

Expert's comment concerning Grand Rounds case entitled “Floating lumbar spine: proposed mechanism with review of literature” (K. Das et al., Eur Spine J. doi:10.1007/s00586-016-4690-2)

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The paper describes a curious relatively low-energy injury that resulted in a traumatic L5/S1 spondyloptosis associated with multilevel pedicle avulsion fractures up to L2 [1]. The case serves to reaffirm a number of issues in the management of spinal trauma: the variation in presentation, the challenges to the current classification algorithms, the importance of understanding the injury mechanism, and the challenges in reduction, and stabilisation are just some to mention.

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Traumatic spondylolisthesis has consistently been linked to high-energy trauma despite the lack of agreement in the literature on the mechanism (i.e., forced hyper-extension, forced hyper-flexion with compression, or horizontal shear combined with rotation) [2–5]. Although a rare injury, a high index of suspicion and early investigation remains a cornerstone in the diagnosis. The history in this case was not suggestive, but the findings on the initial X-rays were striking, as was the delay in presentation. Although not directly relevant to this case, atypical fractures have been reported with bisphosphonate treatment in the appendicular skeleton [6]. This might play a role in some of the more unusual fracture patterns in the spine, although this is yet to be explored in the spinal literature.

Subgrouping spinal injuries under headings that facilitate description objectively quantify severity and inform management is not new. More recently, the AOSpine Trauma Knowledge Forum puts forward the AOSpine Thoracolumbar Spine Injury Classification System [7] to replace the previous classification systems and simply, yet comprehensively, cover the spectrum of thoracolumbar spinal injury drawing from the previous experience with classifications such as the TLICS and Magerl classifications [8, 9]. Despite the large amount of work dedicated to formulate and validate this classification, this case flags up a couple of important aspects; the first pivots around a clear lack of agreement/consistency between spine surgeons in grading injuries (Type C—thoracolumbar injury is defined as “displacement beyond the physiological range of the cranial and caudal parts of the spinal column in any plane”) which fits with the morphological appearance of the injury at the L5/S1 motion segment in this case but was described by the authors as B type. In any case, the description mandates surgical fixation, but this evident lack of uniformity in classification reflects the significant challenges

in evidence extrapolation from the published literature describing certain cohorts of injuries. The second point closely reflects the nature of trauma and its variation that contests even the most comprehensive generic classifications (i.e., segmental injuries above the L5 segment in this case are not readily classifiable under the AO classification).

Of note is that Aihara et al. have described an injury-specific classification for L5/S1 traumatic spondylolisthesis based on the review of 57 cases in 1998. In their classification, the authors described type 1 as a unilateral lumbosacral facet-dislocation, type 2 as a bilateral lumbosacral facet-dislocation, and type 3 as a unilateral lumbosacral facet-dislocation and contralateral lumbosacral facet fracture. Type 4 is a dislocation of the L5 body with bilateral fracture of the pars interarticularis, while type 5 is a dislocation of the body of L5 with fracture of the body and/or pedicle either with or without injury of the lamina and/or facet [10].

Miyamoto et al. reported an L5/S1 grade 2 traumatic spondylolisthesis with multilevel pedicle fractures from L2 to L5 [11]. The injury followed high-energy trauma (motorbike vs a tractor) where the 20-year-old patient was thrown in the air approximately 7 m and suffered transient neurologic injury in both lower limbs. CT myelography was used to investigate the injury and identified no neural compression. The patient was managed conservatively with 5 weeks of bed rest followed by a body cast with a bilateral Spica, which was removed 13 weeks post-injury with subsequent CT images to show satisfactory bony bridging/union across the broken pedicles. Das et al. [1] managed their case surgically capitalising on two principles: the first is reversing the deforming force; here, the authors felt that it was forceful hyper-extension and, therefore, attempted flexing the lower limbs during surgical positioning to facilitate pelvic flexion which partially improved the displacement. The second was the use of a lag technique initially at L5 to “bring up” the translated column back into its anatomical bed. The details of the lag technique used to achieve the reduction were not clearly outlined. Once the spine was reduced through the initial L5 lag, the remaining pedicle screw instrumentation was performed routinely.

The concept of “lagging” a distal fragment onto the proximal one is commonly used in general orthopaedic trauma surgery. Its application in this case is certainly commendable and was, very likely, challenging at the L5 segment. Techniques for managing such an injury are not well documented in the literature, witness to its rarity. My preferred approach in the surgical management of this injury is along the same lines mentioned above; through positioning the patient with the hips flexed, but I favour the lag, and the reduction, to be carried out from L2 down.

This exploits the smaller displacement in the upper segments, which should make the instrumentation easier; in addition, it will reduce the multi-directional instability of the distal fragment during instrumentation (i.e., in this injury, it is expected that the multi-directional excretion of the L5 is more than L4 which is more than L3 and so on). At levels with displacement, a Jamshidi needle is passed under X-ray guidance through the broken pedicle bilaterally to facilitate the introduction of a guide wire through the pedicles into the vertebral body. This guide wire is then used to measure screw length (estimated to be shorter than the measured length of the wire) and used to guide a tap into the distal fragment before introducing an appropriately sized cannulated screw. The screw anchors into the vertebral body and once the head of the screw rests on bone, further rotations will widen its path in the proximal fragment (due to stationary rotation of the threads in bone), while its tip continues to advance in the distal fragment (bringing it closer). This is ideally done under lateral fluoroscopy and can be done simultaneously on both sides of each vertebra to reduce the pull out force during the reduction. The procedure is repeated gradually at the lower levels. Once the spine is reduced, the intervertebral disc at L5/S1 is prepared to accept an inter-body cage and bone graft before the rods are secured.

The variation in injury patterns in trauma surgery is challenging and exciting all the same. The surgical outcome in this case was very satisfactory and goes back to emphasise the important principles of understanding the injury, planning the intervention before embarking on the surgery, and drawing on expertise when needed.

Compliance with ethical standards

Conflict of interest The author declares that he has no conflict of interest.

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