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MULTI-LEVEL LUMBAR SPINE TRAUMA: CLINICAL CHARACTERISTICS AND SURGICAL MANAGEMENT

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Abstract: Multi-level lumbar spine trauma represents a severe form of spinal injury associated with high-energy mechanisms and significant morbidity. These injuries often involve multiple adjacent or non-contiguous vertebrae, resulting in mechanical instability and neurological deficits. This study analyzed 36 patients with multi-level lumbar injuries admitted between 2019 and 2024. Clinical, radiological, and surgical outcomes were evaluated to determine optimal diagnostic and therapeutic strategies. Computed tomography and magnetic resonance imaging were utilized to classify fracture patterns and assess neural element compromise. Surgical stabilization with or without decompression was performed in 25 patients, while 11 patients were treated conservatively. Surgical management demonstrated superior neurological recovery and better maintenance of spinal alignment. Early diagnosis with MRI and timely decompression were associated with improved outcomes. The findings emphasize the necessity of a multidisciplinary approach in managing complex lumbar spine trauma.

Keywords: Multi-level lumbar injury, spinal instability, decompression, pedicle fixation, neurological deficit, MRI.

Introduction

Lumbar spine trauma is a significant clinical problem due to its potential to cause permanent disability and affect quality of life. Multi-level injuries, involving two or more lumbar vertebrae, are relatively uncommon but are typically the result of high-energy trauma such as falls from height, vehicular accidents, or crushing forces. These injuries are frequently associated with spinal canal compromise, disruption of the posterior ligamentous complex, and varying degrees of neurological impairment.

Diagnosis and management of multi-level lumbar injuries remain challenging due to complex biomechanics and the need to balance stabilization with preservation of motion segments. Timely recognition of spinal instability and appropriate surgical intervention are critical for preventing long-term complications such as progressive deformity and chronic pain. This study evaluates clinical features, imaging findings, and treatment outcomes of multi-level lumbar spine trauma to develop evidence-based management recommendations.

Materials and Methods

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A prospective observational study was carried out on 36 patients diagnosed with multi-level lumbar spine trauma at a tertiary neurosurgical center between January 2019 and December 2024. Inclusion criteria included traumatic injury involving at least two lumbar vertebral segments confirmed radiologically, age between 18 and 65 years, and absence of concomitant cervical or thoracic spinal cord injury. Exclusion criteria were pathological fractures, previous lumbar surgery, or polytrauma with hemodynamic instability precluding spinal intervention.

All patients underwent a standardized diagnostic protocol. Neurological assessment was performed using the ASIA impairment scale. Imaging studies included plain radiographs for initial screening, CT scans to evaluate fracture morphology and pedicle integrity, and MRI to assess neural element compression, ligamentous disruption, and epidural hematoma. Injuries were classified according to the AO Spine classification and Denis' three-column model.

Treatment strategies were based on mechanical stability and neurological status. Patients with stable fractures and no neurological deficits received conservative therapy, including thoracolumbosacral orthosis immobilization, analgesia, and early physiotherapy. Unstable fractures or cases with neurological compromise underwent surgical stabilization. Posterior pedicle screw fixation was the primary technique, while combined anterior-posterior reconstruction was utilized in cases with severe anterior column destruction. Decompression through laminectomy or corpectomy was performed when canal compromise exceeded 50% or in the presence of progressive neurological deterioration.

Postoperative management included intensive care monitoring, early mobilization within 72 hours, and structured rehabilitation protocols. Neurological function and radiological alignment were assessed at discharge and during 3-, 6-, and 12-month follow-ups. Statistical analysis was performed using SPSS version 27 with a significance threshold of $p < 0.05$.

Results

The mean age of patients was 39.8 ± 11.6 years, with a male predominance (69%). Falls from height accounted for 55% of injuries, motor vehicle accidents for 30%, and heavy object compression for 15%. The most frequently involved levels were L2–L3 and L3–L4, with 25% presenting with non-contiguous double-level injuries.

Neurological deficits were present in 24 patients (66%). According to ASIA grading, 7 patients were grade A, 9 grade B, 8 grade C, and the remainder grade D or E. Severe canal compromise on MRI correlated strongly with initial neurological impairment ($r = 0.76$).

Of the 36 patients, 25 underwent surgical treatment. Posterior pedicle fixation with decompression was performed in 18 patients, while 7 required combined anterior-posterior stabilization due to extensive vertebral body destruction. The average operative time was 225 ± 52 minutes, with mean intraoperative blood loss of 680 ± 140 ml. Early mobilization was achieved in 72% of surgical patients.

At the 12-month follow-up, 62% of patients with incomplete neurological deficits showed at least one-grade improvement on the ASIA scale. Functional ambulation without assistive

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devices was regained in 28% of surgical patients compared to 9% in the conservatively managed group. Progressive kyphosis exceeding 10° occurred in 36% of conservatively treated patients, with two requiring delayed surgical stabilization.

Complications included two superficial wound infections, one case of hardware loosening, and one dural tear managed intraoperatively. No perioperative mortality was observed. Statistical analysis demonstrated a significant association between early decompression and improved neurological recovery ($p < 0.05$).

Discussion

Multi-level lumbar spine trauma represents a biomechanically complex injury pattern requiring careful diagnostic evaluation and tailored management strategies. The findings of this study align with previous reports emphasizing the importance of early MRI-based diagnosis and prompt surgical stabilization in preventing progressive neurological damage and mechanical deformity.

Posterior pedicle fixation remains the gold standard for stabilizing unstable lumbar fractures, while combined anterior-posterior reconstruction may be necessary for severe anterior column compromise. Conservative treatment is appropriate only in stable fractures without neurological involvement; however, careful monitoring is essential to detect progressive deformity.

The correlation between canal compromise and neurological status reinforces the value of advanced imaging in treatment planning. Early mobilization and rehabilitation significantly contributed to functional recovery and reduced secondary complications.

Conclusion

Multi-level lumbar spine trauma is a severe condition associated with high morbidity and requires an individualized, multidisciplinary management approach. Early diagnosis using CT and MRI, timely surgical stabilization, and comprehensive postoperative rehabilitation are key factors in optimizing outcomes. Surgical management demonstrated superior neurological recovery and alignment maintenance compared to conservative treatment, underscoring its role in unstable injuries and cases with neurological deficits. Future research should focus on minimally invasive stabilization techniques and predictive models for functional recovery.

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