Evaluation of Trans-laminar Facet Screw for Lumbar Spine Fixation and Fusion

Systematic Review

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Abstract

Background: Translaminar facet screws are an excellent solution for stabilization of the vertebral motion. It is simple, does not require any specialized equipment, and has the advantages of being a procedure of lesser magnitude, lesser operative time and few complication rate. Recently there is growing interest in this technique to augment the anterior lumbar fusions to achieve global fusion less invasively.

Aim of the Work: to evaluate the role of translaminar facet screw in lumber fixation and fusion inclusion different techniques of translaminar facet screw fixation, its advantages and disadvantages. Methodology: This systematic review included a discussion of all available studies meeting the eligible criteria including: well conducted descriptive studies, cohort, articles, accepted manuscripts, clinical trials, analytic studies and the literature of reviews, technical notes.

Results: The small volume of the metal in comparison with pedicle screw constructs provides faster patient recovery and reduce the rate of infection and also provide an adequate area for placement of bone grafts. The low cost of the implants is an added advantage in view of the rising costs of health care.

Conclusion: Translaminar facet screw fixation is feasible, cheaper and effective in lumbar fixation. The technique is not demanding as transpedicular screw with easier learning curve.

Key words: Trans-laminar Facet Screw, lumbar spine, fixation, Fusion

INTRODUCTION

Although the new era in spine surgery is highly focused on preserving mobility, fusion is still an accepted way of treatment for a variety of spinal disorders. To stabilize the spine until a fusion consolidates, spine surgeons have used combinations of hooks, wires and pedicle screws. The main problem with these implants is the need for an extensive soft tissue dissection which potentially contributes to increased number of and more significant complications. To implant pedicle screws in a safe and anatomically correct position, the proximal facet joint of the segment to be fused needs to be exposed and may well be damaged by the screw. In addition, pedicle screw constructs are expensive and the screws and rods form a bulky hardware mass in the back of the patients, which may be disturbing and lead to implant removal which means another operation.

The use of translaminar facet screws may eliminate many of these issues. Contrary to popular belief facet screw fixation is not new. King described his method of transfacet fixation as early as 1948 ***(King D).*** This technique was modified by Boucher in 1959 ***(Boucher HH).*** Both techniques were transfacet but not translaminar. Magerl in 1984 revised a new transfacet screw fixation technique which was also truly translaminar ***(Magerl FP).*** He used the contralateral side of the spinous process as the starting point of drilling for this procedure. The use of this implantation trajectory increases screw length and the potential stability of the fixation. In addition to decreased operative costs, the application of this technique required a limited soft tissue dissection only to the outer side of the facet joint and required only exposure of the facet joint of the involved level. The implants are not bulky and are less likely to disturb the patients. The earlier applications were performed by using 4.5 mm regular cortical bone screws but today special sets are designed for this technique. With the advent of less invasive surgical techniques and increased imaging and guidance capabilities translaminar screws can be employed in a much less invasive fashion through small stab wounds ***(Schim CS et al., 2005)***.

Indications of translaminar facet screw fixation include; Degenerative conditions requiring a fusion with a stable anterior column (an end-stage collapsed disk with peripheral osteophytes), Posterior stabilization after interbody reconstruction ***(Grob D et al., 1998)***. To provide additional contralateral fixation in thoracolumbar fusions treated with unilateral posterior instrumentation ***(Yin QD et al., 2004).***

AIM OF THE WORK

To evaluate the role of translaminar facet screw in lumber fixation and fusion inclusion different techniques of translaminar facet screw fixation, its advantages and disadvantages.

REVIEW OF LITERATURE

Anatomy of the lumbar Spine

Important Structures

The important parts of the lumbar spine include:

- Bones and joints.
- Nerves.
- Connective tissues.
- Muscles.
- Spinal segments.
- This section highlights important structures in each category.

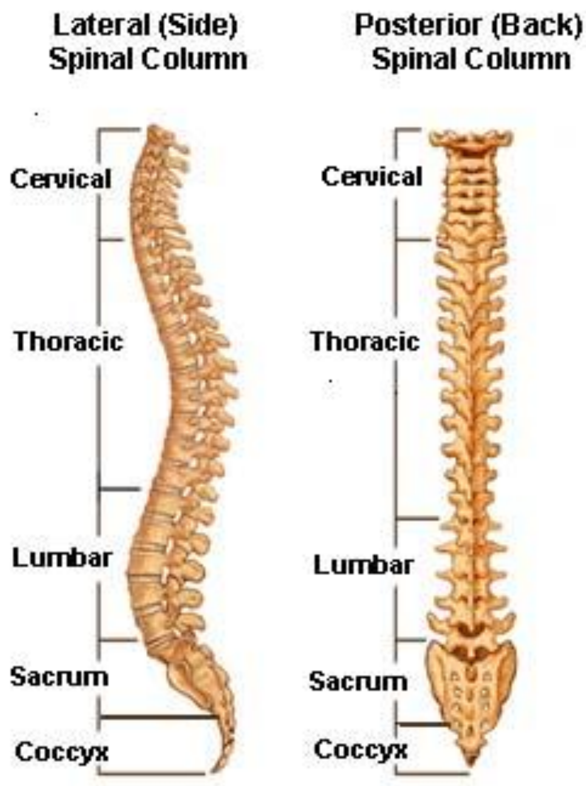

Fig. (1): General outline of the spine (Reference from spineuniverse.com /anatomy)

Bones and Joints

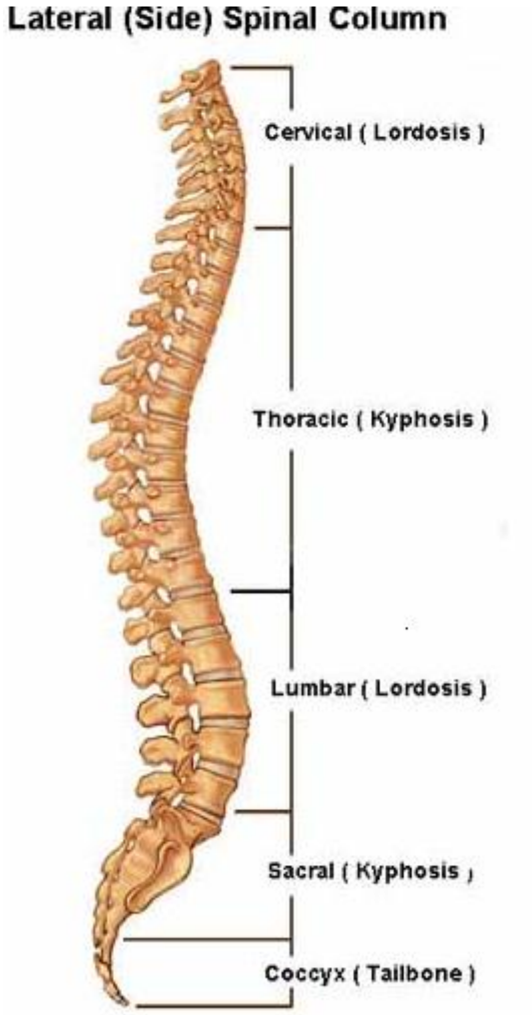

Fig. (2): Curves of the spine (Reference:spineuniverse.com/anatomy)

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), and designed as outriggers to increase the efficiency of muscle action ***(Wong & Transfeldt, 2007 A).***

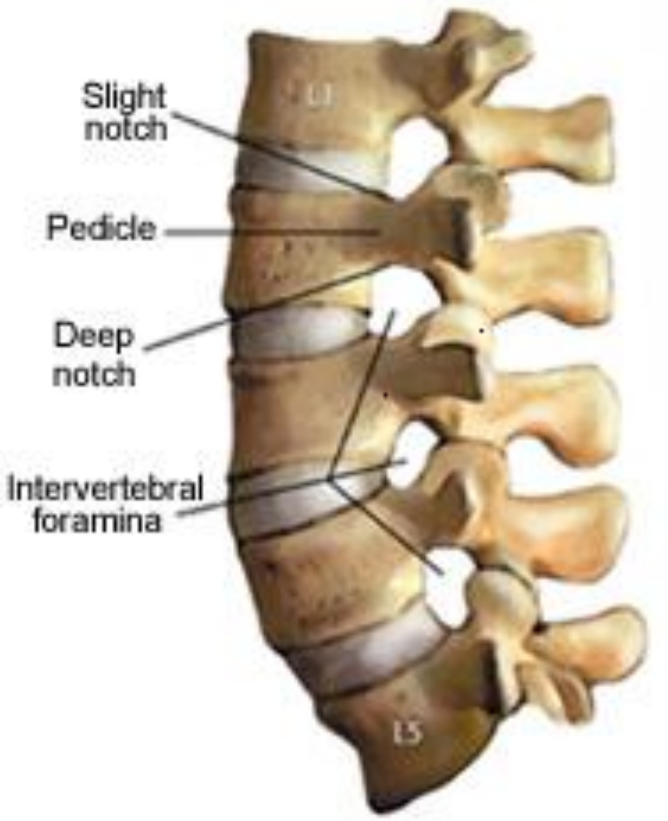

Fig. (3): The lumbar spine (from back.com/anatomy)

The **lumbar vertebra** (Figs.4&5) are the largest segments of the movable part of the vertebral column, and can be distinguished by the absence of a foramen in the transverse process, and by the absence of facets on the sides of the body. The **body** is large, wider from side to side than from before backward, and a little thicker in front than behind. It is flattened or slightly concave above and below, concave behind, and deeply constricted in front and at the sides. The **pedicles** are very strong, directed backward from the upper part of the body; consequently, the inferior vertebral notches are of considerable depth. The **lamina** are broad, short, and strong; the **vertebral foramen** is triangular, larger than in the thoracic, but smaller than in the cervical region. The **spinous process** is thick, broad, and somewhat quadrilateral; it projects backward and ends in a rough, uneven border, thickest below where it is occasionally notched. The **superior** and **inferior articular processes** are well-defined, projecting respectively upward and downward from the junctions of pedicles and lamina. The facets on the superior processes are concave, and look backward and medial ward; those on the inferior are convex, and are directed forward and lateral ward. The former are wider apart than the latter, since in the articulated column the inferior articular processes are embraced by the superior processes of the subjacent vertebra. The **transverse processes** are long, slender, and horizontal in the upper three lumbar vertebra; they incline a little upward in the lower two. In the upper three vertebrae they arise from the junctions of the pedicles and lamina, but in the lower two they are set farther forward and spring from the pedicles and posterior parts of the bodies. They are situated in front of the articular processes instead of behind them as in the thoracic vertebra, and are homologous with the ribs. Of the three tubercles noticed in connection with the transverse processes of the lower thoracic vertebra, the superior one is connected in the lumbar region with the back part of the superior articular process, and is named the **mammillary**

process; the inferior is situated at the back part of the base of the transverse process, and is called the **accessory process** ***(Gray et al., 2008).***

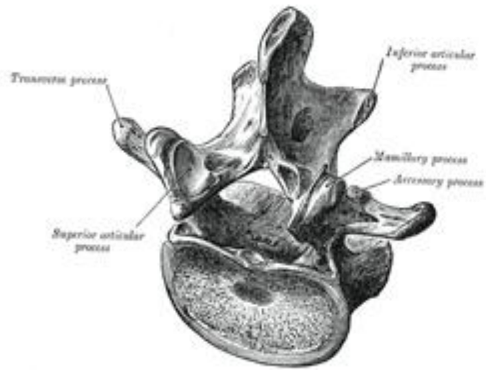

Fig. (4): A lumbar vertebra from above and behind **(*Gray et al., 2008*)**

Fig. (5): Fifth lumbar vertebra, from above ***(Gray et al., 2008).***

The **Fifth Lumbar Vertebra** (Fig.5) is characterized by its body being much deeper in front than behind, which accords with the prominence of the sacrovertebral articulation; by the smaller size of its spinous process; by the wide interval between the inferior articular processes; and by the thickness of its transverse processes, which spring from the body as well as from the pedicles ***(Gray et al., 2008).***

The facet joints

The zygapophyseal joints are synovial joints that permit simple gliding movements. Although the lax capsule of the joints is supported to some extent from anteriorly by the ligamentum flavum, and posteriorly by supraspinous ligament, the major structure restraining movement in these joints are the outermost fibers of the annulus fibrosus. When these annulus fibers exhibit degenerative changes, excessive joint play is permitted. This is why degenerative changes within the discs render the related posterior joints vulnerable to strain ***(Wong& Transfeldt, 2007 A).***

The nerve supply of the facet joint is derived from the branches of the dorsal ramus of each spinal nerve that branches in and just beyond the neural foramen into ventral and dorsal rami. These branches of the dorsal rami also supply the periosteum of the posterior bony elements and the overlying muscle and skin ***(Williams et al., 2005).***

The neural foramen

On the left and right side of each vertebra is a small tunnel called neural foramen. (**Fig.6**) the two spinal nerves that leave the spine at each vertebra go through the foramina, one on the left and one on the right. Each nerve branches in and just beyond the foramen into ventral and dorsal rami. The dorsal rami supply the facet joints as mentioned above. Besides, there is the recurrent nerve (sinuvertebral or nerve of Von Luscka) which is the recurrent branche of the ventral rami. They receive sympathetic input via grey rami communicantes or directly from thoracic sympathetic ganglia. Then the sinovertebral nerve re-enter the foramen to supply the structures forming the walls of the vertebral canal as well as the dura and epidural soft tissue.(***Williams et al., 2005***). The intervertebral disc (described later) sits directly in front of the opening. A bulged or herniated disc can narrow the opening and put pressure on the nerve. A facet joint sits in back of the foramen. Bone spurs that form on the facet joint can project into the tunnel, narrowing the hole and pinching the nerve.

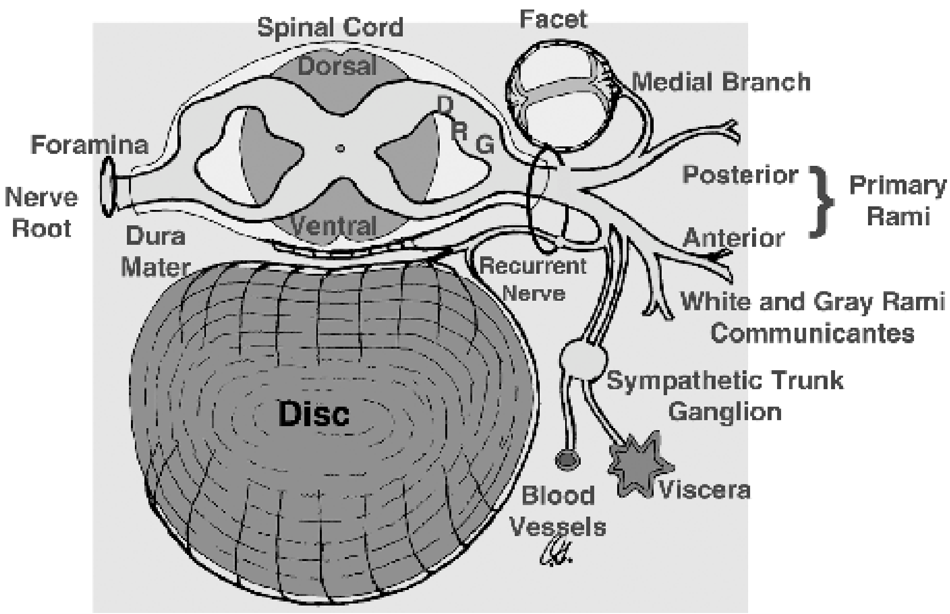

Fig. (6): The neural foramen (spineuniverse.com/anatomy).

Nerves

The spinal cord extends down to the L2 vertebra. Below this level, the spinal canal encloses a bundle of nerves that goes to the lower limbs and pelvic organs. The Latin term for this bundle of nerves is cauda equina, meaning horse's tail and is enclosed within the thecal sac where it is accompanied by the filum terminale that connects the lower conical part of the spinal cord (the conus medullaris) to the back of the coccyx.

Between vertebrae, two large nerves branch off the spinal cord, (**Fig.7**) one on the left and one on the right. Each spinal nerve branches in and just beyond the intervertebral foramen into ventral and dorsal rami. There is also an important input from the sympathetic system via grey rami communicants or directly from thoracic sympathetic ganglia. The branches of the spinal nerve concerned are the dorsal ramus and the recurrent meningeal or sinovertebral nerves ***(Williams et al., 2005).***

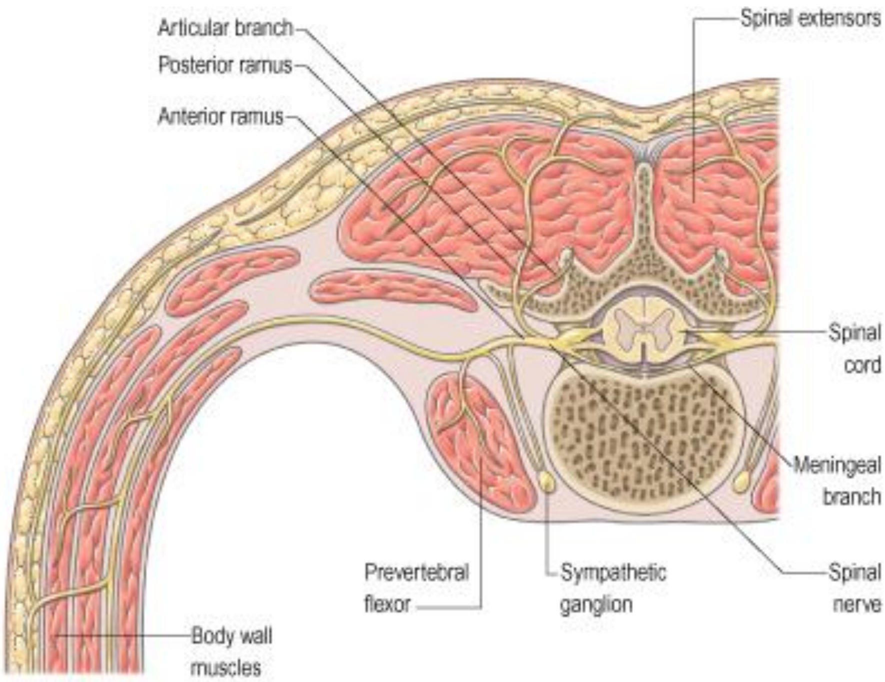

Fig. (7): Formation and branching of a typical spinal nerve ***(Williams et al., 2005).***

The ligaments

Anterior longitudinal ligament (ALL)

This ligament runs the length of the anterior aspect of the spine. It is intimately attached to the anterior annular fibers of each disc and is a fairly strong ligament useful in fracture reduction. (**Fig.8**)

Posterior longitudinal ligament (PLL)

This is the posterior mate of the anterior longitudinal ligament (**Fig. 8**). It is a significant ligament in all areas of the spine except the lower lumbar region. Although frequently