Review of Techniques

An endoscopic surgical technique for treating radiculopathy secondary to S1 nerve compression from a pedicle screw: technical note

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Abstract: Pedicle screw instrumentation is a widely used technique for fixating the spine in fusion surgery. One of the complications associated with pedicle screw placement is when a screw breaches the pedicle medially and causes the patient radicular pain or numbness or weakness. Revising a breached pedicle screw in a patient who has undergone a multilevel fusion surgery often requires that the patient undergo a very invasive revision surgical procedure. Here the authors present a technical note on decompressing an S1 nerve compressed by a breached pedicle screw by performing an endoscopic surgical approach through a 1-cm incision and drilling down the threads of the pedicle screw, directly decompressing the nerve without removing the screw.

Keywords: Endoscopic spine surgery; minimally-invasive spine; pedicle screw; laminectomy; radiculopathy

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Introduction

Pedicle screw instrumentation is used world-wide as an effective means of internal stabilization for spinal arthrodesis. One of the risks of pedicle screw placement is the possibility of the pedicle screw breaching the medial pedicle wall during its placement: this can result in nerve injury or radicular pain and numbness. Although the higher accuracy of navigated pedicle screws has been described in the literature, pedicle screw misplacement even in navigated cases occurs (1-10). The treatment for a patient symptomatic from lumbar radiculopathy secondary to a medially breached pedicle screw is a hardware revision that can often involve a large incision in multilevel fusion cases in order to remove the rod, revise the screw position, and replace the rod. The patient morbidity is significant and the liability to the hospital and surgeon are also significant. Here we present a minimally invasive endoscopic technique for the decompression of an S1 nerve resecting the thread profile and screw edge of a too medially placed S1 pedicle crew utilizing endoscopic drilling. The procedure is performed through a 1-cm incision.

Case report

History and presentation

A 60-year-old female patient underwent a lumbar 4–5 transforaminal lumbar interbody fusion (TLIF) in 2011 and had her fusion extended from lumbar 3 to sacral 1 in 2017. Immediately following that fusion surgery and for the next year, she complained of continuous left S1 radicular pain and numbness despite physical therapy and interventional pain management. A CT scan indicated that the left S1

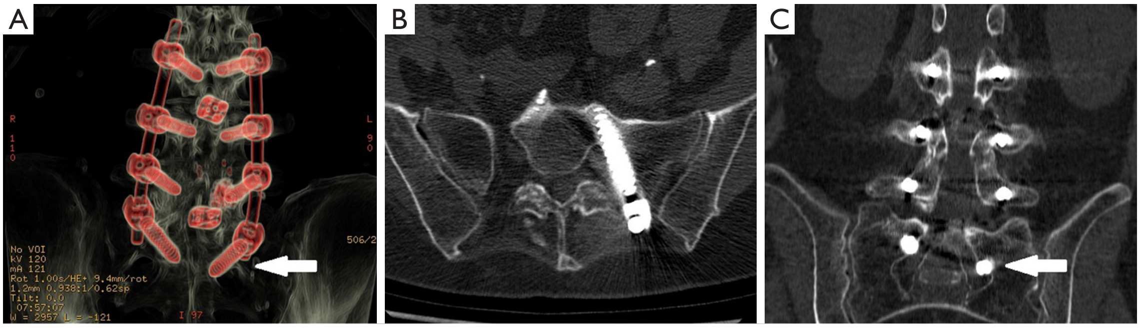

Figure 1 Lumbar CT after L3–S1 instrumented fusion depicting left S1 pedicle screw medial breach. (A) 3D CT reconstruction shows the medal left S1 screw (arrow); (B) axial CT image depicting the left S1 pedicle screw in the sacral foramen where it is compressing the left S1 nerve; (C) coronal CT reconstruction depicting the left S1 pedicle screw (arrow) in the sacral foramen where it is compressing the left S1 nerve.

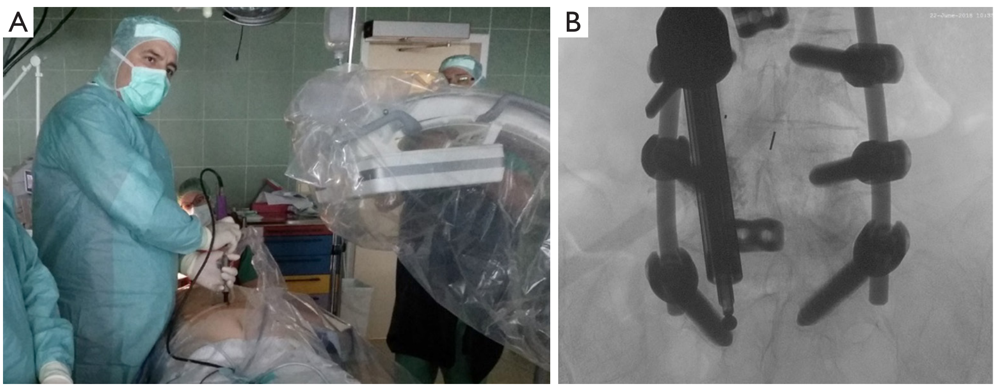

Figure 2 Endoscopic left S1 nerve decompression procedure. (A) Intraoperative photograph of the surgeon performing endoscopic drilling through a 1-cm diameter working channel endoscope and tubular retractor inserted with fluoroscopic guidance at the lumbosacral junction; (B) AP fluoroscopic image depicting the endoscopic drill performing the S1 screw reduction. AP, anteroposterior.

pedicle screw had breached the medial wall of the pedicle and was likely compressing her left S1 nerve (*Figure 1*). Options for treatment discussed with the patient included revising the screw, removing the screw, and decompressing the S1 nerve by drilling down the screw threads that were impinging on the S1 nerve. The patient sought out a surgeon with experience in endoscopic spine surgery, so opted for a minimally invasive endoscopic approach. The patient underwent an endoscopic interlaminar hemi-laminotomy, medial facetectomy and partial resection of the protruding S1 pedicle screw to decompress and skeletonize the traversing S1 nerve above and below the S1 pedicle. The patient's radicular symptoms improved immediately, and she remained asymptomatic at the 6-month follow-up.

Operative procedure

For the endoscopic sacral endoscopic interlaminar hemi-laminotomy, medial facetectomy and partial resection of the protruding S1 pedicle screw the patient was positioned in the prone position on a Kambin frame with flexed hips and knees (*Figure 2*). The procedure was done under general anesthesia. The Joimax iLESSYS® Delta endoscope was used for the procedure (*Figure 2*). AP and lateral fluoroscopy were used intermittently throughout the case. A 1-cm incision was made 2 cm left of midline (location determined by fluoroscopy) with a scalpel. Under fluoroscopic guidance, a Jamshidi needle and then sequential dilators were used to target the S1 lamina as a starting point and the final

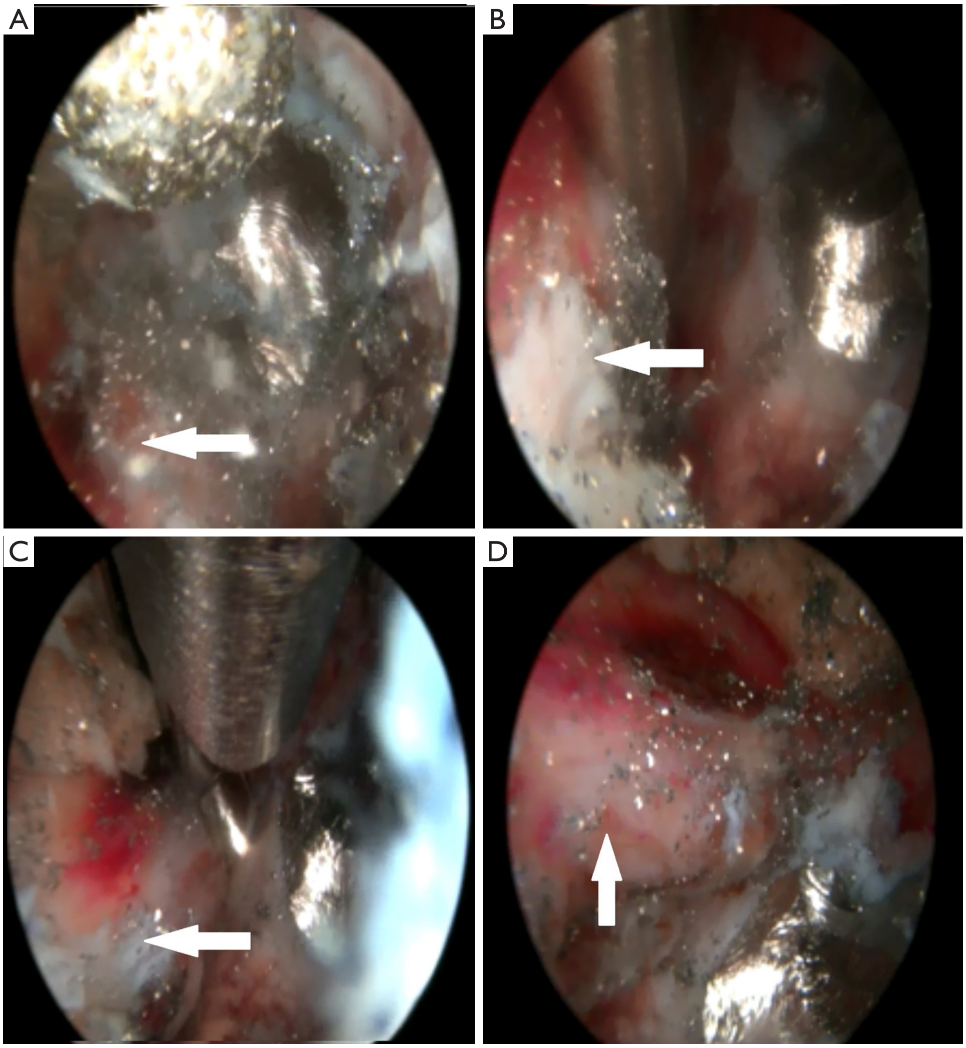

Figure 3 Endoscopic camera views of surgical procedure for the endoscopic left S1 nerve decompression. (A) Endoscopic camera-view shows the endoscopic round diamond drill bit and the smooth edge of the S1 pedicle screw after initial drilling (arrow indicates the S1 nerve); (B) endoscopic camera-view shows the endoscopic dissector retracting the S1 nerve off the pedicle screw (arrow indicates the S1 nerve); (C) endoscopic camera-view shows the endoscopic kerrison rongeur performing a foraminotomy to completely decompress the S1 nerve (arrow indicates the S1 nerve). Here the red spot on the nerve likely indicating chronic inflammation can be well seen; (D) endoscopic camera-view shows the decompressed S1 nerve passing freely over the pedicle (arrow indicates the S1 nerve).

11.5-mm tubular retractor was inserted. At this point the Joimax® rigid laminoscope with a 10mm outer diameter and 6-mm working channel was inserted through the tubular retractor (*Figure 2A,B*). Under direct continuous endoscopic visualization, laminar decompression and partial resection of the titanium pedicle screw was achieved using a highspeed endoscopic burr (Joimax®) with a 4.5-mm outer diameter head (*Figure 3A*). In order to avoid a dural tear, meticulous dissection of the interface between the titanium screw and nerve root was performed with a blunt dissector (*Figure 3B*). Hemostasis was achieved with a radiofrequency probe. Once titanium screw threads were sufficiently reduced in size by drilling, a lateral recess decompression was performed with a kerrison rongeur decompressing the traversing S1 nerve root along its course over the S1 pedicle (*Figure 3C,D*). *Figure 3* displays the endoscopic camera images from the procedure, and in these images, a large red spot can be seen on the S1 nerve that is likely from the chronic inflammation from the compressed nerve. Once the S1 nerve was completely decompressed, the tubular retractor and endoscope were removed, and the wound was closed with a dissolvable suture.

Postoperative course

The postoperative course was uncomplicated, and the patient's radicular pain improved immediately after surgery. Six months after his endoscopic procedure, the patient had no clinical symptoms related to the S1 nerve root compression.

Discussion

One interesting feature of the literature on endoscopic spine surgery is how it is used as a rescue procedure for complications associated with many spine surgical procedures: kyphoplasty (11), minimally invasive surgery (MIS) TLIF (12,13), lumbar fusion (14,15), and artificial lumbar disc replacement (16,17). Many advances in spine surgery today are fueled by a rapid influx of new implants. The early phase of clinical studies on spine implants tend to focus on understanding the benefits of these implants. The later phase of clinical studies, after widespread implant adoption and use, then focuses on how to best deal complications that result from these implants. Endoscopic spine surgical approaches certainly offer an interesting minimally invasive approach to dealing with spine implant complications.

There are several drawbacks to consider before embracing endoscopic surgery as the salvage procedure for complications secondary to instrumented spine surgeries. First, there is a learning curve to endoscopic spine surgery. Today, it is uncommon for spine surgeons to be trained in residency or fellowship in endoscopic spine surgery techniques. It is not suggested here that endoscopically exposing and drilling down a pedicle screw be considered by anyone other than a surgeon with significant endoscopic spine surgery experience. Second, the surgery performed here is done with one instrument at a time down the endoscope's working channel. A retractor is not retracting the nerve while the drill is drilling the pedicle screw. This is a clear disadvantage of a "one instrument at a time" technique. This disadvantage was overcome here by the freedom of angling the endoscope to avoid the nerve and often the continuous irrigation which was used as a gentle dural retractor. If the surgery were performed with a smaller endoscope and beveled tubular retractor, the beveled edge of the tubular retractor could have been used to retract the S1 nerve safely. The larger endoscope used here made it possible to use a larger drill and made drilling out the fusion bone more expeditious.

Conclusions

Minimally invasive endoscopic spine surgery offers many benefits that are attractive to patients: shorter recovery times, small incisions, and less pain. The authors present this technical note for others to consider as a possible minimally invasive solution for the treatment of a radiculopathy caused by a pedicle screw that breached the medial wall of the pedicle. The authors present this technique to make other surgeons aware of the possibility of an endoscopic surgical approach in the case of a hardware complication, but do not suggest this technique be attempted unless the surgeon has significant experience in endoscopic spine surgery.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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