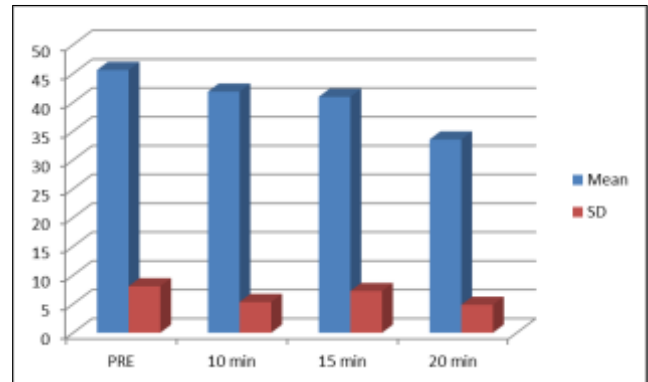
Since it was a single group on whom the above parameters were measured a few times and since the data did not pass the normality, Freidman’s non parametric test was used

AJRS at 10DF	Mean	SD	P value	Significance
PRE	8.3	2.203		
10 min	9.15	1.46		
15 min	10.75	3.38		
20 min	12.5	5.680		
Pre vs 10 min			>0.05	Non-significant
Pre vs 15 min			>0.05	Non-significant
Pre vs 20 min			<0.05	Significant
10 vs 15 mins			>0.05	Non-significant
15 vs 20 mins			>0.05	Non-significant
10 vs 20 mins			>0.05	Non-significant



Mean and SD for 20 degrees of Plantarflexion

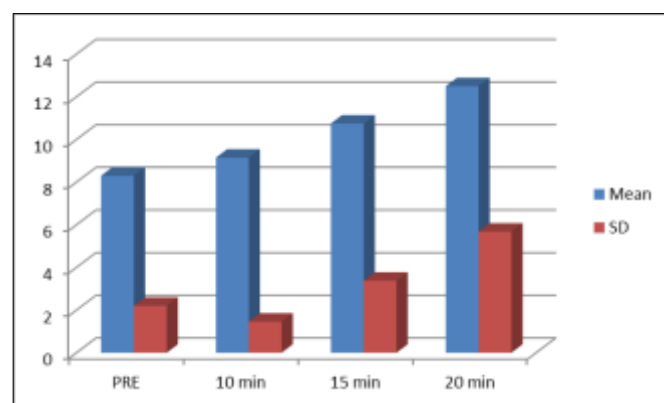
AJRS at 20 PF	Mean	SD	P value	Significance
PRE	20.25	2.099		
10 min	20.75	3.23		
15 min	22.95	5.47		
20 min	24.3	4.86		
Pre vs 10 min			>0.05	Non-significant
Pre vs 15 min			>0.05	Non-significant
Pre vs 20 min			<0.01	V Significant
10 vs 15 mins			>0.05	Non-significant
15 vs 20 mins			>0.05	Non-significant
10 vs 20 mins			<0.05	Significant



Mean and SD for SLST

SLST in seconds	Mean	SD	P value	Significance
PRE	45.6	8.07		
10 min	41.85	5.34		
15 min	40.95	7.24		
20 min	33.55	4.85		
Pre vs 10 min			>0.05	Non-significant
Pre vs 15 min			>0.05	Non-significant
Pre vs 20 min			<0.001	V Significant
10 vs 15 mins			>0.05	Non-significant
15 vs 20 mins			>0.05	Non-significant
10 vs 20 mins			<0.05	Significant

From the above data it is certain that 20 mins of cryotherapy application to the ankle affects proprioception significantly.



Mean and SD for 10 degrees of Dorsiflexion

Discussion

Cold's effects on the muscle spindle and the myotactic reflex is of great importance when considering the muscle's physiology. When reductions in intramuscular tissue temperature occur, the neuronal discharge and sensitivity of the muscle spindles are impeded. Additionally, even if stimulation from the muscle spindle activates the reflex arc, the neuronal message for increased muscle excitability may be inhibited due to a significant decrease in the motor end plate's potential.

Mecomber and Herman 25 clinically validated these findings by noting a decrease in the amplitude of action potentials, twitch contraction, and nerve conduction time following maximal tendon taps of precooled Achilles tendons. Consequently, the resultant force development within the muscle and the myotactic reflex's protective mechanism may be negatively influenced.

When nerve temperature decreases, nerve conduction velocity decreases in proportion to the degree and duration of the temperature change. Fifteen minutes of cooling may have no effect on the function of proprioception but using lower temperatures or longer periods may indicate the other findings because of further affecting conduction velocity of afferent fibers running from receptors to CNS.

The positive dependence of the velocity of adenosine triphosphate (ATP) splitting on muscle temperature may also be a factor in the decreased maximal muscle activity. However, due to the negative effects of cold treatments on ATP resynthesis, subjects' energy supply in the treated extremity may not have had adequate time to rebuild.

Conclusion

20 minutes of cooling of the ankle joint affects proprioception significantly as compared to ice application for 10 and 15 minutes

Limitations

Different individuals may have differences in thickness of cutaneous fat and hence the resultant change the intramuscular and joint temperature may also differ.

The findings of this study cannot be extrapolated to individuals with ankle injuries

Clinical Implications

Sports medicine professionals utilizing cryotherapy as part of clinical rehabilitation techniques or with the intention of returning an athlete to play or practice should consider the implication of decreased dynamic balance. Also when treating older individuals who may already have some degree of proprioceptive loss may be prone to falls considering the immediate effects of cryotherapy on proprioception.

Master Chart

Sr No	AJRS 10 Df Before	AJRS 10 Df After 10 Mins	AJRS 10 Df After 15 Mins	AJRS 10 Df After 20 Mins
1	7	8	13	15
2	8	11	15	17
3	8	11	13	15
4	11	10	7	6
5	11	8	7	18
6	8	12	15	11
7	11	8	6	0
8	8	8	14	15
9	10	8	7	17
10	9	11	13	18
11	4	8	12	16
12	7	8	13	15
13	8	11	13	15
14	5	7	8	6
15	11	9	7	0
16	8	10	13	14
17	6	8	13	16
18	11	10	7	6
19	10	9	6	15
20	5	8	13	15

Sr No	AJRS 20 PF Before	AJRS 20 PF After 10 Mins	AJRS 20 PF After 15 Mins	AJRS 20 PF After 20 Mins
1	22	17	25	28
2	21	18	23	27
3	17	19	25	27
4	21	19	14	13
5	21	22	23	25
6	23	26	29	30
7	23	25	13	26
8	22	22	24	25
9	21	17	21	18
10	18	19	25	25
11	18	23	30	24
12	17	18	26	28
13	20	18	25	29
14	23	26	30	31
15	22	25	13	22
16	18	24	26	24

17	21	16	13	18
18	19	19	26	25
19	17	20	25	26
20	21	22	23	15

Sr No	SLST Before	SLST After 10 Mins	SLST After 15 Mins	SLST After 20 Mins
1	44	41	35	30
2	48	42	44	29
3	32	36	26	27
4	39	41	40	35
5	53	50	45	39
6	42	41	40	35
7	50	36	44	38
8	46	40	41	35
9	44	45	39	37
10	49	42	42	28
11	60	52	54	40
12	32	35	27	29
13	44	40	36	30
14	39	42	40	34
15	49	42	42	28
16	51	36	40	38
17	53	49	47	39
18	59	52	56	40
19	46	40	45	35
20	32	35	36	25

Patient Information Sheet

Study Title: Effect of duration of cryotherapy on ankle proprioception.

Introduction: You are invited to participate in this research study. It is important that you read the description of this study and understand your role in it including the nature of participation. Please give your consent to participate in this study only if you have completely understood the nature and course of the study and if you are aware of your rights as a participant.

Purpose of the study: In acute traumatic cases we use cryotherapy to lower the effects of the injury. But lower the body temperature reduces the nerve conduction velocity and directly affects proprioception. This study is conducted to check the relationship between the time of application of ice and its effect on proprioception.

Study Procedure: If you agree to participate in this study, you will be asked about your current health status and questions related to it. You will be explained about the need and the procedure of the experiment which involves you to apply a cold gel pack around the ankle for the required time. The therapist will compare between the amount of time you could stand on your dominant leg pre and posttest and your ability to sense movement occurring your ankle will be measured (ankle joint repositioning sense)

Risks of Participation: None.

Possible benefits of the study: It will encourage therapists to make use of this treatment modality within the safety limits

Right to withdraw from the study: Participation in the study is entirely voluntary. You may choose not to take part or you may leave the study at any time.

Confidentiality: All study records will be kept confidential at all times. Your identity will not be revealed except as required by law. The results of your assessment may be published for scientific purpose. Your identity will not be revealed in these publications.

Information regarding rights as a research participant: You may contact the Ethics Committee Institutional Secretary for queries related to your rights as a study participant.

Further Study Related Information: If you have any questions, please let us know. If you wish to ask questions later, you may contact the study investigators.

Investigator: Elton John Menezes, IV BPT, K.J. Somaiya college of Physiotherapy.

Guide: Dr. Geeta Bhatt, Professor and Head of Department of Neurosciences, K.J. Somaiya college of Physiotherapy.

रोगी की सूचना पत्र

स्टडी टाइटल: टखने की प्रोप्रायसेप्शन पर क्रायोथेरेपी का प्रभाव।

परिचय: आपको इस शोध अध्ययन में भाग लेने के लिए आमंत्रित किया गया है। यह महत्वपूर्ण है कि आप इस अध्ययन का वर्णन पढ़ें और इसमें भागीदारी की प्रकृति सहित अपनी भूमिका को समझें। कृपया इस अध्ययन में भाग लेने के लिए अपनी सहमति दें, यदि आपने अध्ययन के स्वरूप और पाठ्यक्रम को पूरी तरह से समझ लिया है और यदि आप एक प्रतिभागी के रूप में अपने अधिकारों के बारे में जानते हैं।

अध्ययन का उद्देश्य तीव्र दर्दनाक मामलों में हम चोट के प्रभावों को कम करने के लिए क्रायोथेरेपी का उपयोग करते हैं। लेकिन शरीर का तापमान कम होने से तंत्रिका चालन वेग कम हो जाता है और सीधे प्रोप्रायसेप्शन को प्रभावित करता है। यह अध्ययन बर्फ के आवेदन और प्रोप्रियोसेप्शन पर इसके प्रभाव के बीच संबंधों की जांच करने के लिए किया जाता है।

अध्ययन प्रक्रिया: यदि आप इस अध्ययन में भाग लेने के लिए सहमत हैं, तो आपसे आपकी वर्तमान स्वास्थ्य स्थिति और उससे संबंधित प्रश्नों के बारे में पूछा जाएगा। आपको आवश्यकता और प्रयोग की प्रक्रिया के बारे में समझाया जाएगा जिसमें 20 मिनट के लिए अपने पैर को बर्फ के पानी के टब में डुबोना शामिल है। चिकित्सक परीक्षण से पहले और बाद में आपकी त्वचा के तापमान को मापेगा। वह आपके प्रमुख लेग प्री और पोस्ट टेस्ट में खड़े होने के समय की मात्रा और आपके टखने में होने वाले संवेग आंदोलन की क्षमता (टखने की संयुक्त प्रतिक्रिया भावना) के बीच तुलना करेगा।

भागीदारी का जोखिम: कोई नहीं।

अध्ययन के संभावित लाभ: यह चिकित्सकों को सुरक्षा सीमा के भीतर इस उपचार के तरीके का उपयोग करने के लिए प्रोत्साहित करेगा।

अध्ययन से राइट टू राइट: अध्ययन में भागीदारी पूरी तरह से स्वैच्छिक है। आप भाग नहीं लेने का चयन कर सकते हैं या आप किसी भी समय अध्ययन छोड़ सकते हैं।

अवधारणा: सभी अध्ययन रिकॉर्ड को हर समय गोपनीय रखा जाएगा। कानून द्वारा आवश्यक के अलावा आपकी पहचान उजागर नहीं की जाएगी। आपके मूल्यांकन के परिणाम वैज्ञानिक उद्देश्य के लिए प्रकाशित किए जा सकते हैं। इन प्रकाशनों में आपकी पहचान उजागर नहीं की जाएगी।

एक शोध पत्र के रूप में जानकारी की जानकारी: आप एक अध्ययन प्रतिभागी के रूप में अपने अधिकारों से संबंधित प्रश्नों के लिए आचार समिति के संस्थागत सचिव से संपर्क कर सकते हैं।

अन्य अध्ययन संबंधित जानकारी: यदि आपके कोई प्रश्न हैं, तो कृपया हमें बताएं। यदि आप बाद में प्रश्न पूछना चाहते हैं, तो आप अध्ययन जांचकर्ताओं से संपर्क कर सकते हैं।

निवेशक: एल्टन जॉन मेनेजेस, IV बीपीटीएच, के.जे. सोमैया कॉलेज ऑफ फिजियोथेरेपी।

गाइड: डॉ. गीता भट्ट, प्रोफेसर और तंत्रिका विज्ञान विभाग के प्रमुख, के.जे. सोमैया कॉलेज ऑफ फिजियोथेरेपी।

रोगी माहिती पत्रक

अभ्यास शीर्षक: एंकल प्रोप्रियोसेप्शनवर क्रायोथेरेपीचा प्रभाव.

परिचय: या संशोधन अभ्यासात सहभागी होण्यासाठी आपल्याला आमंत्रित केले गेले आहे. आपण या अभ्यासाचे वर्णन वाचले पाहिजे आणि सहभागाच्या स्वरूपासह आपली भूमिका समजून घेणे आवश्यक आहे. जर आपण अभ्यासाचे निसर्ग आणि अभ्यासक्रम पूर्णपणे समजून घेतला असेल आणि सहभागी म्हणून आपल्या अधिकारांची आपल्याला जाणीव असेल तरच केवळ या अभ्यासात सहभागी होण्यासाठी आपली संमती द्या.

अभ्यासाचा उद्देश तीव्र श्वासोच्छ्वासाच्या घटनांमध्ये आम्ही जखमांच्या प्रभावांना कमी करण्यासाठी क्रायोथेरेपीचा वापर करतो. परंतु शरीराचे तापमान कमी केल्याने नर्व चालन वेग कमी होते आणि थेट प्रवाहावर परिणाम होतो. हिमशास्त्राच्या प्रक्रियेची तपासणी करण्यासाठी आणि प्रोप्रियोसेप्शनच्या प्रभावाची तपासणी करण्यासाठी हा अभ्यास आयोजित केला जातो.

अभ्यास प्रक्रिया: जर आपण या अभ्यासात सहभागी होण्यास सहमती दर्शविली तर आपणास आपल्या सध्याच्या आरोग्याची स्थिती आणि संबंधित प्रश्नांबद्दल विचारले जाईल. आपल्याला 20 मिनिटांकरिता बर्फ पाण्याच्या टबमध्ये आपले पाय विसर्जित

करण्यासाठी आवश्यक असलेल्या प्रयोग आणि प्रक्रियेच्या प्रक्रियेबद्दल आपल्याला समजावले जाईल. चिकित्सक चाचणीपूर्वी आणि नंतर आपल्या त्वचेचे तापमान मोजेल. ते आपल्या प्रभावी पाऊल पूर्व आणि पोस्ट चाचणीवर आपण किती वेळ उभे करू शकता आणि आपल्या गळक्यामुळे होणार्या चळवळीचा अर्थ समजून घेण्याची क्षमता मोजली जाईल याची तुलना देखील केली जाईल (एंकल जॉइंट रिपॉझिझिंग अर्थ)

भागीदारीचे धोके: काहीही नाही.

अभ्यासाच्या संध्याक्या फायद्यांमुळे: हे चिकित्सकांना उपचारांच्या मर्यादेत या उपचार पद्धतीचा वापर करण्यास प्रोत्साहित करेल.

अभ्यासातून बाहेर येण्याचा अधिकार: अभ्यासात सहभाग पूर्णपणे स्वैच्छिक आहे. आपण भाग घेण्यास निवडू शकता किंवा आपण कोणत्याही वेळी अभ्यास सोडू शकता.

गोपनीयते: सर्व अभ्यास नोंदी नेहमीच गोपनीय ठेवल्या जातील. कायद्यानुसार आवश्यक असल्याशिवाय आपली ओळख उघड केली जाणार नाही. आपल्या मूल्याचे परिणाम वैज्ञानिक हेतूसाठी प्रकाशित केले जाऊ शकतात. आपली ओळख या प्रकाशनांमध्ये उघड होणार नाही.

संशोधन अभ्यासाच्या अधिकारांबाबतची माहिती: अभ्यास सहभागी म्हणून आपल्या अधिकारांशी संबंधित प्रश्नांसाठी आपण एथिक्स कमिटी इंस्टीट्यूशनल सेक्रेटरीशी संपर्क साधू शकता.

अधिक अभ्यास संबंधित माहिती: आपल्याकडे काही प्रश्न असल्यास, कृपया आम्हाला कळवा. आपण नंतर प्रश्न विचारू इच्छित असल्यास, आपण अभ्यास अन्वेषकांशी संपर्क साधू शकता.

गुंतवणूकदार: एल्टन जॉन मेनेझेस, चौथा बीपीटीएच, के.जे. सोमैया कॉलेज ऑफ फिजियोथेरेपी.

मार्गदर्शक: डॉ गीता भट्ट, प्राध्यापक आणि न्यूरोसायसिस विभाग प्रमुख, के. जे. सोमैया कॉलेज ऑफ फिजियोथेरेपी.

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AJRS AT 10 DF				
AJRS AT 20 PF				
SLST				

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