A Systematic Review of Advantages of Percutaneous Pedicle Screw Fixation for Neurologic Intact Thoracolumbar Burst Fractures

A Systematic Review

For Partial Fulfillment of Master Degree In Orthopedic Surgery

By

Mohamed Elsaba Ali Abdellatif

MB BCh, Faculty of Medicine Ain Shams University

Under Supervision of

Prof. Dr. Aly Ibrahim Abdellatif Hussien

Professor of Orthopedic Surgery

Faculty of Medicine – Ain Shams University

Dr. Zakaria Hassan Ibrahim Abu-Elgait

Lecturer of Orthopedic Surgery

Faculty of Medicine – Ain Shams University

Faculty of Medicine

Ain Shams University

2019

سورة البقرة الآية: ٣٢

Acknowledgment

First and foremost, I feel always indebted to **ALLAH**, *the Most Kind and Most Merciful.*

I'd like to express my respectful thanks and profound gratitude to **Prof. Dr. Aly Ibrahim Abdellatif Hussien,** *Professor of Orthopedic Surgery Faculty of Medicine – Ain Shams University for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

I am also delighted to express my deepest gratitude and thanks to **Dr. Zakaria Hassan Ibrahim Abu-Elgait,** *Lecturer of Orthopedic Surgery Faculty of Medicine – Ain Shams University, for his kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

Mohamed Elsaba Ali Abdellatif

List of Contents

List of Abbreviations

Abb.	Full term
ALL	Anterior longitudinal ligament
CT	Computed tomography
FSU	Functional Spinal Unit
MISS	Minimally Invasive Spine Surgery
MRI	Magnetic resonance imaging
PLC	Posterior ligamentous complex
PLL	Posterior longitudinal ligament
PPSF	Percutaneous pedicle screw fixation
RCT	Randomized controlled trial
STSG	Spine Trauma Study Group
TLICS	Thoracolumbar Injury Classification and Scoring System
VAS	Visual analog scale

List of Tables

List of Figures

INTRODUCTION

Thoracolumbar burst fractures are most common in spine injuries. However, the management of unstable thoracolumbar burst fracture still remains controversial, especially for patients without neurologic deficit. [1]

Although nonoperative management including bed rest, brace, or cast have been reported to produce good results for those patients, it is well known that nonsurgical management may be related with some early or late complications such as residual kyphosis, prolonged recumbency, pressure sores, and late neurologic impairment. [2]

Operative methods have been proved to provide satisfactory outcomes with improved surgical techniques and implants. Surgical treatment provides immediate spinal stability and more reliably restores sagittal alignment, vertebral height, and canal dimension than does cast or brace management. [3]

Among operative options, posterior short-segment pedicle instrumentation is most widely used for thoracolumbar fractures around the world because of its 3-column fixation. [4]

However, open posterior approach with short-segment pedicle instrumentation involves conventional extensive exposures that can be associated with significant morbidity owing to high intraoperative blood loss, increased infection rates, and para spinal muscle denervation or injury. [5]

Minimally invasive surgery including percutaneous pedicle screw fixation (PPSF) has become increasingly popular in spine surgery. [6]

The technique of percutaneous lumbar pedicle screw fixation was initially introduced by Magerl [7] in 1977, and used for temporary external fixation.

Some authors subsequently reported the percutaneous technique for the temporary stabilization in the patients with suspected segmental lumbar instability. [8]

Foley et al. [9] reported pedicle screw internal fixation for low lumbar fusion. Kim et al. [10] proved that PPSF caused less paraspinal muscle damage than open pedicle screw fixation.

Aim of the Work

The aim of the study to review the literature for available evidence about the advantages and disadvantages of Percutaneous Pedicle Screw Fixation for Neurologic Intact Thoracolumbar Burst Fractures in comparison with the open surgical procedure.

REVIEW OF LITERATURE

Anatomy

The functional spinal unit is made up of an intervertebral disc, the adjacent superior and inferior vertebra, the interconnecting right and left facet joint, and the surrounding ligamentous tissue. The two adjacent vertebrae are linked by three joints (the intervertebral disc, the right and left facet joints) (Fig. 1). This joint complex allows three-dimensional movements: flexion-extension, axial rotation, and lateral bending. [11]

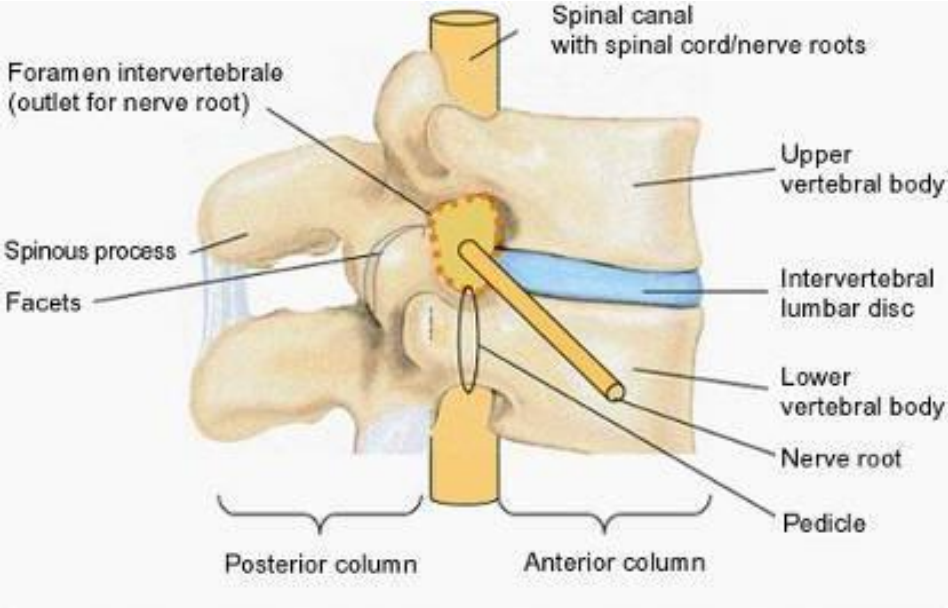

Fig. (1): Functional Spinal Unit (FSU). [11]

Osseous support:

A typical vertebra has a ventral body, a dorsal vertebral (neural) arch, extended by lever-like processes, and a vertebral foramen, which is occupied in life by the spinal cord, meninges and their vessels. (12)

Pedicles are short, thick, rounded dorsal projections from the superior part of the body at the junction of its lateral and dorsal surfaces: the concavity formed by the curved superior border of the pedicle is shallower than the inferior one. (12)

When vertebrae articulate by the intervertebral disc and facet joints, these adjacent vertebral notches contribute to an intervertebral foramen. The complete perimeter of an intervertebral foramen consists of the notches; the dorsolateral aspects of parts of adjacent vertebral bodies and the intervening disc, and the capsule of the synovial facet joint (Fig. 2). (13)

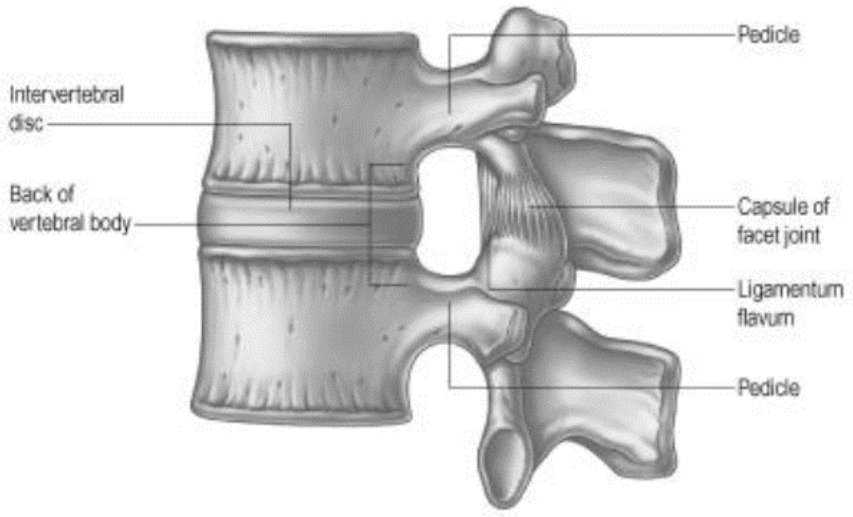

Fig. (2): Osseous anatomy of the vertebrae. (13)

2- Ligamentous and muscular support:

The soft tissue structures of the lumbar spine include the ligaments, the musculature and the fascia. (14)

The main supporting ligaments of the lumbar spine are the anterior longitudinal ligament (ALL), posterior longitudinal ligament (PLL), the outer part of the annulus fibrosus, sacrotuberous ligament, iliolumbar ligament, ligamentum flavum and facet capsular ligament (fig.3). (15)

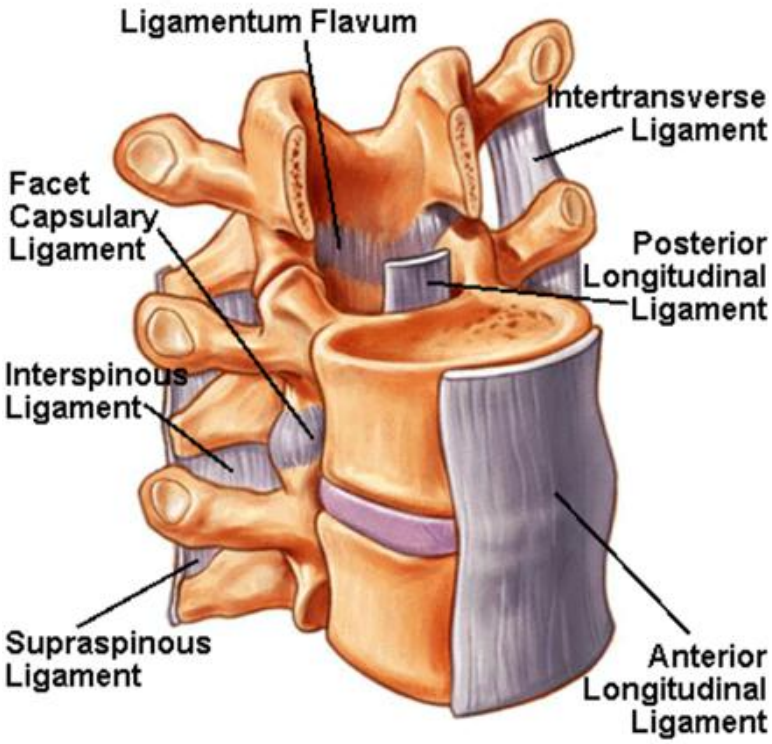

Fig. (3): Ligamentous support of the spine. (15)

The ligamentum flavum, otherwise known as the yellow ligament, is a short and thick ligament which connects the laminae of consecutive vertebrae. Its function is to prevent flexion, as well as prestress the disc for functional activities. (16)

It is known as the yellow ligament because it is comprised of 80% elastin and 20% collagen which gives it a yellowish hue and makes it more elastic than other ligaments in the body. This is important functionally so that during backward bending the ligament does not buckle and put pressure on the spinal cord. (16)

The anterior longitudinal ligament (ALL) lies on the front of the spine and attaches segmentally to the vertebral bodies. The function of this ligament is acting as restraint to prevent extension. (16)

The posterior longitudinal ligament (PLL) is a narrow band that attaches segmentally to the back of the vertebral bodies. It widens over the discs and is narrower over the vertebral bodies. The function of this ligament is to resist flexion. (16)

Thoracolumbar fracture classifications

Denis Classification

Denis described a three-column theory in a study performed in 412 patients using radiological investigation in 1983 [17].

The three column theory of Denis is a mechanical classification more than an anatomical classification.

He provided an entirely new viewpoint on thoracolumbar fractures by defining the middle column and provided a better method for analysing thoracolumbar fractures.

His classification system remains indispensable even today.

According to the Denis classification:

The anterior column consists of the anterior portion of the vertebral body, the anterior longitudinal ligament and the anterior portion of the intervertebral disc.

The middle column consists of the posterior portion of the vertebral body, the posterior portion of the intervertebral disc and the posterior longitudinal ligament.

The posterior column consists of all of the structures behind the posterior longitudinal ligament [18].