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# The Role of the Iliolumbar Ligament in Low Back Pain

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Abstract — Low back pain is caused by a variety of etiologies. Some clinicians have postulated that much low back pain is due to trauma to the iliolumbar ligament. The iliolumbar ligament is one of the three pelvic-lumbar ligaments and develops during the 12th week of gestation. The iliolumbar ligament appears to be a major stabilizing component between the vertebral spine and the pelvis. The innervation of the iliolumbar ligament appears similar to the posterior lumbar ligaments. Our hypothesis is: micro-trauma to the iliolumbar ligament is the primary cause of many cases of chronic low back pain because (1) it is the weakest component of the multifidus triangle; (2) there is increased susceptibility to injury due to its angulated attachment; (3) it is a primary inhibitor of excess sacral flexion; (4) it is a highly innervated nociceptive tissue; and (5) it plays an increased role with progressive disc degeneration.

## Introduction

Low back pain can be caused by a variety of etiologies. Most research emphases have been on the intervertebral discs and their potential effects on adjacent nervous system structures. Accurate diagnosis of the cause of back pain is difficult because the vertebral column is a multi-segment, multi-functioning unit. Compounding this difficulty is the theory of hyperconvergence (1) which says that in the lumbar region of the spinal cord most nociceptive interneurons in the lateral border of the dorsal horn receive somatosensory input from many different deep tissues and from the skin of the low back, hip, and proximal leg.

Recently, clinicians in the practice of physical medicine have postulated that much low back pain is due to trauma to the iliolumbar ligament. However, in the past, very little attention had been paid to the iliolumbar ligament and its clinical importance remains unknown. Our hypothesis is: micro-trauma to the iliolumbar ligament is the primary cause of many cases of chronic low back pain. Repetitive micro-trauma (occupational), acute strain, and/or poor posture (e.g. due to obesity) might push the iliolumbar ligament past its physiologic limit, creating a physical state conducive to chronic low back pain. These types of trauma to the illolumbar ligament could be the direct cause of the chronic low back pain. In addition, edema and/or scarring of the iliolumbar ligament could

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cause entrapment of dorsal rami of spinal nerves exacerbating the chronic low back pain (2).

## Epidemiology of low back pain

The impact of back pain on society is staggering. Back pain is the second leading cause of work absenteeism (after upper respiratory complaints) and results in more lost productivity than any other medical condition (3). The lifetime prevalence of back pain exceeds 70% in most industrialized countries. National statistics from the USA indicate a one-year prevalence rate of 15–20%. Back pain is the third ranking reason for surgical procedures and fifth most frequent reason for hospitalization. About 1% of the US population is chronically disabled because of back pain each year.

Data from the National Center for Health Statistics show that 14.3% of new patient visits to the physician are for back pain. The highest prevalence of back pain is in the 45–64 age group. Rates were also higher for whites (16.5%) than for any other group. The primary site of pain was the low back (85.1%). The mean days of restricted activity due to back problems were 23.5, with eight days completely lost from work. Most episodes of low back pain resolve spontaneously within the first two weeks, and a minority take 6–12 weeks. Only 1–2% should require evaluation for operative management.

Back pain is a disorder with many possible etiologies. Many different risk factors have been studied in an attempt to isolate major causes of back pain. But there is no dominating consensus, and many conclusions are conflicting. Physical factors associated with increased risk of low back pain include heavy work, lifting, static work positions (prolonged sitting and standing), bending and turning, and vibration. However, it has been suggested that psychologic risk factors are more predictive than any of the physical risk factors, i.e. monotony at work, job dissatisfaction, and poor relationships with coworkers.

Low back pain due to organic changes in the structures of the lumbosacral region of the vertebral column might arise from any or all of the structures (1). Most of the spinal ligaments are innervated and therefore potential sites of back pain (4–7). However, it is the intervertebral disc that has been the center of attention in studies of etiologies of back pain. Studies have been done to determine the biomechanical properties of spinal ligaments, but the role of spinal ligaments, especially the iliolumbar ligament, in the etiology of low back pain, is still unclear (8–10). One manifestation of injury to the structures associated with that of the vertebral column might be abnormal motion patterns under physiologic loads (11). However, documenting changes in motion patterns of the vertebral column is difficult because movement of the vertebral column is three-dimensional.

## Development

Until recently, the iliolumbar ligament was thought to develop during late childhood or adolescence from stress-induced metaplasia of the quadratus lumborum muscle (12). However, in studies of fetuses aged 5.5 weeks to term, the iliolumbar ligament was found to develop during the 12th week of gestation (13). At later times, the iliolumbar ligament was always easily distinguishable from the quadratus lumborum muscle by the different craniocaudal direction of the muscle fibers. In addition, both the anterior and posterior bands of the ligaments could be identified but never in the same section.

## Anatomy

The iliolumbar ligament is one of the three pelviclumbar ligaments. The other two ligaments are the sacrotuberous and the sacrospinous ligaments.

Anatomical descriptions of the iliolumbar ligament vary greatly. Bogduk and colleagues (14) describe the ligament as consisting of five parts, whereas *Gray's Anatomy* describes the ligament as consisting of three parts.

Most recently, Hanson and Sonesson (15) performed detailed studies to determine the anatomy of the iliolumbar ligament. They dissected 100 cadavers, chosen at random, from newborns to the age of 90 years. All specimens came from routine autopsies. The ages ranged from newborn to 90 years. However, half the specimens were in the group newborn to 10 years old.

The classical descriptions of the ligament include a portion attaching to the transverse process of the L4 vertebra. No evidence of this part of the ligament could be found in the 100 cadavers used in the study. In the adult, the anterior band of the ligament was broad, flat and approximately 30–40 mm long, 5–10 mm wide, and 2–3 mm thick. It originated from the antero-infero-lateral part of the transverse process of L5 and inserted into the upper part of the iliac tuberosity. The posterior band of the ligament was considerably shorter and thicker (almost entirely round), 10–12 mm long, and a diameter of 5–7 mm. It also originated from the antero-infero-lateral part of the transverse process of L5. It inserted below the medial part of the iliac crest or the anterior part of the iliac tuberosity. However, the posterior band

of the ligament attached superior to the anterior band of the ligament.

## Innervation

The innervation of the structures of the lumbar region of the vertebral column is of fundamental importance to those treating low back pain. Little is known about the innervation of iliolumbar ligament since most literature concerning the innervation of the structures of the lumbar region of the vertebral column lack mention of innervation of the iliolumbar ligament. However, we may postulate that the innervation of the iliolumbar ligament is similar to that of the posterior lumbar ligaments.

The dorsal compartment of the lumbar region of the vertebral column contains the vertebral arches, their joints and ligaments, and the intrinsic back muscles. These structures are innervated by dorsal rami of lumbar spinal nerves (4). The dorsal rami of L1–L4 arise from their spinal nerves and pass dorsal through the intertransverse spaces, each entering the dorsal compartment through a foramen in the dorsal leaf of the intertransverse ligament.

The dorsal rami of lumbar spinal nerves are said to each have three branches: a medial, an intermediate, and a lateral branch. The principal distinction among the three branches is their muscular distribution. The skeletal distribution of the dorsal rami of lumbar spinal nerves is through each medial branch. Each medial branch curves around the root of a superior articular process and passes through a notch bridged by the mamillo-accessory ligament. Branches then arise which innervate the posterior ligaments and zygopophyseal joints.

The lumbar posterior ligaments are known to be highly innervated. Immunostaining procedures have been used to study the histology of the supraspinous ligament, interspinous ligament, ligamentum flavum, and the lumbodorsal fascia (6,7). Specific immunoreactivity to neurofilament was observed in all consecutive tissue sections of ligaments examined. In the ligamentum flavum, nerve fibers were distributed most numerously around blood vessels. Nerve-like structures were also found in the supraspinous ligament, interspinous ligament, and lumbodorsal fascia. However, no specialized nerve terminals such as Ruffini and Pacinian corpuscles were found using this technique. However, in other studies (5) using a gold chloride impregnation method, Paciniform corpuscles, Ruffini end organs, Ruffini receptors, and very fine free fibers were found in spinal ligaments. The function of these mechanoreceptors is thought to be to monitor proprioceptive information and to signal potentially injurious deformation of the ligaments and joints.

Needless to say, if the iliolumbar ligament is similar to the other ligaments in the lumbar region of the vertebral column, it should be highly innervated.

## Biomechanics

The biomechanics of the vertebral column has been a subject of much research. However, only a small number of studies have dealt with the biomechanics of the iliolumbar ligament.

The iliolumbar ligament appears to be the major stabilizing component between the vertebral spine and the pelvis. Comparative anatomic studies in quadripedal mammals (rats, rabbits, dogs, and monkeys) have shown that this ligament is only present in animals that assume an erect posture (9). The evolutionary development of this ligament was probably directly related to the stress created across the lumbosacral joint in this posture. The direction in which the two bands of this ligament run suggests that they serve different functions in the stability of the lumbosacral junction. The anterior band is probably important in maintaining the L5 vertebra centered over the sacrum. The posterior band might prevent anterior shear of L5 on the sacrum.

The function of the iliolumbar ligament in stabilization of L5 on the sacrum has been assessed during flexion, extension, torsion, and lateral bending of the lumbar region of the vertebral column (9). During flexion, the iliolumbar ligament significantly limits anterior displacement of L5. When the ligament was divided bilaterally, there was significant increase (77.5%) in anterior deflexion of L5. The posterior bands alone accounted for the majority (61.2%) of the increase. The anterior bands of the ligament contributed only a small amount to anterior stability of L5. During extension, there was also a significant increase (20.41%) in deflexion of L5 after bilateral division of the ligament. The anterior bands contribute all of the stability during extension. During torsion, the division of the ligament did not produce much change in deflexion of L5. Both bands together contributed a 5.3% restriction in torsion. During lateral bending, bilateral division of the ligament results in a dramatic increase (141.7%) in deflection of L5 during contralateral lateral bending. Much of this increase can be attributed to the anterior bands. These results suggest that the iliolumbar plays the least role in limit displacement of L5 on the sacrum during torsion. More important, this suggests that other structures are primarily responsible for limiting displacement of L5 during torsion.

It has been suggested that torsion injury is mainly responsible for intervertebral disc rupture and degeneration (8,10). It has also been suggested that, because of the presence of the iliolumbar ligament, the L4–L5 joint is more susceptible to torsion injury than the L5–S1 joint. The biomechanics research suggests that with increasing disc degeneration, the iliolumbar ligament appears to have a more significant role in stabilizing the lumbar region of the vertebral column and the anterior band might become more important in restraining forward flexion of L5 on the sacrum.

## Conclusions

Most of the patients with chronic back pain fall into the category of idiopathic low back pain. This category includes low back pain in which no specific pathology can be detected by X-ray, laboratory tests, or biopsy. Clinical presentation is the only means of distinguishing between different etiologies.

Hirschberg (16) describes such a syndrome – called the iliolumbar syndrome – in which the patient reports spontaneous pain, pain on exertion, and pain on the posterior aspect of the iliac crest. In the typical case, the patient complains of unilateral, localized pain on the posterior iliac crest. The most common complaint is of pain after prolonged standing or sitting, or for a brief period upon getting out of bed. The pain can vary from severe to a dull ache. The patient is usually able to put a fingertip on the exact site of pain. Increased pain upon lateral bending to the unaffected side is also a characteristic of iliolumbar syndrome. The patient typically has no neurologic deficits. The relief of all signs and symptoms after injecting the affected ligament's attachments is confirmation of the diagnosis.

There is controversy over whether an iliolumbar syndrome exists. Many contend that the ligament plays a very small role, if any, in the cause of low back pain. However, others believe it is the most common cause of permanent or recurrent low back disability (16). We believe this premise is valid because of the clinical and physiologic data to support it. We will discuss five concepts that support the high probability of the iliolumbar ligament as a cause of low back pain.

1. *The iliolumbar ligament as a stabilizer in the 'multifidus triangle'.* The multifidus triangle is created by the ilium and its articulation with the pelvis, the sacrum and its articulation with the fifth lumbar vertebra, and the attachment of the fifth lumbar vertebra back to the ilium via the iliolumbar ligament (17). The function of the triangle is to add stability to the lumbosacral joint. Without the iliolumbar ligament, there would be decreased stability of the vertebral column in relation to the pelvis. All of the tissues of the triangle are potential nociceptive sites. However, by virtue of its anatomy, the iliolumbar ligament is the weakest part of the triangle.

2. *Increased susceptibility to injury of the iliolumbar ligament due to its attachment.* A ligament attached to a bony surface at an angle might not be as strong as a ligament attached parallel to a bony surface (18). This would be due to the decreased surface area available to form fibrous interactions, thus decreasing strength. The iliolumbar ligament attaches to the ilium at approximately a 45° angle. The weight of the entire upper body is concentrated at the L5–S1 vertebral junction and accentuated during flexion and lateral bending, thereby further stressing the ligamentous junction.

3. *The iliolumbar ligament as a primary inhibitor of excess sacral flexion.* The axis of rotation for the entire vertebral column in relation to the pelvis is at the sacroiliac joints (17). This is a horizontal axis running between the upper articulation of both sacroiliac joints. Three sets of ligaments limit and restrict excess rotation of the sacrum around this axis; the sacrotuberous, sacrospinous, and iliolumbar ligaments. The sacrotuberous and sacrospinous ligaments lie inferior to the sacroiliac joints and limit posterior movement of the inferior pole of the sacrum. The iliolumbar ligament limits excessive anterior movement of the superior part of the sacrum. Body weight transmitted inferiorly through the vertebral body of L5 tends to rotate the sacrum anteriorly due to gravity and the normal lumbar lordotic curve. As the sacrum tilts anteriorly, the fifth lumbar vertebra tends to displace anteriorly. Resisting this motion, is a primary function of the iliolumbar ligament. Any compressive trauma to the spine poses a possibility of straining the site of supportive ligaments. Common mechanisms of injury (e.g. a fall on the buttocks, stepping off a curb, or lifting excessive weight in the flexed position) describe this type of trauma to the lumbosacral junction. This might explain obesity as a cause of back pain; the excess weight anterior to the sacral axis has a lever affect on the superior sacrum.

Of the three sets of stabilizing ligaments, the iliolumbar is the weakest and more susceptible to excess motion of not only the sacrum but the vertebral column.

4. *The iliolumbar ligament as a highly innervated nociceptive tissue.* Spinal ligaments are highly innervated with proprioceptive, mechanoreceptive, and nociceptive nerve fibers (5–7). The iliolumbar ligament is probably innervated in a similar fashion. The periosteum is also highly receptive to nociceptive stimuli.

Therefore, stress at the fibro-osseous junction of the iliolumbar ligament at the ilium could trigger pain from both tissues. This is the premise behind prolotherapy, the use of injectable proliferative solutions to strengthen ligamentous attachments. Hackett (18) claims that ligamentous laxity is caused by acute or repetitive trauma to the fibro-osseous junction, and this laxity puts tension on the intrinsic nerve fibers in the 'relaxed' ligaments causing a pain pattern. Recent double-blind studies (19) have supported this premise.

5. *The increased role of the iliolumbar ligament with disc degeneration.* The increased incidence of low back pain with advancing age seems to coincide with normal disc degeneration. With disc degeneration, there is less stability between adjacent vertebra due to decreased turgidity of the intervertebral disc. This creates the possibility of aberrant motion between two vertebra. Farfan (9) alludes to a 'hammock' effect of the L5 vertebra supported between the two iliolumbar ligaments as the L5 disc space narrows. This effect restricts excessive anterior motion upon forward flexion and relieves the compressive force on the disc space. Therefore, not only must the iliolumbar ligament restrict forward sacral motion, it has an increasing role of stabilizing the L5 vertebra on the sacrum. This increased stress might create a strain pattern in the ligament leading to chronic low back pain.

Clinical data and biomechanical studies suggest that the iliolumbar ligament is the probable cause of a majority of chronic low back pain. With the lack of agreement on the cause(s) of low back pain, physicians must rely on clinical data to separate possible causes and isolate specific syndromes. Also needed is a movement toward therapies directed at specific syndromes rather than at non-specific low back pain.

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