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The Role of Fascia in the Musculoskeletal System

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THE ROLE OF FASCIA IN THE MUSCULOSKELETAL SYSTEM

by

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An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
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1996
This Independent Study, submitted by Lori Folkers in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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Title The Role of Fascia in the Musculoskeletal System

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Date April 10, 1996
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ABSTRACT

The function of fascia in the human body is poorly understood. This anatomical structure has not been given the clinical significance it may deserve. The purpose of this literature review is to provide a physiological explanation for physical therapy techniques that manipulate fascia. The review is designed to facilitate an understanding of the role of fascia in the musculoskeletal system.

Physical therapists may deal with musculoskeletal system pathologies on a daily basis. In order for the therapist to utilize soft-tissue techniques, it is necessary to have a working knowledge of the involved structures. Anatomical material is presented to define the structure and function of fascia. However, it is equally important to understand the process of tissue healing as the fascia has the potential to become restricted during the healing process. Therefore, the stages of inflammation and repair are outlined.

Manual techniques like Myofascial Release are being used in the clinics to treat fascial restrictions. Many clinicians are claiming to have successful treatment techniques, yet they have very little scientific evidence to support their claims. Few articles dealing specifically with Myofascial Release have been published in professional journals. Case studies are the main type of literature available. There is a definite need for future research in this area. The case
studies presented in this review used objective data and may provide future researchers with study designs upon which to build.
CHAPTER I

INTRODUCTION

The function of fascia in the human body is poorly understood. When something is not clearly understood, it has a tendency to be overlooked. Until recently, the role of fascia in the body was almost completely ignored. Some anatomy text books from as little as 25 years ago fail to even mention fascia as an anatomical structure. Even though fascia has gained acceptance as a viable structure, it still has been classified as a passive component. This same approach has been taken in the past with other anatomical structures. For example, the role of menisci in the knee joint was not understood and they were considered unnecessary. It was not uncommon for physicians to totally remove a meniscus during knee surgery. The short term results of this type of surgery were positive, but the long term effects were not desirable. Now that the role of the meniscus is more clearly understood, every effort is made to preserve the structure even if it is badly damaged.

Every structure should have a purpose and a valid reason for existing. It may not always be obvious, but with time the purpose or function may eventually be discovered. Fascia is a structure that is still a mystery to most. However, it seems to have an important function in the human body. Some physical
therapists are attempting to incorporate the fascial tissues into their soft-tissue treatment techniques.

The purpose of this literature review is to provide a physiological explanation for physical therapy techniques that manipulate fascia. This review of the literature is designed to facilitate an understanding of the role of fascia in the musculoskeletal system and its impact on physical therapy treatment techniques.

In order for a therapist to properly use soft-tissue techniques, it is necessary to have a working knowledge of the involved structures. Therefore, one chapter of this literature review looks at the structure and function of fascia. The role fascia plays in the human body will be defined and its specific functions will be discussed.

The next important step in the process of understanding the role of fascia is to analyze what occurs under abnormal conditions. Fascia, like any other tissue in the body, is prone to injury. This makes the healing process of soft tissue important to understand. The stages of inflammation and repair are outlined to promote a better understanding of how tissues heal. Fascial dysfunctions or limitations may account for some musculoskeletal problems including myofascial trigger points and myofascial pain syndromes.

Physical therapy is a combination of scientifically proven techniques and artistry. Some of the techniques therapists utilize appear to be achieving positive clinical results, but they have very little scientific evidence to support
their claims. Techniques used by physical therapists to address fascial limitations in their treatment techniques will also be discussed. Manual techniques are noninvasive and utilize a hands-on approach by the therapist. Myofascial Release is one specific manual technique that is utilized to release fascial restrictions. It has been theorized that fascial restrictions have the potential to limit normal function of the musculoskeletal system. These restrictions may limit normal joint range of motion, cause tissue adhesions, and also have the potential to elicit pain. The premise is that, over time, the body is pulled out of its ideal anatomical alignment. Poor posture habits, physical injuries, and disease processes may alter the fascial structures. Myofascial Release is a mild stretching technique that addresses abnormal fascial alignments. Myofascial Release works on the assumption that fascia responds to external stress and the fascia realigns along lines of tension.

Overall, this literature review is intended to give clinicians a better understanding of the role of fascia in the musculoskeletal system. Fascia has the potential to bind down and limit movements. Understanding treatment techniques like Myofascial Release that address fascial restrictions within the musculoskeletal system may be a valuable skill for physical therapists. Fascial treatment techniques can be used in conjunction with traditional physical therapy treatments. With this knowledge, clinicians should be better equipped to utilize fascial treatments in conjunction with traditional therapy techniques to improve the outcomes of their patients.
CHAPTER II

STRUCTURE AND FUNCTION

It is important to understand the structure and function of the body's fascial system. A solid background of the anatomical make-up of fascia will facilitate learning its role in the human body. The body is comprised of four tissue types. They include muscle, nerve, epithelium, and connective tissue. The fascial tissues of the body are histologically classified as dense regular connective tissue (CT).\(^1,2\) This is in the same histological category as ligaments and tendons. Fascia is similar to many types of tissue in the body. Like all other functional tissue, fascia is innervated and has a limited blood supply.\(^1\) As the name suggests, the primary function of CT is to connect or hold structures together. Connective tissue has many other specific functions that include supporting nerves and blood vessels, giving shape and stability to muscles, and supporting joints and internal organs.\(^3-8\) Connective tissue provides support, protection, and a framework for the entire body.\(^6\) It exists as a delicate, paper thin web that holds internal organs together and gives them shape. It is also found as strong cords, rigid bones, and even as a fluid: blood. Lymphatic tissue is also classified as CT.\(^5\) The immune system that defends the body against microbes and other invaders is a part of the connective tissue system.\(^6\)
John Barnes, an international lecturer on the topic of myofascial release, describes fascia as a continuous laminated sheet of CT that extends from the top of the head to the tip of the toes. Barnes believes the key to many pathological dysfunctions is within the fascia itself. He describes fascia as existing in sheets or planes that are thicker in some areas of the body. He tries to assist the understanding and visualization of this concept with an illustration (Fig 1). Barnes has named this drawing "Fascia Man."

Cellular Makeup of Fascia

Connective tissue develops from an embryonic tissue called the mesenchyme. Most CT develops from the middle layer of the embryo called the mesoderm. This tissue type also develops into specialized CT, such as vessel walls and blood cells. All forms of CT have the basic elements of ground substance, fibers, and cells. The nature, the amount, and the arrangement of these structural elements are used to differentiate various types of CT. In some cases, the differences are very minimal. Hollinshead summarizes this by pointing out that tendons, ligaments, and fascia all have the same fundamental structure. In some places, it is almost impossible to differentiate between them. The CT tissues often mesh together in areas where they are closely approximated.

Wilson points out that CT is often considered in a special category. Connective tissue stands out because it initially consists of irregularly shaped mesenchymal cells. At a cellular level, the CT cells are found lying in a large
Fig 1 -- Fascia Man
© MFR Seminars
amount of homogenous ground substance. The intercellular ground substance or matrix is colorless and transparent. In healthy samples, the ground substance is comprised primarily of water.\textsuperscript{5} The job of the ground substance is to lubricate and fill the spaces between the cells and the fibers of the CT. These fibers and the ground substance are actually produced by CT cells, called the fibroblasts. Within the ground substance, the fiber types present are primarily collagen fibrils along with some elastin and reticulin as well as the cellular component, fibroblasts.

Fascial Organization

Most generally, fascia is described as a visible membrane that lacks obvious organization or structure. Barnes\textsuperscript{13} describes fascia as tough CT which spreads throughout the body in a three dimensional web from head to foot without interruption. Since fascia essentially connects every structure in the body, it tends to be difficult to visualize. Most fascia is arranged in sheets or tubes that form layers between and around other tissues and structures.\textsuperscript{5,7,13} For example, all muscles, nerves, vessels, and organs are encased in CT coverings. The term myofascial refers specifically to the fascia surrounding muscles. The name that is given to the fascial sheath which encases skeletal muscle is the epimysium.\textsuperscript{12} Many layers of fascia can surround any given structure. In an attempt to differentiate between the different layers, fascia has been subdivided into different divisions.
Superficial Fascia

The first layer of fascia is the closest to the surface of the skin and is called the superficial fascia. This layer could be thought of as a second layer of skin. It lies directly below the dermis.\textsuperscript{13} The dermis of the skin merges into a layer of areolar tissue or loose CT. This allows the skin to move more or less freely over the underlying structures.\textsuperscript{3,4} However, in the soles of the feet and the palms of the hands, the superficial fascia is tightly fused with the deep fascia, which allows the skin in these areas to be more stable or durable than other parts of the body. The superficial fibers in the hands and feet are arranged in tight lobules to absorb pressure and withstand friction.\textsuperscript{14} Except for the eyelids, nose, ears, penis, and the scrotum, the superficial fascia contains various amounts of fat.\textsuperscript{3,4,14} The fat functions as the insulating layer of the body. This is important for preventing the loss of body heat. This fatty layer of the superficial fascia is also called Camper's fascia. The amount of fat determines the thickness of the superficial layer.

Below the fatty layer, or Camper's fascia, there is a deeper membranous layer of the superficial fascia called Scarpa's fascia. There are many blood vessels, lymph vessels, and nerves within this layer of the superficial fascia that are responsible for supplying the skin. In the face and neck, some of the superficial fascia serves as the origin and insertion site for the skeletal muscles responsible for fascial expressions. Smooth muscle may also be found in the superficial fascia of the nipples and scrotum.\textsuperscript{14}
Deep Fascia

Deep fascia is the wrapping material surrounding individual organs and the packing to fill the interstitial spaces. The deep fascia is under the superficial layer and is comprised of much denser fibrous tissue. In some areas, the fascia forms sheets or a flexible layer with the texture and consistency of plastic wrap or a balloon. Like the superficial layer, the deep layer is further subdivided into two layers. They are named the internal and external investing layers. The deepest layer which lines the cavities of the body is the internal investing layer. This layer is specifically named in several parts of the body. For example, the internal investing layer in the cervical region is called the prevertebral layer and in the thorax it is called the endothoracic layer. The more superficial layer of the deep fascia is called the external investing layer. This layer forms a continuous external cover for many structures. It encloses or covers neurovascular bundles and the musculature. All muscles are surrounded by a layer of deep fascia, called the epimysium. A anatomical picture with the muscles removed may assist visualization of the fascial systems. Figure 2 displays a cross-section of an arm.

When healthy, the fascia is smooth and slippery. This facilitates the sliding movements of the muscle fibers over each other. An example of this movement would be the motion of the scapula along the posterior wall of the thorax during shoulder elevation. The scapula is able to slide freely along the
Fig 2--Cross section of an arm.
fascial plane found between the posterior thoracic musculature and the
subscapularis muscle.

**Fascial Plane and Spaces**

There does not seem to be a clear cut definition on how dense or big
fascial fibers need to be in order to be classified as fascial planes. Nor is there
a specific definition of spaces. Therefore, the descriptions and arrangements of
fascial planes and spaces are different from source to source. In most cases,
the large sheets of fascia have planes between them. When looking at a
specific area of the body, the planes may be defined as spaces. Fascial spaces
are usually described as spaces or potential spaces filled with loose CT that lie
between structures. Since the CT is loose, fluid such as blood or pus can
accumulate in these spaces and potentially increase the volume of that space.¹²

The fascial planes are comprised of sheets of deep fascia. The density of
the CT is not easily penetrated by fluids³ and actually forms a physical barrier.
For this reason, infection tends to spread within the area bounded by the planes
from one part of the body to another.

The role of the fascial spaces in the spread of infection is a controversial
subject. One argument supports the idea that infection is spread via the path of
least resistance. This means the infection will move from space to space
following the fascial planes. However, another theory is that the infection is
encapsulated within the fascial space. Both of these theories have been
documented with scientific studies.¹² Therefore, the nature of the specific
infection may be the determining factor in how infection spreads and both
theories may be correct under certain circumstances.

The anatomical makeup of fascial planes may assist surgeons with new
surgical procedures that are less traumatic to soft tissues. A technique that was
based on anatomical planes was studied by Hutchinson and Dall.\textsuperscript{16} This
procedure utilized a midline fascial splitting approach to the iliac crest for the
harvest of a bone graft. Since the anatomical planes were utilized, this was less
traumatic than the midline subcutaneous approach that has traditionally been
used to harvest the graft. In this study, 200 subjects had iliac crest bone
removed via the fascial approach. The results were retrospectively compared to
chart reviews of patients who had undergone the traditional procedure. The
fascial approach is simple, straightforward, anatomic, and decreased the amount
of trauma to the soft tissue. The new technique takes advantage of the fascial
layers or planes of the dorsal lumbar fascia to reach the iliac crest, while the
traditional method cut through these tissues. Advantages that were noted as
being significant for the fascial approach in this study are: 1) less trauma to the
soft tissue, 2) reduction in postoperative complications, 3) ease of the
procedure for the surgeon to perform, and 4) decreased postoperative pain for
the patient.\textsuperscript{16}

Mechanical Properties of Fascia

Studies have also described the role of fascia in muscle tension and
pressure. In 1981, Garfin and colleagues\textsuperscript{17} showed the importance of fascia on
muscle strength. This study was performed on the hind legs of dogs. In the experiment, a small slit was made in the epimysium. This procedure is called a fasciectomy. Splitting the fascia resulted in a 15% loss of muscle strength. The strength of the muscle or muscle tension was measured by a force transducer attached to the tendon of the muscle. Changes were also noted in the internal pressure of the area. The pressure in the muscle belly decreased by 50% after the fasciectomy. The interstitial fluid pressure within the muscle belly was measured with a Wick catheter. Muscle fatigue was not a factor in the decreased strength. The study concluded that fascia is important in development of muscle tension and changes in interstitial pressure.17

Other studies on the gastrocnemius of a frog used similar methods and have had the same results. In 1966, Elftman18 showed that fascia contributes passive tension to stretched muscle. A follow-up study in 1969 tried to determine if the snug fascial membrane around the muscles has any effect upon the strength of isotonic muscle contractions. Mozan and Keagy19 cited a definite decrease in the strength of isotonic muscular contractions following a fasciectomy. However, when a tight fitting glass tube or a "pseudo-fascia" was placed around the muscle, the strength measurements increased.19 These studies demonstrate fascia's role in inhibiting and facilitating muscle function.

Summary of Fascial Functions

Fascia has a variety of different functions. Fascia varies physically from dense fibrous to loose areolar tissue. The differences in structure are dictated
by the function of the tissue. Most of the functions of fascia tend to be passive structural roles that provide support. It binds organs together and provides a bed for all blood vessels, nerves, and lymphatic tissues. The fascial tissues are essential for the connection, support, metabolism, and defense of the body. The deep fascia is an insertion for some muscles. In the lateral thigh, the iliotibial tract of the fascia lata is a good example. In these areas, the fascia becomes thickened or aponeurotic. There are many specific layers of deep fascia that have been anatomically named. For example, in the low back, there is the lumbo-sacral fascia, which also serves as an attachment for muscles.

Physically, the strength of fascia is important to the function of the entire body. Fascia can determine the length and function of the musculature. For example, if the fascia is too tight or too loose, it may inhibit the function of the muscles it surrounds. If the fascia is too loose, it will not provide the support the tissues need to function optimally. On the other hand, if the fascia surrounding a muscle is too tight, the muscle may be inhibited by decreasing the blood flow to the area.

The fascial planes and spaces give fascia a unique function. In healthy tissue, the fascial spaces and planes are closely approximated. These areas have the potential to increase in volume when edema is present. Following an acute injury, they provide a space for the byproducts of inflammatory reactions to accumulate. Hall and Craggs give fascial planes and spaces another clinically significance function. They state these structures are responsible for
determining the direction and/or spread of infections. The potential space accepts the products of the inflammatory response when tissues are injured.\textsuperscript{14} The fascial spaces or planes are where the edema from an acute injury will accumulate.

Fascial tissue, like any other tissue in the body, has the potential to be damaged. All tissues are subject to inflammation, disease, and structural changes.\textsuperscript{1} Therefore, it is also important to understand the healing process of CT in order to fully conceptualize what is happening during Myofascial Release or soft tissue mobilizations. The following chapter will investigate the physiological aspects of inflammation and repair of fascia.
CHAPTER III
INFLAMMATION AND REPAIR

Almost every aspect of physical therapy deals with injury in one form or another. In order to treat patients and perform appropriate rehabilitation procedures, it is very important to understand the concepts of tissue healing. This is a very complex process which has been well documented in scientific literature. However, specific articles outlining the phases of fascial healing have not been found. Nevertheless, the preceding chapter showed how structurally similar the various components of connective tissues are. All soft tissue is comprised of the same basic ingredients. Ford's\textsuperscript{20} article regarding the physiology of soft-tissue healing states, "The process of healing may slightly differ between kinds of tissue, but generally follows a similar basic sequence of events."\textsuperscript{(p-85)} She classified all soft tissues in the same category. To further support this theory, another author similarly describes the human body's response to pain and injury. He describes the healing process as the same regardless of the type of tissue or location of the injury.\textsuperscript{21} Based on these and others findings, it does not seem unreasonable to classify fascial healing procedures in the same category as that of other connective tissue or soft-tissue structures.
The beginning of this chapter will be devoted to analyzing the stages of the normal healing process of soft tissue. The healing phase will be divided into three stages. It includes the inflammatory phase, the fibroblastic phase, and the remodeling phase. After the healing stages of fascia have been discussed, some abnormal tissue presentations will be considered. This will include myofascial trigger points and myofascial pain syndromes.

Tissue Healing

Inflammatory Phase

Inflammation is the human body's reaction to injury and is the first step toward recovery. It sets the stage or provides the environment for the other healing phases to occur. There is some disagreement in the literature regarding the duration of this phase. Estimates range from as little as one day to as much as a week.\textsuperscript{22} Even though the exact duration of this phase is unclear, it is clear that several complex activities are occurring. The time frame of the process may be directly related to the extent of the injury and to the size of the injured area.

There are five outward clinical symptoms that are considered by many to be the cardinal signs of inflammation. These localized signs are redness, heat, swelling, pain, and loss of function.\textsuperscript{20,23,24} The redness and increase in temperature are a direct result of the increased vascularity. Initially, vasodilation of vessels in the area with an increase in permeability of the capillaries are responsible for the fluid accumulation or swelling in the fascial spaces.\textsuperscript{12} The
inflammatory response increases metabolic activity and the mediated cells now act to regulate blood flow to the injured area.\textsuperscript{23}

Pain in the area can be a result of several factors. Sources of pain may include physical damage to the nerves, increased pressure on the nerve endings due to swelling or chemical irritation to the nervous tissue.\textsuperscript{20} Loss of function is often caused by reflex guarding and muscle spasms. The pain causes a muscle spasm which may cause more pain. This phenomenon is often referred to as the pain-spasm cycle. This cycle increases swelling in the fascial spaces which can also elicit more pain by applying pressure on the nerves in the area. The area of inflammation may be difficult to visualize if it is in deep fascial tissue areas, since there may be no visible signs on the outer surface of the skin.

The healing process is initiated when soft tissue trauma occurs. Blood vessels in the area are damaged and substances from the blood stream are released into the injured area.\textsuperscript{20-26} First, there is an immediate reaction of vasoconstriction. This is followed by a period of vasodilation that causes an increase in blood flow to the area. The components necessary to repair the body are located in blood and are recruited to the site of injury at this time. Hardy\textsuperscript{21} describes the cellular and vascular activities associated with the inflammatory phase in three steps. Initially, the goal is to minimize further damage and seal off the wounded or injured area. The next step is to recruit the defensive cells, the phagocytes, whose job is to clean the area. The phagocytes do this by destroying bacteria and eliminating debris from dead and dying cells.
Finally, the emphasis is on reestablishing the blood supply to allow the repair process to begin. The inflammatory phase ends when the wound is free from all debris, isolated from healthy tissue, and circulation has been restored.

Fibroblastic Phase

The function of the fibroblastic phase is to actually repair the damaged tissue. This phase begins a few days after the injury and can last for weeks. Specifically, in connective tissue, the fibroblastic phase consists of wound contraction and collagen production. The fibroblastic phase is complete when the area is consolidated and the new collagen is sufficient to replace the damaged area. This results in the smallest area of scar tissue possible.

Fibroblasts are the cells that produce the constituents of connective tissue. The fibroblasts migrate to the damaged tissue area during the inflammatory phase. The cells gather along strands of existing fibrin and begin to synthesize collagen and the extracellular matrix. The ground substance or cellular matrix provides lubrication and space between the collagen fibrils.

The goal of wound contraction is to approximate the margins of the wound. This is possible due to the function of specialized fibroblast cells. These cells are referred to as myofibroblasts. The prefix myo refers to muscle. These cells were named because of their ability to contract like muscle tissue. Myofibroblasts also contain the protein filaments called actin. Actin is a component in muscle that facilitates contraction. The myofibroblast cells
line up along the edges of the damaged tissue which allows the edges to be drawn toward the center.

The wound contraction phenomenon is not always beneficial. The end result may be the formation of tissue contractures that limit functional abilities. Contraction may involve the movement of existing tissue toward the center of the wound. Existing tissues are defined as the anatomical structures that surround the damaged tissue area. McGonigle and Matley summarize this by further defining specific structures that may be involved, which include the joint capsules, muscles, tendons, ligaments, sheaths, and fascia. These structures have the potential to be drawn along with the healing tissue as the wound contracts. If any of these structure are involved, they can cause physical movement barriers which can limit the person's functional level.

Remodeling

The goal of the final stage of healing is to return the tissue to an optimal functional level. This stage of tissue healing is the longest in duration. It can last from a few weeks to a few years. During the remodeling phase, the quantity of fibroblasts, myofibroblasts, and capillaries in the healing tissue decreases. The amount of water in the tissue also decreases. However, the amount of collagen produced actually increases during remodeling more than any other phase. Once the myofibroblasts have contracted the wound, the remaining area must be consolidated. Collagen is the material that fills in the wound and forms the scar tissue.
In order to provide the best outcome and to improve the function of the damaged tissue, collagen must have three characteristics. First of all, it needs to be an appropriate length to perform the work that will be required. Next, it must be strong enough to support the tissue it surrounds. Third, the collagen must be properly aligned. If the collagen is lacking any of these properties, there is potential for the new tissue to be unable to perform the functions of the original tissue. Therefore, it is important to provide the appropriate stress to the collagen during this phase of healing to line up the fibers in a functional position.

Tissue tends to form along the line of tension that is imposed upon it. Studies have shown that the application of tension while the tissue is healing or maturing will cause an increase in the tensile strength. Fascia was specifically tested in a study by Thorongate and Ferguson. They demonstrated that the remodeling phase is the most important time to stress the tissues to encourage proper alignment and to increase the tensile strength of new fascial tissue. The stages of tissue healing do not always return tissue to its previous functional level. The following section will discuss a few abnormal tissue presentations.

Abnormal Tissue Presentations

Myofascial Trigger Points

Myofascial trigger points are defined by Travell and Simons, the authors of *Myofascial Pain and Dysfunction, The Trigger Point Manual*, as: "A hyperirritable locus within a taut band of skeletal muscle, located in the muscular tissue and/or its associated fascia. The spots are painful on compression and
can evoke characteristic referred pain and autonomic phenomena.\textsuperscript{(p12)} The trigger points are classified as either active or latent. If the point is referred to as active, it is currently causing pain. In contrast, latent trigger points are clinically silent regarding pain, but have the potential to limit movement and decrease strength like the active points.\textsuperscript{30} The trigger point areas have predictable distribution patterns of referred pain.\textsuperscript{31} Travell and Simons\textsuperscript{30} try to explain why trigger points evolve. They theorize mechanical stress, nutritional inadequacies, endocrine imbalances, metabolic inadequacies, psychological factors, and chronic infections are possible causes of trigger points. However, the true biomechanical origin of trigger points has not been specifically defined.\textsuperscript{32}

Pain Syndromes

Myofascial Pain Syndrome is a specific clinical diagnosis. It is a pathologic condition involving muscle and its surrounding tissue.\textsuperscript{33} Myofascial pain syndrome has been defined as musculoskeletal in origin and develops from one or more trigger points. The trigger points are the most common feature of myofascial pain syndrome.\textsuperscript{32} The pain occurs in a regional distribution that can be reproduced with pressure at the site of trigger points.\textsuperscript{30} Myofascial pain syndrome is a vague diagnosis that presents clinically in a variety of ways. The overall description tends to be generalized, but the presence of the trigger points is the one symptom that is constant in all of the patients.\textsuperscript{33} At this time, specific diagnosis criteria for myofascial pain syndromes do not exist. However, based on physical or clinical findings, Simons\textsuperscript{32} has proposed diagnostic criteria. He
listed six major symptoms which the patient must exhibit in order to be classified as having myofascial pain syndrome. They include: 1) localized spontaneous pain, 2) altered sensation in a predicted referred pain area for the given trigger point, 3) a palpable taut band in the accessible muscles, 4) localized tenderness within the band, 5) a twitch response, and 6) a measurable reduction in the range of movement. These criteria may assist the clinician in better defining the condition of myofascial pain syndrome.

Another diagnosis that is similar to myofascial pain syndrome is fibromyalgia. This syndrome is characterized by generalized muscle aching, fatigue, and a disturbed sleep pattern. In 1990, the American College of Rheumatology developed criteria for the classification of fibromyalgia. It is characterized by chronic generalized pain and tender points at specific soft-tissue areas. The tender points are different than the trigger points that were previously explained. The tender points usually do not refer pain, have a taut band, or elicit a twitch response like the trigger points. These tender points are specifically identified in nine pairs or 18 specific sites. The tender points are located bilaterally. These nine points are located in the following anatomical areas: 1) insertion of the suboccipital muscle, 2) anterior aspect of the intertransverse space from the fifth to the seventh cervical vertebrae, 3) midpoint of the upper border of the trapezius, 4) supraspinatus, near the medial border of the scapula, 5) second costochondral junction, 6) two centimeters distal to the lateral epicondyle, 7) upper quadrant of buttocks, 8) posterior to the greater
trochanteric prominence, and 9) medial fat pad proximal to the knee joint line. In order for a tender point to be considered positive, the patient must state that palpation is "painful." These spots are palpated digitally with approximately four kilograms of force. The patient must be symptomatic in at least 11 of the sites to be given the diagnosis of fibromyalgia. There is a poor prognosis for complete symptom resolution and return to full function with the use of traditional therapeutic techniques. Some clinicians are claiming to having success treating pain syndromes with manual fascial techniques like Myofascial Release.

Summary

This chapter has discussed the important elements of inflammation and repair. The three phases of tissue healing, the inflammatory phase, the fibroblastic phase, and the remodeling phase, were defined. This material will provide the therapists with background knowledge to evaluate and understand what is happening in injured tissues. Myofascial pain syndromes and fibromyalgia syndrome, which are fascial in origin, were outlined. In the past, treatment for these syndromes has been primarily symptomatic and has not been successful with long-term results. Myofascial Release is a relatively new treatment technique that specifically targets fascial restrictions. The concepts and theories for this procedure will be discussed in the following chapter.
CHAPTER IV

CLINICAL IMPLICATIONS

The role of fascia in the musculoskeletal system needs to be addressed at a clinical level. As clinicians are becoming more aware of fascia and its potential to impact patient outcomes, techniques to address fascia are being incorporated into their treatment regimens. This chapter is intended to focus on the clinical aspects of the fascial system. A treatment technique called Myofascial Release (MR) will be discussed and the results of studies analyzing this technique will be reviewed.

Myofascial Release has roots as an ancient healing concept. At the current time, the exact way that MR works has not been defined. However, MR therapy appears to be gaining popularity and medical acceptance. Health care professionals who deal with musculoskeletal disorders are becoming more aware of the fascial system. A physical therapist named Carol Manheim has written a manual to facilitate learning the concepts of MR. Another prominent figure in the area of MR is John F. Barnes. Mr. Barnes is also a physical therapist and an author of a book about MR. He is the President and Director of the Myofascial Release Treatment Centers and Myofascial Release Seminars in Paoli, Pennsylvania, and Sedona, Arizona. Barnes treats patients and teaches
health care professionals his techniques worldwide. Benjamin M. Sucher is an osteopathic physician who has successfully used myofascial techniques. He has published case studies in the Journal of American Osteopathic Association. Dr. Sucher reported successfully treating carpal tunnel and thoracic outlet syndromes. Sucher's articles will be reviewed following a description of MR in the later part of this chapter.

Myofascial Release Therapy

Myofascial Release is a manual technique used in the clinic to mobilize soft tissues. The prefix "myo-" originates from the Greek word meaning muscle. "Fascial" represents the connective tissue or fascial systems of the body. As mentioned before, fascia encases every structure in the body and is a continuous system. The "release" is the desired outcome of the treatment and is actually the release of restricted fascia in the body.35 Myofascial Release is an extremely mild form of stretching that has demonstrated profound effects on the body.36

Patients should be carefully evaluated and a good history should be obtained prior to any treatments. Every case may have a different presentation; therefore, each patient should be evaluated individually. In the article by Glenn Hunter37 titled, "Specific Soft Tissue Mobilization in the Treatment of Soft Tissue Lesions," the key components for soft-tissue evaluation are outlined. They include the following: 1) What anatomical structures have been damaged? 2) What specific areas of the structure have been damaged? 3) What is the
function of the tissue? 4) To what stress are the tissues normally subjected 
5) What are the biomechanical factors of the injury? 6) How great is the soft 
tissue damage? 7) What phase of the healing process have the tissues 
reached? 8) How can the clinician apply tension to the area? The information 
gathered during the evaluation will enable the clinician to specifically identify the 
primary site of tissue damage. This will help the clinician in determining the 
direction and magnitude of the mobilization to release the restricted structures.

As with any procedure, the technique for MR may be contraindicated. 
Myofascial Release may be contraindicated with a positive vertebral artery test 
or pathologies like malignancies or osteoporosis. Other precautions include 
inflammatory skin conditions, hypermobility, fractures, hemorrhage sites, acute 
rheumatological conditions, or localized infections. In order to find out the status 
of a patient, the therapist must do a comprehensive clinical evaluation and be 
able to identify contraindications or red-flags that may be present. The overall 
health of the patient and findings from the comprehensive evaluation must be 
considered before initiating MR treatments. In addition to the comprehensive 
evaluation, it is necessary for the therapist to rely on palpation skills to detect 
restrictions and to interpret feedback from the patient to obtain the desired 
outcome.

The goal of MR techniques as outlined by Manheim is to "facilitate the 
most efficient posture and movement patterns the patient can maintain." Myofascial Release is a whole body, hands-on approach to treatment of
musculoskeletal disorders. Dysfunctions, like whiplash, for example, need to be analyzed and treated with a whole body approach.\textsuperscript{15,35} Manheim points out in her book that muscle cannot be considered an individual unit or be isolated from other structures in the body. Problems are rarely isolated to one area of the body. Limitations in one part of the body can effect other parts of the body. The body is a kinetic chain and every link is important to the overall strength and function. The human muscular and connective tissue systems function as a single myofascial unit. Therefore, all types of muscle stretching actually stretch every single myofascial unit.\textsuperscript{15}

MR techniques are utilized by therapists to release muscle (soft-tissues) from the abnormal grip of tight fascia.\textsuperscript{9,35} This grip may be described as the fascia binding down as a result of trauma. The natural phases of the inflammation and repair cycle can cause binding down of the fascia to the surrounding tissues. During the wound contraction phase, there is the opportunity for fascial tissues to become restricted. This has the potential to put pressure on the nerves, muscles, or cause trigger points.\textsuperscript{36} As fascia tightens, it becomes a source of tension. The tension can cause pain or limit movements.\textsuperscript{35}

The techniques of MR are also individualized and need to be adapted to the patient. Myofascial therapy is a philosophy of care rather than a series of protocol techniques. The techniques are designed to eliminate fascial restrictions, to balance structures, and to restore postural alignment.\textsuperscript{38}
Myofascial Release targets the origin of the pain rather than just treating the symptoms.

The key to success of the treatment lies in the proper administration of the procedure. The restricted area has to be positioned so that it can be stretched. A gentle traction or low-load and prolonged stretch is administered. This is the distinguishing factor of the MR technique.\textsuperscript{9,15,35,37} Studies have shown the low-load and prolonged stretch approach to be successful in the elongation of inert or non-contractile structures.\textsuperscript{39,40} A prolonged stretch for MR is defined as lasting from 90 seconds to three or four minutes.\textsuperscript{9,16} Warren and Lehman\textsuperscript{40} found a low-load and prolonged stretch to be more effective in lengthening tissues than high-load and brief stretch. In another study by Light,\textsuperscript{39} the same conclusions were made.

The MR techniques are to be utilized to free up soft-tissue restrictions. It is a wholistic approach, and there are many other factors that are important in treating and maintaining a positive outcome. For example, the compliance with home stretching programs and education of the patient are also very important in the success of the overall treatment. It is pointed out by the promoters of MR that these techniques are not intended to be a "cure-all." They should be utilized by therapists as another weapon in their arsenal of treatment techniques.\textsuperscript{15,36} Other modalities such as heat and massage may be indicated and may enhance the effects of the MR treatment. Ultrasound is a deep heating
modality that may render the myofascial structures more elastic and stretchable prior to treatment. This could give the treatment a better effect.

Although therapy techniques applied to soft-tissues have been shown to be effective in the clinic, very little research has backed up these claims. This is a very subjective treatment and the techniques are not easy to quantify. For example, details like the amount of force and duration needed to release the fascial structures have not been addressed. The phase of healing needs to be considered when evaluating MR outcomes. However, few articles dealing specifically with the topic of myofascial release have been published in professional journals. The majority of the literature is in the form of case studies. The following will summarize the results of the available literature.

Myofascial Release Studies

The first article gives the results of four case studies. Dr. Benjamin Sucher, an osteopathic physician, treated patients clinically diagnosed with mild to moderate cases of carpal tunnel syndrome with myofascial release techniques. The subjects had been unresponsive to routine conservative care and met specific diagnostic criteria which included decreased nerve conduction velocity in electromyographic testing. Before the treatment, the subjects were analyzed with magnetic resonance imaging (MRI) to document the size of the carpal tunnel. The specific procedure for myofascial technique was outlined by Sucher in another article. The release technique was aimed at the transverse carpal ligament. The myofascial release and stretching maneuver averaged
about 5 to 10 minutes to perform. The patients were also instructed in a home stretching program and claimed to be compliant with the program. Some of the patients recorded positive results from the treatment after just one treatment session.

Once the subjects reported improvement, the electromyographic test was repeated. If there had been a significant improvement in the nerve conduction velocity, the subjects were given a second MRI. In this study, the results of all of the second MRI tests showed a significant increase in size of the carpal tunnel. This study provides two objective measures of improvement: 1) increased nerve conduction velocity and 2) increase in the measured area of the carpal tunnel. These results document the effectiveness and support the use of myofascial techniques to treat mild or moderate cases of carpal tunnel syndrome.43

Sucher also published an in-depth, three part series on thoracic outlet syndrome; a myofascial variant. Thoracic outlet syndrome was critically analyzed and the series focused on related pathology, clinical diagnosis, specific treatment, and postural considerations. This series also included four case studies. The subjects were all clinically diagnosed with thoracic outlet syndrome and were considering the possibility of surgical intervention (resection of the first rib). The subjects had been experiencing symptoms ranging from six months to three years. The diagnosis of thoracic outlet syndrome was confirmed with the use of thermography, a sensitive and non-invasive procedure. Thermography also provides objective evidence of the condition. Temperature
changes in the upper extremity are mapped and analyzed. Areas with myofascial trigger points were also indicated with the thermography. This type of testing gives physiological data regarding both vascular and neurologic status of the upper extremity. The thermograph can direct the clinician to the areas of restriction. The tests were also repeated to document the effects of treatment.44

The specific treatment is outlined in the second part of the series of articles.41 The treatment program was specifically directed toward the involved anatomical structures. All of the subjects appeared to have significant involvement with compressive or constrictive effects at both the scalene and the pectoralis minor musculature. Other surrounding muscles were also involved. This was a direct result of the specific mechanism of injury and varied for each subject. Therefore, it is necessary to evaluate each patient to determine the involved structures. Sucher45 described the treatment as a form of deep myofascial release combined with a self stretching program. The treatment did not stop with only stretching or releasing the involved area. Postural correction and strengthening exercises were also incorporated into the protocol. This whole body approach is necessary for the best overall outcome.41,44,45

Another study in September of 1994 by physical therapists Hanten and Chandler46 compares techniques to increase hip joint range of motion. Myofascial Release leg pulling technique is compared to Isometric Contract-Relax techniques on the hip musculature. Both treatments had significantly better results than the control group. However, the Contract-Relax group scored
the highest and appeared to be more time efficient. Since this study was performed on healthy subjects, it may not truly reflect accurate findings for fascial tissues. The techniques and results may vary in pathological tissue. If abnormal fascial restrictions were not present, the myofascial variant of this study may have been eliminated.

Again, the amount of research in this specific area is very limited. There is a need to pursue further research projects that may attempt to quantify some of the myofascial techniques. Since fascia extends from head to toe in the body, there are many different areas that can be addressed. Presently, there are a lot of unanswered questions regarding the specific mechanisms for the MR techniques.
CHAPTER V
CONCLUSION

The role of fascia in the musculoskeletal system is gaining recognition by clinicians. Fascia is an anatomical configuration that encases every structure and connects every part of the body from head to foot. Fascia, like any other tissue in the body, has the potential to be injured. Fascia progresses through the inflammation and repair phases like any other soft tissue. During this time, if the fascia is not functionally stressed, there is the potential for the fascia to adhere to surrounding tissues. This can result in restrictions that can limit normal movement and cause pain. This usually happens during the wound contraction phase. These fascial restrictions are actually what needs to be identified and "released" with myofascial techniques.

Understanding how fascial planes and spaces are organized makes it possible to conceptualize how a fascial restriction in one area of the body can limit functions in a seemingly unrelated area. This may help explain why some patients do not present with typical or textbook patterns of symptoms.

A wholistic approach is one common emphasis the promoters of the myofascial techniques seem to support. This means that they try to treat the whole body and not just the specific symptoms in the affected area. Eliminating
the cause of the myofascial pain is the primary goal of the clinicians. A great deal of emphasis is placed on a detailed evaluation to localize the source of the problem. Postural changes, muscle strength imbalances and bilateral symmetry are factors that are incorporated in the treatment plans of these clinicians.

Physical therapists may deal with musculoskeletal pathologies on a daily basis. It is very important to have an open mind and a working knowledge of the human body. It is also important to consider all of the structures as part of a complex system and not as individual structures. For example, it is not realistic to consider only muscles or only nerves when treating problems. The structures function in the body as a unit and need to be treated in this manner. The function of fascia and its potential to limit movement and cause pain should be understood. This knowledge is important and needs to be incorporated into treatment. The fascia surrounding the muscle is not just in the cardinal planes. Therefore, traditional stretching patterns that were designed to target one muscle may not provide the tension in the plane of the fascia that is necessary to stretch or release it. The amount of time to hold a stretch indicated for the myofascial techniques is at least one and a half to two minutes. This may be longer than clinicians typically hold traditional stretching techniques.

As recently as May 1995, the Journal of the American Osteopathic Association has defined some potential research areas for MR techniques. They have defined nerve compression syndromes as an area of study. This type of research would help to establish validity of the techniques. There is a definite
need for concrete data in this area. Many clinicians are claiming to have successful treatment techniques, yet they have little scientific evidence to support their claims. The case studies of Sucher that were reviewed provide a starting point for future research study designs. Sucher found ways to quantify his results with objective measures. His studies provide future researchers with an excellent research design upon which to build. This area of MR seems to have a lot of promise and some specific research may benefit clinicians as well as the patients who suffer from myofascial pain.
October 23, 1995

Tara Kolinger
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