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Fascia and Myofascial Pain Syndrome - An Overview

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Abstract

This paper synthesized the available published literature on myofascia, its structure, myofascial disorder, causative factors, scientific methods for evaluation and treatments, etc. The importance of myofascial in chronic and acute musculoskeletal pain is overlooked. According to Waller *et al*., mention in their article, up to 85% of people will experience myofascial pain at least once during their life. The myofascia is a musculoskeletal cell matrix that supports muscular connective tissue, it is essential for generating forces between muscles and also provides better flexibility. Myofascial pain syndrome is described as sensory, motor, and autonomic signs and symptoms that are produced by trigger points or taut bands of skeletal muscle or fascia. A myofascial trigger point is painful on compression and can give rise to referred pain, motor dysfunction, and automatic event, it restricts the range of motion and force generation capacity. Therefore, it is utmost importance to know about myofascial disorders, their prevention techniques, diagnosis, and treatment.

Keywords: Musculoskeletal pain, Myofascia, Myofascial pain syndrome, Myofascial trigger point, Trigger point

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Introduction

"Fascia" is an indistinguishable terminology, derivative of the Latin word that means band or bandage. Anatomists have long used it to describe a range of undifferentiated mesenchymal tissues that surround all-around organs and tissues of the body.[2,3] Fascia is the soft connective tissue layer system that spread throughout the human body, it provides a constant three-dimensional organized matrix, for the whole body as stated by the Fascia Research Congress (2007).[1] In Bruno Bordoni's view, there may be scientific uncertainty about fascia, but there is an agreement with medical text that fascia protects all structures of the body and provides the shape and function of tissues and organs.[4] Found the fascia to be a viscoelastic structure that encircles organs, bones, and muscles and forms an incessant network all over the body.[1] Myofascia is a musculoskeletal structure consisting of connective tissue supporting muscles[5] it acts as a significant character in the transmission of mechanical forces between muscles.[1,6] According to the American Heritage Stedman's Medical Dictionary (2007), fascia is "a sheet or band of fibrous connective tissue enveloping, separating, or binding together muscles, organs, and other soft structures of the body". In past, it was believed that the fasciae are less important than the tissues, more and more errors are being revealed about this assumption, and it is without any doubt physicians, physiotherapists, osteopaths, massage therapists, and others in the health-care profession believe fascia is essential for human body.[2] Anatomists used to confuse superficial fascia with deep fascia in the past. The Areolar connective tissue or adipose tissue make up the superficial fascia, whereas deep fascia is a dense fibrous connective tissue that continues underneath the skin. In general, the deep fascia organized as layer and creates a cover that warped skeletal muscles and placed beneath tendons. Research of fascia has recently gained a lot of attention, and many manual and alternative therapies involve working with the fasciae. It indicates that, fascia is very imperative for various aspect of human body as blood flow of the body,[7] reduction of tensional stress focused at the sites of entheses,[8] causation of this pain, interactions among limb muscles,[9-12] and movement perception and coordination. According to Huijing *et al.,* tendons transmit 70% of muscle tension, which undoubtedly have a biomechanical function; however, 30% of muscle power is transferred to muscles covering connective tissue, demonstrating the characteristics of deep fasciae in peripheral harmonization of agonist, antagonist and synergist muscles.[13] In addition to muscle attachments and supporting sheets, the fasciae perform multiple functions in the ectoskeleton.[2] The fascial system in the body is also thought to function as a proprioceptive/communicating organ, it has been demonstrated recently through new research findings.[14-16]

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Structure of Fascia

Fibrous connective tissue is properly called fascia if its layers are well defined, but it is inappropriate to use this word to describe any connective tissue in the body. From the skin to the muscular plane, the human body typically has three basic layers of fibrous connective tissue: superficial fascia, deep fascia, and epimysium, as well as all visceral fasciae. It is not always easy to distinguish the fascial layers, since sometimes one or two layers disappear, or they are closely linked together. In the palmar and plantar regions, a single aponeurosis connects the superficial fascia to the deep fascia, forming the palmar aponeurosis; as well as a similar layer in the plantar fascia/aponeurosis, respectively.[17,18] According to researcher Purslow, myofascial tissue comprises three distinct layers of connective tissue, with the epimysium covering the muscle surface; the perimysium consisting of fascicles underneath the epimysium; and the endomysium, comprising the muscle fibers themselves.[19]

The Aponeuroic Fasciae

Aponeurotic fasciae refer to all the fibrous connective tissue that surround, protect, and hold together a muscles group and that assist as an insertion site for big muscles.[20] The most well-known fascia, for example., are the thoracolumbar fascia, fascia lata, and crural fascia. There are several fibrous bundles that run in various directions inside the aponeurotic fascia that can be seen macroscopically. Since their shape is irregular, traditionally, the aponeurotic fasciae were categorized as thick connective tissue and fibers are not arranged in parallel way. According to a latest study, aponeurotic fasciae are made up of two or three layers of parallel collagen fiber bundles in an intertwined arrangement, average thickness of 277 μm.[21] Furthermore, adjacent layers of collagen fibers are oriented differently, forming 75–80° angles. This decoration of deposition was established by the 3D rebuilding of the crural and thoracolumbar fasciae. A thin sheet of loose connective tissue separates each layer from the next (mean thickness 43 ± 12 μm) and allows gliding of each layer over the other, so, from a mechanical standpoint, each layer may be considered autonomous, with each layer having a different effect on the tissue's function.[22]

The Epimysial Fasciae

A thin collagenous layer strictly attached to a muscle is called epimysial fascia. The fiber bundles have a fibrous structure and are capable of generating forces between neighboring synergistic muscular fiber groups, regardless of whether or not these muscle fibers belong to the same motor unit, this definition includes the epimysium and perimysium. Epimysial fasciae include the deep fascia of the pectoralis major, latissimus dorsi, and deltoid muscles, as well as the deep fascia of the majority of other trunk muscles. Furthermore, the epimysial fasciae are made up of connective tissues layers and that are layered on top of each other's. There's no denying about epimysial fasciae is organized in the same way as the aponeurotic fasciae; they are made up of collagen fibers. As a result, they play a fundamental role in transmitting the force in the muscle towards the bone levers. Epimysial fasciae, interestingly, serve as insertion points for aponeurotic extensions that attach into muscles and muscle fibers. Depending on the degree of shoulder-joint movement, different portions of the pectoralis major muscle fibers are recruited. As a result, various parts of the homologous fascia are stretched in different ways. As a result, distinct patterns of intrafascial receptors might be triggered in response to various ranges of motion and movement orientations. The epimysial fasciae appear to have a proprioceptive role as a result of this. The epimysial fasciae are also associated with muscle spindles, which are another form of nerve receptor.[22] The perimysium, epimysium, and fascial septae all correlate to the capsule of the muscle spindles.[23,24] Researchers Von Düring and Andres examined the connective tissue of the supinator muscle, affirming that it contains a large number of muscle spindles directly inserted into the septum. A study of the septum of the supinator muscle by Trasmann *et al*. find that, a considerable number of muscle spindles are implanted straight into the septum's connective tissue. Furthermore, as proven in lampreys, muscle spindles are tightly tied to the fascia when looking at the development of the locomotor system.[24,25] In general, muscle spindles detect changes in a muscle's length primarily through their sensory receptors within its belly. This threshold corresponds to a tension of 3 g, which stimulates the sensitive fibers of the muscle spindle. In actuality, the epimysial fascia plays an essential role. The spindles can be shortened in response to the gamma stimulation as long as the perimysium is elastic and flexible. When the epimysial fascia is thick, it can inhibit the muscle spindle from shortening and co-activating with other fibers.[22] Stretching (see patellar reflex) can also activate the muscles spindles, causing the relevant muscles to contract. A myofascial expansion that stretches an epimysial fascia too far could trigger the chronic stretching of muscle spindles associated with this area, thereby activating them. It means that the corresponding muscle fibers are continually stimulated to contract, which might explain why acetylcholine levels are higher in myofascial pain, especially near trigger point (TrP).[26] Furthermore, this second condition results in an unbalanced utilization of muscles, resulting in an erroneous and unbalanced joint movement.[22]

Myofascial Disorders

Sensory, motor, and autonomic symptoms are all part of the myofascial pain syndrome (MPS), which is produced by myofascial TrP (MTrP). Dysesthesias, hyperalgesia, and transferred pain are the sensory abnormalities that result, autonomic signs of myofascial pain include coryza, lacrimation, salivation, changes in skin temperature, sweating, piloerection, proprioceptive abnormalities, and erythema of the overlying skin.[27] Waller *et al*. mention in their article up to 85% of people will experience myofascial pain at least once during their life.[28] The MTrPs definition given by Travell and Simons as A hyperirritable spot, usually, in a taut band of skeletal muscle or in the muscle fascia, this feels uncomfortable when compressed and can cause referred pain.[29] This region of referred pain is what distinguishes MPS from other types of pain.[27] After an initial muscle fiber damage, TrP may develop. This injury may include an obvious traumatic event or repetitive microtrauma to the muscles. In the muscle or muscle fiber, the trigger point induces pain and tension as the stress level rises, the muscles acquire fatigue and more sensitive to trigger point activation. The activation of a trigger point happens when susceptible variables combine with a triggering stress event. This concept is called as the "Injury pool theory".[29]

Causative Factors

Through the detailed observation of the previous studies the researcher found that there are three well established theories behind the mysofascial pain syndrome that is discussed below. According to the book of "MTrP comprehensive diagnosis and treatment," the author mentions the causative factors of acute and chronic myofascial pain. Blunt muscle trauma (contusion), pulled muscle (usually eccentric muscle strain), Torn muscles (complete or incomplete, usually caused by eccentric muscle strain), Sprain or dislocation of joints increase isometric muscle contractions, shortening of the muscles, upsurge in muscle tension caused by climate, change in muscle tension of psychogenic cause, slight muscular strain due to prior conditions - these are the reason of acute myofascial pain. And reason of chronic myofascial pain is chronic strain and psychogenic factors such as depression, anxiety, and stress.[30] Some other researcher suggested that chronic minor muscle strain, poor posture, systematic sickness, or a soft-tissue lesion are all examples of chronic minor muscle strain.[31] The most popular credited concept for primary TrP

development is the "Integrated hypothesis," given by Mense and Simons (2001). The main disfunction of a TrP would include of an irregular construction and release of acetylcholine (Ach) packets from the axon terminal under resting circumstances. The muscle fiber's post junctional membrane depolarizes and as sustained releases of acetylcholine from the motor endplate. This might be the source of continuous calcium ion release and insufficient absorption from the local sarcoplasmic reticulum, resulting in sarcomere shortening. If the problem persists, a vicious cycle develops, with hypoxia leading to the production of vasoactive and algogenic chemicals, which cause local nociceptors to become sensitized, resulting in local hypersensitivity to pain. Hypoxia also produces a disparity in the generation of energetic molecules like as ATP, resulting in a failure re-uptake of Calcium ions into the sarcoplasmic reticulum – that is an active process that requires energy and a persistence of local sarcomere contracture with continued hypoxia. Until disrupted, this cycle is self-sustaining and leads to the creation of TrP.[32,33] Integrated trigger point hypothesis assumes that there is an energy crisis in the muscle; the energy crisis theory is based on three key properties of contractile muscle fiber bundles: (1) There are no other action potentials, (2) the fiber bundles are locally sensitive to pressure, and (3) if the trigger point is inactivated there is an immediate relaxation and decrease in tenderness. A local physiological contracture, without the effect of the electrical activity of motor neurons, reason of increased metabolic rate and ischemically induced hypoxia also occurs. This is caused by continuous maximum activity and an increased energy requirement. In terms of an energy crisis the cited pathomechanisms lead to the distribution of neuroreactive substances, for example, bradykinin, serotonin (5-hydroxytryptamine, 5-HT), prostaglandin,[28,32,34] and the sensitization of surrounding nociceptors. According to the energy crisis theory, this local hypoxia does not just result in a release of neuroreactive substances but also in an increase in vasoneuroactive messengers, which leads to local edema and further promotes local ischemia or hypoxia. Local hypoxia then causes a lack of ATP, which leads to dysfunction of the muscular Ca2þ pump. The sarcomeres are no longer able to free themselves and remain hooked up to each other. This intensifies the formation of taut bands, found similar connection with Cinderella hypothesis. As a result of vascular compression in the muscle produced by higher energy demands, persistent contraction causes local ischemia and hypoxia. The release of neuroactive substances irritates the sensory and autonomic nerve endings and nociceptors. This is the reason for tenderness on palpation, referred pain, the twitch response and malfunction, as well as for disorders of autonomic function (e.g., skin temperature and sweat secretion). This leads to advanced mechanical, biochemical and/or electrophysiological irritation of neighboring muscle fibers and their sarcomeres (a chain reaction), so that the symptoms become chronic. Persistent strain factors favor the perpetuation of this process.[30,35]

Evaluation of MPS and TrP

MPS that initiated from TrPs, this is the reason for pain, encountered by individuals, and concerned as a major public health problem. It is difficult to make a clear diagnosis in the majority of individuals. MPS, a disorder marked by painful TrPs in muscles, might be one reason for these pain sensations. Accurate diagnosis is the first step in prescribing the right therapy. If the diagnosis is inaccurate, a successful therapy may fail because it is administered to people who do not have the ailment. The accuracy of a diagnosis is determined by the test's reliability. The degree to which examiners agree on the test findings while conducting the same test on the same patients is referred to as reliability. Various technologies have been used to investigate TrPs, including microdialysis, biopsies, imaging techniques, and electromyography; however, none of them are definitive or acknowledged as a reference standard. The only way to make a diagnosis is to use hard digital pressure on the muscle to identify diagnostic criteria and get input from the patient.[36] According to Simons *et al.*, if five main criteria and at least one of three minor criteria are met, MPS can be diagnosed. Among the most important factors are: (a) Infrequent, localized pain; (b) in the predicted referred region for a certain TrP, there is spontaneous pain or changed sensations; (c) a tight, perceptible ring in a muscle that can be accessible; (d) exquisite, localized tenderness along the taut band; and (e) there is a noticeable reduction in range of motion. Minor requirements include the following: (i) Pressure on the TrP reproduces spontaneously felt pain and changes in sensations; (ii) Elicitation of an LTR of muscle fibers by transverse 'snapping' palpation or by needle insertion into the TrPs; and (iii) muscle stretching or a TrP injection can help to ease discomfort.[37] There were several variations across the investigations, including participants, examiners, settings, muscles, and diagnostic technique variances. Two systematic reviews, in particular, have been done with the goal of assessing the reliability of physical examination in detecting an MTrP. Although many methodological biases were detected, all of the included studies explored the repeatability of manual palpation to identify MTrPs using an adequate repeated measures methodology. The reliability of the MTrP diagnostic criteria, according to both authors, was varied, ranging from good to poor. In a few particular muscles, the hypersensitive region is the sole criteria that provided adequate reliability.[38] According to a common correlation-based metric, the results acquired from the electronic pressure algometer and the force plate are identical.[39] In the latent phase, the MTrP somehow doesn't induce voluntary pain or discomfort, by nature, only the application of strong digital pressure causes local or referred pain.[40] Fisher claims that the importance of TrP in immediate and overuse injuries, the pain has been overlooked due to a lack of objective ways for recording them. Thermography is the first diagnostic method for soft tissue disease, he claims. Fisher and Chang discovered 'hot spots' during their initial thermographic examination, which they attributed to the placement of active and latent TrP sites.[41] Pressure algometers were used to measure pain threshold. Using a basic pressure algometer in five sites on the body in young healthy volunteers, a high level of intra observer reliability was discovered. An inter-observer error of greater magnitude also observed, but this was statistically significant only on the medial aspect of the upper tibia. He utilized a basic pressure algometer to demonstrate that pain threshold may be assessed with great precision, especially when done by a single observer.[42] According to the author, using an algometer could be an effective way of quantifying pains and tracking the process of recovery. Comparing the algometer's readings with force plate readings, the algometer displayed high reliability and validity[43] to find out the TrPs authors suggested, under normal circumstances, the difference in pain threshold between the right and left sides of identical muscles is negligible. MTrP or organic pain can be associated with a decrease in pressure pain threshold (>2 kg/cm^2) when compared to the opposite side.[44,45]

Treatment

For the deactivation of MTrPs, a variety of therapies are presently used. Given the low level of inter-rater reliability and agreement on the presence of TrPs, as well as the lack of homogeneity in the application of diagnostic manual, the findings of various articles and research revealed that various modalities and techniques are effective or ineffective. The main methodologies are described below: - (1) Muscle stretch - It is an effect method in the acute stage but less effective in the chronic and multiple MTrP region. (2) TrP injection - This practice is more effective than the stretching technique. (3) Acupuncture - According to some research studies it is clear that this technique has significant effect on MTrP. (4) Therapeutic ultrasound.[46] This method looks to be a potential new treatment option. Experiments have shown that ultrasound may efficiently and noninvasively trigger MTrPs. The ultrasound approach might be especially useful in the treatment of TrPs in deeper muscles that are difficult to reach with manual therapy.[37] According to Saxena *et al.* in their published article mention some non-invasive, nonmanual therapies, that is, TENS, EMS, HVGS, IFC, and FREMS. They stated that the lesser treatment has strong evidence to relief of acute and chronic MPS and moderate effect has been observe by the use of TENS, magnet, and acupuncture.[47]

Discussion

As a matter of longstanding interest to surgeons, fascia is regarded with considerable importance by paramedical practitioners such as manual therapists, osteopaths, chiropractors, and physical therapists. Myofascial fascia wraps and encases muscles, producing connective chains that extend from the skull to the toes, and fascia is a crucial component of connective tissue. Mechanical forces are transmitted between muscles by myofascia and also important for range of motion. TrPs as hyperirritable regions into taut bands of skeletal muscle, correlating local and/or referral pain patterns, as well as autonomic, motor, and/or sensitive syndromes, are common musculoskeletal conditions, though MPS is overlooked. The reason behind these musculoskeletal conditions is given by the researchers that are overuse injury, acute injury, poor posture, abnormal release of acetylcholine, the most popular energy crisis theory etc. Therefore, it is a very important aspect for every individual to know about the prevention and treatment of MPS.

Conflicts of Interest

The authors have no conflict of interest to disclose.

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