Treatment of a Case of Subacute Lumbar Compartment Syndrome Using the Graston Technique

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ABSTRACT

Objective: To discuss subacute lumbar compartment syndrome and its treatment using a soft tissue mobilization technique.

Clinical Features: A patient presented with low back pain related to exercise combined with prolonged flexion posture. The symptoms were relieved with rest and lumbar extension. The patient had restrictive lumbar fascia in flexion and rotation and no neurological deficits.

Intervention and Outcome: The restrictive lumbar posterior fascial layers and adjoining restrictive fascia (thoracic, gluteal, hamstring) were treated with a form of instrument-assisted soft tissue mobilization called the Graston technique. Restoration of fascial extensibility and resolution of the complaint occurred after 6 treatment visits.

Conclusions: The posterior spinal fascial compartments may be responsible for intermittent lower back pain. Functional clinical tests can be employed to determine whether the involved fascia is abnormally restrictive. Treatment directed at the restrictive fascia using this soft tissue technique may result in improved fascial functional testing and reduction of symptoms. (J Manipulative Physiol Ther 2005;28:199-204)

Key Indexing Terms: *Low Back Pain; Compartment Syndromes; Fasciotomy; Musculoskeletal Manipulations; Graston Technique*

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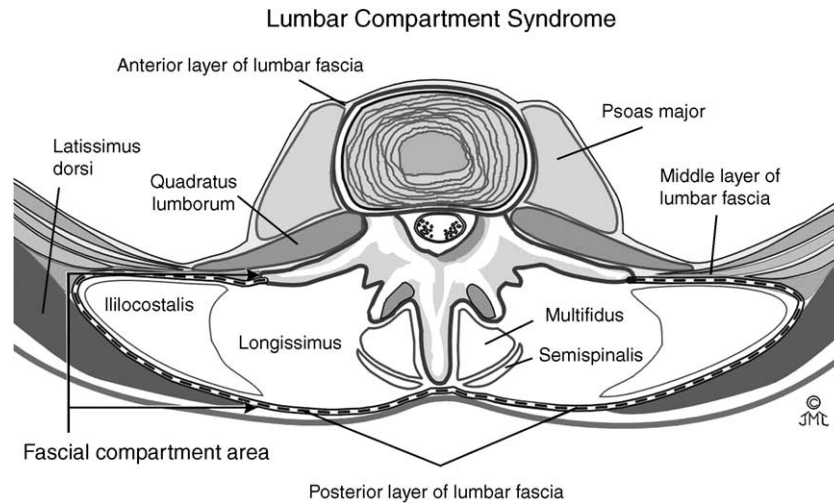It has been established that pain due to compartmental pressure occurs in various areas of the human body.[1-4] Compartment syndrome is defined as,[5] "…a condition in which increased pressure in a confined anatomical space adversely affects the circulation and threatens the function and viability of the tissues therein." The posterior and middle layers of lumbar fascia create a compartment that bounds the erector spinae muscles. Most of the case reports dealing with lumbar compartment syndromes describe an acute lumbar pain syndrome associated with elevated creatine kinase, the presence of urinary myoglobin, and muscle edema appearing on Mifi scan.[6-8] A prior case report describes successful management of acute lumbar paraspinal compartment via surgical fasciotomy.[7]

Paraspinal muscular pressure has been found to be highly increased in the flexed standing position with loading in normal control groups and significantly higher in patients with osteoporosis, degenerative spondylolisthesis, lumbar compartment syndrome, and previous lumbar spine surgery.[9] Lumbar paraspinal muscle pressure has also been found to be significantly higher in subjects with disk herniation than in controls when a straight leg raising test was performed.[9] It is proposed that some cases of low back pain may be related to this overlooked condition related to increased compartment pressures.

Dissections in the lumbar region confirm a clearly defined, well-developed compartment consisting of the erector spinae muscles encased by the posterior and middle lamellae of the lumbodorsal fascia.[6] The posterior layer of the lumbar fascia is composed of a superficial and deep layer that covers the iliocostalis, longissimus, and multifidus muscles (Figs 1 and 2).[10,11] Barker[10] demonstrated by dissection, for the first time, the connection of the posterior lumbar spinal fascia superiorly with the splenius muscles. She found that the superficial fascial layer in the lumbar area maintained a cross-hatched arrangement of fibers to T12,

Lumbar Compartment Syndrome

Fig 1. *Posterior lumbar fascial compartment surrounded by the posterior and middle layer of the lumbar fascia. The posterior layers originate medially from the lumbar spinous processes and interspinous ligaments and wrap around laterally to join the lateral raphe, the dense union where the posterior and middle layers meet. The middle layer provides the fascial anterior border of the erector spinae muscles as it attaches to the tips of the lumbar transverse processes and is directly continuous with the inter-transverse ligaments.*

whereas the deep fascial layer fiber angles were more consistent in angular alignment. Barker[10] concluded that the posterior fascial layer generated tension in tests involving movements of the entire spine, head, and limbs.

Bogduk and Twomey[12] describe bands of collagen fibers passing from the L4 and L5 spinous processes to the posterior superior iliac spine and lateral raphe ("posterior accessory ligaments") making up part of the deep posterior fascial layer. The quadratus lumborum muscle lies anterior to the middle layer. Peck et al[13] demonstrated the connections of the posterior fascia by injecting dye into the paraspinal compartment at various levels of the spine. They found that the dye traveled freely along a compartment between the occiput and sacrum, staining paraspinal muscles including multifidus, splenius cervicis, and capitis muscles.

Vleeming et al[14] demonstrated how traction to the biceps femoris caused displacement of the deep lamina up to the level L5-S1 as load transfer occurred by way of the sacro-tuberous ligament. They noted how tension of the posterior layer of the thoracolumbar fascia was influenced by contraction or stretch of a variety of muscles, especially the latissimus dorsi and gluteus maximus. These tissues are responsible for what is known as the "force closure" of the sacroiliac joint.

Bogduk and Twomey[12] found that a significant function of the posterior layer of the thoracolumbar fascia was that it resisted the normal expansion by its increased tension during contraction of the lumbar muscles. They stated that contraction of the lumbar back muscles increases the tension in the posterior layer thereby enhancing the antiflexion functions of the thoracolumbar fascia. This phenomenon is called the hydraulic amplifier mechanism.[15]

The posterior spinal fascia passively restricts forward bending. It was found that intramuscular pressures were dependent on posture. Kyphotic back posture produced intramuscular pressures of 120 to 130 mm Hg, compared with the 10 to 25 mm Hg produced when volunteers were in the erect position.[16] Hukins et al[17] propose that the lumbodorsal fascia increases the force per unit of the erector spinae muscles by limiting the bulging of the muscles when they shorten.[7]

This case demonstrates reduced pain and improved range of motion in a patient with lumbar compartment syndrome after instrument-assisted soft tissue mobilization using the Graston technique (GT).

CASE REPORT

A 59-year-old man complained of intermittent lumbar pain of 2 weeks' duration. He worked as a shoe salesman and became aware of his pain especially in the flexed lumbar position. His pain became severe every 2 to 3 months for the ensuing year, causing him to miss work 2 to 3 days at a time. Usually, bed rest and analgesics provided relief. This time his pain continued and although bed rest still relieved him, the pain persisted especially when he flexed forward. Bending backward relieved his pain. He denied any radiation of pain to the buttocks or lower extremities. The patient had no medical history significant to his presenting symptoms. Lower extremity motor strength, reflex, and sensory test results were negative.

The patient's posterior spinal fascia was stressed by passively flexing the spine in the sitting position, beginning
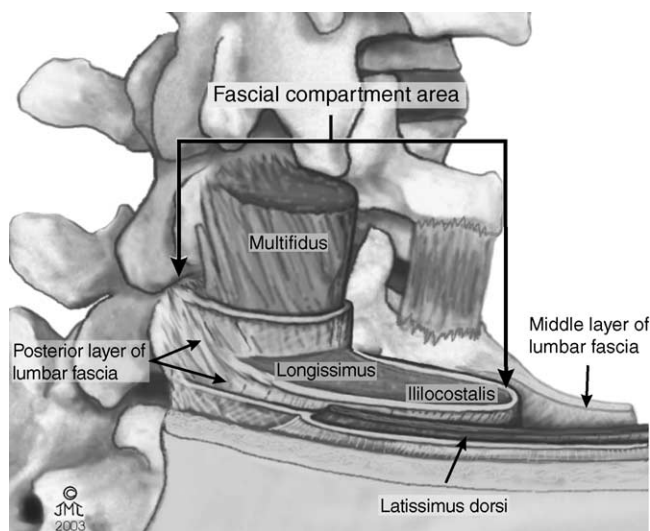
Fig 2. *Three-dimensional view of the posterior lumbar fascial compartment.*

Fig 3. *Passive flexion and right rotation of the spine to determine areas of involvement.*

Fig 4. *Use of a Graston instrument along the paralumbar fascia.*

Fig 5. *Use of a Graston instrument along the hamstring fascia.*

with the cervical spine and bending the entire spine in a variety of directions (flexion, lateral bending, rotation) creating tension down to the left lower thoracic paralumbar areas (Fig 3). The purpose of the passive stretch was to detect shortening with the expression of pain and/or abnormal tension. In this case, cervical and thoracolumbar flexion and right rotation created abnormal tension caudally to the T12-L2 level on the left side. The same forward motion with left cervical and thoracic rotation created abnormal tension at the medial right scapula and right paralumbar L4-Sl levels. Passive forward flexion evaluated in the standing position caused a complaint of sacral and hamstring pain and tension. Supine evaluation for restrictive

tissue revealed shortening of his hamstrings bilaterally with tightness and palpable restriction at 70° and shortening of the external hip rotators on the right. Ober's sign was negative bilaterally, and the triceps surae and hip adductors demonstrated normal extensibility.

The patient's superficial and deep fascia was evaluated and treated by the GT at the areas of complaint found during the flexion tests and at other related fascial areas that demonstrated restriction. In addition to treating the posterior fascia by the GT (Fig 4), the fascia overlying the hamstrings bilaterally (Fig 5), sacrum (Fig 6), and right hip lateral rotators were also treated. Immediate postfacilitation stretch was applied to the involved areas and taught to the patient to continue at home (Fig 7).[18] Two sets of 3 stretches were recommended twice a day. These exercises are contraindicated in the morning because of increased disk fluid content. According to McGill,[19] disk-bending stresses are increased by 300% and ligament stresses by 80% in the morning compared with the evening.

After 6 visits at 2 visits per week the patient was discharged. He was asymptomatic and able to actively and

Fig 6. *Use of a Graston instrument for local release of tissue in the lumbosacral area.*

passively flex in all directions without feeling any spinal restrictions or pain. The functional flexion tests were normal. Hamstring flexibility and flexibility of the right external rotators demonstrated significant improved range of motion.

Discussion

It is not uncommon to see patients with low back pain whose symptoms are increased by exercises or activities involving repetitive forward flexion and are relieved by rest and backward extension. Often, these patients do not have neurologic deficits in their lower extremities. Styf and Lysell[20] mention these symptoms in a diagnosis of "chronic compartment syndrome" in the erector spinae muscle. The treatment described was fasciotomy of the erector spinae muscles which normalized the intramuscular pressure. A microcapillary infusion technique recording the patient's intramuscular pressure during exercise was used. In another study, Songcharoen and Thanapipatsfri[21] measured the paraspinal compartment pressure by a slit catheter system connected to a pressure transducer. The paraspinal lumbar muscle pressure was not directly measured in this study, but as previously noted, there is a pressure increase in the normal flexed lumbar position and a "significantly" increased amount in patients with osteoporosis, degenerative spondylolisthesis, lumbar compartment syndrome, and previous lumbar spine surgery.

To determine the cause of spinal pain, it is necessary to pay increased attention to the passive structures that can be evaluated and treated by manual methods. The posterior layer of the lumbar fascia is connected caudally to the fascia which encloses the sacrum, glutei, hamstrings, and gastrocnemius muscles, and superiorly to the fascia enclosing the erector spinae, latissimus dorsi, and rhomboids up to the occiput by way of the tendons of the splenius cervicis and capitis.[11] By way of the interspinous-supraspinous-thoracolumbar ligamentous complex,[22] a direct connection has been shown between the
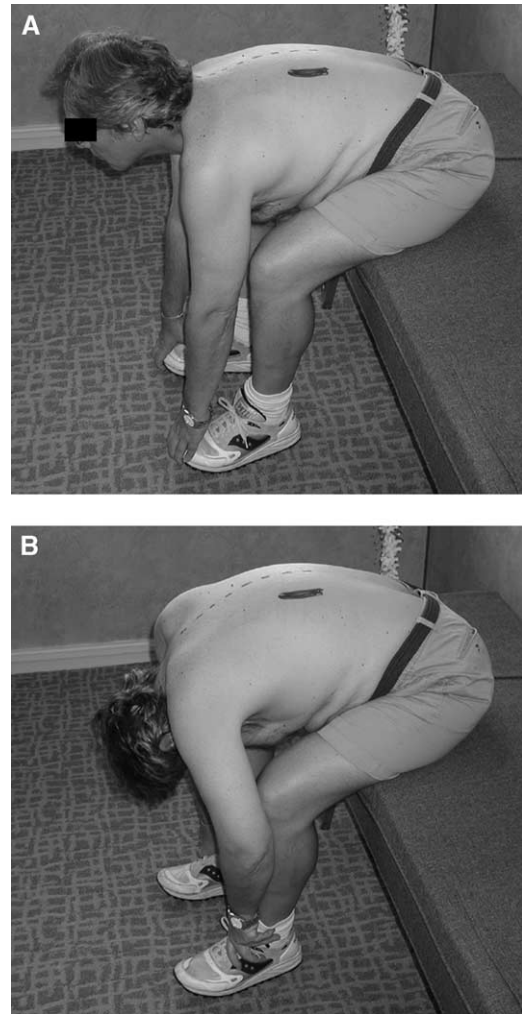
Fig 7. *Postfacilitation stretch for the erector spinae. The patient flexes forward and pulls his toes with his arms while extending his head and spine to feel his posterior spinal muscles to contract. He holds this position for 7 seconds (A). Next (B) the patient flexes forward and holds the stretch for 12 seconds.*

thoracolumbar fascia and multifidus sheath to the facet joint capsules. It is theorized that "freeing" posterior lumbar fascia and its connections both superior and inferior could also result in easing the pressure on lumbar facets. As the multifidus muscles and the facet joints are innervated by medial branches of the posterior rami, facet joint pain may produce a reactive constriction that increases intramuscular pressure, temporally decreasing blood to the multifidus muscles.[9] Restricted posterior lumbar fascia may have a direct effect on increasing the compartmental pressure of the erector spinae muscles. Fascial restriction likely increases intramuscular pressure in the erector spinae muscles.

There are several tests for screening for shortened erector spinae. First, the patient may sit at the end of a table with the knees flexed at the edge to relax the

Fig 8. *Flexion test to determine restriction of the posterior fascia. Practitioner's hands on the iliac crest should not move until the patient's head reaches 8 in from his thigh.*

Fig 9. *Hump test: patient attempts to create a local lumbar kyphosis while holding down the iliac crests. Failure to create a kyphosis indicates restricted posterior lumbar fascia.*

hamstrings. The examiner places his/her hands flat on the lateral iliac crests with the thumbs on the posterior iliac spine. The patient is told to flex the neck first and curl the body forward, starting with the head progressing forward followed by flexion of the thoracic and lumbar spine. As soon as the examiner feels the pelvic movement, the patient is asked to hold his/her position. If the distance between the patient's knees and forehead is less than 8 in (15-20 cm), then the back extensors are considered short (Fig 8).[23] Lewit[24] says that this test may be invalidated because a patient with a short trunk and long thighs may give a false-negative result, whereas if the patient has a long trunk and short thighs there may appear a false-positive result. Some only consider the posterior fascia shortened if the iliac crests move anteriorly almost immediately after the patient flexes rather than waiting for iliac movement before the head is 8 in from the thighs.[23] Lewit[24] prefers a test where a seated patient fixes his/her pelvis by placing the hands on the iliac crests and flexes ("humps") his/her lumbar spine. If the lumbar erector spinae are shortened, no lumbar kyphosis is created (Fig 9).

The GT is a patented instrument-assisted soft tissue mobilization diagnostic and therapeutic technique developed approximately 10 years ago. The Graston instruments are made from stainless steel designed with a unique curvilinear edge, contoured to fit various shapes on the body. These instruments were developed as an alternative to transverse friction massage. The rationale for using the GT is based upon the rationale for using manual soft tissue mobilization as proposed by Cyriax.[25] Cyriax used deep friction massage to affect soft tissues.

According to Norris,[26] the purpose of frictional massage is to promote a local hyperemia, massage analgesia, and reduction of scar tissue. In addition, it has been hypothesized that frictional massage may facilitate tendon healing by augmenting the inflammatory process to completion so the late stages of healing can occur.[27]

Further support for this theory was demonstrated by Davidson[28] who found that soft tissue mobilization using Graston procedures significantly promotes increased fibroblast recruitment. Gehlsen[27] also found that application of heavy pressure using Graston instruments promoted the healing process as measured by fibroblast response to a greater degree than light or moderate pressure. Treatment components using the GT also include pretreatment warming of the area and also emphasize the importance of posttreatment passive and active stretching exercises targeting the restricted tissues.

The GT plus stretching of the involved areas is promising in the treatment of subacute lumbar compartment syndromes. The GT provides a controlled microtrauma to the involved areas. It is possible that the stainless steel instruments used in the GT enhance the palpatory skill of the practitioner as he/she glides them over the surface of the patient's superficial and deep fascia. The instruments may also provide a mechanical advantage to the clinician, allowing deeper penetration and possibly greater specificity. Often, the area becomes hyperemic with petechiae formation. This reaction represents the stimulation of a local inflammatory response which can lead to remodeling and repair of the area. It is accepted that fibroblastic stimulation and an inflammatory reaction, cytoskeletal remodeling, altered ion transport, and diminishing of cell-matrix adhesions occurs with mechanical loading on soft tissue.[28-32] It appears that the formation of fibroblasts by mechanical load is the main effect as the repair and maintenance of connective tissues are performed predominately by the mesenchymal cell, the fibroblast.[33]

Posttreatment stretching and strengthening are necessary to provide the forces for adaptive remodeling of new collagen in the affected areas. Toyoda[34] found that chondrocytes when loaded align to the direction of the tensile load by reconstructing their cytoskeleton. The tensile

load also resulted in an increase in proteoglycan synthesis and collagen synthesis in the extracellular matrix.

CONCLUSION

This case describes the treatment of a patient with subacute lumbar compartment syndrome using the GT. Previous descriptions of treatment for this syndrome involve surgical intervention to normalize intramuscular pressures. In this case study, it is hypothesized that intramuscular pressures were normalized after instrument-assisted soft tissue mobilization and stretching. Future prospective research is needed to quantify lumbar compartmental pressures before and after intervention.

ACKNOWLEDGMENTS

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