

REVIEW ARTICLE

Physical modalities used in rehabilitation of musculoskeletal injuries sustained during sports and physical exercises

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Injuries are common during sports and exercise. In addition to medication, physical exercise and massage therapy, rehabilitation specialists use a variety of physical modalities to reduce pain, facilitate healing and restore function. These include the use of therapies such as cold, heat, light, ultrasound, extra corporeal shock wave and electrical stimulation. However, if used in an incorrect manner these modalities can cause further harm and delay healing. Hence proper usage is important to maximize benefits and avoid harmful effects. This narrative review will discuss the different physical modalities and techniques, together with their indications, contraindications and techniques of usage.

Keywords: Physical modalities, Rehabilitation, Musculoskeletal**Introduction**

Injuries are common during sport and exercise, and they are classified as either acute or overuse injuries. Fractures, dislocations, subluxations, sprains, strains, contusions and concussions are considered as acute injuries, while rotator cuff tendonitis, iliotibial band friction syndrome, popliteus tendonitis, patellar tendonitis, achilles tendonitis, medial and lateral epicondylitis, are some examples of overuse injuries [1]. In addition to medication, physical exercise and massage therapy, rehabilitation specialists use a variety of physical modalities such as cold, heat, light, ultrasound, extra corporeal shock wave and electrical stimulation to reduce pain, facilitate healing and restore function [2].

However, if used in an incorrect manner these modalities can cause further harm and delay healing. Therefore, an understanding of the appropriate indications, contraindications and techniques of usage is important when utilizing these physical modalities to get the required benefits and avoid harmful effects.

Cold

Cold treatment or ice therapy is used to reduce blood flow, excessive inflammation and reduce swelling of an injured joint or muscle [2]. Due to these effects, ice therapy is used in the acute stage of an injury, to reduce tissue irritation after therapeutic exercises, and to improve the range of movement of an injured joint, which makes ice an important modality used in rehabilitation. Prior to using ice, it is important to find out whether following contraindications are present; hypersensitivity to cold, Raynaud's

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phenomenon and circulatory insufficiency [3].

Contrast baths

They are used to reduce pain and stiffness of joints. However, this method should not be used in the acute stage. In contrast bath, both cold and heat modalities are used in the following manner; in hot tub - 40.5 °C for 4 minutes and in cold tub - 15.5 °C for 1 minute.

Heat

Dry heat and moist heat are the two types of heat therapies used. Dry heat has been used to treat subacute and chronic injuries for a long period of time due to its local effects, such as the ability to decrease pain and increase mobility. However, it can cause burns in skin, fat and other superficial tissues. Moist heat is another form of superficial heat therapy, given by applying damp heat packs to injured areas. It works in a similar manner to dry heat, but certain studies have shown that moist heat penetrates deeper and faster into injured tissues [1]. Heat is known to improve nutrition and oxygen to injured tissues, transport more cells required for wound healing, reduce joint stiffness, decrease muscle spasms, reduce nerve irritation and make soft tissues more elastic [4]. Heat treatment should be avoided within the first 72 hours of injury, hypersensitivity to heat, history of heat injury, sensory and circulatory impairments [4]. The following methods are used to provide heat to injured tissues; Infrared lamp and Diathermy Short wave.

Infrared Lamp: provides superficial heat and it is used to treat pain and improve healing of injuries involving superficial tissues, especially when a large area is involved. The lamp is generally kept about 1-2 feet away from the

patient, and the treatment session usually lasts for 10-15 minutes. To avoid risk of cataract formation, the patient is advised not to look directly at the light. This type should not be used during the acute stage of inflammation. The heat produced from an infrared lamp does not penetrate >5mm beneath the level of the skin [4].

Shortwave diathermy: uses high frequency electromagnetic waves such as microwave and short-wave diathermies. In this method superficial heating is minimal and the heat can penetrate even tissues lying 5cm deeper to the level of the skin. This type of heat is contraindicated during the acute stage, pregnancy, malignancy, infections and in those with metal particles present in the body [3].

Ultrasound

Ultrasound is used for the treatment of a wide variety of conditions such as fracture healing, thrombus dissolution, plantar fasciitis and epicondylitis. Ultrasound waves produced by the transducer are high pitched and are capable of producing heat. Depending on the frequency used, ultrasound can heat tissues deeper than 5cm below the level of the skin. Due to the heating effect, the blood flow to the injured tissues can increase. In addition to the heating effect, the ultrasound waves have a cavitation effect. In most occasions, the transducer is moved in a circular motion over an injured area. One reason for this circular motion is to prevent injuries due to the cavitation effect [2]. Ultrasound is known to have many biological effects such as increasing extensibility of collagen-rich scar tissues, tendons and joints, relieving pain and muscular spasm, stimulation of cells by upregulation of signaling molecules,

activation of immune cells, remodeling of scars, and accelerating bone fracture healing [5]. Following are contraindications for the use of ultrasound; acute stage of inflammation, pregnancy, malignancy, infection, metal particles, opens epiphysis, treatment over major nerves, eyes and gonads [4]. There are two types of ultrasound that are used; a) traditional type – used for 5 min, 2 times per week and b) low intensity pulsed ultrasound (LIPUS) – used for 20 min, 3 times per week.

Phonophoresis

Phonophoresis is the specific application of ultrasound to enhance the delivery of topical medicines such as corticosteroids into the blood stream. In this method, topical medicine is combined with a gel rubbed into the affected area. Since ultrasound waves dilate nearby blood vessels, it enhances uptake of the medicine into the bloodstream [2].

Iontophoresis

In iontophoresis, an electrical current is used to push ionized topical medicines through the skin into the bloodstream [1]. Sometimes during iontophoresis, superficial burns may occur due to the current used [3].

Electrical Stimulation

Electrical stimulation, or E-stim, is the broad term used for several modalities that involve electrodes attached to a patient's skin (These modalities are being used for both pain relief and functional improvements. In patients with Bell's palsy electrical stimulation is being used to facilitate functional facial movements [2].

Transcutaneous Electrical Nerve Stimulation (TENS)

Transcutaneous electrical nerve stimulation commonly referred to as TENS, is a type of E-stim used to manage acute and chronic pain. Although the exact mechanism of action is not known, it is believed that TENS acts by inhibiting transmission of pain impulses and triggering the production of endorphins [2]. In TENS, high and low frequency currents are used, with both types being used for acute and chronic pain management. High frequency currents initially show good results, but later tolerance can develop. TENS is contraindicated in the presence of pacemaker type appliances in the body and should not be used over the carotid sinus [4].

High voltage, low voltage and interferential stimulation types

For electrical stimulation, in addition to high frequency and low frequency currents, high voltage, low voltage and interferential stimulation types are used. High voltage stimulation is used for stimulating muscles and reducing pain. Low voltage stimulation is two types; galvanic and faradic. The galvanic is used to stimulate denervated muscles and faradic is used to stimulate innervated muscles. Low voltage stimulation has a chance of causing chemical and thermal burns. In Interferential stimulation two alternating medium frequency currents are used. This type of stimulation is done for pain reduction, muscle stimulation (0-10 Hz) and vasodilatation (90–100 Hz).

Light Therapy

Light therapy involves the application of lasers (light amplification by stimulated emission of radiation), light-emitting diodes (LEDs) and

other light sources to injured tissues. Different types of light work in slightly different ways, but in general, they all exert their effects on chromophores, light-absorbing molecules similar to chlorophyll in plant cells. Chromophores use the energy from absorbed light to produce more ATP, the cellular energy needed to synthesize enzymes, DNA, RNA and other materials critical to the repair process [2]. There are two types of lasers; high powered lasers (100 mW) and low powered lasers (50 mW) also known as cold lasers. High powered lasers are used by the military and the engineers and low powered lasers are used in the treatment of musculoskeletal lesions. The commonly used low powered laser types are the Gallium Arsenide and Helium Neon. Gallium Arsenide lasers are not visible to the eye and Helium Neon lasers are visible to the eye [4].

Laser treatment is used to treat conditions such as carpal tunnel syndrome, low back pain, neck pain and subacute tendinopathies due to the effects such as the ability to reduce pain, tenderness and facilitate healing. Generally, only little evidence is available from clinical trials that laser therapy is effective in the treatment of musculoskeletal pain. To get the benefit from laser treatment it is essential to give the location specific dose and follow the proper treatment protocol. The dosage used will vary according to the age of the patient, amount of adipose tissue overlying the injury, response to bio-stimulation and temperature of the diode. Laser is contraindicated in pregnancy, malignancy and infancy [4].

Extracorporeal Shock Wave Treatment (ESWT)

There are 3 main techniques for the generation

of shockwaves; which are electrohydraulic, electromagnetic, and piezoelectric. In orthopedics, electrohydraulic principle is used. The electrohydraulic shockwaves are high-energy acoustic waves generated by underwater explosion with high-voltage electrode spark discharge. Then the acoustic waves are focused on an elliptical reflector and targeted at the diseased area to produce a therapeutic effect. This modality is used in the treatment of tendinopathies, lateral epicondylitis, plantar fasciitis, nonunion of fractures, calcific and non-calcific tendonitis [6]. ESWT is a new non-invasive therapeutic modality with effectiveness, convenience and safety. The complication rates are low and negligible. However, this modality should not be used during the acute phase of inflammation [6]. The exact mechanism of ESWT still remains unknown. Animal experiments have demonstrated that ESWT can induce a cascade of biological responses and molecular changes, including the ingrowth of neovascularization and up-regulation of angiogenic growth factors leading to the improvement in blood supply and tissue regeneration. There is a great potential for translational research and development in the armamentarium of extracorporeal shockwave technology [6].

Conclusion

In conclusion, the clinician should evaluate the effectiveness of each type of treatment by comparing the symptoms and signs before, immediately after and next treatment visit. This will enable the clinician to choose the most appropriate mode of treatment for the specific injury and the specific individual. There are no well-designed randomized controlled clinical trials done to conclusively demonstrate the

efficacy and safety of these modalities.

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