Comparative Study Between Different Minimally Invasive Techniques for Lumbar Interbody Fusion

Essay

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Abstract

This manipulation can lead to nerve damage or neurogenic pain. Additionally, PLIF usually is limited to L3–S1 because of the increased risk of damage to the conus medullaris and cauda equine resulting from the need for retraction above these levels. Recent evolution in minimally invasive techniques has generated much interest in the TLIF procedure, and has led spine surgeons to consider it to be less invasive.

Key word

Minimally Invasive Techniques- Biomechanics of -Interbody Fusion lumbar- MOTLIF

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List of abbreviations

Abbreviation	Description
IAR	Instantaneous axis of rotation
ALL	Anterior longitudinal ligament
ODI	Oswestry disability index
ALIF	Anterior lumbar interbody fusion
EMG	Electromyography
PLIF	Posterior lumbar interbody fusion
TLIF	Transforaminal lumbar interbody fusion
MISS	Minimally invasive spine surgery
MRI	Magnetic resonance imaging
AP	Anteroposterior
XLIF	Xtreme lateral interbody fusion
MOTLIF	Mini open transforaminal lumbar interbody fusion

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Conventional lumbar fusion is associated with significant muscle stripping and retraction that can adversely affect both short and long term patient outcomes.[30]

In contrast, minimally invasive lumbar fusion is performed via a muscle dilating approach and significantly diminishes the amount of iatrogenic soft tissue injury. As a result, the new procedures have shown the potential to reduce the amount of intra operative blood loss, the intensity of postoperative pain and the duration of hospital stays.[113]

The goal of any minimally invasive procedure is to achieve the same surgical objectives as the corresponding open procedure through a less traumatic approach. It is believed that these less invasive approaches will result in decreased intra operative blood loss, less postoperative pain, and shorter hospital stays without compromising the efficacy of the procedure.[28]

Conventional anterior approach fell out of favor because of vessel injuries, presacral plexus injuries, urinary retention, retrograde ejaculation and abdominal muscle weakness, because of large incision and extensive anatomical dissection. The development of minimally invasive techniques such as endoscopic surgery and mini open surgery has revived anterior lumbar spinal surgery. The advantages of anterior spinal fusion

can be achieved easily and safely.[110] The mini open anterior spine surgery technique is feasible, effective and safe for patients with various anterior lumbar diseases; including vertebral fractures, failed back surgery, segmental instability or spondylolisthesis, infections, herniated disc and undetermined lesion for biopsy etc.

Posterior lumbar interbody fusion is an effective treatment option for patients with symptomatic degenerative disc disease, spondylolisthesis and other painful lumbar spinal pathologies that have failed with conservative medical treatment modalities. Fusion of the pathologically unstable lumbar spine segment can offer significant relief from this often progressive and debilitating medical condition.[35]

Transforaminal lumbar interbody fusion procedure was first introduced by Harms and colleagues as an alternative to posterior lumbar interbody fusion for the management of a variety of spinal disorders that require Lumbar fusion.[36] This procedure offers some distinct advantages to posterior lumbar interbody fusion; including unilateral exposure, decreased neural retraction and a more lateral angle of the approach that facilitates revision surgery.[74] Because access is obtained via a transforaminal approach, little if any neural retraction is required to enter the disc space. In contrast, posterior lumbar interbody fusion almost always requires neural manipulation

and retraction, so neurological injury is one of the most commonly reported complications of that procedure.[104]

Disadvantages and limitations of anterior, posterior, and direct lateral approaches to the lumbar spine have resulted in the development of techniques to address the spine axially (perpendicular to the vertebral endplate along the long axis of the spine). Conceptually, interbody fusions with instrumentation placed along the long axis of the spine have appeal from a biomechanical standpoint because of the ability to place instrumentation close to the bending axis of the spine and in line with the compression movements of the vertebral bodies. This has been recognized for years, and although not a new concept. Para-axial open approaches to the lumbosacral spine have been described through the use of a fibular strut graft from L5 to S1. A true axial approach to the lumbosacral spine has been limited by the availability of appropriate techniques and implants.[18][82][136]

Surgical Anatomy of the Lumbar Vertebrae

Morphology of Individual Vertebra:

The vertebral column is composed of alternating bony vertebrae and fibrocartilaginous discs that are connected by strong ligaments and supported by musculature that extends from the skull to the pelvis and provides axial support to the body. There are 33 vertebrae (7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 coccygeal) (Fig.1). The sacral and coccygeal vertebrae form the sacrum and coccyx. A typical vertebra is composed of an anterior body and a posterior arch made up of two pedicles and two laminae that are united posteriorly to form the spinous process. To either side of the arch of the vertebral body is a transverse process, superior and inferior articular processes. The articular processes articulate with adjacent vertebrae to form synovial joints. The relative orientation of the articular processes accounts for the degree of flexion, extension or rotation possible in each segment of the vertebral column. The spinous and transverse processes serve as levers for the numerous muscles attached to them. The vertebral bodies increase in size from cephalic to caudal, and this is believed to be the result of the increasing weights and stresses borne by successive segments. (131)

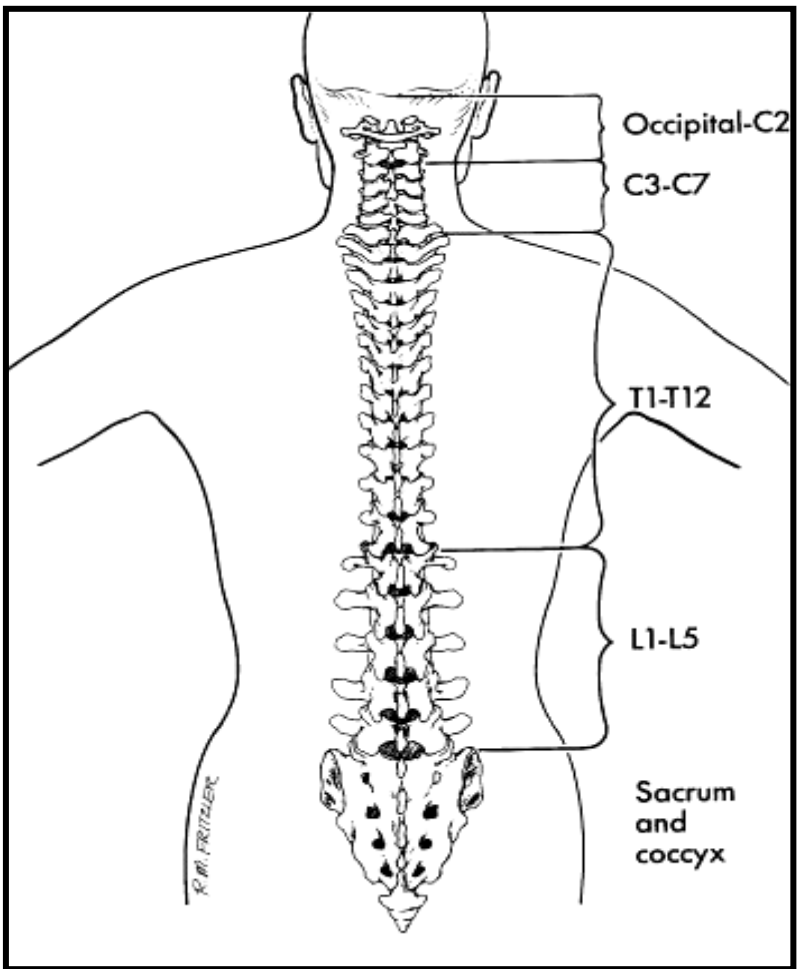

Figure (1): Vertebral column: upper cervical vertebrae (occiput to C2), lower cervical vertebrae (C3-C7), thoracic vertebrae (T1-T12), lumbar vertebrae (L1-L5), sacrum, and coccyx. (131)

The relationship of the synovial joints to the planes of the vertebral body varies from one region to another, but in general the superior articular processes tend to face posteriorly, while the inferior articular processes face inferiorly, and thus from a posterior approach overlie the superior processes this particularly important in the lower lumbar and lumbosacral region, where the tendency of one vertebra to slide forward on the succeeding one is resisted by the overlapping of its inferior articular processes with the superior articular processes of the next vertebra. **(116)**