Massage Therapists' Association of British Columbia

Clinical Case Report Competition

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First Place Winner

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Use of myofascial intervention to reduce post surgical scar tissue proliferation

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Abstract

Scar Tissue proliferation in days 60-360 of the healing process results in wound edges being centripetally drawn together in an inwards direction (Hertling & Kessler, 2006, p. 21). The resultant process has been shown to exhibit decreased tissue mobility as collagen from scar tissue formation adheres to adjacent structures. This study investigated the potential application of Myofascial release technique by inducing a mild and slow shearing strain to tissues surrounding the scar tissue site over 5 treatments. A BROM goniometer was used to find mean readings of all ranges pre and post treatment.

Results showed that Myofascial release to the scar tissue site and surrounding structures was followed up by a temporary decrease in range of motion in most ranges, with subsequent tests in the following treatment showing a return, or increase in range of motion. A combination of Myofascial release, postural awareness, and core strengthening could be used as a preventative measure to avoiding decreased functional tissue, and possibly avoid onset of chronic pain due to compromised tissue function

Keywords: Myofascial Release, Thoracolumbar Fascia, Scar Tissue Reduction, Fascial Shear Strain, Post Surgical Scar Tissue.

The role of Fascia in biomechanics and ambulation is beginning to come to light as studies are discovering more detail in cellular anatomy, regeneration and a tension-integrity relationship. According to Thomas Myers (2011), fascia is a type of connective tissue that unfortunately is misunderstood by many anatomy texts (p. 36). The role of fascia and its interaction around scar tissue and its subsequent efficiency as a result due to the presence of scar tissue was the focus of this case study. Can a proliferation of scar tissue be limiting, or directed to allow for not only functional muscle function, but for functional fascial relationships within the healing tissue?

Through use of specific myofascial release techniques, this study aimed to limit scar tissue proliferation after day 60 following a post surgical spondylolisthesis correction. The focus will be on the etiology of scar tissue formation.

Properties of Fascia

Myofascia is a specialized type of connective tissue. In regards to this case study, the fascia being examined is commonly known as the thoracolumbar fascia, or fascia lumbodorsalis. The properties of fascia are what make it so notable, and difficult to categorize. At a tissue level, it is capable of actions called tensegrity, thixotropy and somatic recall. "Tensegrity is a combination of the terms 'tension' and 'integrity', and its action reflects this union. This mechanism operates on a system of using tension to resist compression. The only requirement of this model is that tension must be continuous, and compression must be localized" (Lindsay & Robertson, 2008, p. 38). When this concept is applied to the body on an organismal level, the "skeletal bones act as 'struts', pushing out; while the muscle tissue as well as the fascia act as the counterforce, pushing in" (Myers, 2011, p. 41).

Through mechanotransduction, a continuous tension will result in restructuring of the microfilaments into linear bundles known as "stress fibers". "Stress fibers are created by tensional forces, and dissolved if tension is eliminated" (Lindsay & Robertson, 2008, p. 41). Prolonged tension can result in dysfunction, which includes inflammation, adhesion or postural stress. This dysfunction may cause tissue to develop intermolecular cross linking of fibers, wherein the fibers will adhere to each other, resulting in a loss of glide or mobility (Hertling & Kessler, 2008, p. 132). A reduction of mechanical stress therefore can result in a reduction of stress fiber production, thereby limiting adhesion of the cell to its environment. Ground substance as a result may become more dense or viscous, this is known as thixotropy.

The impact of water content in regards to connective tissue (fascia), has a substantial bearing on the mechanism of gelation and thixotropy. Via hyaluronic acid, glycosaminoglycans attract more water into ground substance as they combine to form proteoglycans. With the addition of increased mechanical stress, as in the previously mentioned tensegrity model, Lindsay and Robertson (2009) state "macromolecules have a tendency to unfold and dissociate in high-pressure environments. Under this high pressure, gelation is suppressed, melting temperature of gelatin is increased, collagen triple helices are stabilized and fibril formation is decreased" (p. 45).

Properties of Scar Tissue

In regards to this case study, the focus is deep wound healing. As per Tortora & Derrickson (2009), “there are four phases of deep wound healing: Inflammatory, migratory, proliferative and maturation” (p. 162). The purpose of this case study was to target the proliferative phase of scar tissue proliferation.

The proliferative phase is a “continuation of the migratory phase, and lasts approximately 3 weeks” (Hertling & Kessler, 2006, p. 20). Wound contraction is the final portion of the proliferative phase, wherein the edges of the wound are centripetally drawn together. This is mediated by “myofibroblasts producing a contractile protein actin which anchor to each other and to fibrillar structures within the ECM, resulting in contraction of any one cell in the wound causing contraction of the entire unit, called a fibronexus” (Hertling & Kessler, 2006, p. 21). Large wounds contract 50% or on half their size at a rate of approximately 5-10% every 6 weeks or so (Hertling & Kessler, 2006, p. 22).

Research Findings

At this time, there was minimal to no research available concerning the use of manual fascial manipulation to reduce scar tissue proliferation in post surgical candidates. In a case study that “explored the implications of an ‘active’ scar, twenty years following its surgery, the subject of scar tissue complications following the initial healing phase were currently of no clinical interest to surgeons” (Kobesova, Morris, Lewitt & Safarova, 2007, p. 234). Kobesova et all’s case study proposed that for assessment of complications in scar tissue healing use the “same palpatory principles of a barrier phenomenon, and can apply to scar tissue as well as any other connective tissue. It is therefore logical that the same therapeutic procedures suitable for soft tissue lesions may also be applied to a scar." (2007, p. 237). Kobesova et al maintain that "functional tissue must include all layers of soft tissue remaining and moving independent of each other, and that a scar that fails to successfully establish this independent layering is defined as an 'adhesive scar' (2007).

As adhesions alter tissue tension, the inherent awareness of the involved structures becomes skewed, or perhaps inaccurate. Kobesova et al (2007) stressed the importance of "palpatory assessment to diagnose and treat active scar tissue. This includes assessing free mobility range of the tissue until tissue barriers are engaged, signaling the first point of resistance" (p.236). Introduction of a pathology to the tissue, which in this case study is the development of scar tissue, creates a pathologic barrier, creating a restricted free range, and thereby altering the neutral point of the tissue to its physiological barriers.

Research conducted by Klinger, Schleip & Zorn (2004) for the Journal of the Rolf Institute have proposed a correlation between the density of collagen fibers and the amount of crimp formation (waves) in collagen fibers. I.e. "in areas with a more straight fiber arrangement, hardly any contractile cells are found; whereas their density is much higher in areas with more wave-like collagen fibers" (p.7). Their research is an extension on literature citing the "ability of all fibroblasts to become contractile by expressing smooth muscle actin fibers as well as special focal adhesions on their membrane" (Klinger et al, 2004, p. 3). As the new contractile nature of these fibroblasts are subject to increased mechanical stress due to the increase in concentrations, crimping can lead to postural complications, which can lead to decreased movement, and decreased tissue hydration. As the body adapts to a new altered posture, pain can result, and the pain compounds the compromised posture, movement and hydration in a cyclical manor.

This remodeling of tissue is further supported in a recent study on static stretching connecting dense connective tissue to a temporary stiffness along with an enhanced matrix hydration. Schleip, et al (2011) “found that in testing a sustained contraction on ligaments, followed by a lengthy rest resulted in an increase of strength and tissue resistance” (p. 95). This is accomplished via a “sponge like effect of the tissue caused by the isometric stretch caused a dehydrating action within the tissue” (Schleip et al, 2011, p.99), resulting in a thixotropic effect of increased gelation. A sufficient rest, or removal of this strain allowed for an almost “hyperhydrating effect on the tissue so that an increase of elastic modulus and temporary change in the arrangement of the collagen fibers encouraging further crimping” (Klinger et al 2004, p.4). Klinger et al’s study did not have any results for the duration of stiffness following this rehydration effect.

The bonding between cross- bridges of collagen fibers provides structural support to normal connective tissue. However, “injury, chronic stress by dehydration, and immobility cause excessive bonding and lead to the formation of scars and adhesions, which limits tissue movement” (Lindsay & Robertson, 2008, p. 72). As limited movement continues, dehydration causes “ground substance to gradually diminish, causing an increase in cross-linking of collagen fibers, and involved connective tissue loses elasticity” (Lindsay & Robertson, 2008, p. 73).

Case Study:

Candidate is a 58 year-old male.. He underwent surgery to correct for spondylolisthesis at the level of L4-L5 in August 2011, treatments for this case study began at the end of October 2011 to allow a 60-day grace period for adequate acute and migratory phases of wound contraction to occur post- surgery. Treatments commencing in October 2011 allowed for proliferatory phase to be targeted. Patient also underwent a discectomy in 2008 between L5-S1. Still maintains a lack of cutaneous sensation in his left leg along his L5 dermatome. All manual modalities utilized were cleared by his surgeon prior to commencing the case study. No medications were being taken.

Observations:

Fascial pull directed inward towards scar site along L4-L5, primarily in superior lateral direction.

Palpation:

Palpation of Lumbar Spine: no tenderness along scar site or in nearby tissue. At initial assessment, slight swelling was evident, and muscle tone was displaying slight hypertonus. The swelling around the scar tissue minimized throughout the duration of the case study.

Movement:

All AROM assessments were conducted with use of a BROM goniometer. A mean average was determined after each range was tested 3 times as shown in Table 1 below

Measurement was applied at the level of L5-S1 to gauge full lumbar spine involvement with flexion and extension. Passive ROM was consistent with AROM measurements. Resisted ROM was a consistent grade 5 in all ROM with no pain throughout the case study.

Table 1: Active ROM of L5-S1 Using BROM.

	Treatment 1		Treatment 2		Treatment 3		Treatment 4		Treatment 5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Flex	10.6		12.3	9.0	8.3	7.3	8.0	6.66	10.0	9.3
Ext	2.6		0.6	1.0	1.3	0.3	0.33	0.33	0.3	0.3
L Lat Flex	1.0		6.3	4.6	5.6	6.6	6.6	8.0	10.6	6.3
R Lat Flex	1.3		6.3	6.6	6.0	6.0	6.6	7.3	9.3	8.3
L Rot	1.0		6.0	5.3	7.0	4.6	14	6.3	10.6	6.6
R Rot	1.6		7.6	7.3	7.0	6.0	13.3	7.6	11.0	6.0

All Measurements are Mean Calculation of that Portion of Treatment

Neurological:

Chronic lack of cutaneous sensation to the L5 Dermatome segment of his left leg.

Referred Pain:

Patient complained of no referred pain patterns during case study.

Special Tests:

Straight Leg Raise Test was negative.

Standing Wall and Standing Flexion tests were negative.

From treatment 3-5, Thoracolumbar fascia length test was conducted pre and post treatment also with use of the BROM. 3 measurements were taken pre and post to determine mean result.

Table 2: Active Thoracolumbar Fascia Stress Test						
	Treatment 3		Treatment 4		Treatment 5	
	Pre	Post	Pre	Post	Pre	Post
L Rotation	3.3	10.3	14.6	12.6	17.3	12.3
R Rotation	3.0	8.6	20.3	15.6	17.6	13.0
All Measurements are a mean calculation of readings from that treatment.						

Treatment Overview:

Treatment Goals:

Aim of treatment was to limit fascial adhesion to thoracolumbar fascia, to maintain lumbar spine ROM by limiting a possible decrease in shear strain to the 3 layers and improve tissue hydration.

Modalities used:

Fascial manipulations were selected in an attempt to remove a strain upon connective tissue from the scar tissue as the collagen fibronexus created an increase of collagen crimping, while tissue distal to the scar site was under a low level inverted strain. Blocking the tissue at the scar site initially allowed the physiologic barrier in the distal tissue away from the fibronexus to be engaged in an attempt to ultimately remove strain on the distal tissue and allow a rehydrating effect after treatment. This was conducted at any restrictions found 360° around the thoracolumbar fascia while the patient was in prone position.

Long lever techniques were applied to each arm by blocking the tissue and fascia over the latissimus dorsi along its posterior lateral aspect over ribs 7-12. This technique engaged the latissimus dorsi and indirectly engage the thoracolumbar fascia. Blocking the tissue medially towards the lumbar spine, the investing layers of the fascia within the latissimus dorsi via the thoracolumbar fascia were subject to an isometric strain for 1 minute. This was also done to rehydrate the connective tissue in an attempt to create an increased tissue resistance as suggested by Schliep et al, as opposition to any tissue strain towards the fibronexus of the surgery site.

Skin rolling was applied to the scar itself to mobilize induce a longitudinal strain in a cephalad caudal direction, to limit possible shear strain and adhesion as the thoracolumbar fascia invested superiorly into the fascia dorsi profunda, and fascia profunda nuchae of the posterior neck.

Remedial Exercise:

Isometric contractions of the transverse abdominis to improve core strength and in doing so would create increased stability in the midsection, and therefore decrease potential strain and fatigue on the lumbar erectors and gluteals.

Frequency: 2x a week to begin

Intensity: Isometric contractions while laying supine. Patient told to "bring umbilicus towards spine to attain contraction of TA".

Duration: 3 sets. Each set would stop at point of fatigue.

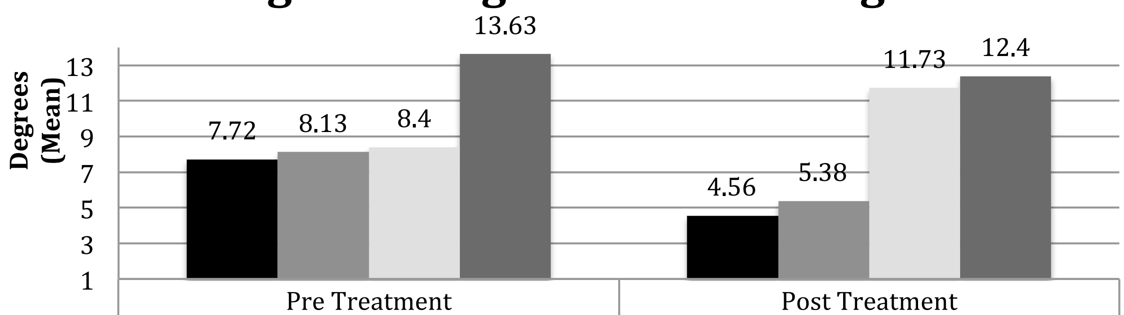
Hydrotherapy:

Hydrotherapy was not used, in respect to not applying extremes of hydro in hot or cold temperatures to newly installed surgical pins.

Results:

Through use of visual analog scale, patient found that ROM was improving with each visit. On first visit, time constraints limited a post treatment BROM reading of the lumbar spine ROM, however a slight decrease in flexion, rotation, and lateral flexion throughout the case study is consistent with the principle of a sustained tissue stretch followed by rest while patient lay prone resulting in an increased tensile strength/strain resistance.

Table 3:
Testing AROM Against TLF Testing



	Pre Treatment	Post Treatment
Left Rotation	7.72	4.56
Right Rotation	8.13	5.38
TLF Left	8.4	11.73
TLF Right	13.63	12.4

This is mostly corroborated by results of thoracolumbar fascia length tests, as end ranges of this movement would indirectly strain the fascia via active lengthening of latissimus dorsi muscle fibers. Table 3 shows the comparison of mean calculations of right and left rotation pre and post treatment, compared to the results of the thoracolumbar fascia stress test pre and post. While results are not conclusive throughout the study to lend support to Klinger et al's study of increased fascial shear strain, the data does follow the hypothesis with the exception the results on left thoracolumbar fascia testing. Further testing with a larger range of candidates, and an extended study period is recommended.

Conclusion:

Encouragement of a functional scar is very much within the realm of manual therapy. Fascial techniques used show a positive direction towards limiting tissue fibrosing to underlying structures, and encouraging a formation and deposition in a functional matter. Therapists would be well served to keep in mind that the tissue may show a decreased ROM post treatment as the connective tissue has rehydrated and becomes temporarily more strain resistant. Use of the BROM goniometer can be subject to human error, and while each 3 readings were taken in each range of every treatment to get a mean result, final readings may not accurately represent the absolute ROM.

Future case studies would benefit from incorporating passive stretch techniques to the hamstring muscles and gluteus maximus to further limit fascial strain from a caudal direction. Incorporating proprioceptive neuromuscular facilitation, specifically a slow reversal technique in order to encourage a positive neurological connection within the fascial tissue and muscle fibers would also be a beneficial complement to further case studies of this nature. This could be accomplished by stimulating the latissimus dorsi and the gluteus maximus. Fascial release technique applied to the abdomen could serve to complement this case study, as strain along the fascia transversalis may be decreased, indirectly affecting the thoracolumbar fascia.

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