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Research Paper Review

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Training Principles for Fascial Connective Tissues: Scientific Foundation and Suggested Practical Applications

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ABSTRACT

Conventional sports training emphasizes adequate training of muscle fibres, of cardiovascular conditioning and/or neuromuscular coordination. Most sports-associated overload injuries however occur within elements of the body wide fascial net, which are then loaded beyond their prepared capacity. This tensional network of fibrous tissues includes dense sheets such as muscle envelopes, aponeuroses, as well as specific local adaptations, such as ligaments or tendons. Fibroblasts continually but slowly adapt the morphology of these tissues to repeatedly applied challenging loading stimulations. Principles of a fascia oriented training approach are introduced. These include utilization of elastic recoil, preparatory counter movement, slow and dynamic stretching, as well as rehydration practices and proprioceptive refinement. Such training should be practiced once or twice a week in order to yield in a more resilient fascial body suit within a time frame of 6-24 months. Some practical examples of fascia oriented exercises are presented.

ANALYSIS

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Background Information

Acute musculoskeletal injuries rarely occur due to problems with the muscular or skeletal systems. Rather, it is most often the connective tissue network (i.e. ligaments, tendons, joint capsules, etc.) that have been taxed beyond their load-bearing capacity. The connective tissue alluded to in the last sentence is fascia: the ever-so recently popularized tensional tissue network, enveloping and connecting all muscles, organs, joints, retinaculae, aponeuroses, ligaments and tendons. In other words, this organ (if you will) is a body-wide network, designed to transmit tensional strain and force during movement.

Purposeful training of the fascial network may be of great importance for our clients and patients. For example, if the fascial network is optimally elastic and resilient, it has the capability to offer a high degree of injury prevention (1). The following article aims to present some biomechanical and neurophysiological foundations for designing training programs specific for fascia.

SUMMARY

Fascial Stretching

Different types of stretching appear to impart different effects on fascial tissues. For instance, classic weight training loads muscle within its available range of motion, leading to a strengthening effect of the fascial tissues that are arranged in series with muscle fibers (at the myotendinous junctions) and those fascial fibers that are arranged transversely across the muscular envelope. However, little effect is exerted on extramuscular fascia and intramuscular fibers that are arranged in parallel to the active muscle fibers.

On the contrary, classic Hatha Yoga stretching, where extended muscle fibers are relaxed, has little effect on fascial tissues arranged in series with muscle fibers. This is because relaxed myofibers are softer than the myofibers found in series with tendons. The softer myofibers will swallow most of the elongation, decreasing how much tension is imparted on fascial tissues oriented in series at the musculotendinous junctions. However, these stretches stimulate fascial tissues found in the extramuscular fascia and intramuscular fascia found in parallel to myofibers. Interestingly, yoga's effect on fascia is directly opposite to the effect of weight training on fascia.

Ballistic, or dynamic stretching, as opposed to static stretching also has merit when it comes to fascial health. Long-term and regular use of properly performed dynamic stretching positively influences fascial architecture by creating a more elastic environment. The long-term use of both static and dynamic stretching can yield an improvement in force, jump height and speed (2). This is because it provides a loading pattern where the muscle is briefly activated in its lengthened position, leading to a more comprehensive stimulation of fascial structures. This means that to train fascia, soft elastic bounces in the end ranges of available motion are required. However, adding variation to one's stretching routine is important as well, to prevent the tendency for limited movement that comes with aging. Before sporting events, ballistic stretching is more beneficial; but slow and static stretching can induce great changes as well.

Fascial Hydration & Renewal

Approximately 1/2 of fascial tissue is made up of water. Much like when one squeezes a sponge, when you load fascia (via stretching or local compression), water is pushed out into the surrounding environment. This allows more fluid to enter the connective tissue. Application of external load can result in refreshed hydration of fascial tissues that lack adequate hydration. This is important in many clinical scenarios, such as inflammatory conditions and edema, where a higher percentage of water resides within the ground substance. When local tissue is squeezed like a sponge, rehydration can occur, leading to a healthier water composition in the ground substance.

Preparatory Counter Movement

This motion uses the catapult/elastic effect of fascial tissues by pre-tensioning the fascia in the opposite direction. Take, for instance, 'the flying sword' exercise (add picture?), where the anterior fascia is pre-tensioned by tilting backward briefly to increase the fascial elastic tension. This pre-tensioning allows the upper body and arms to spring in the sagittal plane anteriorly and inferiorly, much like a catapult. The motion is then performed in reverse to straighten up: simply pre-tension the posterior fascia by briefly contracting the anterior musculature, leading to a passive recoil of the posterior fascia, swinging the body to its original, upright position. The most important quality here is to make sure that the client/patient is using the kinetic/elastic energy stored by the fascial network to move the body, and not muscular action. The action should be perceived as fluid and pleasurable.

The Ninja Principle
The key here is to execute movements (hopping, running, dancing, etc) as softly and smoothly as possible. Each movement flows from the previous movement, with gradual smooth decelerations, and fluid accelerations. Jerky movements should be avoided and should appear elegant and graceful, which result in a reduction in the risk of injury. One way to train this is to attempt to climb stairs barefoot with as little noise as possible. Using more fascial 'spring' leads to quieter and gentler stepping. A similar exercise for the anterior body fascia would be to place your hands on a wall and lean forward in a push-up position and to quickly bounce off the wall. Pre-tensioning the entire body and not allowing the body to collapse into a 'banana-like' posture is required.

Slow and Dynamic Stretching
Rapid and fluid stretching is recommended. However, prior to performing any dynamic stretching, performing prolonged stretching along long myofascial chains is suggested. Rather than pausing in these poses, performing multidirectional movements, with slight changes in angle are most applicable. For instance, one could perform a standing, chair-assisted cat stretch with bent knees, leading to a similar stretch with straight legs; the client/patient could even be challenged further by straightening one leg at a time, in an alternating fashion. Changing the tension along the whole posterior myofascial line by repeatedly and rhythmically straightening the knees dramatically increases the stretch along the whole posterior chain. Once this is mastered, mini-bounces in the stretched position can be used as soft, low intensity progressions. Then, the client/patient can explore a dynamic, fast stretching with a preparatory counter-movement.

Proprioceptive Refinement
To be successful with refining one's proprioception, it is necessary to limit how much the reticular formation in the brain stem filters information from the brain, as it has the ability to restrict the transfer of proprioceptive information to the brain from somatic structures. The application of shear, gliding and tension through motion and variety are necessary to encourage this. In addition to performing the exercises described above, having variety in the speed and quality of movement is needed. For instance, one could perform extreme slow motion movements, interspersed with large, macro-movements involving the whole body.

Squeezing & Rehydrating the Sponge
Foam rolling can be used to increase hydration to tissues, and to simulate manual myofascial release treatments. If properly applied at a slow speed, with finely-tuned directional change, this has the power to fine-tune inhibited or desensitized fascial proprioceptors. Additionally, cyclical training, with periods of more intense effort, interspersed with purposeful break periods is recommended. This is because, when the tissues are strained, the fluid is pressed out and the fascial tissues begin to function less optimally. Short pauses at a lesser intensity allow for the tissues to be rehydrated. This is yet another reason why high intensity interval training is a great way to train!

It is important to understand that generally, the benefits of fascial training occur very slowly and are long lasting. Constant and regular training pays off. This sort of training does not have to occupy a lot of your training time. A few minutes of appropriate exercises, performed 1-2x/week is sufficient; complete renewal of fascial structures will take between 6 months – 2 years.

CLINICAL APPLICATION & CONCLUSIONS

Basic Foundations

Fascial Remodeling: Connective tissue is highly adaptive. With increasing physiological strain, fibroblasts increase their remodeling activity in the cellular matrix to allow the tissue architecture to meet the imposed demand. For instance, the fascia on the lateral thigh is quite dense because of the imposed demands on those fascial structures due to bipedal stance. A similar phenomenon would occur on the inner thigh in individuals who regularly ride horses. Such firmness or tissue tension is rarely found in individuals who are wheelchair bound. This is because fascial tissues react to the dominant loading pattern. Fibroblasts react to every day strain and to specific training by remodeling the arrangement of their collagen network. In fact, regular exercise can create a more youthful, wavy fascial arrangement (as younger individuals, for the most part, have fascia that are reminiscent of elastic springs). However, there appears to be an exercise-specific relationship, whereby the strain magnitude needs to exceed the amount which occurs during habitual activities.

The Catapult Mechanism: The spring-like efficiency which allows kangaroos to jump so high and far is not due to the force of contraction created by their leg muscles. Instead, the tendons and fascia are tensioned like a rubber band, leading to an explosive release of stored energy. Human fascia has a similar ability to store potential energy. This ability is displayed during various tasks, such as jumping and even walking; a significant part of the energy and efficiency of these movements comes from this springiness. A new model of movement during oscillatory movements has been recently proposed, where the length of the muscle fibers change very little and contract in an isometric fashion. The increase in stiffness by the muscles creates a fixed point where the fascial elements can shorten to create the intended movement. This is in direct contrast to the classic explanation of energy transfer, where muscles shorten, and tendons and fascia simply play a more passive role. While the traditional explanation still remains true while performing some activities, such as bicycling, oscillatory movements such as sprinting rely on the surrounding fascial network more so than muscular contraction.

This organization of contractile elements explains why as humans age, we lose the springiness in our gait; as we get older, the fascial network takes on a more haphazard, multidirectional fiber arrangement, as opposed to the elastic, two-directional, lattice-like arrangement found in younger individuals. This negative change is thought to be mediated by a lack of movement and activity, which leads to the creation of additional cross-links among fascial tissues, leading to a decrease in elasticity, a lack of gliding and adhesion between fascial layers. It is thus the goal of fascial training to create more youthful fiber arrangement.

Fascial oriented training is a useful addition to a comprehensive training or rehabilitation program. However, before prescribing exercises, it is necessary for clinicians to understand the basic sciences surrounding fascia, namely anatomy, biomechanics, histology and biochemistry. Articles like this one give clinicians a brief window into this fascinating anatomical structure, while giving us tools and concepts to apply in practice.

STUDY METHODS

This article is a description of how one can apply theoretical and clinical research to a clinical setting. The inherent weakness of a publication such as this is that it includes clinical opinions that are backed up by specifically selected research projects. Therefore, author bias (or research 'cherry-picking') could come into play. In this particular case, the lead author is one of the world's leading experts on this topic, so this risk should be minimal. Further, no objective search strategy was described. However, the lack of a described search strategy matters very little, as no descriptive or inferential analysis was performed to draw a statistical conclusion.

STUDY STRENGTHS/WEAKNESSES

Strengths

- High degree of clinical applicability, with relevant discussion backed up with information from a number of research laboratories around the world.

Weaknesses

- Papers like this are subject to incredible bias, as no objective search strategy was performed.
- More examples of exercises could have been provided to increase clinical utility.

Additional References:

1. Kjaer M, Langberg H, Heinemeier K et al. From mechanical loading to collagen synthesis, structural changes and function in human tendon. Scandinavian Journal of Medicine & Science in Sport 2009; 19: 500-510.
2. Shrier I. Does stretching improve performance? A systematic and critical review of the literature. Clinical Journal of Sport Medicine 2004; 14: 267-273.

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