

Treatment Algorithms for Continuous Low-Level Heat Wrap Therapy for the Management of Musculoskeletal Pain: An Italian Position Paper

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Abstract: Musculoskeletal pain (MSP), which impacts bones, muscles, tendons, and ligaments, is a substantial worldwide pain disorder, characterized by muscle soreness, fatigue, inflammation, muscle spasms, sleep disruptions, and functional limitations. MSP is predominantly managed within the primary care setting. Recent consensus recognizes that heat therapy (HT) may provide potential benefits, especially in treating chronic MSP. To develop shared algorithms for the treatment of MSP through local superficial HT (SHT) using continuous low-level heat wrap therapy, a four-member board of experts was designated. Three anatomical sites have been deemed of particular interest regarding potential response to exogenous SHT. Neck and shoulder pain are commonly attributed to traumatic experiences, muscle spasms, postural defects, or poor posture as common potential causes. HT may be helpful for painful contractures, although treatment should be limited in duration to prevent instability. Low back pain, the leading cause of disability, may have either specific or non-specific etiology. SHT, physical therapy, instrumental therapy, manual therapy, therapeutic exercise, motor activity, and trunk orthoses are all potential treatment options. SHT should be considered in chronic degenerative disc disease, non-specific LBP with muscle spasm or contracture, postural and overuse myalgia, and osteoarthritis (OA), excluding the inflammatory phase. Assessment of knee pain includes both a review of the patient's medical history and a careful physical examination. SHT of the knee should be considered in case of muscle spasms, overuse pathology, early OA, and indirect muscle lesions. Patients who receive SHT may experience a reduction in pain, restoration of muscle strength, loosening of stiffness, and an overall improvement in their quality of life. This expert opinion proposes shared algorithms for MSP treatment via local SHT with the aiming to provide practical guidance on its proper application, highlighting specific potentialities as well as contraindications.

Keywords: musculoskeletal pain, superficial heat therapy, heat wraps, algorithms

Introduction

Musculoskeletal pain (MPS) is the most prevalent clinically significant pain disorder and the leading cause of disability on a global scale. MPS can involve muscles, tendons, ligaments, or bones. In recent decades, MSP has increased, posing a substantial health burden and contributing to considerable healthcare expenditures. MSP may manifest as acute (immediate and severe), as in the case of strains, fractures, or other traumas, or as chronic (long-lasting), as in the case of chronic inflammatory conditions or osteoarthritis (OA). Frequently, MSP can restrict regular physical activity and mobility, thereby elevating the risk of developing additional chronic conditions.¹

Over the past three decades, the Global Burden of Disease (GBD) study has documented a greater than 30% rise in health estimates pertaining to various musculoskeletal disorders, including hip and knee OA, back and neck pain, gout, rheumatoid arthritis, and a group of “other” musculoskeletal conditions (including inflammatory, joint, ligament, tendon, and muscle disorders). The second leading cause of years lived with disability is low back pain (LBP).^{2–4}

Musculoskeletal pain frequently arises due to various factors, such as musculoskeletal dislocations, joint fractures, sprains, overuse injuries, and posture abnormalities. Symptoms may differ based on the location and etiology of MSP. In recent years, the prevalence of MSP has increased due to a combination of factors including sedentary lifestyles, static working postures, overweight and obesity, aging, cardiometabolic and systemic inflammation, and physical inactivity.^{5,6} Several of the most prevalent symptoms include muscle pain and stiffness, fatigue, muscle spasms or contractures, sleep disturbances, and functional limitations.

MSP is predominantly treated in primary care, primarily through consultations with general practitioners (GPs) or during interactions with the pharmacist, and a diverse range of interventions are utilized. Non-pharmacological interventions encompass a range of strategies, such as psychosocial interventions, exercise therapy, exogenous Superficial Heat Therapy (SHT), manual therapy, acupuncture, and self-management advice and education. Pharmacological treatments include analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), and corticosteroids, among others. Referral to a specialist may be necessary when initial therapeutic approaches fail to alleviate pain or when certain conditions necessitate consultation with a physiatrist, orthopedic, or rheumatologist.

Particular attention was paid to the physicians' attitudes and beliefs regarding the use of thermotherapy as delivered by superficial heat pads or wraps for the treatment of MSP, which were investigated in a survey conducted in Italy in 2022 regarding the prescribing practices of the participating physicians. Emails were sent to 26,000 Italian doctors who were registered on the online platform "MediKey" asking them to fill out a questionnaire. Of those, 455 responded, with 61% being general practitioners, and 39% specialists in physiatry or sports medicine. General practitioners (GPs) are at the forefront of the MSP patient journey. They preferentially prescribe NSAIDs as first-line treatment for OA, muscle stiffness, and strains, while heat wraps were suggested as the first treatment for muscle spasms or contractions. Notably, specialists exhibited a comparable pattern of prescription practices, albeit with a greater propensity for employing ice/cold therapy to alleviate muscle strain pain and limited paracetamol use.⁷

In clinical practice, SHT, particularly through continuous low-level heat wrap application, is commonly used to relieve MSP. Local SHT increases blood flow, stimulates vasodilation, and elevates temperature. In a contracted muscle, the localized thermal increase promotes relaxation, both by acting directly on the neuromuscular spindles and Golgi muscle-tendon organs, and through localized vasodilation. This vasodilation increases the influx of oxygen and nutrients and stimulates the wash-out of toxic metabolites, promoting greater perfusion of the muscular structures.^{8,9} The pro-metabolic effect, resulting from increased enzymatic activity stimulated by the thermal rise, also accelerates recovery. Additionally, heat-induced changes in the viscoelastic properties of collagen increase the elasticity of connective tissue. These changes also contribute reducing muscle tension, resulting not only in pain relief but also in a greater Range Of Motion (R.O.M).^{10,11} Furthermore, SHT can promote direct control over painful symptoms by acting on the peripheral receptors contained in the free nerve endings present in the skin (ie nociceptors).¹² SHT can also inhibit the perception of painful symptoms by direct action on the dorsal horn of the spinal cord, as postulated by the Melzack and Wall gate theory.¹³

A recent literature review and meta-analysis demonstrated that local SHT induces rapid pain reduction, restores physical function, reduces stiffness, and increases range of motion.¹⁴ Local SHT is a viable therapeutic option that is well tolerated and can be combined with other MSP treatments in various settings and by different specialists, including at-home self-management. Although a more robust body of scientific evidence is required, a recent consensus acknowledges the potential benefits of HT, particularly in the case of chronic MSP.¹⁵

Despite the widespread adoption of local SHT, guidelines or recommendations regarding its optimal indications and conditions of use are lacking. To address this gap, a selected group of experts in MSP management and SHT application collaborated to develop shared algorithms for MSP treatment with local SHT, providing practical guidance on its proper application.

Methods

Based on their proficiency in managing MSP and utilizing HT, as well as their prior publications in these domains, a four-member board was appointed: three primary care physicians and one physiatrist.

Initial contact occurred on July 25, 2023. An approach known as “cocreation” was utilized in the development of the treatment algorithms. Cocreation, which originates from digital marketing research,¹⁶ is presently acknowledged as a collaborative effort in which stakeholders actively participate and/or choose the substance of a novel process. As is typical of the cocreation methodology, the group work consisted of two stages: a first stage of contribution of content and a second one of selection of the best contributions. Neck and shoulder, back, and knee were the three most frequent MSP locations that the board initially identified in order to develop treatment algorithms. Then, specific clinical presentation and symptoms, as well as potential diagnoses, were deliberated and chosen for each anatomical site. In addition to considering alternative non-pharmacological options that might be combined with SHT, the design of treatment algorithms was focused on the indications and contraindications of SHT. Regarding the pharmacological management of MSP, paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs), analgesics, corticosteroids, and antidepressants are among the available options. However, a comprehensive discussion of the drugs used to treat MSP is beyond the scope of this expert opinion, for which reference is recommended to recent clinical practice guidelines for the pharmacological management of non-cancer pain.¹⁷

Since this was a discussion between experts to develop expert opinion-based recommendations and not research involving patients or institutions in any way, approval from an Ethics Committee or Institutional Review Board was not required.

Algorithms for SHT Utilization in MSP

The experts delineate certain aspects that ought to be considered for every MSP localization as a premise.

- Comorbidities, concurrent therapies, the possibility of pregnancy, and a well-documented oncological disease history are elements that should consistently be taken into account when selecting an appropriate therapeutic approach. According to the technical data sheets of medical devices that offer exogenous thermotherapy, such as adhesive heatwrap, individuals with circulatory issues, diabetes, heart conditions, rheumatoid arthritis, and pregnant women should seek medical advice before using these products. Diabetes, for instance, is a complicated disease that, on the one hand, reduces the skin's sensitivity to pain. In the event that the skin becomes irritated, diabetic patients might not be aware that the skin is inflamed and that the heatwrap needs to be removed. On the other hand, diabetes increases the skin's sensitivity to heat; for instance, heat levels that are comfortable for a healthy individual can elicit burn sensations on the skin of a diabetic individual.
- Sporting level, sport type, functional requirements, and competitive season phase are all factors that must be considered when treating athletes.
- Irrespective of the prescribed treatment, it is imperative to inform the patient that failure to observe improvement within a span of seven days warrants a consultation with the physician to reassess the therapeutic approach or obtain a referral to a specialist.

Neck and Shoulder MSP

In the same paragraph, this article will describe musculoskeletal disorders that are associated with the cervical spine and the shoulders. The heatwraps are suitable for treating diseases that are associated with the muscles of the shoulder girdle as well as those that are associated with the cervical region.

The prevalence of neck and shoulder pain in the general population varies from 16% to 75%. This condition imposes a significant burden on patients' Health-Related Quality of Life (HRQoL) and musculoskeletal disability.^{18,19} Shoulder and neck pain are frequent complaints in clinical practice, as the majority of individuals experience this condition at some stage in their lives.

Symptoms

The symptoms of neck and shoulder pain can manifest in various ways, including functional limitation of the affected limb, acute or chronic cervicgia or cervico-brachialgia, acute or chronic pain in the humerus, or headache primarily concentrated at the base of the skull. Headache warrant special consideration due to its high prevalence, necessitating meticulous anamnestic and clinical evaluation to rule out conditions other than tension-type headaches, which extend beyond pain in the shoulders and neck and require alternative treatment approaches.

Possible Differential Diagnoses

Pain symptoms associated with the cervical spine can be linked to several specific and non-specific reasons, similar to those mentioned in the lumbar area. Specific causes of the condition include degenerative problems affecting the discs and vertebrae, such as discopathies involving protrusions, bulging, and herniations of the discs, as well as osteodegenerative spondyloarthritic issues. These issues can lead to the formation of osteophytes and even bony bridges between neighboring vertebrae. Cervical discopathy can result in compression of the discs in the neck, causing nerve involvement and potential disruptions to the nervous system. This can lead to neuropathic disturbances, with symptoms radiating to the upper limb on the same side as the affected disc. This article explores several primary muscular causes of cervicgia and shoulder discomfort, which can arise from different underlying conditions.

A traumatic experience, muscle spasm or contracture, postural defects, or poor posture while working or sleeping can all be potential causes of muscular symptoms. The most common diagnoses affecting cervical spine include whiplash, cervical OA, muscle injury, myofascial syndrome (trigger points), discopathy, and tension-type headache. The most common issues affecting shoulder muscles are acute or chronic tendinopathy, subacromial impingement, tendinopathy of the long head of the biceps brachii, and Delayed Onset Muscle Soreness (DOMS), a form of exercise-induced muscle damage that should be considered in subjects who practice sports.

Superficial Heat Therapy (SHT)

Heatwraps are a potential component of a multimodal therapy or alleviating somatic muscle pain in patients experiencing cervical discomfort due to predominant muscular disorders, such as muscle spasms or contractures. To reduce the persistent muscle contractions resulting from various issues, such as strains on the cervical spine, postural disorders, or issues that arise from biomechanical overload (such as repetitive movements or prolonged postures), the authors recommend this therapeutic approach once the acute phase ends.

To prevent a temporary exacerbation of the local inflammatory problem, the authors suggest using external thermotherapy as part of a multimodal treatment only if there is no evidence of radicular involvement. For patients showing sensory and motor symptoms of nerve root involvement, it is essential to adhere to the primary international guidelines for treating cervical pain with a neuropathic element. Heat therapy should be employed only after the resolution of the more acute radicular inflammatory problem.

Regarding the duration of the treatment cycle, the authors agreed on the relevance of limiting the treatment days (eg, to 3 consecutive days) as extended thermal treatment of the cervical musculature might lead to feelings of instability or imbalance. It is also useful to inform the patient, at the time of prescribing thermotherapy for cervical pain, that sensations of instability or weakness in the cervical spine may occur because of the sudden and desirable resolution of muscle contracture and spasm.

Literature evidence underscores that thermotherapy with heatwraps can be effective in managing cervical pain associated with the onset of DOMS, particularly following athletic activities. Despite ongoing controversies regarding the etiopathogenetic mechanisms of DOMS, enhancements in muscle perfusion, local vasodilation, and the increased elasticity of collagen fibers at the site of thermotherapy application may aid in alleviating symptoms of persistent muscle spasm after intense physical activity. These activities may include sustained postures, biomechanical overloads, or repetitive movements. A 2021 systematic review and meta-analysis of 32 randomized controlled trials concluded that the application of heat therapy within 1 hour after exercise could effectively reduce pain in DOMS patients.²⁰ A schematic representation of the HT decisional algorithm is shown in [Figure 1](#).

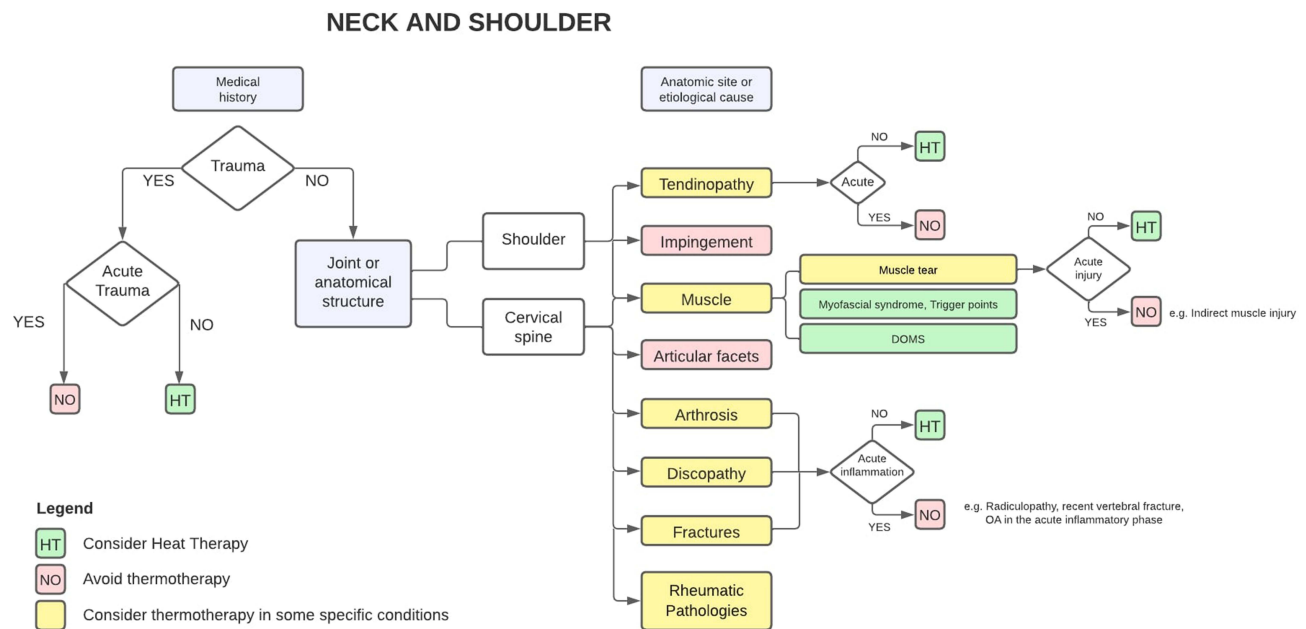


Figure 1 A schematic representation of the heat therapy decisional algorithm for neck and shoulder musculoskeletal pain.

Notes: Green box: consider Heat Therapy; Red box: avoid thermotherapy; Yellow box: consider thermotherapy in some specific conditions.

Other non-pharmacological methods can be considered, potentially in conjunction with HT. In cases of OA and muscle injuries, treatment options such as instrumental therapy, manual therapy, and therapeutic exercise may be beneficial. Physio-kinesitherapy is also an effective treatment option for conditions such as myofascial syndrome, tension-type headaches, and trigger points.

Back Pain

Lumbosacral pain is characterized by discomfort felt in the region between the lower rib cage and buttock creases, with the potential to radiate into the legs. This type of pain is also referred to as lumbar pain. According to the World Health Organization, low back pain (LBP) is the most common type of musculoskeletal conditions, affecting nearly everyone at some point in their lives.²¹ LBP is currently the leading cause of disability. Globally, 619 million people were diagnosed with LBP in 2020; by 2050, this number is projected to rise to 843 million, primarily due to population growth and aging.²² There is a general upward trend in prevalence from birth to age 80, with the highest incidence occurring between the ages of 50 and 55. LBP is more prevalent in women.³ LBP can manifest as specific or non-specific. In the former, the pain originates from a disease or structural issue in the spine or radiates from another region of the body. In the latter, the inability to identify a specific disease or structural cause for the pain characterizes the condition. In approximately 90% of cases, there is no clear cause for LBP.²³

Symptoms

Back pain is a common condition that can be caused by a variety of factors and is characterized by a wide range of symptoms that have been thoroughly researched and documented in an enormous amount of published research. Symptoms can range from intense, deep pain to long-lasting, throbbing discomfort. These symptoms are typically centered in the lower back or middle back. In some cases, patients report discomfort that spreads to the limbs, in addition to sensations of tingling, numbness, or paralysis, all of which are indicative of the possibility of nerve involvement. Musculoskeletal symptoms, which include rigidity, muscle spasms, and restricted movement, are regularly experienced by individuals. These symptoms frequently exacerbate functional restrictions and reduce overall well-being. Additionally, discomfort typically becomes more severe with intense physical activity, extended periods of standing or sitting, and during the night, leading to disruptions in normal sleep rhythms. Anxiety and

depression often occur concurrently, adding another layer of complication to the clinical presentation. Due to the complex interaction of various symptoms, a comprehensive and multidisciplinary approach to diagnosis and treatment is necessary. This highlights the relevance of individualized treatment strategies for managing the numerous forms of back pain. It is imperative that the treatment be multimodal and in accordance with the most recent standards established by both national and international organizations.

Possible Differential Diagnoses

Spondyloarthritis, discopathy, overuse/overload, and postural muscle injuries are all possible diagnoses for patients complaining of back pain. In the presence of LBP, specific causes of the pain, including but not limited to underlying conditions (eg, cancer), tissue damage (eg, fractures), or referrals from other organs (eg, renal or aortic aneurysms), should be ruled out first. Such diagnoses require the involvement of a specialist.

Conditions That Warrant Consideration

When dealing with back pain, it is prudent to consider other concurrent conditions, such as local or systemic infection, advanced age, female gender, and menopausal status due to the increased risk of osteoporotic vertebral fracture.

Superficial Heat Therapy (SHT)

Consider using SHT in the following circumstances: chronic degenerative disc disease, non-specific LBP with a muscle spasm or contracture component, postural and overuse myalgia, OA (excluding the inflammatory phase), and postural and overuse myalgia. However, it is crucial to refrain from using it when symptoms of root compression are present.

In Figure 2, the HT decisional algorithm is schematized.

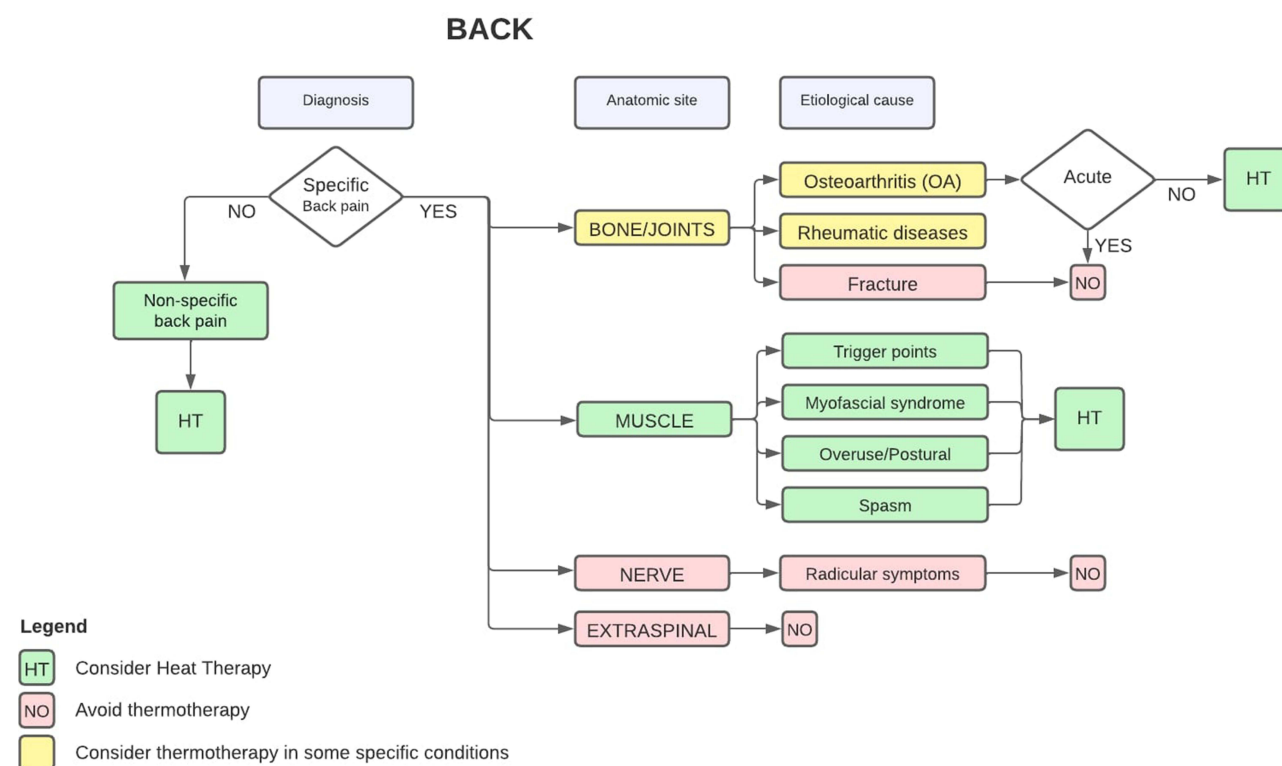


Figure 2 A schematic representation of the heat therapy decisional algorithm for back pain.

Notes: Green box: consider Heat Therapy; Red box: avoid thermotherapy; Yellow box: consider thermotherapy in some specific conditions.

Further non-pharmacological approaches may be considered, potentially in conjunction with HT, including physical therapy, instrumental therapy, manual therapy, therapeutic exercise, motor activity (but only for non-specific LBP), and trunk orthoses (such as braces or corsets). In a randomized controlled clinical trial, heat therapy combined with transcutaneous electrical nerve stimulation significantly increased pressure pain threshold measures for LBP after both 30 min and 4 weeks.²⁴ In chronic back pain, dietary supplements (eg, palmitoylethanolamide and alkaline minerals) can be effectively combined with thermotherapy. Cognitive-behavioral therapy may also be beneficial.

Knee Pain and/or Involvement of the Flexor and Extensor Muscles

In the last two decades, the incidence of knee pain has increased by approximately 65%. At the present time, affects around 25% of the adult population and warrants nearly 4 million visits to primary care physicians each year.²⁵ The assessment of knee pain requires careful consideration of the patient's medical history and physical examination. The medical history can provide vital insights into the site and duration of the discomfort, recent traumatic events, and prior medical and/or surgical procedures. The physical examination can identify potential lymphovascular involvement, deformities, asymmetry, signs of acute inflammation, and limitation of Range Of Motion (R.O.M). Laboratory tests may be utilized to confirm a specific diagnosis when the initial medical history and physical examination provide clues but fail to establish a definitive diagnosis. In contrast, radiographic imaging is most appropriate in cases of acute traumatic pain or chronic knee pain.^{26,27}

Symptoms and Signs

Knee pain can arise in various ways, including acute or chronic forms, occurring only during motion or even at rest, and with or without functional impairments such as weakness, instability, stiffness, inability to fully extend the knee, or difficulty walking. Manifestations of acute inflammation include warmth to the touch, redness, and swelling. Additionally, popping or creaking sounds may be audible.

Possible Differential Diagnoses

Acute trauma or its consequences, acute sprains, direct or indirect muscle injury, pes anserine tendinopathy, Baker's cyst, overuse/overload pathology (including degenerative meniscopathy, early OA, and DOMS in athletes) and phlebo-lymphological pathology can all contribute to knee pain.

Conditions That Warrant Consideration

Beyond the aforementioned factors, body weight, posture modifications, axis deviations, and biomechanical changes are additional conditions worth considering when addressing knee pain.

Superficial Heat Therapy (SHT)

SHT of the knee should be considered in the following cases: muscle spasms (but not tendonitis), overuse pathology, early OA (non-inflammatory phase), and indirect muscle lesions (apply HT post-acute phase resolution). HT can help prevent DOMS. For instance, ice applied to the knee (ie, pes anserine) and heat applied to the thigh are both efficacious treatments for preventing the persistence of spasms caused by tendinopathy. Acute phlebo-lymphological conditions warrant avoiding HT application.

Figure 3 depicts the HT decision algorithm.

Additional non-pharmacological methods, even when combined with HT, may be considered. Physiotherapy should be considered for all the aforementioned conditions; braces may be advantageous for sprains and traumas. Physical activity, weight loss, walking aids, and biomechanical gait correction should be suggested for overuse conditions.

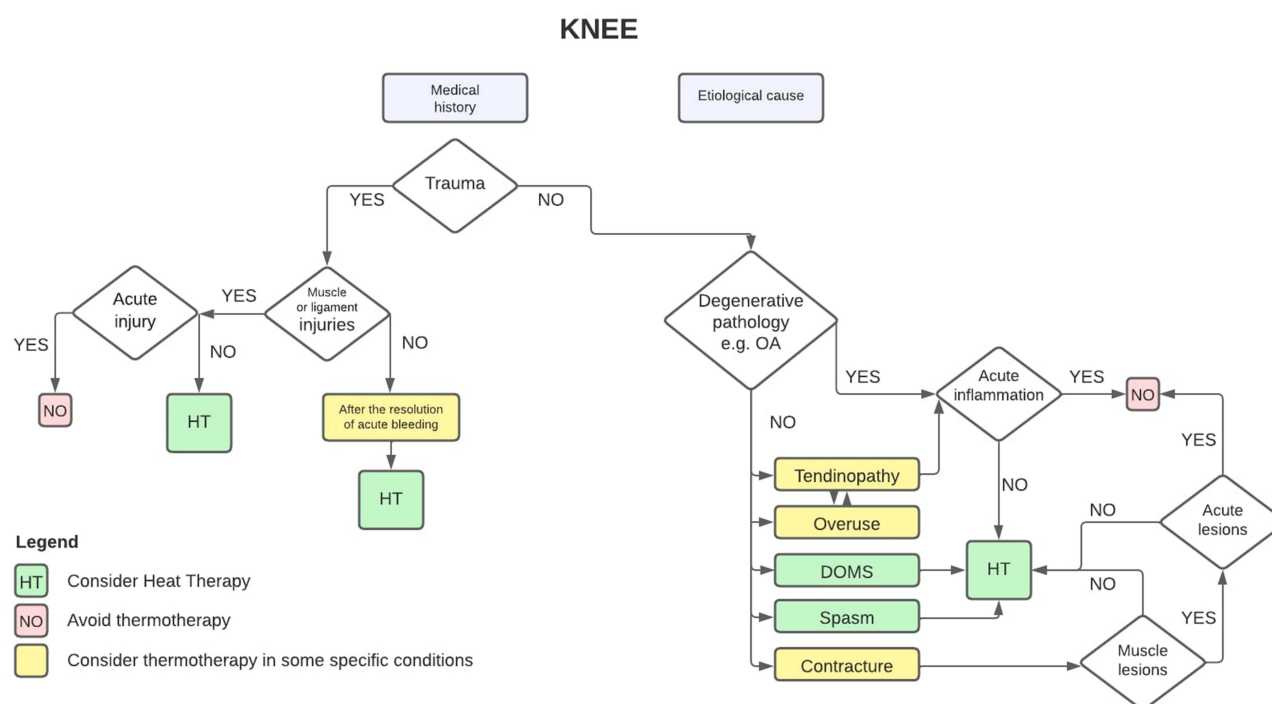


Figure 3 A schematic representation of the heat therapy decisional algorithm for knee pain.

Notes: Green box: consider Heat Therapy; Red box: avoid thermotherapy; Yellow box: consider thermotherapy in some specific conditions.

Conclusions

Superficial Heat Therapy (SHT) using heatwraps can help alleviate muscle pain by addressing the sustained contraction that arises from muscle spasms or contractures. The mechanisms of action have been extensively researched and described in the literature. These mechanisms include: local vasodilation, which increases blood flow and nutrient supply; removal of catabolic and inflammatory substances (wash-out); improvement in the elasticity of collagen fibers and fascia, making it easier to elongate muscles; direct analgesic effects on peripheral nociceptors, reducing antalgic spasms commonly seen in persistent or chronic pain; and increased metabolism due to thermal elevation and enhanced oxygen supply through stimulated blood perfusion in treated tissues.

Prescribing Superficial Heat Therapy (SHT) through the application of heating patches or wraps can effectively facilitate the management of muscle pain, promote the restoration of strength, alleviate muscle spasms and contractions, and improve the patient's subjective feeling of weakness. The exogenous application of heat to the muscle can aid in the recovery of complete patient independence, enhance functional or athletic performance, and ultimately improve the overall quality of life.

The use of heat with Superficial Heat Therapy (SHT) in the multimodal treatment of muscle pain is considered safe. In most patients, thermotherapy can indeed be a valid non-pharmacological therapeutic option. As indicated in the technical specifications and usage recommendations of the main medical devices available for exogenous thermotherapy, it is important to emphasize the need for a medical consultation if one wishes to consider recommending SHT in specific patient categories, such as pregnant women, diabetic patients, or patients with sensory disorders. It is important to remember that the use of thermotherapy is not recommended on damaged skin or on areas of the skin with alterations at the site of application.

In clinical practice, as acknowledged by a recent European Delphi consensus,¹⁵ treatment with SHT may be beneficial for several MSP conditions, particularly in primary care; however, it is essential to have a thorough understanding of the circumstances under which HT can be successfully applied, as well as the conditions that may serve as potential contraindications to its utilization.

It is important to approach the recommendations in this article with caution, as they are based on expert opinion derived from guidelines, clinical practices, and practical daily experience. Nevertheless, the authors assert that the recommendations provided here offer practical guidance for utilizing Superficial Heat Therapy (SHT) in managing musculoskeletal pain (MSP) at prevalent sites, such as the neck, shoulder, back, and knee. Moreover, these recommendations are supported by user-friendly treatment algorithms that can be easily referenced. For patients with MSP, consulting specialists such as physiatrists, orthopedists, rheumatologists, and endocrinologists (for assessing and treating bone metabolism) is advisable based on the patient's specific pain and characteristics. These specialists can offer additional multimodal therapeutic options for managing muscular pain.

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