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IMPROVEMENT OF FRACTURES OF THE LOWER THORACIC AND LUMBAR SPINE USING TRANSPEDICULAR OSTEOSYNTHESIS

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Abstract: Fractures of the lower thoracic and lumbar vertebrae represent one of the most common and clinically significant spinal injuries. These fractures are frequently associated with high-energy trauma and can lead to severe neurological deficits, spinal instability, and chronic pain if not treated adequately. Transpedicular osteosynthesis has emerged as an effective surgical technique for achieving stabilization, deformity correction, and improved functional outcomes. This article reviews current approaches to surgical management and highlights advancements aimed at improving treatment outcomes in patients with lower thoracic and lumbar spine fractures.

Introduction

Traumatic injuries of the lower thoracic (Th10–Th12) and lumbar (L1–L5) spine occupy a leading position among axial skeleton traumas. The anatomical transition between the relatively rigid thoracic spine and the more mobile lumbar region makes this segment biomechanically vulnerable. Fractures in this region commonly result from road-traffic accidents, falls from height, and industrial trauma.

The primary goals of surgical treatment are to restore spinal stability, decompress neural elements, correct deformity, and ensure early mobilization. Over the past decades, transpedicular osteosynthesis has become the gold standard for stabilizing unstable vertebral fractures due to its biomechanical strength and minimally invasive potential.

Epidemiology

Lower thoracic and lumbar spine fractures represent approximately 50–60% of spinal injuries. High-energy trauma, such as falls from height, motor vehicle accidents, and sports injuries, are the leading causes in young adults. Osteoporotic fractures in elderly populations can also compromise vertebral stability. The male-to-female ratio is higher among young adults due to occupational and activity-related risk factors.

Anatomical and Biomechanical Considerations

The lower thoracic and lumbar spine possess unique structural properties:

- Load-bearing function: The lumbar vertebrae carry substantial axial load, requiring strong fixation methods.

- Mobility transition zone: The thoracolumbar junction experiences high mechanical stress.

- Pedicle structure: The vertebral pedicles provide a strong anchor for screw placement.

Classification of Thoracolumbar Fractures

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1. AO Spine Classification: Types A, B, C.

2. TLICS System: Injury morphology, neurological status, ligamentous complex integrity.

Mechanism of Injury

Common mechanisms include:

1. Axial compression – leading to burst fractures
2. Flexion-distraction – associated with seatbelt injuries or sudden bending forces
3. Rotational or translational forces – causing fracture-dislocations with significant instability
4. Low-energy osteoporotic fractures – common in elderly patients

Transpedicular Osteosynthesis: Principles and Technique

Pedicle screws are inserted into the vertebral pedicles above and below the fracture site.

• Rods connect the screws, creating a stable construct that allows for spinal alignment restoration and load sharing.

• The technique provides immediate stabilization, enabling early mobilization and rehabilitation.

• Unstable compression or burst fractures
• Fracture-dislocations with or without neurological deficit
• Progressive deformity or kyphosis
• Failure of conservative treatment

Surgical Technique

1. Preoperative planning – Imaging with CT and MRI to assess fracture morphology, pedicle integrity, and neural compression.
2. Patient positioning – Prone position on a radiolucent table.
3. Pedicle screw insertion – Screws are inserted bilaterally above and below the fracture using fluoroscopic guidance.
4. Rod placement and reduction – Rods connect screws, restoring vertebral height and sagittal alignment.
5. Decompression (if necessary) – Laminectomy or discectomy performed in cases with neural compression.
6. Closure and postoperative care – Drain placement if needed; early mobilization encouraged within days post-surgery.

Advantages:

- Strong fixation

- Early mobilization

- Reduced postoperative pain

Clinical Improvements

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Studies indicate that transpedicular osteosynthesis provides:
• Effective stabilization of unstable fractures
• Restoration of sagittal alignment and vertebral height
• Reduced risk of post-traumatic kyphosis
• Favorable neurological recovery in patients with incomplete deficits
• Early ambulation and shorter hospital stay
Complications are relatively low but may include screw malposition, infection, or adjacent segment degeneration.

Discussion

Transpedicular osteosynthesis provides reliable stabilization for thoracolumbar fractures, though complications such as implant failure or adjacent segment degeneration remain concerns. Technological improvements continue to enhance outcomes.

Conclusion

Transpedicular osteosynthesis is a highly effective method for the stabilization of thoracolumbar fractures. Continued innovation promises further improvements in patient outcomes. Proper patient selection, preoperative planning, and surgical technique are critical for achieving optimal outcomes.

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