

CASE REPORT

Temporary Iliac Fixation to Salvage an Acute L4 Chance Fracture

Following Pedicle Screw Fixation for Adolescent Idiopathic Scoliosis

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Study Design. A case report.

Objective. The aim of this study was to describe a technique of temporary distal fixation to the ilium to salvage an acute L4 fracture following a T3-L4 kyphoscoliosis correction.

Summary of Background Data. Pedicle fracture is a possible complication in pedicle screw fixation for scoliosis, which may lead to postoperative instability, resulting in loss of fixation and pseudoarthrosis. This report highlights the salvage treatment of a chance fracture that occurred in the lower instrumented vertebra following deformity correction for adolescent idiopathic scoliosis (AIS) without sacrificing further distal motion segments.

Methods. A retrospective chart and radiograph review of a 13-year-old female who underwent surgical treatment for correction of AIS was performed.

Results. Following a T3-L4 correction with apical posterior column releases, an L4 Chance fracture with loss of distal fixation occurred on post-op day 3. Following an unsuccessful salvage with an infralaminar hook, a second revision was performed replacing the hook and adding bilateral temporary fixation to the ilium connected to the distal ends of the main rods through side-to-side connectors. The temporary fixation was removed 6 months later with successful healing of the fracture maintenance of the scoliosis correction at 2-year follow-up.

Conclusion. Temporary extension of the construct to the ilium was successfully utilized in this case to salvage an acute L4 Chance fracture that occurred following a T3 to L4 construct for

kyphoscoliosis. With this technique, successful reduction and healing of the fracture occurred with maintenance of the deformity correction without the need to fuse further distal segments.

Key words: adolescent idiopathic scoliosis, chance fracture, connector, iliac wing screws, kyphoscoliosis, pedicle screw fixation, temporary iliac fixation.

Level of Evidence: 4

Spine 2017;42:E313–E316

Pedicle fracture is a possible complication in pedicle screw fixation for scoliosis, which may lead to postoperative instability, resulting in loss of fixation and pseudoarthrosis.^{1–4} This report highlights the treatment of a chance fracture⁵ that occurred in the lower instrumented vertebra following deformity correction for adolescent idiopathic scoliosis (AIS). A salvage technique with temporary fixation to the ilium was utilized to protect the primary construct and treat the fracture without sacrificing further distal motion segments.

CASE REPORT

A 13-year-old female adolescent (Figure 1A,B) underwent posterior spinal fusion for her kyphoscoliosis. Initial surgical procedures included T3-L4 all pedicle screw construct with T12-L1 and L1-2 Smith-Petersen osteotomies. Fixed angle pedicle screws with diameters ranging from 5.0 to 6.5 mm were used. A 5.5 mm cobalt chrome rod was used on the left side and a 5.5 mm titanium alloy rod was applied on the convexity. An intraoperative posteroanterior (PA) radiograph confirmed good position of the implants and a balanced correction (Figure 1C). No complications were noted during the procedure and the patient was neurologically intact. On the third postoperative day, the patient developed new left radicular leg pain and postoperative radiographs and CT scans demonstrated a Chance fracture of L4 with left pedicle fracture and focal kyphotic deformity at L3-4 (Figure 2A–C).

Surgical Treatment

The patient was returned to the operating room one week after the initial procedure. The left L4 pedicle screw was replaced with an L4 upgoing infralaminar hook.

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Acknowledgment date: December 2, 2015. First revision date: June 7, 2016. Acceptance date: June 23, 2016.

The device(s)/drug(s) is/are FDA-approved or approved by corresponding national agency for this indication.

No funds were received in support of this work.

Relevant financial activities outside the submitted work: payment for development of educational presentations, stocks, travel/accommodations/meeting expenses.

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DOI: 10.1097/BRS.0000000000001786

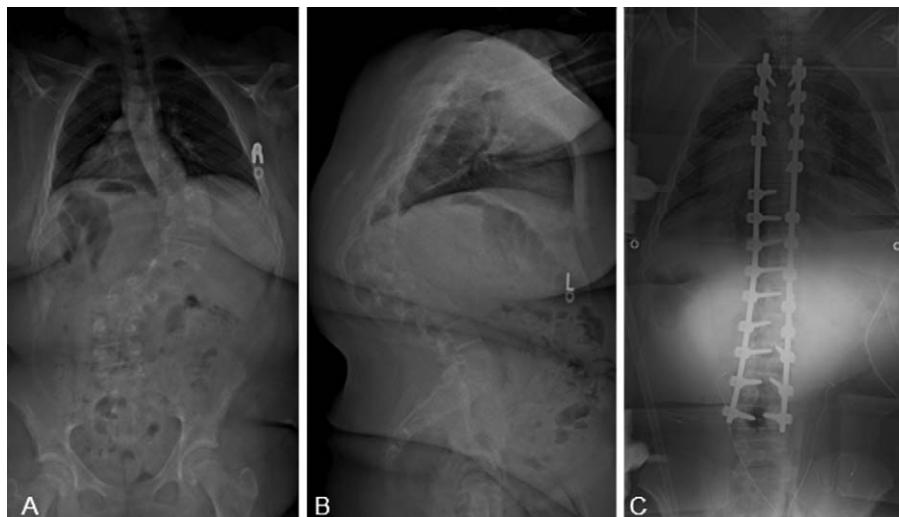


Figure 1. Standing posteroanterior (A) and lateral (B) radiographs of a 13-year-old female with a maximum coronal Cobb of 70° and a sagittal Cobb of 90°. Intraoperative posteroanterior radiograph (C) demonstrating reduction of the coronal deformity with an all pedicle screw construct from T3 to L4.

Compression was applied to reduce the deformity. The right L4 pedicle screw was exchanged for a longer 45 mm (Figure 2D). Two weeks later, the L4 hook dislodged (Figure 3A,B). A second revision procedure was performed by resecuring the hook and adding bilateral temporary rods, which extended through a side-to-side rod connector, from the distal end of the rods to 7.5 mm iliac wing screws placed in each hemipelvis (Figure 3C,D). The deep distal dissection was carried out through the Wiltse plane to avoid the L4-5 and L5-S1 facet joints.

Postoperative Course

The patient's symptoms resolved and neurological function normalized. Six months postoperatively, the bilateral iliac screws, connectors, and rod extensions were removed. The fracture healed and the deformity correction was maintained. At 2 years following the revision surgery (Figure 3E,F), the patient was pain free with radiographs demonstrating maintained correction of her deformity. There is a significant improvement between pre-op and post-op SRS 30 total scores, self-image scores, mental

health, and satisfaction scores. Magnetic resonance imaging (MRI) was performed 3 years following the index procedure shows well preserved discs at L4-5 and L5-S1 with some minimal degeneration (Figure 4A–E).

DISCUSSION

This report describes an acute L4 Chance fracture of the lower instrumented vertebra following pedicle screw fixation for AIS salvaged with temporary extension to the ilium. Following removal of the temporary fixation, successful healing of the fracture occurred with maintenance of the deformity correction without the need to fuse further distal lumbar segments.

Although there have been only limited numbers of case reports describing Chance fractures as a postoperative complication of pedicle screw fixation,^{6–9} pedicle fracture itself has been reported.^{10–12} Its rate in scoliosis surgery has been reported from 0.24% to 13%.^{2,4} There are two factors that potentially cause this complication. Suk *et al.*² argued that the mismatch of the diameter of pedicles and screws inserted is the main factor. Inserting an oversized screw can split the

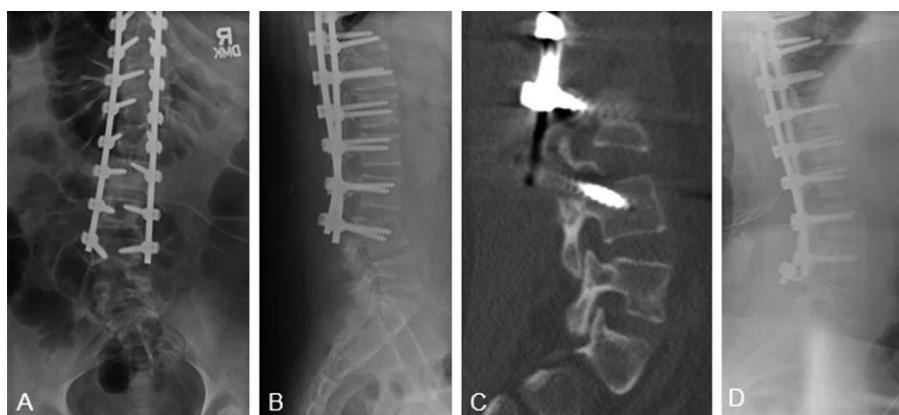
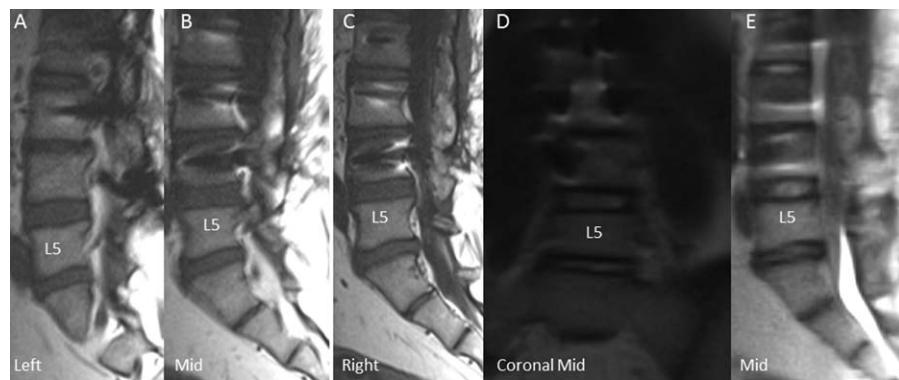


Figure 2. Postoperative day 3 posteroanterior (A) and lateral (B) lumbar radiographs demonstrates a focal kyphotic deformity at L3-4 with proximal plowing of the L4 screws. Left sagittal CT scan (C) confirms a Chance fracture through the pedicle of L4. Intraoperative lateral prone radiograph (D) following revision of the right L4 pedicle screw and replacing the left L4 screw with an upgoing infralaminar hook on L4 shows reduction of the L3-4 deformity.

Figure 3. Two weeks following the revision, the patient returns with recurrence of the L3-4 deformity and pull-out of the left L4 laminar hook (**A,B**). The patient was revised with resetting of the hook and the addition of temporary rods that span from newly placed iliac wing screws to the distal ends of the rods through side-to side connectors (**C,D**). The temporary fixation was removed 6 months later. Two-year postoperative posteroanterior (**E**) and lateral (**F**) radiographs demonstrate reduction of the L3-4 fracture and good maintenance of the deformity correction and balance.



Figure 4. MRI performed 3 years following the index surgery. Sagittal T1 images (**A–C**), coronal mid-body (**D**) and sagittal T2 mid-body (**E**) demonstrate well preserved discs at L4-5 and L5-S1 with some early degenerative changes.



pedicle apart, which is more commonly seen at L1 and L2, where the pedicles tend to have small diameters. Others describe the shift of the mechanical axis and the excessive load at the end of the long construct as an important factor for a Chance fracture.^{7–9} This is likely the mechanism in this case wherein significant correction in a larger patient was achieved.

While extending the construct distally² is a viable option, fusions to L5 or the sacrum could negatively impact the patients' quality of life.¹³ As a salvage technique, Coscia⁶ reported that the application of distal laminar hooks successfully achieved the fusion from T11 to L3, which was not effective for our long construct. Lattig *et al.*⁸ reported temporary distal extension by pedicle screw fixation without fusion and cerclage wiring of the fractured pedicles. The concept of our second revision is similar, but we believe that there is risk of damaging the distal facet through pedicle screw insertion and nonfusion of the level is not guaranteed.

CONCLUSION

Temporary extension of the construct to the ilium was successfully utilized in this case to protect the primary construct and salvage an acute L4 Chance fracture that occurred following a T3 to L4 construct for kyphoscoliosis. With this technique, successful reduction and healing of the fracture occurred with maintenance of the deformity

correction without the need to fuse further distal segments, preserving important lumbar motion segments.

➤ Key Points

- Acute pedicle fracture leading to kyphotic deformity and loss of fixation can occur at the distal end of a pedicle screw construct for scoliosis.
- Temporary extension of the construct to the ilium was successfully utilized to salvage an acute L4 Chance fracture that occurred following a T3-L4 construct for adolescent kyphoscoliosis.
- The temporary extension to the ilium protected the primary construct and obviated the need to fuse further distal lumbar segments in this case.

References

1. Hicks JM, Singla A, Shen FH, et al. Complications of pedicle screw fixation in scoliosis surgery: a systematic review. *Spine (Phila Pa 1976)* 2010;35:E465–70.
2. Suk SI, Kim WJ, Lee SM, et al. Thoracic pedicle screw fixation in spinal deformities: are they really safe? *Spine (Phila Pa 1976)* 2001;26:2049–57.
3. Ruf M, Harms J. Pedicle screws in 1- and 2-year-old children: technique, complications, and effect on further growth. *Spine (Phila Pa 1976)* 2002;27:E460–6.

4. Di Silvestre M, Bakaloudis G, Lolli F, et al. Posterior fusion only for thoracic adolescent idiopathic scoliosis of more than 80 degrees: pedicle screws versus hybrid instrumentation. *Eur Spine J* 2008;17:1336–49.
5. Chance GQ. Note on a type of flexion fracture of the spine. *Br J Radiol* 1948;21:452.
6. Coscia MF. Pediatric chance fracture associated with pedicle screw use: a case report. *Spine (Phila Pa 1976)* 1997;22:2698–2701.
7. Levine DS, Dugas JR, Tarantino SJ, et al. Chance fracture after pedicle screw fixation. A case report. *Spine (Phila Pa 1976)* 1998;23:382–5; discussion 6.
8. Lattig F, Fekete TF, Jeszenszky D. Management of fractures of the pedicle after instrumentation with transpedicular screws: a report of three patients. *J Bone Joint Surg Br* 2010;92:98–102.
9. Hu X, Lieberman IH. Proximal instrumented vertebral body chance fracture after pedicle screw instrumentation in a thoracic kyphosis patient with osteoporosis. *J Spinal Disord Tech* 2015;28:31–6.
10. Blumenthal S, Gill K. Complications of the Wiltse pedicle screw fixation system. *Spine (Phila Pa 1976)* 1993;18:1867–71.
11. Esses SI, Sachs BL, Dreyzin V. Complications associated with the technique of pedicle screw fixation. A selected survey of ABS members. *Spine (Phila Pa 1976)* 1993;18:2231–8; discussion 8–9.
12. Lonstein JE, Denis F, Perra JH, et al. Complications associated with pedicle screws. *J Bone Joint Surg Am* 1999;81:1519–28.
13. Sanchez-Raya J, Bago J, Pellise F, et al. Does the lower instrumented vertebra have an effect on lumbar mobility, subjective perception of trunk flexibility, and quality of life in patients with idiopathic scoliosis treated by spinal fusion? *J Spinal Disord Tech* 2012;25:437–42.