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Case Report

Rib Fracture at the Level of Proximal Junctional Kyphosis as a Result of Stress Riser After Costovertebral Joint Fusion of the Same Level: A Case Report and a Literature Review

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Abstract

Introduction and Importance: PJK/PJF are well-recognized consequences of long construct fusion, commonly seen post deformity correction in adults with pre-existing osteoporosis. However, it is not well understood in terms of all its manifestations and ways to treat it. This case report highlights a feature of PJK/PJF.

Case Presentation: An elderly man with multiple comorbidities and a very complex spinal surgical history sustained a rib fracture following the development of asymptomatic PJK after the revision of his degenerative kyphoscoliosis correction. This case emphasizes the importance of careful postoperative monitoring and management in patients with extensive surgical and medical histories, particularly those at high risk for complications such as PJK.

Management and Outcome: After a thorough review of the case and investigation, we decided to cut down the rods and remove the top end screw, in addition to augmenting the fracture site with a bone graft. This approach aimed to reduce pain, hasten recovery, and aid in rehabilitation. Regular follow-ups and tailored physiotherapy was implemented to ensure optimal healing and functional improvement.

Conclusion: Rib fractures may occur in the setting of fused stable PJK/PJF, manifesting as sudden acute pain at the site of PJK/PJF in thoracic spine. A thorough history, physical examination, and appropriate imaging are essential for accurate diagnosis. Recognizing this potential complication can lead to timely and effective management, improving patient outcomes.

Keywords: *Rib Fracture; Proximal Junctional Failure; Proximal Junctional Kyphosis; Scoliosis; Long Construct*

Introduction

The aging population has highlighted osteoporosis and associated fractures as major health concerns [1]. The patient's quality of life is severely affected by worsening thoracolumbar kyphosis caused by osteoporosis, patient age, vertebral fracture, and collapse. Long-segment internal fixation is effective in stabilizing the spine, correcting deformities, and relieving neural compression. However, certain patients are at an increased risk of surgical complications due to old age, poor bone quality, and other medical comorbidities [2].

Proximal junctional kyphosis (PJK) and proximal junctional failure (PJF) are defined as a kyphotic deformity of > 10 degrees that occurs at the topmost vertebra of the construct and are well-known complications following adult spinal deformity correction or long construct

fusion. These complications can occur due to screws pulling out in the upper instrumented vertebra, junctional fractures, progressive kyphosis due to ligamentous or bony failure, and subsequent instability [3-5]. Various factors contribute to these complications, most importantly the stress riser between a rigid segment and a flexible segment. Understanding these risks is crucial for developing preventative strategies and optimizing patient outcomes in spinal surgery.

Case Presentation

An 85-year-old gentleman with a complex medical history, including congestive heart failure, ischemic heart disease post cardiac stenting and pacemaker insertion, hypertension, chronic kidney disease, chronic lower limb deep vein thrombosis on anticoagulants, and a surgical history including Nissen fundoplication, hemicolectomy, hip replacement, cervical microdiscectomy, lumbar laminectomy in 1997 and 2004 (Figure 1), L2-3 discectomy in 2011, and lastly XLIF and posterior percutaneous fusion at L3-4 and L4-5 with laminectomy in 2011 (Figure 2), presented to our clinic on 29-09-2018 with significant back pain.

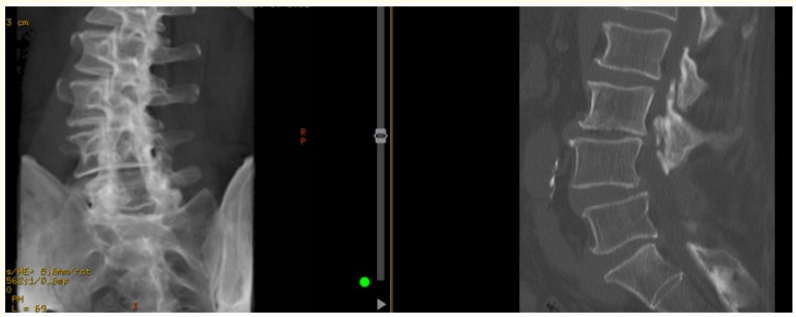

Figure 1: *Lumbar laminectomy in 1997 and 2004.*

Figure 2: *L2-3 discectomy in 2011, and lastly XLIF and posterior percutaneous fusion at L3-4 and L4-5 with laminectomy in 2011.*

The pain was constant, persisting 24 hours a day, with increasing intensity when he walked for more than half an hour or stood for more than 10 minutes. The pain was localized in the lower lumbar region, radiating into his buttock. In recent months, he also experienced significant left-sided radiculopathy, starting from the buttock down to his hamstring, calves, and foot. The patient had no bladder or bowel dysfunction and remained quite active and independent.

On examination, the patient used a single-point walking stick and had a limp. Neurological testing revealed global hyporeflexia in his lower limbs; however, power and sensation were normal. Additionally, the straight leg raise test was positive on the left side at 40 degrees, indicating positive sciatic tension. Sacroiliac joint provocative maneuvers were negative.

A CT myelogram was ordered for further assessment, which showed a significant flow problem occurring around the junction of the previous surgery at the upper level, where there was significant canal stenosis and coronal plane deformity with disc degeneration and flattening. There was also L5-S1 neural canal compromise. A long spine scoliosis film (EOS) X-ray was ordered to assess his global alignment.

Finally, the patient was diagnosed with adjacent segment disease at the L2-3 and L5-S1 levels with left S1 radiculopathy. This case underscores the importance of comprehensive diagnostic evaluations in patients with extensive medical and surgical histories to develop effective treatment plans.

Management and outcome

The plan was to perform a revision scoliosis correction, specifically OLIF at L5-S1 and L2-3, and extend the construct after medical optimization on 12-10-2018 (Figure 3). The patient had an uneventful postoperative period except for a superficial wound infection, which was treated with debridement, a course of oral antibiotics, and daily dressing changes. At the 5-week postoperative clinic visit, the wound had healed with no residual signs of infection. However, the patient was complaining of back pain, was disappointed with his lack of progress, and seemed to have unrealistic expectations. He was already going to the gym, spending 2 - 3 hours daily on the treadmill and bike riding, which concerned us. The patient insisted on following his own exercise regime and declined the rehabilitation hospital program.

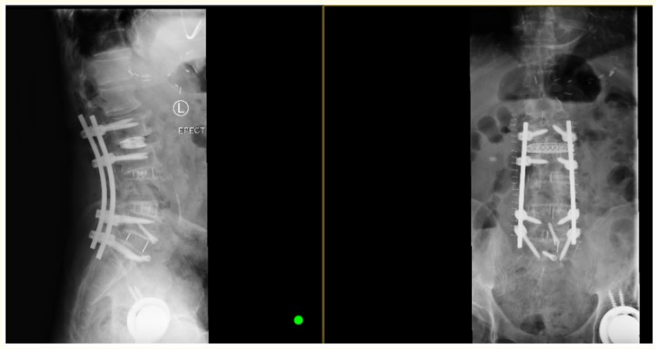

Figure 3: *OLIF at L5-S1 and L2-3, and extend the construct.*

An urgent X-ray was ordered to rule out fractures or implant subsidence/loosening. The X-ray was reviewed, and the patient was reassured and advised to reduce the extreme gym exercises for three more months. Upon a 3-month follow-up, the patient was very happy, walking around with no symptoms of back or leg pain. However, during the 6-month follow-up, the patient complained of right flank pain and pain in the right paracentral region of the lower back, believed to be caused by irritation from the metal hardware. Despite the fact that the dynamic X-ray showed stable fusion from L2-S1, the patient was scheduled for a CT scan at 12 months to assess the fusion rate. If fusion was confirmed, he would have been booked for rod and screw removal. Meanwhile, a referral to a pain specialist was made to assist in pain management.

The patient sought a second opinion, and the other surgeon agreed with the above-mentioned plan. Following this, the patient was lost to follow-up as he felt better and was able to mobilize without much trouble. In October 2020, he had a fall and sustained an L1 vertebral body crush fracture. He was admitted for management of his medical condition but not the fracture, and was discharged with pain medication, bracing, and a physiotherapy program, but without significant improvement. He presented back to our clinic on 19-01-2021 with severe back pain, an inability to stand straight or walk for more than 2 minutes, and a forward stooped posture with normal neurology. X-ray examination revealed a positive sagittal balance, 40-degree junctional kyphosis, and significant spondylolisthesis and canal compromise.

We were concerned that the patient would progress and develop cauda equina if left untreated, so he was admitted for urgent reconstruction and stabilization of his kyphoscoliosis. Although his peri-operative geriatric risk was 3.1%, the patient agreed to proceed with the surgery. A two-staged prone-to-lateral L1 corpectomy and extension of the instrumented fusion to T10 was performed (Figure 4). Postoperative X-rays showed restoration of coronal and sagittal alignment with a 30-degree correction of the thoracolumbar junction.

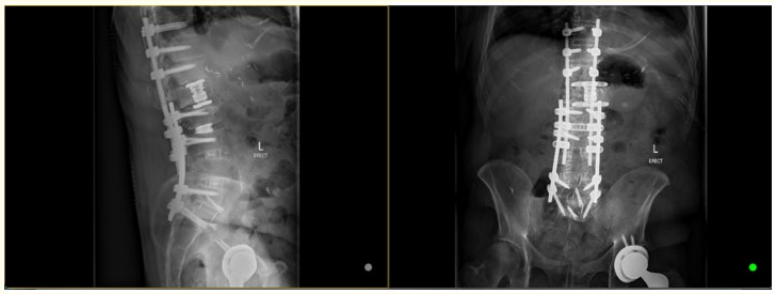

Figure 4: *Two-staged prone-to-lateral L1 corpectomy and extension of the instrumented fusion to T10.*

At the 3-month follow-up, the patient was very happy and asymptomatic, although his EOS X-ray showed slight loss of correction at the top end due to slight wedging of the T10 vertebral body (Figure 5). At the 9-month follow-up, there was an improvement of 20-30 degrees in his PJK level (Figure 6), but he complained of left-sided flank pain where the rib resection was made. The patient was referred to a pain specialist for intercostal nerve denervation.

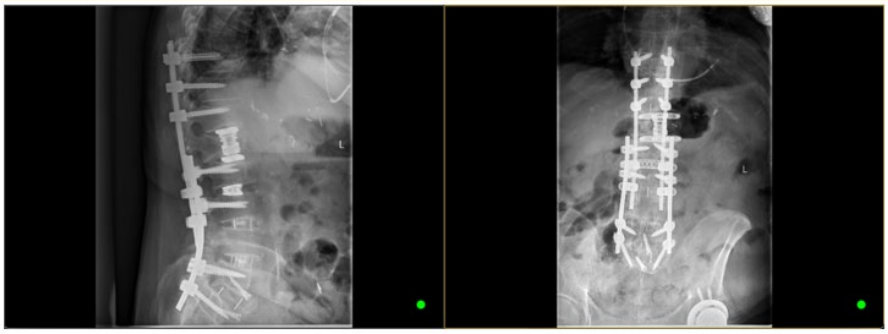

Figure 5: *Slight wedging of the T10 vertebral body.*

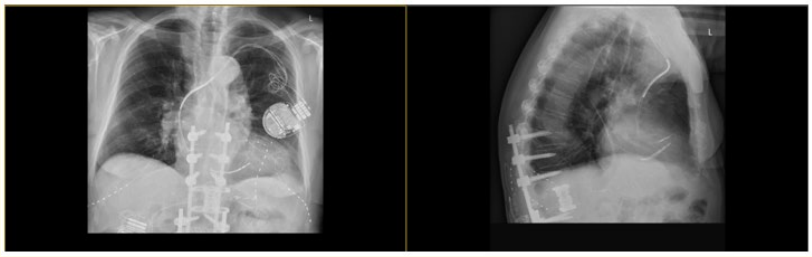

Figure 6: *Stable asymptomatic PJK.*

At 12 months following surgery, the patient was doing very well with excellent healing and union at the corpectomy site and satisfactory global alignment, and was eventually discharged from the clinic. In 2024, the patient returned complaining of severe mid-back pain, and a CT scan revealed a rib fracture at the same level of PJK (Figure 7). At this stage, the patient was scheduled for top screws removal, osteotomies, correction of the deformity and extension of the construct (Figure 8).

Figure 7: *Rib fracture at the same level of PJK.*

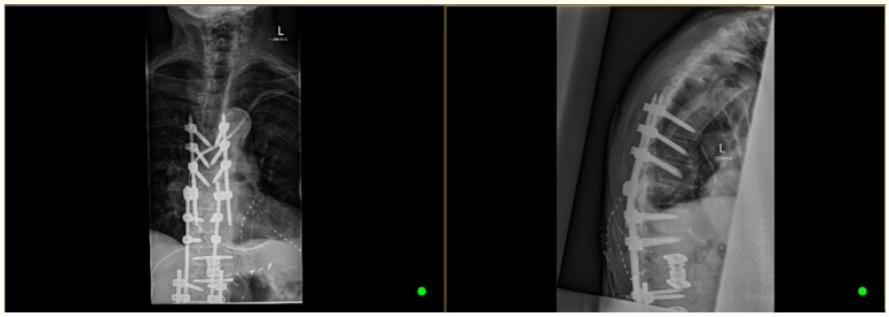

Figure 8: *For top screws removal, osteotomies, correction of the deformity and extension of the construct.*

Discussion

The patient remained asymptomatic for an extended period as his PJK was stable and not progressing in follow-up films. However, he presented to his general physician with a sudden, abrupt onset of pain, initially investigated with an X-ray to check on his PJK progression, which did not show the fracture. Consequently, the patient was referred to a pain specialist and received a nerve block, but the pain returned shortly after. A CT scan was then performed, revealing the rib fracture.

Several segmental complications can occur after long-segment internal fixation, with the most common being PJK (proximal junctional kyphosis), which affects 6 - 40% of patients depending on the disease type, follow-up time, and surgical approach [6-8]. The main risk factors for developing PJK, according to recent studies, include advanced age, BMI (body mass index), BMD (bone mineral density), lumbar lordosis, UIV/LIV (upper and lower instrumented vertebra), and SVA (sagittal vertical axis) [9-11]. Furthermore, studies by Kim., *et al*. and Yang., *et al*. affirm that age over 60 is a significant risk factor for PJK development [12,13].

Moreover, patients with a high BMI (> 25 kg/m^2) are more susceptible to PJK development, likely due to an increased load on the spine with the additional forward shifting of the body's center of gravity. They also tend to have weak muscles [14]. Additionally, the risk of screw loosening and pullout increases as bone mineral density and bone microarchitecture are disrupted [15]. A PI-LL (pelvic incidence-lumbar lordosis) mismatch increases compression and shear forces across L3 to L5 motion segments, leading to accelerated degeneration in adjacent segments [16]. Overcorrection of SVA can lead to higher stress at the proximal junctional area [17]. SVA normally increases with age, and this should be considered when planning for surgery.

Reflecting on this case, the patient was an elderly individual with a long construct in the context of osteoporosis and multiple open spinal surgeries, which progressed to PJK. Even though he was asymptomatic for a long period and did not progress in kyphosis due to the fusion of the adjacent costovertebral joints, we believe the load transferred to the weakest point next to the fused joints, which was the rib.

Conclusion

Early identification and appropriate imaging are crucial for timely management, potentially preventing further complications. This case highlights the need for vigilant monitoring and a comprehensive approach to diagnosing and managing unexpected pain in patients with complex spinal histories and long-segment internal fixation. Recognizing the risk factors and understanding the mechanics of load transfer in fused segments can aid in better anticipating and addressing such complications.

Abrupt pain in the setting of a stable, asymptomatic PJK/PJF in the thoracic spine should raise the suspicion of rib fractures. Given the limitations of X-rays in detecting such fractures, a CT scan should be obtained for a more accurate diagnosis.

Provenance and Peer Review

External peer review.

Patient Informed Consent

Informed consent was obtained from the patient prior to publication.

Conflict of Interest

No conflict of interest was reported by any of the authors.

Bibliography

1. Compston JE., *et al*. "Osteoporosis". *Lancet* 393.10169 (2019): 364-376.

2. Doodkorte RJP., *et al*. "Instrumentation techniques to prevent proximal junctional kyphosis and proximal junctional failure in adult spinal deformity correction-a systematic review of biomechanical studies". *The Spine Journal* 21.5 (2021): 842-854.

3. Wu Y., *et al*. "The stability of long-segment and short-segment fixation for treating severe burst fractures at the thoracolumbar junction in osteoporotic bone: a finite element analysis". *PLoS ONE* 14.2 (2019): e0211676.

4. Cerpa M., *et al*. "Revision surgery in proximal junctional kyphosis". *European Spine Journal* 29.1 (2020): 78-85.

5. Kim HJ and Iyer S. "Proximal junctional kyphosis". *Journal of the American Academy of Orthopaedic Surgeons* 24.5 (2016): 318-326.

6. Scheer JK., *et al*. "Results of the 2014 SRS survey on PJK/PJF: a report on variation of select SRS member practice patterns, treatment indications, and opinions on classification development". *Spine (Phila Pa)* 40.11 (2015): 829-840.

7. Kim HJ., *et al*. "Patients with proximal junctional kyphosis requiring revision surgery have higher postoperative lumbar lordosis and larger sagittal balance corrections". *Spine (Phila Pa 1976)* 39.9 (2014): E576-580.

8. Sebaaly A., *et al*. "Proximal junctional kyphosis in adult scoliosis: comparison of four radiological predictor models". *European Spine Journal* 27.3 (2018): 613-621.

9. Im SK., *et al*. "Proximal junctional kyphosis in degenerative sagittal deformity after under- and overcorrection of lumbar lordosis: does overcorrection of lumbar lordosis instigate PJK?" *Spine (Phila Pa 1976)* 45.15 (2020): E933-e942.

10. Zhao J., *et al*. "Incidence and risk factors of proximal junctional kyphosis after internal fixation for adult spinal deformity: a systematic evaluation and meta-analysis". *Neurosurgical Review* 44.2 (2021): 855-866.

11. Zou L., *et al*. "Characteristics and risk factors for proximal junctional kyphosis in adult spinal deformity after correction surgery: a systematic review and meta-analysis". *Neurosurgical Review* 42.3 (2019): 671-682.

12. Kim HJ., *et al*. "Proximal junctional kyphosis results in inferior SRS pain subscores in adult deformity patients". *Spine (Phila Pa 1976)* 38.11 (2013): 896-901.

13. Yang J., *et al*. "What factors predict the risk of proximal junctional failure in the long term, demographic, surgical, or radiographic?: Results from a time-dependent ROC Curve". *Spine (Phila Pa 1976)* 44.11 (2019): 777-784.

14. Yagi M., *et al*. "Fine-tuning the predictive model for proximal junctional failure in surgically treated patients with adult spinal deformity". *Spine (Phila Pa 1976)* 43.11 (2018): 767-773.

15. O'Leary PT., *et al*. "Risk factors and outcomes for catastrophic failures at the top of long pedicle screw constructs: a matched cohort analysis performed at a single center". *Spine (Phila Pa 1976)* 34.20 (2009): 2134-2139.

16. Senteler M., *et al*. "Pelvic incidence-lumbar lordosis mismatch results in increased segmental joint loads in the unfused and fused lumbar spine". *European Spine Journal* 23.7 (2014): 1384-1393.

17. Iyer S., *et al*. "Variations in sagittal alignment parameters based on age: a prospective study of asymptomatic volunteers using full-body radiographs". *Spine (Phila Pa 1976)* 41.23 (2016): 1826-1836.

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