A Scientific Rationale for Treating Lumbar Facet Joint Dysfunction with Physical Therapy

The ever-increasing number of spine related disorders along with limited funds available to treat spinal disorders, has lead to the development and implementation of evidence-based medicine. Third party payers have used evidence-based practice (EBP) to force clinicians to prove the efficacy of their interventions, if they were to be paid for their interventions. This has lead to a hierarchy of evidence, with randomized controlled trials (RCT’s) and systematic reviews of RCT’s as the “highest” forms of evidence. In developing a best-evidence approach for the efficacy of physical therapy (PT) in treating lumbar facet joint dysfunction, EBP would require us to search for the systematic reviews and RCT’s. The main problem with this is that PT, although utilized successfully in various forms of LBP, does not target a specific tissue. Whereas procedures such as medial branch blocks can be very specialized and precise, especially with the visual feedback using fluoroscopy, treatments such as spinal manipulation, exercise, traction and more have shown efficacy in treating LBP, their effect on a precise tissue such as intervertebral disc (IVD), facet joint, muscle or ligament is unknown. To develop a scientific rationale for PT treatment for lumbar facet joints, it is suggested that clinicians view the patho-anatomy of lumbar facet joints, their clinical presentations and the effect of PT on these pathological changes and clinical presentations.

The lumbar spine consists of 5 paired, 10-total facet joints. These joints are synovial joints and anatomically consist of:

1. Superior and inferior articular processes. These processes are lined with hyaline cartilage, which serves as load-bearing surfaces. The hyaline cartilage is dependent on movement, more precisely compression and distraction to maintain adequate nutrition to the cartilage. The articular surfaces are avascular through diffusion, via movement, allows nutrition to flow from mainly the synovial fluid inside the facet joint to keep the cartilage healthy. Numerous studies have shown that in the absence of movement, articular cartilage in the lumbar facet joints will imbibe more fluid, cause the articular cartilage to swell and ultimately lead to articular splitting and wearing of the cartilage, potentially exposing the subchondral bone-plate, which is highly innervated and a potential cause of facet joint pain, especially on weight-bearing. The fact that articular cartilage is dependent on movement to keep it healthy and hydrated would imply that
movement-based treatments such as spinal mobilization (level-specific, oscillating compression and distraction techniques on the facet joints) and exercises aimed at creating movement of the lumbar spine may be of benefit in treating lumbar facet joints. A recent cadaver study on patients that did not survive car accidents, by dissecting the lumbar spines, have shown that > 70% of these facet joints showed damage, none of which were shown on standard lumbar X-rays, pre-dissection\(^\text{12}\). These joints showed damage (articular splitting and swelling) of the facet joints. It could be argued if these patients survived the accidents, and after subsequent X-rays, may have been referred to PT. Treatments aimed at allowing normal movement, along with compression/distraction techniques would more than likely allow the injured cartilage receive much needed nutrition, which may/may not correlate to decreased pain and increased function. The facet can be viewed the same as swollen, inflamed knee joint. Best evidence would require early, gentle movement to a “swollen, hot” knee. The same may apply to lumbar facet joints.

Recent MRI studies have implicated facet joint swelling in LBP populations.\(^\text{13}\) The authors argue that increased mechanical loading on facet joints, along with degenerative changes cause swelling in facet joints, which can be readily detected on MRI, compared to uninjured levels and normal healthy volunteers.\(^\text{13, 14}\) These studies would imply that injured and degenerated facet joints are swollen, which I turn makes an added case for the potential of movement based strategies such as mobilization and exercise to decrease joint swelling and thus pain.

2. Capsule. The articular surfaces are surrounded by a thick, fibrous capsule, which encapsulates the synovial fluid, which is critical to maintain nutrition of the articular cartilage (see above). The collagenous capsule allows for normal movement in various planes. As with any other collagen, it responds well to slow movements as well as sustained movements. The capsule, however, does not respond well to sudden movement. Sudden movement of the lumbar spine, especially at end-ROM, may result in tearing of the collagen.\(^\text{12}\) This could be compared to an ankle sprain, where sudden movement causes different degrees of collagen damage (grade I, II or III). The injured tissue (capsule) will go through the normal phases of healing: inflammation, scarring and remodeling. In ankle sprains, early movement and subsequent progressive load is applied to the ligament to help the ankle heal. Basic sciences would imply that progressive exercises towards the end-ROM of the joint (flexion and extension) may help keep the capsule “stretched out” – which in turn allows normal movement of the joint, adequate synovial fluid flow and thus healthy cartilage (see above).\(^\text{4}\) Also interesting to note is that recent studies have implicated facet joints in the development of lumbar radiculopathy.\(^\text{15}\) In the past inflammatory properties of the IVD have been implicated in the pathogenesis of lumbar radiculopathy due to chemical activation of the dorsal root ganglion.\(^\text{16, 17}\) Tachihara et al, in discussion of the possible causes of lumbar radiculopathy due to lumbar facets, implicates (amongst other potential causes), the facet joint capsule. Movement-based approaches aimed at capsular healing may thus potentially also have an effect on lumbar radiculopathy due to facet joint irritation.
a. Multifidus. In the lumbar spine, the facet joint capsule is reinforced by the multifidus (MF). The lumbar multifidus along with the transverses abdominus (TA) are very important in the spinal stabilization mechanism. In normal, healthy people, MF and TA fires prior to the use of the upper and lower extremities (feedforward control) to allow a person to lift/use the extremity without causing unwanted stress on the local spinal levels. In LBP populations, this feedforward mechanism is altered (delayed), which leads to increased stress on the local spinal level. MRI studies have shown that MF atrophy is side and level-specific, as well as non-pathology specific. This may in essence implicate the facet joints, based on the fact that the MF receives its nerve supply from the dorsal ramus, which also innervates the local facet joint.

Spinal stabilization, by virtue of retraining the feed-forward, co-contraction of the TA and MF may work by abolishing the unwanted stress on the local spinal level, including facet joint. Numerous studies have shown the benefit of spinal stabilization in treating LBP.

An analogy to the facet joint capsule laxity/instability would be a medial collateral ligament (MCL) injury. Injury to the MCL causes the knee to have increased joint play and valgus, thus causing additional painful excursion and loading of the knee joint. To help compensate for the MCL and the knee’s lack of stability, PT will often strengthen the quadriceps, specifically the vastus medialis (VMO) thus utilizing more motor control to take unwanted stress off the knee, allowing it to heal and protecting it from further damage (especially in the healing phase). Could this be the same for MF? By retraining MF (along with TA), the facet joint’s stability could be enhanced, take unwanted stress off the pain-sensitive joint, thus helping control and manage the patient’s LBP.

b. Ligamentum flavum. In the lumbar spine, the part of the facet joint is reinforced by the ligamentum flavum (LF). The LF consists of a high concentration of elsatin fibers, allowing it to always be taught, thus not allowing it to “buckle” into the spinal canal, causing neurovascular compromise. Apart from bony changes to the lumbar vertebrae (bone spurs, vertebral compression) and age-related changes to the lumbar disc the LF has been implicated in the development of degenerative lumbar spinal stenosis. With aging, the LF becomes thicker and less elastic. This allows for a steady encroachment of the spinal canal – hence degenerative spinal stenosis. Spinal stenosis is a progressive disorder and clinical presentations may vary from mild to moderate to severe. Patients with minimal to moderate spinal stenosis often get’s referred to PT for conservative management. A recent systematic review have shown that PT is very effective in treating mild to moderate degenerative spinal stenosis:

i. Treadmill or cycling with body weight support. It could be argued that aquatic exercise that mimic such activities, or an underwater treadmill could potentially provide similar results

ii. Lumbar traction

iii. Flexion exercises
iv. Manual therapy

3. Nerve supply. A final potential mechanism for pain relief from PT for facet joint pain may be the same nerve supply that implicates the utilization of medial branch blocks and radiofrequency. The lumbar facet joint receives innervation from the medial branch of the dorsal ramus. All of the research into spinal stabilization, feedforward control and the immediate effect of pain on the size and contraction of the MF had lead researchers to ask if treatments aimed at a spinal level may have a neuro-physiological effect on the local muscles and thus create a mechanism of pain control. A recent pilot study examined the immediate effect of spinal manipulation (high-velocity, small amplitude) technique on the local stabilizing muscles utilizing diagnostic ultrasound. This preliminary study showed that immediately post-manipulation, that the TA had an immediate statistically significant increase in size in 8 out of 9 patients when asked to perform a deep corset control maneuver. This study showed an immediate neuro-muscular effect of a spinal manipulation, which led to a better quality contraction of the stabilizing muscles, associated with protecting the local facet joint.

The previous passages are aimed at developing a theoretical model for the efficacy of treating facet joint based pain with movement-based approaches utilized in physical therapy. It is interesting to note that each and all of these mechanisms described above are all inter-related – stabilization, movement, motor control and pain relief. These “anatomical” and “biomechanical” models described above do not take into account additional potential benefits of PT intervention on a more cerebral level. New research into pain science education utilized by physical therapists (aimed at explaining a patient’s pain to them, decreasing fear, explaining the biology behind their pain) have shown significant changes in regards to pain beliefs and attitudes, improved cognition and physical performance, increased pain thresholds and improved outcomes from therapeutic exercise. Improved understanding of pain science or neurophysiology may also lead to a decrease in the fear and anxiety associated with spinal surgery, and could potentially result in better outcomes related to decreased pain and improved function.

The aforementioned passages also make for another case: the importance of the relationship between a good manual physical therapist and a physician able to help with diagnostic labeling, testing and pain management. The effect of pain is well-known. Treatments such as radiofrequency and medial branch blocks may be able to help decrease pain associated with a local facet disorder, while the patient (now with less pain) may benefit from physical therapy aimed at restoring normal movement and function along with decreasing fear associated with the injury.

References

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Pictures: Images courtesy of Dr. Lance Twomey (with permission)
Normal facet joint.
Note the medially placed (thick) ligamentum flavum

Lumbar facet s/p MVA – note the capsule damage and potential laxity