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Total Dislocation (Spondyloptosis) of Third Fourth Lumbar Vertebrae: A Case Report and Literature Review

Dr. Govindbhai Jashvantlal Purohit[1], Dr. Yogesh Purohit[2]

[1]MS Ortho, Kheteswar Medical Educational Research Centre, Kirti colony, Usmanpura, Ahmedabad-380013.Gujarat India
Email: *purohit086[at]gmail.com*

[2]MS Ortho, Kheteswar Medical Educational Research Centre, Kirti colony, Usmanpura, Ahmedabad-380013. Gujarat India
Email: *drygp82[at]gmail.com*

Abstracts: ***Introduction: Dislocations of the mid-lumbar vertebrae are exceptional, very rare and results in unstable spine deformity and deformation, which lead to severe spinal cord injury and mortality. Only 16 cases found in the literature, all previously reported cases were treated surgically. We report a case of a male 45-year-old presented to our emergency department with complete dislocation of L3-L4 vertebrae, with neurological deficit. Following injury back resulting from crash of motor lifting tripod falling heavy object on back of patient. The patient developed severe back pain and spinal deformity, and acute neurologic deficit both lower limbs with bowel bladder paralysis. Radiological examinations show complete anterior dislocation of L3 over L4. He also had injury right thigh leading to long spiral fracture of femur at subtrochanteric level. Treatment: After initial assessment of trauma & patient care, initial surgery for fixation of femur was done. The anatomico pathological mechanism of injury is discussed, together with treatment, successful open reduction and stabilization by fixation long construct of pedicle instrumentation and spinal fusion. Outcomes: Postoperative digital radiography showed the correction of the spinal deformity with restoration of lumbar curve. The patient was pain-free and fully rehabilitated 6 months after the surgery. His neurological status improved from grade 0-1 to grade 2-3 with sphincter recovery. At the 1-year follow-up, the patient had pain free back with stable normal alignment. This helped in neurological recovery and was rehabilitated with assisted caliper walking & good sphincter control. Conclusions: We report a case of L3 to L4 traumatic spondyloptosis that involved complete neural damage. Restoring stability and preventing secondary cord injury should be taken into consideration for better rehabilitation & neurological recovery. Conflict of interest statement: The authors have no conflicts of interests to disclose.***

Keywords: Dislocation, mid lumbar, spondyloptosis, intervertebral fusion, pedicle screws

1. Introduction

Traumatic spondyloptosis is defined as 100% traumatic dislocation of vertebral body in the sagittal or coronal plane. Implicated by high-energy impact. it results in unstable spine deformity and spinal canal deformation, which often lead to spinal cord injury with nurological deficit. In the lower back, traumatic spondyloptosis frequently occurs at the thoraco-lumbar or lumbo-sacral junctions, while it has rarely been reported at the mid-lumbar level. To the best of the authors' knowledge, only 16 cases of mid-lumbar spondyloptosis have been described previously in literature. Herein, we present an L3 to L4 spondyloptosis case with neurological deficit, which recovered to extent of rehabilitation, and discuss the injury mechanism and applied treatment.

2. Method - Case report

A 45-year-old man presented to the emergency department after an accident involving a fall of heavy motor on the patient while working in a bore well. The patient developed severe back pain and spinal deformity, and acute neurologic deficit both lower limbs., making patient bedridden following injury with sphincters paralyzed.

Digital radiography (DR) showed, complete anterior vertebral dislocation of L3 over L4, and fractures disruption of pedicle of L3 extending into posterior arch of L3 causing complete disruption at L3-4 level. (Fig. 1).

Magnetic resonance imaging showed complete dislocation with L3 pedicle disruptions with a fractured neural arch, at same level which maintained the space of the spinal canal at the injured segments but the cord structure completely disorganized. indicated only dura sac compression and abnormal curvature at the corresponding segments, and the integrity of the neural arch was compromised (Fig. 2).

There was also associated high energy long spiral fracture of femur left side at subtrochanteric level. (Figure 3)

Figure 1: Preoperative anteroposterior (A) and lateral (B) radiograph show complete anterior vertebral dislocation (spondyloptosis) at L3 to L4 in lateral view and 33% lateral subluxation in AP view. Also there were pedicle fractures at L3 along with posterior arch fractured.

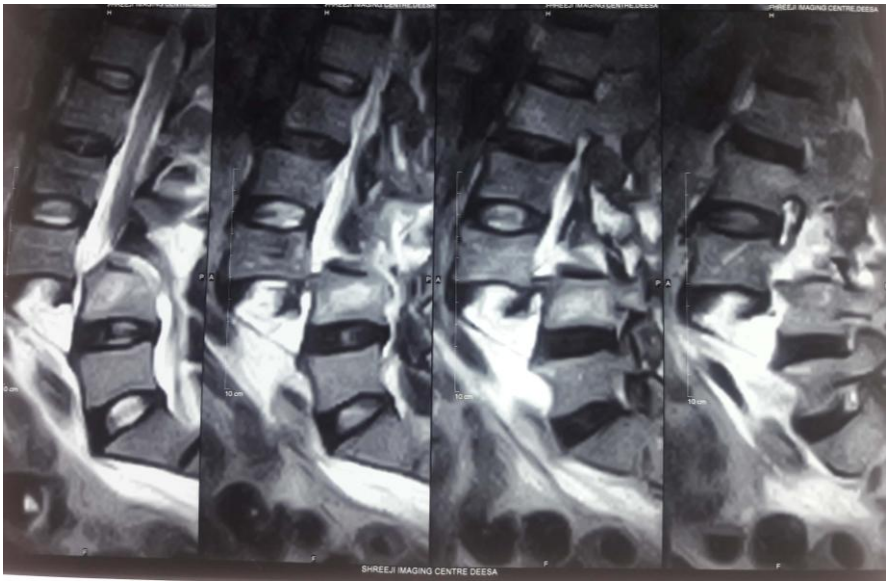

Figure 2: T2-weighted sagital magnetic resonance imaging shows the neural arches at injured segments are badly damaged and the dura sac at corresponding segments is distorted and abnormally compressed. Curved.

Figure 3: Preop x ray show spiral subtrochanteric fracture femur

Figure 4: Post operative x ray show fracture femur well fixed.

3. Treatment Plan

For initial 48-72 hours, because of associated chest injury and compromised respiration, patient was put in ICU for intensive therapy to stabilize till prepared initially for femur fracture fixation. Patient was operated for fracture femur, on fracture table, open reduction & internal fixation with long anatomical Locking plate was used to stabilize the comminuted long spiral fracture. Along with bone graft was also put at fracture site. At the end of femur fixation, traction & counter traction was given at lumbar spine so as to check the reduction of the L3-4 dislocation which could be reduced partly only but again re dislocated.

After recovery from femur surgery, patient was planned for reduction & fixation of L3-4 dislocation. The difficulties predicted were difficulty in reducing the dislocation and maintaining the dislocation while passing pedicle screw in proximal segment as with slightest anterior force to introduce pedicle awl & probe, it will slip forwards and due to lack of couter force, it becomes difficult to pass screws in proximal vertebrae. After exposure from L1 to S1 was done. At L3-4 level careful dissection was done isolating the cord , remaining lateral to cord, a bone spike was introduced at lower surface of L3 body, going back to inferior surface of L3 body negotiating tip of spike to upper surface ,of L4 protection the cord., then by strong joystick method & strong leverage action ,, L4 body was distracted and pushed distally & then brought forward by keeping constant pressure on bone spike pushing L3 posterior and proximal and simultaneously pulling L4 anterior, Reduction was confirmed on C arm but was displacing as soon as bone spike was removed. So, it was decided to keep bone spike in reduced position at L3-4 level and pedicle screws at L1-2-3 passed carefully. This was followed by pedicle screw insertion in L4-5S1 level. Total 6 pedicle screws on either side were passed and carefully fixed with pedicle rods on both sides. Throughout the reduction was to be maintained by strong leverage by bone spike till it was finally stabilized. After fracture reduction, L3 to L4, intervertebral fusion, was done, spinal canal exploration at L3-4 level was done to decompress the cord. Proper distraction compression was applied to restrengthen the construct. During the procedure, the patient's posterior elements were furthest preserved, except for part of the L3 inferior laminae and L4 superior laminae that were removed and bilateral facets that were resected for L4 fixation and spinal canal exploration. Local bone graft was put at fusion site.

The postoperative course was favorable. Postoperative DR showed correction of the spinal deformity and stabilization (Fig. 4A and B). The patient was pain-free and fully rehabilitated 3 months after the surgery. At the 1-year follow-up, the patient was completely asymptomatic and had achieved normal alignment of lumbar spine. The nurologic recovery was incomplete having power grade 3- both lower limbs, patient could walk with walker and caliper. Protective sensation achieved and sphincters recovered. Fig 4A & B

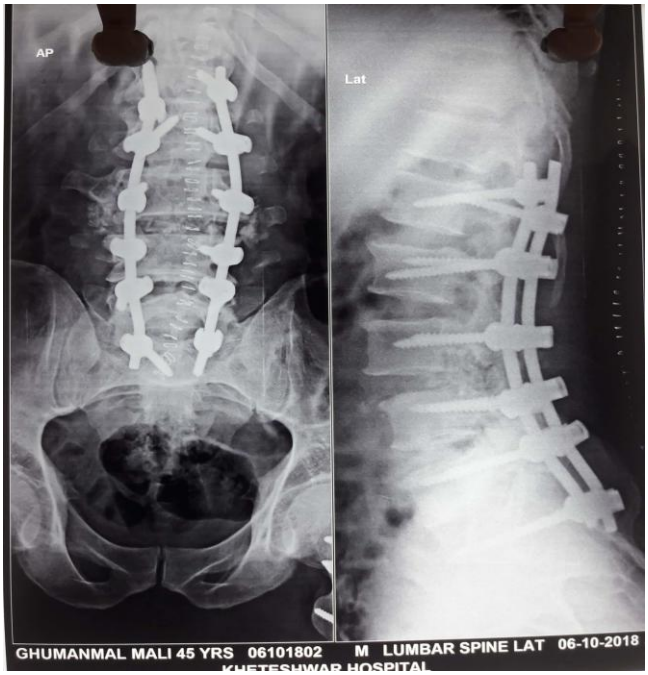

Figure 4: A & B

Postoperative anteroposterior (A) and lateral (B) digital radiographs show the spinal deformity was corrected.

Figure 4A & B: Rehabilitation with walker aided

4. Discussion

Mid-lumbar spondyloptosis is an extremely rare injury caused by high-energy trauma, mostly associated with traffic accidents and falls from height or fall of high impact objects on back. Because of the anatomical structure of spine, the thoraco-lumbar junction (T12–L2) is more frequently implicated by fracture dislocation, but spondyloptosis or complete dislocation is more often reported in the lumbo-sacral junction. In mid-lumbar segments (L2–L4), vertebral dislocation is rarely documented; Only 16 cases have been reported since 1966. The rarity of mid-lumbar spondyloptosis may be attributed to the relatively

rigid anatomic structure and high immediate mortality caused by combined trauma, such as aortic injury and cerebral trauma. Or hypovolemic shock resulting from internal bleeding. Severe axial force after pressure from back to the front caused anterior dislocation.

In the present case, with clues provided by his co-workers and the situation of his lumbar and femoral injury, we speculated that the falling object injured when the patient leaned and suddenly fall of heavy electric motor on his back, and the fracture was induced by extension and shearing violence.

According to the Denis spine fracture classification, fracture dislocation has 3 types: flexion dislocation, flexion–rotation, and shear. The shearing force of which has been classified by Denis which involves translational displacement of vertebra, transection of spinal cord and tear of dura membrane, and almost result in the complete spinal cord injury. Dislocation of a vertebral body is unlikely to be induced by hyperflexion or hyperextension alone, but by the combined effect of shearing and rotational force with sagittal hyper mobility. Denis further divided the shearing type into the posteroanterior and anteroposterior subtypes, and the current case conforms to the latter subtype, which is usually caused by hyperextension and shearing force and results in fractures in the posterior complex and pedicles. By analyzing the trend in spinal fractures, we hypothesized the injury mechanism as follows. The heavy object motor fell from a height with a flexed hip joint and extended lumbar spine. With this unique position, the L3 to L4 disc was at a certain angle to the ground. The axial impact force was mainly conducted through the vertebral body At the L3 to L4 level, the component that was parallel to the disc caused transverse damage to the disc and pedicle fracture, which resulted with the split between posterior elements and vertebral bodies. The component of the impact force that was perpendicular to the L3 to L4 disc pushed the dislocated vertebral bodies to the cranial side and lodged L3 anterior to L4. Mishra et al reported that as many as 80% of patients with spondyloptosis develop complete paraplegia, and very few well-documented cases involve neurologically intact patients. Among the reported mid-lumbar dislocation cases, 6 cases involved complete paraplegia, 4 cases involved varying degrees of partial paraparesis, and 3 cases did not involve neurological deficits

For spondyloptosis, surgical treatment is essential for re-establishing spinal alignment, restoring stability, and spinal canal decompression; In the case series reported by Mishra et al and Chandrashekhara et al, a total of 23 of 24 cohorts underwent surgery via a posterior approach with fixation, fusion, and reduction with/without laminectomy or corpectomy. Despite most patients achieving complete reduction, the neurological outcomes were unfavorable for those with devastating primary cord injury. Gitelman et al reported a decompression procedure in a neurologically intact thoracic spondyloptosis case in which they performed posterior laminectomy and in situ fusion on adjacent vertebra without reduction attempts. Although there was no neurological deficit, Gitelman et al insisted laminectomy for exploration of hematoma and latent compression. The main disadvantage of this surgical strategy is the introduction of posterior instability with an unfixed anterior column. Yamaki et al used an anterior–posterior approach in a pediatric patient with lumbo-sacral spondyloptosis with slight foot weakness. In the procedure, the patient first underwent anterior manual reduction and fixation, and laminectomy and adjacent pedicle screw fixation were then conducted via a posterior approach, which provided adequate realignment and expansion of the spinal canal. Conservative treatment was also reported by clinicians in adolescent patients with spondyloptosis without neurological deficit; despite the outcomes involved being pain-free and neurologically intact, the patient developed residual spine deformity and long-term back pain.

In this case, we conducted posterior decompression and reduction with fixation of the adjacent and 1 injured vertebral bodies. Because of the extra damage induced to the complete posterior column, laminectomy and facetectomy might be a controversial part of the surgical strategy. We had 3 reasons for the procedure:

1) Laminectomy prevents latent compression, including hematoma and bony fragments;
2) With laminectomy and facetectomy, manual reduction can be performed under direct vision, and it also avoids new compression induced by reduction; and
3) Without the blocking floating lamina, internal fixation could be implemented for the injured vertebral bodies, which aided reduction and rebuilding of alignment fixationand stability.

5. Conclusions

Traumatic spondyloptosis is a rare fracture dislocation of spine related to high-energy impact and usually leads to devastating clinical consequences. Here in, we present an L3 to L4 traumatic spondyloptosis case with neurological deficit, For treatment, restoring stability and preventing secondary cord injury might be the principle of traumatic spondyloptosis , which achieved favorable outcomes in our case.

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