The Use of Crosslinks with Posterior Pedicular Screw Fixation in Lumbar Spondylolisthesis

Thesis

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ABSTRACT

Background: Pedicle screw instrumentation has gained wide popularity for stabilization of spinal fusions. The use of pedicle screw fixation has increased fusion rates. The placement of segmental pedicle screws and cross-links in short segment posterior pedicle screw constructs has been shown to increase the construct stiffness in some planes.

Aim of the Work: to evaluate addition of crosslinks to posterior pedicular screw fixation as a modality for surgical management of lumbar spondylolisthesis.

Patients and Methods: This study included 50 patients with lumbar spondylolisthesis divided into two groups according to the surgical approach used in treatment. One group with Posterolateral fixation by transpedicular screws and rods and the other Group had cross-links added to the posterior construct.

Results: There was no significant difference in postoperative JOA score between both groups, while comparing mean of preoperative and postoperative JOA scores in each group showed a significant rise of the score in each group after surgery. There was no significant difference in the variables of postoperative sagittal alignment between both groups, while comparing mean of preoperative and postoperative sagittal alignment variables in each group revealed a significant reduction of the disc height percent in both groups, and in slip angle and lumbar lordosis angle in group B. Regarding postoperative rate and degree of improvement in the studied groups, there was no significant difference in the rate and degree of improvement between both groups.

Conclusion: no appreciable benefit from using cross-links was found in short-segment fixation of lumbar spondylolisthesis, where there's no or little torsional instability encountered

KEY WORDS: Lumbar spondylolisthesis, Cross-Links, Transverse rod connectors, Posterolateral fusion, Transpedicular instrumentation.

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LIST OF ABBREVIATIONS

% slip	Degree of the slip
ALIF	Anterior lumbar interbody fusion
ALL	Anterior longitudinal ligament
AP	Anteroposterior
BMI	Body mass index
BMP	Bone morphogenic protein
CT	Computerized tomography
EZ	Elastic zone
FSU	Functional spinal unit
h	Disc height
H	Posterior wall height of the proximal vertebral body
h/H	Disc height%
Ht	Body height
JOA	Japanese orthopedic association
LL	Lumbar lordosis
MRI	Magnetic resonance image
Mo	Months
N	Number
No	Number
NS	Non Significant
NZ	Neutral zone
P	Probability Value
PLIF	Posterior lumbar interbody fusion
PLL	Posterior longitudinal ligament
PZ	Plastic zone
RCT	Randomized control study
rhBMP-2	Recombinant human bone morphogenetic protein-2
S	Slippage
SA	Slip angle
SCS	Spinal canal stenosis
TENS	Transcutaneous electrical nerve stimulation
TLIF	Trans foraminal lumbar interbody fusion
Wt	Body weight
Yr	Years

Introduction

Since 1782, spondylolisthesis has been recognized as a disorder characterized by a visible lumbosacral deformity, slipped vertebrae, and fractures or other deformities of the pars interarticularis. Several classifications that vary in their descriptions of the deformed but intact pars interarticularis and facet joint anatomy have been proposed. Most classifications include six types of spondylolisthesis:

Type I: Congenital	Type IV: Traumatic
Type II: Isthmic	Type V: Pathological
Type III: Degenerative	Type VI: Postsurgical

The isthmic type of spondylolisthesis is familiar to most neurosurgeons and has been studied extensively. A stress fracture of the pars interarticularis detaches the stabilizing posterior elements from the motion segment and results in biomechanically inappropriate translational and shear forces on the disc annulus. The annulus gradually fails as the vertebral bodies become displaced. Fibrocartilage proliferates at the fracture site, resulting in compression of the nerve exiting the foramen at that level. The forward slip of the upper vertebrae may be accompanied by an angular sagittal plane deformity, which creates a localized kyphosis. A compensatory hyperlordosis can occur above the spondylolisthesis with an associated retrolisthesis and symptomatic disc herniation.

Degenerative spondylolisthesis was first described by Junghans in 1931 as a specific form of listhesis with an intact neural arch. [6]

Degenerative spondylolisthesis typically occurs at the level of L4-L5. It is then most likely at L3-L4, followed by L5-S1. Older people are most commonly affected; the average age at presentation being 60 years. It is four times more likely to occur in women than men, Parity has been associated with an increase incidence of spondylolisthesis. Imaging includes plain X-ray standing lateral, anteroposterior, oblique & flexion/extension views of the lumbar spine are helpful in demonstrating a slip, CT or MRI of lumbar spine. Clinically patients frequently complain of intermittent low back pain, symptoms of neurogenic claudication, occasionally radicular pain from compression by the degenerative facet. [58]

Treatment includes nonoperative care and operative intervention indicated for patients with progressive neurological deficit and those who fail to improve on proper nonoperative treatment, specifically, those people with persistent pain, either radicular or claudicatory, that interferes with professional and personal activity as well as quality of life. [120]

AIM OF THE WORK

- Review of literature and recent publication on common types of lumbar spondylolisthesis and its management.

- Evaluation of crosslinkage addition to traditional posterior pedicular screw fixation as a modality for surgical management of spondylolisthesis as regard indications and outcome.

ANATOMY OF LUMBAR SPINE

There are five lumbar vertebrae and the sacrum making up the lumbar spine. We can consider each vertebra as having three functional components: the vertebral bodies, designed to bear weight; the neural arches, designed to protect the neural elements; and the bony processes (spinous and transverse), designed as outriggers to increase the efficiency of muscle action.

The vertebral bodies are connected together by the intervertebral discs, and the neural arches are joined by the facet (zygapophyseal) joints (Fig. 1). The discal surface of an adult vertebral body demonstrates on its periphery a ring of cortical bone. This ring, the epiphysial ring, acts as a growth zone in the young and in the adult as an anchoring ring for the attachment of the fibers of the annulus. The hyaline cartilage plate lies within the confines of this ring (Fig. 2). The size of the vertebral body increases from L1 to L5, which is indicative of the increasing loads that each lower lumbar vertebral level has to absorb.

The neural arch is composed of two pedicles and two laminae (Fig. 1). The pedicles are anchored to the cephalad half of the vertebral body and form a protective cover for the cauda equina contents of the lumbar spinal canal. The ligamentum flavum (yellow ligament) fills in the interlaminar space at each level.

The outriggers for muscle attachment are the transverse processes and spinous process. [143]

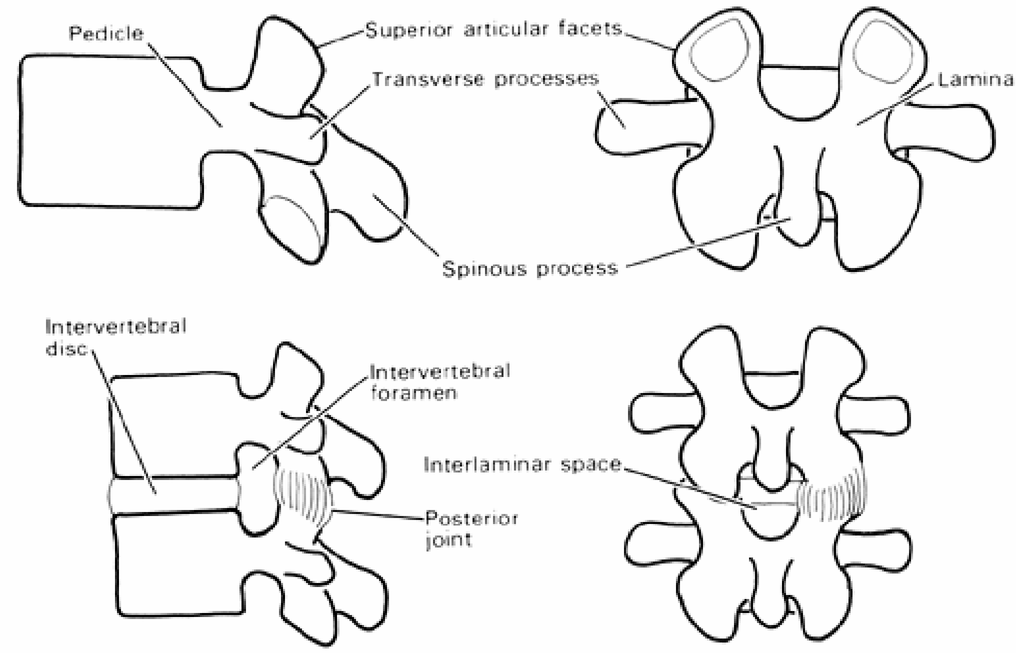

Figure 1: The components of a lumbar vertebra: the body, the pedicle, the superior and inferior facets, the transverse and spinous processes, and the intervertebral foramen and its relationship to the intervertebral disc and the posterior joint.

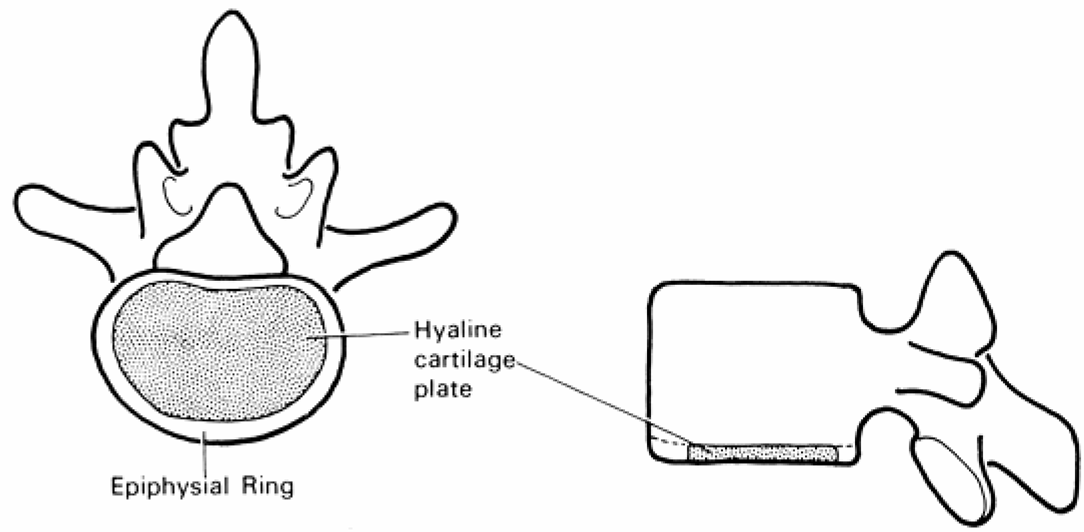

Figure 2: The epiphysial ring is wider anteriorly and surrounds the hyaline cartilaginous plate.

The Intervertebral Disc

The intervertebral discs (Fig. 3) are complicated structures, both anatomically and physiologically. Anatomically, they are constructed in a manner similar to that of a car tire, with a fibrous outer casing, the annulus, containing a gelatinous inner tube, the nucleus pulposus. The fibers of the annulus can be divided into three main groups: the outermost fibers attaching between the vertebral bodies and the undersurface of the epiphysial ring; the middle fibers passing from the epiphysial ring on one vertebral body to the epiphysial ring of the vertebral body below; and the innermost fibers passing from one cartilage endplate to the other. The anterior fibers are strengthened by the powerful anterior longitudinal ligament. The posterior longitudinal ligament affords only weak reinforcement, especially at L4-5 and L5-S 1, where it is a midline, narrow, unimportant structure attached to the annulus. The anterior and middle fibers of the annulus are most numerous anteriorly and laterally but are deficient posteriorly, where most of the fibers are attached to the cartilage plate (Fig. 3).

The fibers of the annulus are firmly attached to the vertebral bodies and arranged in lamellae, with the fibers of one layer running at an angle to those of the deeper layer (Fig. 4). This anatomic arrangement permits the annulus to limit vertebral movements. This important function is reinforced by the investing vertebral ligaments. [143]