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## Effectiveness of heat and cold therapy in muscle spasm: A review

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### Abstract

Muscle spasms are involuntary, prolonged hypertonicities of one or more muscles that are frequently accompanied by pain and irritability. Clinical therapists employ a variety of treatment modalities as well as manual therapy techniques to treat muscle spasm. Thermotherapy and cryotherapy are often valuable in the treatment of pain, inflammation, and muscle spasm. Knowledge of their unique indications and contraindications are essentials for the safe use of different modalities. Understanding the physiological consequences of heat and cold is necessary for selecting a method of application. The size of the area to be treated, convenience of application, affordability, and duration of application and depth of penetration are just a few of the variables that influence which thermal modality is selected. The major intention of this study is to identify the effectiveness of heat and cold therapy in reducing muscle spasm.

**Keywords:** Thermotherapy, cryotherapy, muscle spasm

### 1. Introduction

Spasm in skeletal muscle is a reversible state of persistent, involuntary contraction, accompanied by muscular shortening, and related with electrical potential alterations. It is an involuntary response (reflex spasm) to noxious stimuli that can occur in the muscle itself or a structure nearby [1]. Muscle spasm occurs in reaction to local pain from any pathology to immobilise and shield the injured area [2].

According to the concept of the "vicious circle" of muscular spasm, muscle pain leads to spasm, which in turn makes even greater pain [3]. Muscle ischemia, which causes a reduction in pH and the release of pain-inducing chemicals such as bradykinin, ATP, and H<sup>+</sup>, is the primary cause of pain that develops during muscle spasm. Pathological alterations in an adjacent joint are another cause of muscle spasms. It is necessary to actively look for these sources of discomfort [4]. According to the hypothesis around muscle spasms, pain and ischemia go hand in hand. When seen using unipolar electromyography, the activity of the muscles at rest increased after eccentric activity [5].

Clinical therapists employ a range of therapeutic modalities as well as manual therapy methods to treat muscle spasm. Understanding the treatment along with each individual indication and contraindication is crucial for the safe administration. Treatment of pain, inflammation, and muscular spasms frequently benefits from the use of cryotherapy and thermotherapy [6, 7, 8].

The term "thermotherapy" refers to the therapeutic use of any substance on the body that raises tissue temperature by adding heat to the body [9]. The use of local heat (thermotherapy) may provide relief of pain and painful muscle spasm by acceleration of metabolic processes whereby the concentration of pain inducing toxic metabolites is reduced. Increased local circulation has a major role in achieving this [6, 10].

The therapeutic administration of any substance to the body that removes heat from it, resulting in lowered tissue temperature, is known as cryotherapy [2, 9]. Cryotherapy is often more effective in providing pain relief, especially in acute condition. It works largely by lowering metabolic activity, which reduces inflammation as well as nociceptor excitability, nerve conduction velocity, and muscular contractility, all of which help to lessen painful muscle spasm [6].

The commonest indications for use of therapeutic heat and cold include relief of pain, stiffness, muscle spasm and inflammation. The therapeutic value of heat versus cold is still a controversial issue. Although interest in cryotherapy has grown recently, the therapist's first duty is to properly evaluate the patient for muscle spasms before using any treatments. The size of the area to be treated, convenience of application, affordability, duration of application, and depth of penetration are just a few of the variables that influence which thermal modality is selected. The major intention of this study is to understanding the physiological consequences and effectiveness of heat therapy and cold therapy in reducing muscle spasm.

## 2. Materials and Methods

The approach for this review was developed based on previously reported suggestions and results. The all-original data that included in this review, collected from published articles in Research Gate, Google Scholar, and PubMed. Articles that published in English language are included in the study. The published articles search was done by using the topics of muscle spasm, muscle spasm and heat therapy, muscle spasm and cold therapy, heat versus cold therapy on muscle spasm. After a thorough assessment of the abstract,

introduction, results and discussions, the suitable articles were chosen. References were used to identify additional articles in order to obtain more details and results.

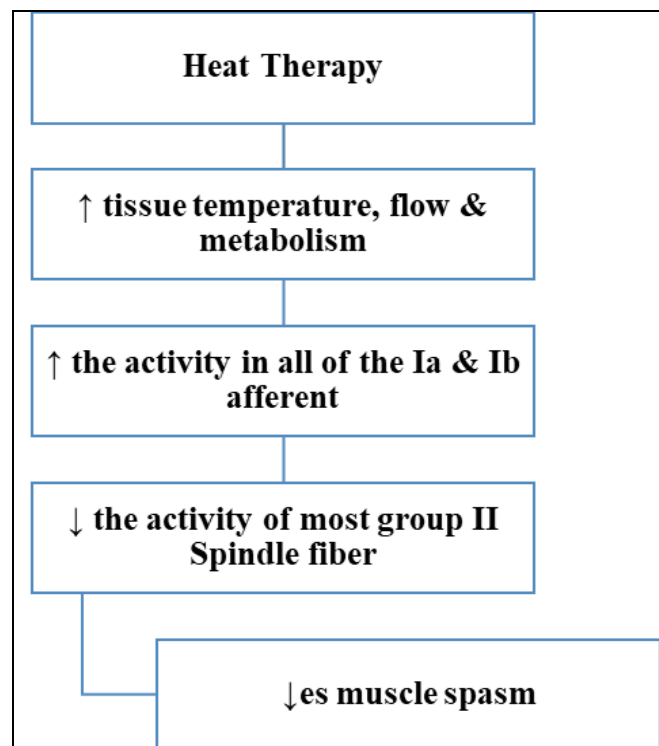
## 3. Results & Discussion

### 3.1 Effects of heat therapy on muscle spasm

The application of local heat (thermotherapy) may relieve pain and uncomfortable muscle spasms by accelerating metabolic processes, which results in a decrease in the concentration of toxic metabolites that cause pain. Increased local circulation has a major role in achieving this <sup>[6]</sup>.

Increasing blood flow helps tissues heal by delivering protein, nutrients, and oxygen to the area of injury. Local tissue metabolism rises by 10% to 15% for every 1°C increase in tissue temperature <sup>[13]</sup>. The environment for tissue repair is created by this increase in metabolism, which also increases the catabolic and anabolic responses required to decompose and eliminate metabolic by-products of tissue damage <sup>[9]</sup>.

Mulkern *et al.* found that heating pad treatment on the skin of the lower back region at 40 °C increased deep muscle tissue temperature 5 °C, 3.5 °C, and 2 °C at muscle tissue depths of 19 mm, 28 mm, and 38 mm below the surface of the skin, respectively <sup>[14]</sup>.



**Graph 1:** Effects of heat therapy in reducing muscle spasm (Kim E J *et al.*, 2015) <sup>[11]</sup>

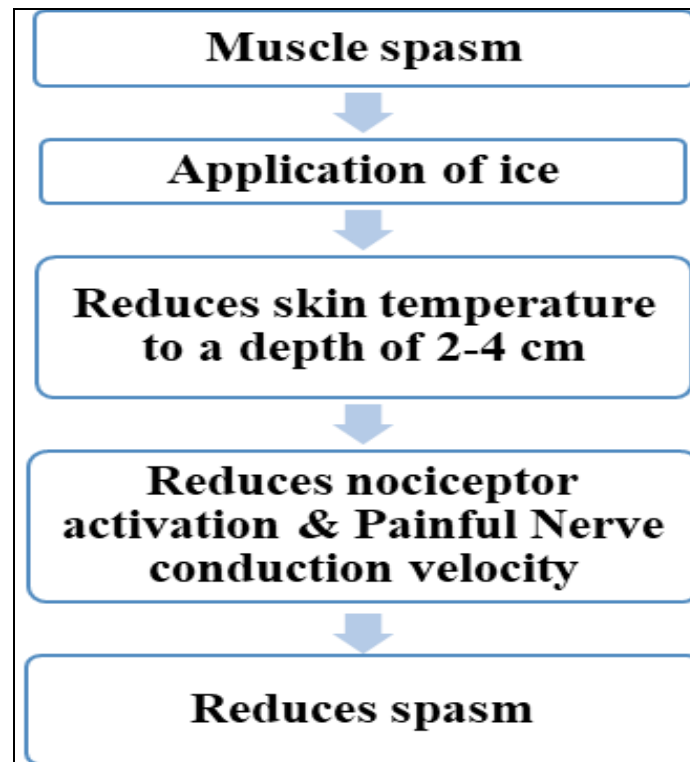
Topical heat therapy may have advantages that are partially mediated by the brain. According to functional brain imaging studies, warmth of the skin without pain causes the thalamus and posterior insula of the brain to become more active. Additionally, the thalamus and S2 region of the cerebral cortex are activated by harmless tactile stimulation of the skin. These direct effects on the brain may lessen the perception of pain there, so offering pain relief <sup>[9, 15]</sup>.

Patients with diabetes, multiple sclerosis, poor circulation, spinal cord injuries, and rheumatoid arthritis should utilize thermotherapy with caution as it could exacerbate their conditions and lead to burns, skin ulceration, and increased inflammation <sup>[9]</sup>.

### 3.2 Effects of cold therapy on muscle spasm

Particularly in cases of acute pain and spasm, local cooling (cryotherapy) is frequently more efficient at relieving it. It works by primarily reducing metabolic activity, which reduces inflammatory response as well as nociceptor excitability, nerve conduction velocity, and muscular contractility, all of which help to lessen unpleasant muscle spasm <sup>[6]</sup>.

M. Ellis, commented on the effect of cold in painful muscle spasm, and put forward the theory that relief was affected by bombarding the skin with such a barrage of cold impulses that the pain was obliterated, with a resultant relaxation in the restricted area <sup>[16]</sup>.



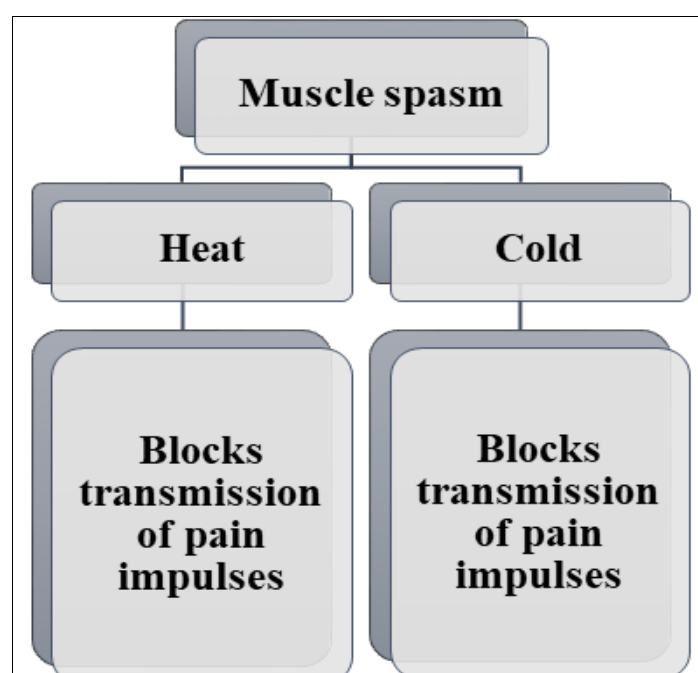
**Graph 3:** Effects of cold therapy on muscle spasm (Nadler *et al.*, 2004) <sup>[9]</sup>

The initial reaction to the application of cold is vasoconstriction involving 1) a localised direct and sustained constriction of the superficial blood vessels, 2) an immediate general vasoconstriction by reflex action through the central nervous system, and 3) a delayed generalised vasoconstriction brought on by the posterior hypothalamus being activated by the cool venous blood returning to the general circulation from the cooled skin <sup>[17]</sup>.

Olson J E, suggested that the penetration of cold on skin temperature and muscle temperature 5.08 centimetres below the skin surface were recorded when ice bag was placed each side of the gastrocnemius for a period of two hours. Skin temperature dropped quickly upon application of cold, and was maintained at approximately 6.1 degrees Celsius,

whereas intramuscular tissue did not begin to show a significant drop in temperature for at least thirty minutes and then only to levels slightly below 32.3 degrees Celsius <sup>[2]</sup>. The extent of the influence of cold in reducing tissue temperature depends upon 1) the nature of the substance applied to the skin surface, 2) its variation from the temperature of the skin surface, 3) the duration of its application, and 4) the region of the body upon which it is applied <sup>[18]</sup>.

Applying cryotherapy close to superficial nerves requires caution, especially if compression and cold are coupled. Cryotherapy has also been linked to various negative effects, such as decreased metabolic activity, Raynaud's phenomenon, cold urticaria, frostbite, and slower wound healing <sup>[9]</sup>.



**Graph 4:** Effects of heat and cold on muscle spasm through pain gate theory (Tepperman PS, Devlin M) <sup>[10]</sup>

### 3.3 Heat vs Cold on muscle spasm

The pathophysiologic effects of cryotherapy and heat therapy

are summarized in Table 1

**Table 1:** Pathophysiologic effects of topical modalities

	Cold	Heat
Pain	↓	↓
Spasm	↓	↓
Metabolism	↓	↑
Blood flow	↓	↑
Inflammation	↓	↑
Edema	↓	↑
Extensibility	↓	↑

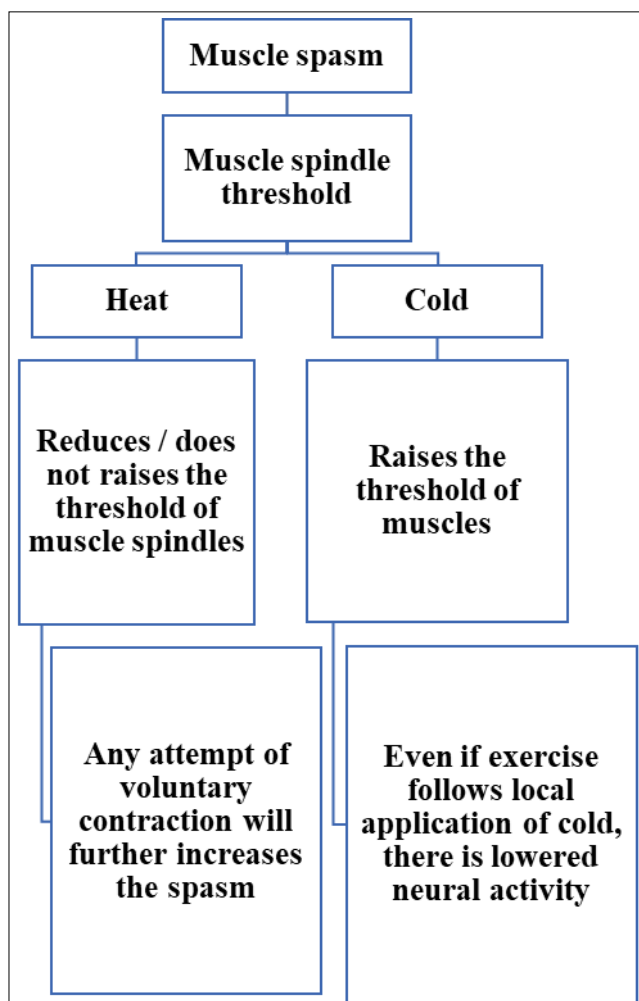
According to Basmajian J V, local application of heat causes relaxation of muscles generally throughout the body and local muscle spasm may be relieved; but the threshold of the local muscle spindles is not raised, and any attempt at voluntary motion will cause a return of muscle spasm [7, 12].

Local application of cold raises the threshold of muscle spindles and increases relaxation, and even when exercise follows local application of cold, there is lowered neural activity [7]. Ice has a far greater depth of penetration than heat and is an excellent agent for cooling muscle [7, 10].

therapy are effective in treating muscle spasm. However, local application of cold would seem to be the ideal emergency measure in the initial treatment option for muscle spasm. The study also found that, when mobilization of a joint is required following muscle spasm then application of cold would give better effects than application of heat therapy. Providing all physiological and therapeutical effects of heat and cold therapy on muscle spasm therapist should thoroughly assess the condition before applying any modalities.

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**Graph 4:** Effects of heat and cold on muscle spindle threshold (Basmajian) [12]

### 4. Conclusion

In summary, the study concluded that both heat and cold

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