Ligamentous Articular Strain Technique – a manual treatment approach for ligamentous articular injuries and the whole body

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ABSTRACT

The scope of practice for the treatment of the ligamentous, capsular and fascial tissues by Manual Therapists (Massage Therapy) limits the therapist to utilizing their hands along with active patient participation. There is a wide range of research documenting the types of mechanoreceptors and their locations within the ligamentous/capsular tissues. A lesser-understood ligamento-muscular reflex has also been documented with limited research. The specific mechanoreceptors and ligamento-muscular reflex are responsive to manual stimulation techniques within the scope of practice for manual therapy. Utilizing specific manual techniques can have positive effects in attenuating the development of scar tissue, adhesions, inflammatory processes and proprioceptive and kinesthetic neurological deficits. Combining these specific manual techniques with therapies such as Prolotherapy minimizes the long-term effects from ligamentous articular injuries and accelerates the recovery period for patients.

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"It's not perverted function but a wrong environment that results in the distorted appearance of function. Function is always true to its environment. Function is dependent upon its environment. Therefore, any change in any part of the environment that is not in tune or balance, will distort the function of the matter so involved."
- Thomas Schooley, DO[1]

There is a wealth of information concerning the treatment of ligamentous, capsular and fascial tissues within the scope of practice of Medicine, Physiotherapy and Naturopathic Medicine. In the Massage Therapy (Manual Therapy) profession where our scope of practice only allows us to treat utilize our hands along with active patient participation; there is very little information or research.

In this article, I discuss a technique developed in the early 1900's to which I have applied today's current research. When combined with therapies such as Prolotherapy, this technique has the potential to accelerate the recovery period for patients suffering from ligamentous articular injuries.

The ligamentous system is part of the fascial tissue referred to as the **Multimicrovacular Collagenic Dynamic Absorbing System.** The role of this rubbery elastic shock absorbing system, found everywhere in our body, is to avoid reaching a threshold of resistance at which the collagen might shear resulting in injury.[2]

Ruptured or injured ligaments are a source of mechanical problems. These injuries cause deficiencies in fine and gross motor controls, lost, altered or impaired sensation, various types of pain/discomfort, joint laxity and can lead to articular surface injury. This dysfunctional state eventually leads to an increased risk of additional injury to surrounding capsules, tendons, neurovasculature and other nearby tissue, can cause a change in sensation thresholds, impaired sensation and impaired reflex muscular activation.[3]

If left untreated or if treated inefficiently, chronic inflammation develops and permanent disability of the affected tissues results. Patients suffer from continual pain, inflammation, neurological implications, muscle stiffness and instability of affected joints, deficient sensation and sensory perception, impaired motor performance, deficient synergy muscle activation, spasms and hyper excitability of the muscular system.[3]

MECHANORECEPTORS

Ligaments have significant input to sensation and contribute to the synergistic activation of muscles. Afferent mechanoreceptors are found everywhere throughout our connective tissues. They are responsible for kinesthetic and proprioceptive sensation.[3]

The four types of these sensory nerve endings or mechanoreceptors that manual therapists have influence on are:

- Golgi Receptors
- Ruffini Receptors
- Pacini Receptors
- Interstitial Receptors

We will briefly look at these four receptors and the effects manual treatment has on them and the body as a whole. (*See Table 1.*) [4, 5, 6, 7, 8, 9, 10, 11]

In a study presented at the Third International Fascia Research Congress, Viklund et al. concluded that specific myofascial receptor techniques might have a longer lasting effect than classical (Swedish) massage techniques. They suggested that "therapists might be encouraged to aim their soft tissue techniques to a lesser area where there is known to be high density of mechanoreceptors".[12]

Manual techniques that target these mechanoreceptors have been proven to affect both the local blood supply and the local tissue viscosity.[11] Research is now confirming the common clinical finding that slow, deep tissue techniques have both local and systemic effects.

LIGAMENTO-MUSCULAR REFLEX

Ligaments are not passive tissue. Ligaments are highly dynamic and non-stationary predictable organs. Afferent mechanoreceptors in ligaments trigger a ligamento-muscular reflex activation of associated muscles. It has been suggested that a reflex might exist between these sensory receptors in the ligaments and surrounding associated muscles. This Ligamento-muscular reflex may directly or indirectly alter the load inflicted on to a ligament.[3]

Table 1. The four types of sensory nerve endings or mechanoreceptors and the effects manual treatment has on them and the body as a whole.

Receptor:	Golgi
Location:	• all dense connective tissues • peripheral joints ligaments • joint capsules • myotendinous junctions • attachment areas of aponeurosis
Responds to:	slow stretch techniques
Results in:	a decrease in active muscle tone
Receptor:	**Ruffini**
Location:	• tissues associated with regular stretching • outer layer of joint capsules dura mater • peripheral joints ligaments • muscle fasciae • the deep dorsal fascia of the hand
Responds to:	constant, slow and deep pressure slow shear forces
Results in:	a lowering of sympathetic nervous system activity
Receptor:	**Pacini**
Location:	• deep portions of joint capsules • deeper spinal ligaments • investing muscular fasciae of antebrachial, crural, • abdominal fasciae, masseter, lateral thigh, plantar and palmar tissues & peritoneum
Responds to:	• rapid changes in pressure • vibratory/oscillatory techniques • HVLA's
Results in:	an increase local proprioceptive attention and self-regulation
Receptor:	**Free/Interstitial Nerve Endings**
Location:	• all fascial tissue • periosteum • interosseous membranes • tendons • fascial connections to bones
Responds to:	• deep, slow or steady manual pressure • Treatment to periosteum, interosseous membranes, and fasciae connected to bones
Results in:	• autonomic functions: changes in heart rate, blood pressure, respiration, increase or decrease blood pressure, sensation of position and movement, increased vagal activity, global muscle relaxation, alterations in local fluid dynamics and tissue metabolism • plasma extravasation

The Ligamento-muscular reflex has been shown to exist in most joints of the extremity and in the spine. Muscular activity elicited by this reflex allows muscles and ligaments to work together as a unit in maintaining joint stability. This reflex may play a role in the preservation of joint stability, inhibiting muscles that destabilize the joint or increasing antagonist co-activation to stabilize the joint.[3]

For many years we learned in our anatomy classes that ligaments and muscles were separate entities. Even many of our most popular anatomy texts still portray ligaments and muscles as separate tissues running from one bone to another, not connected to any surrounding tissues. In reality though, these and the surrounding tissues are inseparable. In 2009, van der Wal published a paper in which he determined that ligaments are mostly arranged in series with the muscles, not parallel.[13] When you contract a muscle, the ligaments are automatically engaged, assisting in the stabilization of a joint, no matter what its position, during both concentric and eccentric contractions.[14]

INJURIES

A state of hypertonicity is created in muscles when a ligament has been injured, or replaced. For example, ACL ruptures and replacements can cause one or all of the quadriceps, hamstring and gastrocnemius muscles to become hypertonic as a result of a lack of the ligamento-muscular reflex. This hypertonic state is also due to the removal of the mechanoreceptors of the original ACL. A large percentage of the receptors are located near the ends of the ligaments as they attach into the sub-chondral layer. This remnant is often removed in order to attach the substituted tissue. Although the stability of the joint has been re-established, patients regularly complain of not only having an increase in tonicity of the muscle groups, but also a deficiency in both proprioception and kinaesthetic awareness. The manual therapist is then charged with the task of attempting various treatment techniques to reduce this hypertonicity. Their efforts are rarely successful and both the patient and therapist become frustrated and discouraged. Thus begins the circle of referral from one therapist to another. [5, 15, 16, 17, 18]

HISTORY OF L.A.S.T.

Ligamentous Articular Strain Technique (L.A.S.T.) was developed to be primarily an Indirect Osteopathic technique. The technique is based on principles and techniques developed by Andrew Taylor Still, DO. The majority of the techniques initially developed were called traction methods, known as “Indirect Techniques.” Several of these techniques were Ligamentous Articular Strain Techniques and some of them also formed the basis of myofascial release techniques. Many of the techniques in the early 20th century were modified by therapists that wanted to focus on a quicker, more direct method of treating. These “Direct Techniques,” became known primarily as high velocity-low amplitude techniques.[1, 19]

The author has re-defined the techniques to suite the Scope of Practice for Massage Therapists. “Indirect Techniques” follow the permitted motions of the dysfunctional tissues into the direction of ease. “Direct Techniques” match the reciprocal tension of the dysfunctional tissues taking the tissues only to the first tissue resistance barrier.

USING L.A.S.T. IN TREATMENT

L.A.S.T. affects the connective tissues of the body, mainly ligaments, joint capsules, fascia, muscles, tendons and indirectly, lymphatic and blood flow and the autonomic nervous system.[11, 20]

L.A.S.T. is a principle-based technique. The basic principles consist of disengaging the dysfunctional tissues from their protective position. The practitioner follows the affected tissues into a position of exaggeration of the injury. This exaggeration leads to a state where all movement within the affected tissues halts. A release of tension within the tissue is felt, allowing the ligaments to draw the articulations back into a more normal balanced relationship.[19]

After an assessment of the affected articular structures, the practitioner palpates for areas of dysfunction or an increased densification within the injured tissues. Slowly disengaging the tissues, (direct or indirect techniques) the therapist exaggerates the permitted motions of the tissues to their end barrier. The reciprocal tension is a tension that is developed between the practitioner loading into the tissue and the tissue reciprocally loading back into the practitioner. The therapist now waits at this point of tissue exaggeration until he or she feels the ligaments draw the articulations back into a normal balanced position. A re-assessment of the permitted motion in the tissues should confirm more suppleness and mobility along with an improvement in kinaesthetic and proprioceptive awareness. (*See Figures 1-4.*)

L.A.S.T., **TGF-B1** AND THEIR POTENTIAL ROLE IN PREVENTING EXCESSIVE SCAR TISSUE DEVELOPMENT

Solomonow states that the acute inflammation in ligaments sets in within several hours may last several weeks and up to 12 months! Only up to 70% recovery

Figure 1. Hand placement for treatment of Annular Ligament.

Figure 2. Sidelying position for treatment of Illiolumbar ligament.

Figure 3. Hand placement for treatment of ASIS attachment for Inguinal Ligament.

Figure 4. Hand placement on patient for treatment of C1 dysfunction.

has been documented. Chronic inflammation can build up over several weeks, months or years depending on dose-duration levels. Rest and recovery of as long as two years only allows partial recovery, full recovery has never been reported.[3]

Bouffard et al. published a study documenting the effects of brief static tissue stretch on TGF-ß1. TGF-ß1 plays a key role in connective tissue regulating the response of fibroblasts to injury, remodelling, scarring, and pathological production of fibrosis.[22] Langevin et al. stated that in cases of minor sprains and repetitive motion injuries, scarring is mostly detrimental since it can contribute to maintaining the chronicity of tissue stiffness, abnormal movement patterns, and pain. Reducing scar and adhesion formation using stretch and mobilization is especially important for internal tissue injuries and inflammation involving fascia and organs.[21]

The results of the Bouffard and Langevin studies showed that brief, moderate amplitude (20–30% strain) stretching of connective tissue decreases both TGF-ß1 and collagen synthesis.

Langevin et al. proposed that therapies which briefly stretch tissues beyond the habitual range of motion (eg, massage) locally inhibit new collagen formation for several days after, and thus, prevent and/or ameliorate soft tissue adhesions.[6, 7, 19, 23, 24]

Thomas Schooley, DO stated, "Function is dependent upon its environment." I believe that by utilizing the principles of L.A.S.T. in various stages of injury, practitioners have the potential to profoundly affect the course of tissue healing. By changing the neuromuscular physiological environment and decreasing the SNS response to injury, a response of decreased TGF-ß1 could lead to decrease in fibrosis and decrease in fascial stiffening of the surrounding and injured tissues. This approach could overall positively affect the functionality of the patient.

MY EXPERIENCE WITH L.A.S.T.

In our office, we treat a variety of injuries ranging from acute to chronic. These injuries lead to the symptoms described earlier in this article. Optimally, I prefer to treat in the acute stages of an injury. By attempting to create as optimal an environment for tissue healing as possible, patients have reported being less symptomatic. Combining L.A.S.T with Prolotherapy treatment, administered by our Naturopathic Physician, creates an opportunity to prevent chronic issues from occurring thereby improving the quality of life for the patient. ■

REFERENCES:

1. The Osteopathic Cranial Association. (1953). Journal of the Osteopathic Cranial Association.
2. Endo Vivo (Producer), & Guimberteau, J. C. (Director). (2004). *Strolling under the skin* [DVD].
3. Solomonow M. Ligaments: a source of musculoskeletal disorders. *Journal of Bodywork and Movement Therapies*, 2009;13(2):136-54. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/19329050.
4. Cottingham JT. (1985) *Healing Through Touch*. Boulder, CO: Rolf Institute Publications.
5. Krogsgaard et al. Cruciate ligament reflexes. *J Electromyogr Kinesiol.* 2002 Jun;12(3):177-82. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/12086811.
6. Langevin HM, et al. Mechanical signaling through connective tissue: A mechanism for the therapeutic effect of acupuncture. *FASEB J.* 2001;15:2275–2282.
7. Langevin HM, et al. Dynamic fibroblast cytoskeletal response to subcutaneous tissue stretch ex vivo and in vivo. *AmJ Physiol Cell Physiol.* 2005;288:C747–C756.
8. Sakada S. (1974). Mechanoreceptors in fascia, periosteum and periodontal ligament. Bull Tokyo Med Dent Univ, 21 (Suppl.), 11-13.
9. Stilwell D. (1957). Regional variations in the innervation of deep fasciae and aponeuroses. *The Anatomical Record*, 127(4), 635-653.
10. van den Berg, F. & Cabri, J. (1999). Angewandte Physiologie – Das Bindegewebe des Bewegungsapparates verstehen und beeinflussen. Stuttgart, Germany: Georg Thieme Verlag.
11. Schleip R. Dynamic Body: Exploring Human Form, Expanding Human Function Fascia as a Sensory Organ: A Target of Myofascial Manipulation.
12. Viklund P. (2012) Comparison of ankle joint dorsiflexion after classical massage or specific myofascial receptor massage technique on the calf muscle. Third International Fascia Research Congress: Basic Science and Implications for Conventional and Complementary Health Care. Munich, Germany: Elsevier GmbH.
13. van der Wal J. The architecture of the connective tissue in the musculoskeletal system—an often overlooked functional parameter as to proprioception in the locomotor apparatus. *International Journal of Therapeutic Massage and Bodywork.* 2009 Dec;2(4).
14. Myers T. (2011). Dynamic Ligaments: Re-visioning the Fascia as a Body-Wide Regulatory System. *Massage Magazine.*
15. Dhillon MS, et al. Proprioception in anterior cruciate ligament deficient knees and its relevance in anterior cruciate ligament reconstruction. *Indian J Orthop.* 2011 Jul;45(4):294-300. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/21772620.
16. Lee BI, et al. Immunohistochemical study of mechanoreceptors in the tibial remnant of the ruptured anterior cruciate ligament in human knees. *Knee Surg Sports Traumatol Arthrosc.* 2009 Sep;17(9):1095-101. Epub 2009 Jun 16. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/19533097.
17. Melnyk M, et al. Changes in stretch reflex excitability are related to "giving way" symptoms in patients with anterior cruciate ligament rupture. *J Neurophysiol.* 2007 Jan;97(1):474-80. Epub 2006 Aug 30. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/16943314.
18. Swanik CB, et al. Reactive muscle firing of anterior cruciate ligament-injured females during functional activities. *J Athl Train.* 1999 Apr;34(2):121-9. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/16558554.
19. Speece CA, et al. (2009). *Ligamentous Articular Strain: Osteopathic Manipulative Techniques for the Body* (Revised edition). Seattle, WA: Eastland Press.
20. Coote JH, et al. The response of some sympathetic neurons to volleys in various afferent nerves. *The Journal of Physiology.* 1970;208(02): 261-278.
21. Langevin HM, et al. Pathophysiological model for chronic low back pain integrating connective tissue and nervous system mechanisms. *Med Hypotheses.* 2007;68:74–80.
22. Bouffard NA, et al. Tissue stretch decreases soluble TGF ß1 and Type-1 pro-collagen in mouse subcutaneous connective tissue: evidence from ex vivo and in vivo models. *Journal of Cellular Physiology.* 2008;214: 389–395, 2008.
23. Langevin HM, et al. Evidence of connective tissue involvement in acupuncture. *FASEB J.* 2002;16:872–874.
24. Langevin HM, et al. Subcutaneous tissue fibroblast cytoskeletal remodeling induced by acupuncture: evidence for a mechanotransduction-based mechanism. *J Cell Physiol.* 2006;207:767–774.