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RESEARCH ARTICLE **Open Access**

THE USE OF CRYOTHERAPY AND HEAT IN THE RECOVERY OF TENDON INJURIES IN RUNNING ATHLETES AUTHORED

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Abstract
Tendon injuries are a common problem among running athletes, as they can disrupt their sports activities and reduce their physical performance. Tendons play a vital role in movement by connecting muscles to bones, so any injury to them can be painful and require a long period of treatment and rehabilitation. Effective recovery from these injuries depends on appropriate medical intervention and appropriate therapeutic techniques, among which are heat treatments, specifically cryotherapy, and heat therapy. Cryotherapy and thermotherapy are two methods widely used to treat sports injuries. Cryotherapy reduces inflammation and pain in the early stages of injury by constricting blood vessels and reducing blood flow to the affected area.

Keywords Treatment and rehabilitation, physical performance, Cryotherapy.

INTRODUCTION

Tendon injuries are a common problem among running athletes, as they can disrupt their sports activities and reduce their physical performance. Tendons play a vital role in movement by connecting muscles to bones, so any injury to them can be painful and require a long period of treatment and rehabilitation. Effective recovery from these injuries depends on appropriate medical intervention and appropriate therapeutic techniques, among which are heat treatments, specifically cryotherapy, and heat therapy. Cryotherapy and thermotherapy are two methods widely used to treat sports injuries. Cryotherapy reduces inflammation and pain in the early stages of injury by constricting blood vessels and reducing blood flow to the affected area.

On the other hand, heat therapy helps promote healing during the later stages of recovery by increasing blood flow and relieving muscle spasms. This research aims to explore the effectiveness of both cryotherapy and heat therapy in the recovery of tendon injuries in running athletes, focusing on the mechanisms of action, benefits, and best practices for each type of therapy. Recent scientific studies will be reviewed to provide a comprehensive overview of these therapeutic approaches and analyze real-life case studies to illustrate their impact on improving the healing and rehabilitation of injured athletes. Through this research, we seek to provide evidence-based recommendations for medical and sports practitioners to improve recovery strategies and reduce the time to return to sports activity safely and effectively.

1.1 The First Section

Introduction and the importance of the research

In recent years, the phenomenon of running has gained momentum in the world, and running is one of the most popular sports because it can be practiced anywhere, in the neighborhood or the gym near the office and at any time, when you start running, you must do it gradually and insist on proper nutrition and proper rest to avoid injuries. Many are in a hurry and need to pay more attention to all these things, which is why running injuries are common. they are injuries that may result from many factors, such as (overexertion, overexertion, amateur training), and failure to adhere to the effort tape. Long-distance running, acute and non-gradually, is an imbalance between physical activity and rest. The result of training that is not subject to professional supervision, unorganized training, anatomical structure (leg position, structural asymmetry, etc.), and changes in the running surface between hard and soft surfaces (running on the street versus running on the track) may also contribute to the occurrence of injuries. Athletes sometimes suffer from injuries and pains resulting from exercise, and tendon injuries are common among runners; these injuries require unique care to promote recovery and a quick return to sports activity. Cryotherapy and heat are traditional methods used in this context. This research aims to review the benefits and risks associated with the use of cryotherapy and heat in the treatment of tendon injuries, relieve these pains, and facilitate the recovery process; many athletes resort to cryotherapy. Cryotherapy is essential for athletes as it is an important tool in sports therapy. It provides many benefits to athletes; cryotherapy reduces the temperature of the injured tissues, leading to reduced blood flow, swelling, and inflammation. Ice is recommended for sudden injuries to the tendons. However, heat may be the best option for chronic tendonitis resulting from overuse.

1-2 Research Problem

Research Problem

Tendon injuries pose a significant challenge for running athletes, significantly affecting their performance and continuity in training and competitions.

Different treatment methods, such as cold and heat therapy, are common tools for accelerating the recovery process from these injuries.

However, there is still a lack of comprehensive understanding of how these two methods affect the recovery process and their effectiveness.

The research problem is evident in the need to understand better how cold and heat techniques affect the healing of tendon injuries and determine their effectiveness.

1.3 Research Objectives

General Objectives

Determine the effect of cold and heat therapy on the recovery of tendon injuries in running athletes—specific Objectives.

1. Explore the physiological mechanisms by which cold and heat techniques affect the healing of injured tendons.

2. Compare the effectiveness of cold and heat therapy in reducing pain and swelling and enhancing functional recovery of injured tendons.

3. Provide practical recommendations for optimal cold and heat therapy use in sports rehabilitation programs.

4. Review current studies and literature to provide a scientific basis to support the use of these two methods in treatment.

1.4 Research hypotheses:

1. Hypothesis of the effect of cryotherapy: cryotherapy contributes to reducing swelling and pain more effectively than heat therapy in the early stages of tendon injuries.

2. Hypothesis of the effect of heat therapy: Heat therapy enhances blood flow and increases tissue elasticity, which contributes to accelerating the recovery process in the later stages of tendon injuries.

3. Hypothesis of differential effect: Hypothesis of joint effectiveness Alternating cryotherapy and heat therapy can be more effective in accelerating the recovery process and improving the functional performance of injured tendons.

The effect of cryotherapy and heat therapy on the recovery of tendon injuries varies depending on the severity of the injury and the type of injured tendons (e.g., large versus small tendons).

1.5 Research areas

A pilot study was conducted that included a group of runners with tendon injuries, where the participants were divided into two groups:

A group received cold therapy, another group received heat therapy, numbering (14), and another did not receive the above treatment, so the recovery rate of those who received treatment was faster.

The participants were evaluated before and after the treatment period using objective pain, swelling, and motor function measures.

Sample of the Isfahan Club track and field team, running team.

Time from 3/1/2024 to 5/1/2024.

Section Two

Tendon Injuries in Runners

Tendons are a part of the human body that helps it perform physical and muscular tasks. They consist of connective tissue and are responsible for stabilizing the joint between bones and muscles ( ).

Tendons connect muscles to bones and other body parts. They are connected at one end to muscle fiber bundles and at the other end to bones ( ).

Tendons connect the various muscles of the human body to nearby motor organs, especially connecting skeletal muscles to bones, and carry the effort resulting from muscle relaxation and the effect on the bones. Human movement depends on the presence of tendons and their contraction and relaxation. The most important types of tendons in the human body are the tendons of the shoulders and arms, the tendons of the pelvis and feet, and the tendons of the head, neck, and trunk.

A tendon is a strong band of fibrous connective tissue that connects a specific muscle to another part of the body, usually to a particular bone (in some instances, it attaches a muscle to another muscle). It is characterized by its ability to withstand pressure.

Tendons are similar to ligaments and tendons in terms of their structure. The tendon transmits the mechanical force resulting from muscle contraction to the bone, as one end is tightly connected to the muscle fibers while the other end is connected to the bone.

Tendons are composed of fibrous connective tissue that consists mainly of spindle-shaped cells called fibroblasts and collagen fibers. Tendons are attached to the bone by collagen fibers that continue to support the bone.

The high tensile strength of tendons is due to the abundance of collagen fibers known for their strength and durability, which are necessary to transmit and withstand the tension from muscle contraction to perform movement.

2-1 Definition of tendon injuries

Tendon injuries are damage or tearing of the tendons that connect muscles to bones. These injuries include tendonitis and partial or complete tendon tears ( ).

Tendinitis is inflammation of the thick fibrous cords that connect muscles to bones, known as tendons. This condition causes pain when touched

just outside the joint.

This inflammation can affect any tendon, but it is most common around the shoulders, elbows, wrists, knees, and heels. Most cases of tendinitis can be treated with rest and physical therapy.

2-2Causes of tendon injuries

Tendon injuries can result from several interrelated factors, including overloading, incorrect techniques, poor nutrition, and genetic factors.

A good understanding of these causes can help take appropriate preventive measures to reduce the risk of injury and maintain the health of the tendons.

Tendon injuries are a common problem among athletes and people who engage in intense physical activity. There are several leading causes of these injuries, and the following is an analysis of the most important of these causes:

First: Overloading:

Excessive exercise without adequate rest occurs when the tendons are exposed to excessive and continuous pressure without adequate rest periods. This leads to tendon fatigue and the development of injuries. Intense exercise without giving the tendons enough time to recover can lead to problems such as tendonitis and tendon tears (1).

Second: Incorrect techniques:

Using incorrect techniques in exercising, such as running incorrectly, can put unbalanced pressure on the tendons, increasing the risk of injury. Incorrect running techniques include taking very long steps or landing heavily on the heel (2).

Third: Improper Nutrition

Lack of nutrition that supports tendon health: Nutrition plays a vital role in tendon health. A lack of essential nutrients such as proteins, vitamins (such as vitamins C and D), and minerals (such as zinc and magnesium) can negatively affect the body's ability to repair tissues and strengthen tendons (3).

Fourth: Genetic Factors

Some athletes may be more susceptible to injuries due to genetic factors. Genetic factors play an important role in determining the strength and hardness of tendons. Some people may be inherited with traits that make their tendons more susceptible to injuries. Genes can affect the formation of tendons and the way the body responds to physical stress (4).

2-3 Symptoms of tendon injuries

First: Local pain: Pain in any body part during or after running, even if mild, maybe a sign of injury.

Second: Swelling and redness: Swelling in the joints or soft tissues may indicate an injury.

Third: Weakness of the associated muscles and difficulty moving the nearby joint: Difficulty of movement means difficulty bending, straightening, or lifting the joint. These signs may indicate injury and decreased performance. Decreased ability to run long distances or at high speed may indicate injury, and the appearance of these signs requires stopping physical activity and a medical examination.

2-4 What are the types of pain that alert you to an active injury?

Sharp pain, pain that gets worse, pain that changes the way you run, pain in the joints or bones while running, pain in the Achilles tendon area.

In addition to the load affecting the Achilles heel, expansion and contraction forces are also applied with each step in the running.

These loads cause shock to the tissues, which results in inflammation and tears, pain during and after running, pain during normal walking, and pain that lasts for several days after the activity

ends.

2-5 What is the correct way to run correctly?

The distance and intensity must be calculated correctly in running training.

That is, you must determine the purpose for which you are running, a hobby, or a competition.

A gradual increase in load should be allowed to give the muscles rest and recovery time between workouts. As a result, muscle endurance will increase, and it is usual not to increase distances more than 10% per week.

It is important to note that running training is individualized, so it is recommended that a program that suits everyone personally, in addition to a running guide, be built.

Previous studies

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Section Three

Cryotherapy and Heat

3-1 Cryotherapy Cryotherapy is a therapeutic procedure that uses low temperatures to cool or freeze the affected area, where carbon dioxide ice

or liquid nitrogen is used as a source of low temperatures. It is the use of low heat in treating injuries to relieve pain, swelling, and tension.

3-2-Mechanism of action of Cryotherapy Cryotherapy works to reduce the temperature of the affected tissues, which reduces blood flow, swelling, and inflammation. Cryotherapy is divided into three stages:

1- Heat transfer from the skin to the heat-dissipating substance (the coolant), which is usually liquid nitrogen, which evaporates immediately after being applied to the skin using a spray.

2- After freezing the cells, the ice is thawed, and this step leads to damage to the targeted cells.

3- Inflammation occurs as a final response to Cryotherapy, which appears in the form of swelling and redness of the skin, and this occurs in response to cell death and helps destroy local cells. Using the following materials:

1- Ice: Use ice packs on the affected area for 15-20 minutes every two hours or as needed. This method is helpful for minor injuries such as muscle sprains or bruises.

2- Ice bath: Use ice baths for the entire body or lower extremities, where runners immerse themselves in cold water mixed with ice. This is often used after strenuous exercise to reduce inflammation and speed up the recovery process.

3- Ice files: Ice files can be used around the affected muscles to reduce inflammation and swelling. This method is convenient for runners because it allows freedom of movement during treatment.

4- Ice spray (cold spray): Cold spray can be used directly on the affected area to relieve pain and swelling. This type of cooling is fast-acting and is often used for sports injuries.

5- Cooling gel bags: Cooling gel bags are a practical option, as they can be reused and shaped around the affected area. They are placed in the refrigerator to freeze and then used by wrapping them with a cloth to avoid ice burns.

6- Compressed cooling system: These systems combine cooling and compression to reduce inflammation and swelling effectively. They use pumps to circulate cooled water through unique sleeves around the affected limb. This can be achieved using cold compresses and ice packs, cold water and cold water tubs and baths, massage using ice cubes, cooling gases, cooling gels, or special cooling devices (6).

3. Benefits of cryotherapy.

1- Reducing pain: It contributes to anesthetizing the affected area, which reduces pain as cold acts as a natural pain reliever by reducing nerve activity in the affected area, which helps relieve the feeling of pain.

2- Reducing swelling: It reduces blood flow to the affected area, which reduces swelling and inflammation because cooling helps reduce inflammation and swelling resulting from sports injuries by narrowing blood vessels (vasoconstriction), which reduces blood flow to the affected area.

3. Reducing inflammation: It helps reduce acute inflammatory reactions; cryotherapy can indirectly accelerate the healing process by reducing inflammation and swelling.

4. Reducing muscle cramps Athletes, especially runners, may suffer from muscle cramps after strenuous exercise; cooling can help reduce these cramps and provide relief to the muscles, eliminate muscle tension, and stimulate movement.

5. Preventing recurrent injuries For athletes who frequently suffer from specific injuries, cold therapy can be part of a preventive treatment program to reduce the risk of recurring injuries.

6. Immediate treatment of minor injuries for minor injuries such as a sprained ankle or muscle spasms, a cold can be used immediately after the injury occurs as part of the rice treatment approach, which includes rest, ice, compression, and elevation.

3-4. The effect of cooling methods in treating injuries in running Cooling methods affect injuries by reducing swelling resulting from running, and blood filtration resulting from the injury, and this is due to the contraction of blood vessels. The relative cessation of blood flow to the site of the injury, which prevents blood filtration, and the effect of blood vessel contraction continues for about (15) minutes in severe injuries. The duration of applying ice should not exceed (12) minutes in severe injuries, and it may be repeated after a period of rest. The time period is less than raising the injured part, tying it with a compression bandage, and repeating the treatment with an appropriate rest interval. The treatment period is calculated based on the severity of the injury, and the duration of stopping bleeding does not exceed (2-4) hours. Cooling treatment stops when pain is felt from the cold (increased physiological contraction of blood vessels) (7).Cooling treatment is used in acute injuries in running from (24-72) hours after the injury, and after that, cold is used in preparation and assistance in treatment with positive exercises. 3-5- Practical applications Cooling is also used with therapeutic exercises to relieve pain, improve range of motion and strength in affected joints, and is used in cases of muscle strain. Cryotherapy is a technique that uses low temperatures to treat various conditions and injuries. In the case of running injuries, cryotherapy is used in particular to reduce pain and swelling and improve recovery. There are several methods and practical applications of cryotherapy for runners, including: First: Local Cryotherapy Cryotherapy works to reduce the temperature of the affected tissue, which leads to reducing blood flow, swelling and inflammation and applying ice directly to the affected area for 15-20 minutes every two hours. This can be achieved using ice packs, cooling gel, or dedicated cooling devices. Second: Cold sprays: Sprays containing substances such as ethyl chloride are used to cool the affected area quickly.

Third: Whole Body Cryotherapy: Cooling chambers Athletes enter extraordinary chambers that are cooled using liquid nitrogen or air cooled to very low temperatures (-100°C to -150°C) for short periods (2-4 minutes). This stimulates a body response that reduces inflammation and speeds up recovery. Cold compression devices also combine cooling and compression to reduce swelling and pain. Fourth: Specialized applications: Cooling shoes: Special shoes containing a cooling gel relieve pain and swelling in the feet and ankles.Wearable ice packs: Cold sleeves that can be worn around muscles and joints to provide continuous and comfortable cooling during rest or light activity.3-6-Risks and warnings 1- Tissue damage: Prolonged exposure to cold can cause tissue damage.2- Numbness: Excessive use may lead to numbness and temporary loss of sensation.3- Arthritis: Caution should be exercised when using cryotherapy in cases of chronic arthritis, as it may increase symptoms. Prolonged exposure to cold should be avoided to prevent frostbite or skin damage. People with conditions such as Raynaud's disease or sensitivity to colds should avoid cryotherapy. It is best to inform your physical therapist before starting cryotherapy sessions, especially if you have previous injuries or health conditions. Cryotherapy can be a practical part of a running injury recovery program. Still, it is essential to use it correctly and under the supervision of a specialist to achieve the best results and avoid complications.

Section Four

Heat Therapy

Heat therapy raises the temperature of vital tissue and cells to degrees ranging from (14 to 54) degrees Celsius or more in this type of physical therapy. These methods are of two types: superficial and deep, reducing muscle tension in the event of muscle injury.

Heat also increases blood flow to the affected area, which relieves the causes of pain. As soon as blood flow increases, it is accompanied by an increase in oxygen directed to those cells, an increase in blood flow to them, and an increase in efficiency.

Heat also increases the speed of nerve conduction, which increases the efficiency of the muscles fed by

that nerve and the skin's vitality. These thermal methods help treat lower back pain and various joint pain.

Heat therapy, or heat therapy, is commonly used to treat chronic tendon injuries, especially among runners. The main goal of this treatment is to improve blood flow to the affected area, which helps reduce pain and enhance the healing process. Here is a scientific definition and details on how to use heat therapy for injured tendons in runners:

How heat therapy works:

Heat therapy increases tissue temperature, increases blood flow, and promotes healing. Hot packs, heating devices, or warm baths can achieve this.

Heat therapy for injured tendons:

Heat therapy involves relieving pain and stiffness in muscles and joints.

It is usually applied using heating pads, warm baths, or infrared light.

Heat therapy dilates blood vessels, increasing blood flow to the injured area, promoting the transfer of oxygen and nutrients that aid in healing, and reducing muscle stiffness.

When and how to use heat therapy:

1. To relieve chronic pain: Heat treats chronic tendon injuries such as tendinopathy (tendinopathy) as it helps reduce pain and ease joint and muscle stiffness.

2. Before exercise: Heat can be used to prepare muscles and reduce the risk of injury by increasing their flexibility.

3. After the initial stage of injury: After 24 to 72 hours of the initial injury and the disappearance of swelling, heat can be used alternately with ice therapy to improve blood circulation and relieve pain.

How to apply heat therapy for tendon healing correctly:

1. Duration of application: Heat sessions should last between 15 to 20 minutes.

2. Temperature: The heat should be warm, not burning, to avoid any damage to the skin.

3. Mediation: Use a barrier, such as a towel, between the skin and the heat source to prevent burns.

Heat therapy can be very effective when used at the right time and in the right way.

Benefits of heat therapy for tendon injuries:

Improving blood flow:

Heating the affected area stimulates blood flow to it, which helps transport nutrients and oxygen. Increasing cell nutrition and oxygenation in the affected area speeds up healing.

Reducing muscle stiffness:

Heat also helps reduce fluid buildup in tissues (edema). Heat therapy is used to relieve pain and stiffness in people with some forms of arthritis, reduce muscle spasms associated with injuries such as sprains and strains, and help reduce muscle and tendon stiffness, making movement easier.

Pain relief:

It has a calming effect on muscles, which helps to relieve chronic pain associated with injury, especially muscle pain.

Heat helps relax muscles and relieve tension, which reduces the pain associated with tendon injuries.

Improving flexibility:

Using heat before exercise can help improve the flexibility of tendons and muscles, which reduces the risk of injury.

Types of heat therapy: There are three types of heat therapy:

Moist heat therapy.

Dry heat therapy.

Professional heat therapy.

There are also treatments at a level of which are:

1. Superficial heat therapy

2 . Deep heat therapy

3. Electrical heat therapy

Includes hot water therapy, hot compresses, thermal baths, paraffin wax baths, infrared, ultraviolet rays, hot air with cellulose particles, and comparative or opposite heat therapies ( ).

The research was used to treat tendon injuries in runners, and several types of heat therapy can be used to improve healing and relieve pain. These types include:

1. Heating Pads:

Heating pads are a popular and easy-to-use option. They can be heated electrically or in the microwave and applied directly to the affected area.

Heating pads increase blood flow to the affected area, which helps relieve pain and muscle stiffness.

2. Warm Baths:

Immersing the affected part in warm water can be very relaxing. Epsom salts can be added to the bath to increase the benefit; this method relieves muscle tension and promotes relaxation.

3. Infrared Therapy: Infrared rays increase the temperature of deep tissues, improving blood circulation and promoting healing. This treatment is beneficial for chronic injuries because it can reach deep into the tissues.

Comparison between cryotherapy and heat therapy

When is cryotherapy used?

Cryotherapy is best used within 48 hours after injury to reduce swelling and acute inflammation.

When is heat therapy used?

Heat therapy is best used after the acute phase of injury to aid recovery, improve blood flow, and relieve muscle stiffness.

Section Four

General Guidelines

Depending on the stage of injury and associated symptoms, both cryotherapy and heat therapy should be integrated into a comprehensive treatment program. Consult a sports specialist or physician to ensure the appropriate treatment is used at the proper time. Cryotherapy and thermotherapy are two common strategies in sports medicine for recovering tendon injuries, especially in runners. Here are some conclusions and a conclusion about the use of these two types of treatment:

CONCLUSIONS

1. Cryotherapy:

Reducing pain and swelling: Cryotherapy effectively reduces pain and swelling after an acute injury by reducing blood flow to the injured area and reducing cell metabolic activity.

Improve recovery: It can help reduce inflammation and swelling in the early stages of injury, speeding up the recovery process.

Reduce tissue damage: It helps reduce tissue damage by reducing the inflammatory process.

2. Thermotherapy:

Improve blood flow: It helps improve blood flow to the injured tissue, which enhances the delivery of oxygen and nutrients needed for tissue repair.

Relieve chronic pain: It is effective in relieving chronic pain and improving the flexibility of tendons and muscles, which can reduce the risk of future injury.

Accelerate recovery in advanced stages: It can be used in advanced stages of recovery to enhance the functional recovery of injured tendons.

RECOMMENDATIONS

Individual assessment:

It is essential to evaluate the athlete's condition individually to determine the most appropriate treatment based on the stage of injury and recovery needs.

Coordination with the healthcare team:

It is preferable to coordinate with doctors and physical therapists to ensure optimal treatment and achieve the best recovery results.

Balancing the two treatments:

To achieve maximum benefit, it is helpful to balance the use of cold and heat therapy according to the athlete's stage in the recovery process. In summary, combining cryotherapy and heat therapy can significantly positively impact the recovery of tendon injuries in runners.

CONCLUSION

Tendon injuries are a significant challenge for runners. Both cryotherapy and heat therapy provide tangible benefits at different stages of recovery.

Treatment choice depends on the stage of injury and symptoms, with specialists being consulted to ensure safe and effective use. Cryotherapy and heat therapy can be used complementarily to recover tendon injuries in runners.

In the acute phase after injury, cryotherapy can be the best option to reduce pain and swelling. In the advanced stages of recovery, heat therapy can enhance blood flow and improve the elasticity of injured tissues. Combining these two strategies can improve recovery and reduce the time required to return to sports activity safely and effectively.

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