

An Elite Triathlete with High-grade Isthmic Spondylolisthesis Treated by Lumbar Decompression Surgery without Fusion

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The patient was a 48-year-old female recreational triathlete who had been experiencing mild low back pain since high school. She had recently developed right leg pain and had gradually worsening difficulty in running. She preferred to undergo spinal surgery without fusion so that she could return to triathlons as soon as possible, and she was referred to our hospital. Plain radiographs showed Meyerding grade 3 isthmic spondylolisthesis at L5 and a slipped L5 vertebral body. Selective nerve root block at L5 relieved the right leg pain temporarily. The final diagnosis was right L5 radiculopathy due to compression by the ragged edge of the L5 pars defect from the posterior side and by the upside-down foraminal stenosis at L5–S1. An L4–L5 partial laminectomy was performed with resection of the ragged edge and one-third of the caudal pedicle at L5. Adequate decompression was achieved by exposing the L5 spinal nerve root from the branch portion to the outside of the L5 pedicle. The right leg pain disappeared postoperatively and she returned to participating in triathlons. One year after surgery, there was slight radiographic progression of the slip in 5 mm; however, there had been no recurrence of the right leg pain. Several studies have reported excellent outcomes after decompression surgery in patients with isthmic spondylolisthesis. To our knowledge, this is the first report of successful lumbar decompression surgery without fusion for high-grade isthmic spondylolisthesis in a triathlete, although in short-term results.

Keywords: minimally invasive surgery, spondylolisthesis, athlete, lumbar decompression surgery

Introduction

Isthmic spondylolysis is a defect of the pars interarticularis and a causative factor in up to 47% of young athletes presenting with low back pain.¹ The incidence of spondylolysis in professional soccer players has been reported to be 38% and that in baseball players to be 44%.² Furthermore, in a study of 3132 symptomatic competitive athletes, spondylolysis was diagnosed in 43% of divers, 30% of wrestlers, and 23% of weightlifters.³

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Received: October 20, 2019; Accepted: February 12, 2020
Online September 15, 2020

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A discontinuity of the pars interarticularis induces a forward slip of the involved vertebral body. As a result of the pseudarthrosis, fibrocartilaginous tissue develops at the isthmic defect. Patients may present with low back pain, leg pain, or neurogenic claudication due to anterior slippage of the vertebral column and fibrocartilaginous mass at the isthmic defect. The percentage of slippage of the vertebral bodies greater than 50% is generally considered to be a high-grade isthmic spondylolisthesis. Spinal fusion with resection of a hook-like osteophyte, ragged edge, at the pars defect is often performed in patients with unstable high-grade isthmic spondylolisthesis to treat the low back pain caused by lumbar instability and to prevent progression of the slip in the future.^{4,5} However, spinal fusion is more invasive than decompression surgery and patients need to wear a brace for a lengthy period until union of the grafted bone is complete. Therefore, we hesitate to perform spinal fusion surgery in active young patients or athletes. Here, we report a case of successful lumbar decompression surgery without fusion in a triathlete with high-grade isthmic spondylolisthesis.

Case Report

The patient was a 48-year-old female recreational triathlete who first became aware of mild low back pain in high school but had continued playing various sports. She had developed right leg pain a few months earlier and had gradually worsening difficulty in activity of the daily living as well as running. She had consulted several doctors who had recommended spinal fusion surgery with instrumentation. However, she preferred to undergo spinal surgery without fusion so that she could return to competing in triathlons as soon as possible. Therefore, she was referred to our hospital. Her main complaint was right leg pain, not low back pain. The neurological findings at the first visit indicated numbness in the right leg in the distribution of the L5 dermatome but no muscle weakness in the lower limbs.

Plain radiographs of the lumbar spine revealed Meyerding grade 3 isthmic spondylolisthesis at L5 and a collapsed degenerative disc at L5–S1 (Fig. 1). Sagittal and axial computed tomography (CT) scans revealed a ragged edge around a pars defect at the right side (Fig. 2B). A sagittal CT scan showed that the L5–S1 disc had collapsed completely and the right spinal nerve root at L5 seemed to be impinged between the pedicle at L5 and the superior endplate at S1 (“upside-down” foraminal stenosis; Fig. 2A). T2-weighted magnetic resonance images also showed nerve root impingement at L5 because of the upside-down stenosis in the



Fig. 1 Flexion and extension radiographs of lumbar spine obtained before surgery demonstrate grade 3 isthmic spondylolisthesis with a collapsed degenerative disc and no obvious instability at the L5–S1 level.

intervertebral foramen (Figs. 2C and D). A selective nerve root block at L5 relieved the right leg pain temporarily. The diagnosis was right-sided L5 radiculopathy resulting from compression by the ragged edge of an L5 pars defect from the posterior side and by upside-down foraminal stenosis at L5–S1.

We recognized the patient's desire to avoid spinal fusion surgery with instrumentation. In children, the isthmic vertebra slips forward through the growth plate^{6–8)} whereas in adults, it slips at the level of a degenerative disc, as in degenerative spondylolisthesis. Our patient was an adult in whom the disc had already completely degenerated and collapsed, so we assumed there would be little chance of further slippage. The decision was taken to perform decompression without fusion, with spinal fusion surgery reserved for a later date if necessary.

A 4-cm longitudinal skin incision was made in the middle of the back over the L4–S1 spinous processes. The back muscles were retracted on the right side to expose the lamina, and a right-sided partial laminectomy was performed at L4–L5. After resection of the ragged edge, the L5 nerve root was confirmed visually to be traveling through the vertebral foramen beneath the L5 pedicle. However, the L5 nerve root was still impinged by the upside-down foraminal stenosis, so the caudal third of the L5 pedicle was also resected. Adequate decompression was achieved by exposing the L5 spinal nerve root from the branch portion to the outside of the L5 pedicle.

The patient's right leg pain disappeared after surgery during the activity of the daily living (ADL). Postoperative sagittal and axial CT scans revealed complete decompression of the upside-down foraminal stenosis at L5–S1 and removal of the ragged edge (Figs. 3A and B). Three-dimensional CT scanning visualized the extent of the right-sided bone resection at L4 and L5 (Figs. 3C and D). She returned to triathlon training 3 months postoperatively and returned to competition 7 months postoperatively. One year after

surgery, despite slight radiographic progression of the slip in 5 mm (Fig. 4). During the ADL, the patient remains asymptomatic and no pain any more. Regarding the triathlon, in swim and bike she does not have any problems; however, leg numbness along the right L5 dermatome appears during the final marathon. Despite the symptom, she is performing the sports now.

Discussion

We have presented a case of a triathlete with high-grade (Meyerding grade 3) isthmic spondylolisthesis at L5 that was treated by decompression surgery alone without fusion. The clinical outcome at 1 year was satisfactory. Intervertebral body fusion with instrumentation is generally recommended for adults with symptomatic high-grade isthmic spondylolisthesis.^{4,5)} However, the patient described here was a very active athlete who wanted to return to competition as soon as possible. She also feared the prospect of degeneration at an adjacent level following fusion surgery in view of her very high level of activity.

As mentioned earlier, we predicted that the risk of further slippage would be minimal. An isthmic vertebra can slip in two ways. In the pediatric spine, the vertebra can slip forward through the endplate,^{6–8)} whereas in the adult spine, it slips at the level of a degenerating disc, as in degenerative spondylolisthesis. Therefore, further slipping in the forward direction is possible in adults; however, in the present case, the disc had already degenerated completely and had collapsed (Fig. 1). The decision was taken to perform decompression without fusion after explaining to the patient that spinal fusion surgery might be needed in the future.

In 2003, Sairyo et al.⁹⁾ described an endoscopic technique that could decompress lumbar nerve roots affected by spondylolysis without fusion. The indications for this technique were radiculopathy without low back pain, no spinal instability on dynamic radiographs, and age older than 40 years.

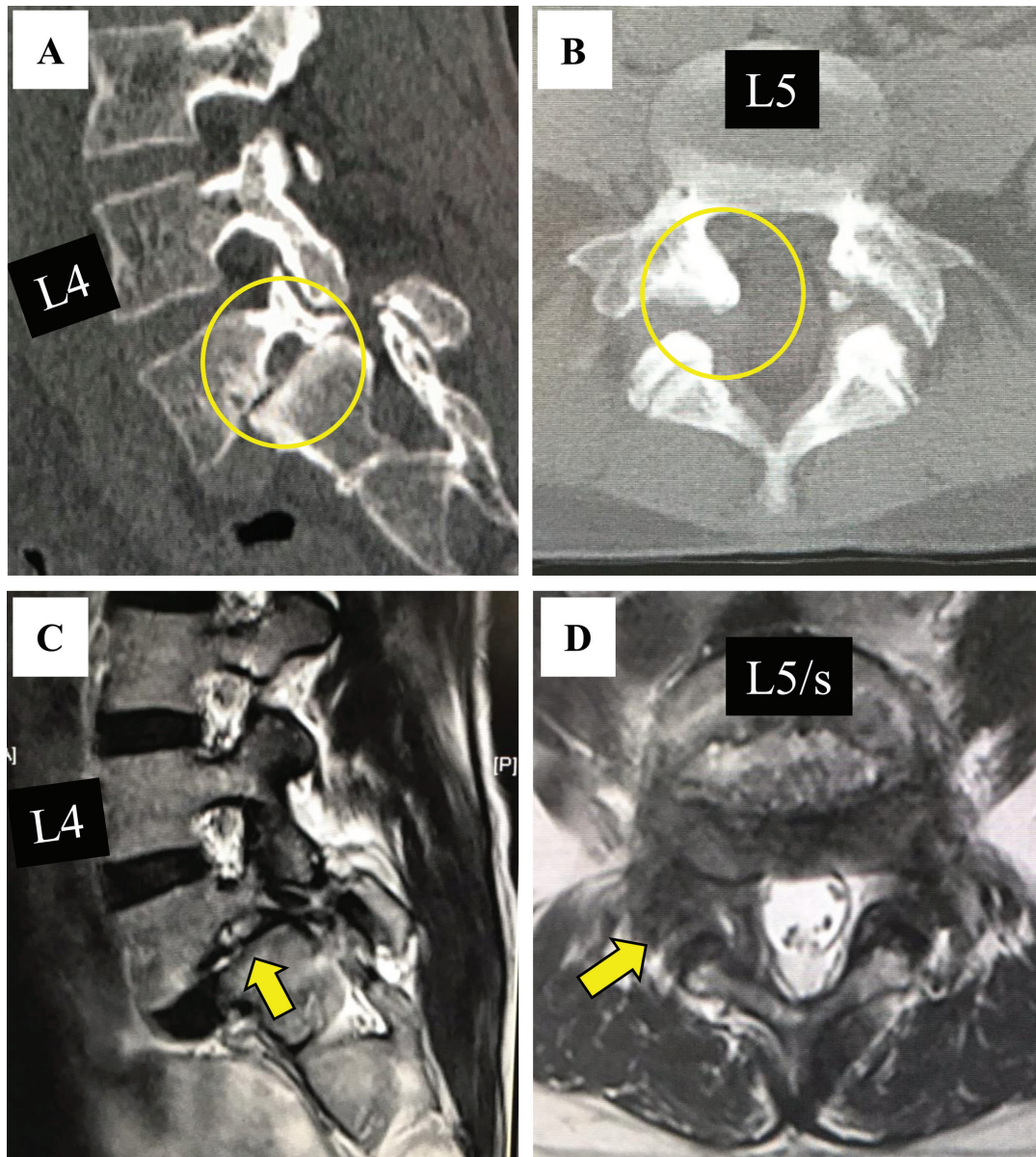


Fig. 2 Preoperative sagittal (A) and axial (B) CT scans show a ragged edge at L5 on the right, indicated by yellow circles. Preoperative sagittal (C) and axial (D) T2-weighted magnetic resonance images reveal a completely collapsed disc at L4–L5 and impingement of the L5 nerve root on the right between the pedicle of L5 and the superior endplate at S1, indicated by yellow arrows. CT: computed tomography.

In a recent report, Yamashita et al.¹⁰⁾ described successful endoscopic surgery in a professional baseball player with grade 2 isthmic spondylolisthesis and considered that minimally invasive endoscopic surgery is an option for radiculopathy in very active patients who need an early return to their previous level of physical activity, such as professional sports players. The patient did not have upside-down stenosis and only a ragged edge needed to be removed, so endoscopic surgery was possible.

Like the patient described by Yamashita et al.,¹⁰⁾ our patient was considered for minimally invasive endoscopic surgery. However, the major difference between these cases is that our patient had upside-down foraminal stenosis and

the degree of slippage was high grade. Therefore, endoscopic surgery was not considered to be appropriate for our patient.

The main concern after surgery is progression of the slip. Gill et al.¹¹⁾ first described decompression without fusion surgery for isthmic spondylolisthesis. Although the short-term outcome was encouraging with regard to radiculopathy, additional fusion surgery may sometimes be required in the long term because of slip progression.^{12,13)} Sairyo et al.¹⁴⁾ analyzed intradiscal pressure before and after Gill's surgery by finite element modeling and found that the pressure increased by twofold. They concluded that disc degeneration may be accelerated postoperatively. Therefore, Gill's decompression surgery with fusion is recommended for isthmic spondylolisthesis.

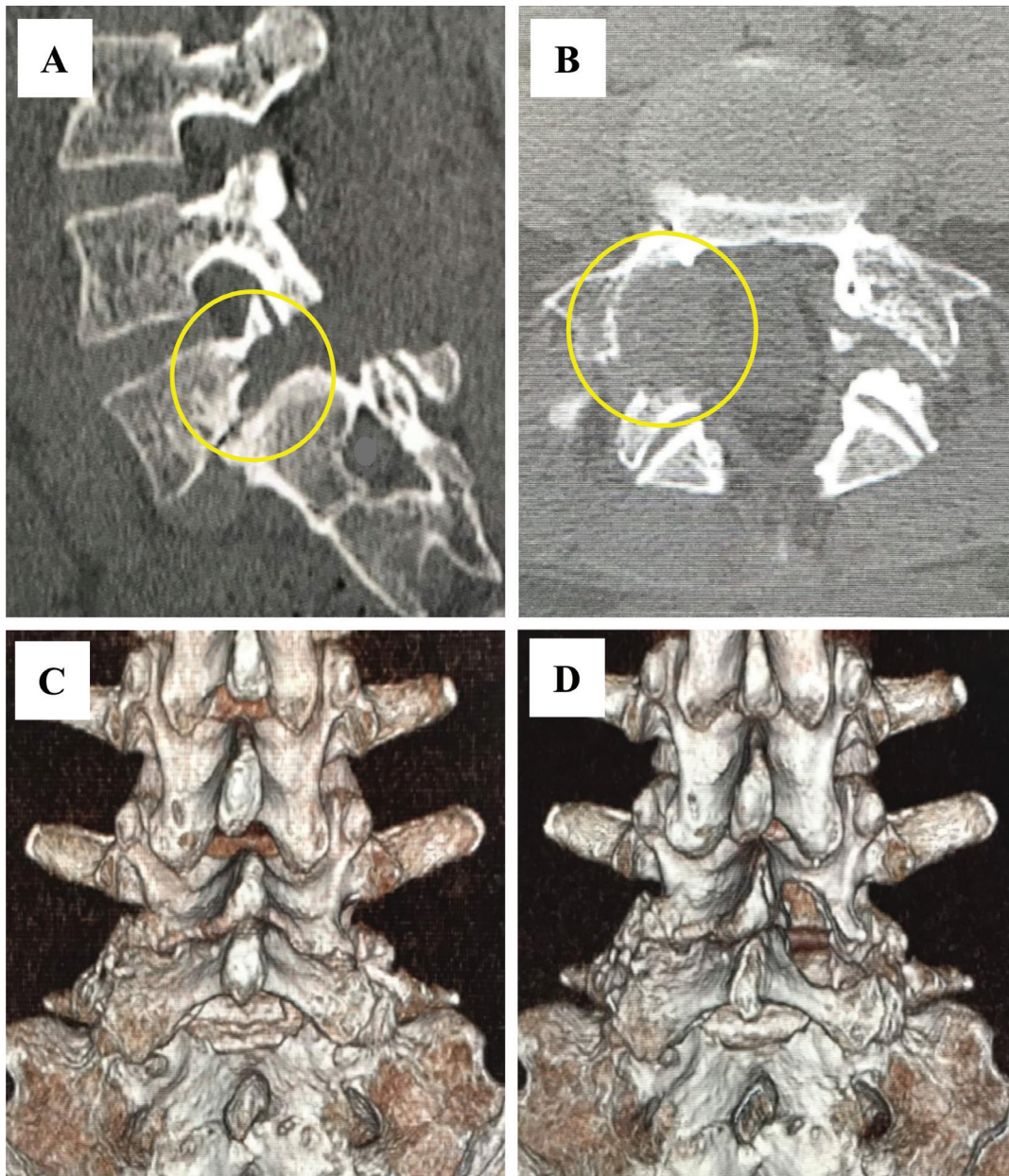


Fig. 3 Postoperative sagittal (A) and axial (B) CT scans confirming complete removal of the ragged edge at L5 on the right, indicated by yellow circles. Preoperative (C) and postoperative (D) three-dimensional CT scans confirming completion of partial laminectomy at L4–L5 on the right and resection of the lamina around the pars interarticularis at L5 on the right. CT: computed tomography.

Another approach may be decompression without surgery. Gill's surgery involves total removal of the posterior elements, including loose lamina.¹¹⁾ However, Johnson and Power¹⁵⁾ have proposed a unique concept, namely, decompression around the pars defect (e.g., resection of the ragged edge) with preservation of the posterior elements, which may provide adequate decompression of the nerve root without an increased risk of further instability. The results of the above-mentioned biomechanics study using finite element analysis¹⁴⁾ support this concept. In our patient, we preserved most of the posterior elements, including the loose lamina, and only the affected nerve root was decompressed. Therefore,

further slippage was unlikely, and follow-up radiographs showed that progression of the slip was minimal.

In summary, spinal surgery without fusion may be performed in the first instance in athletes with isthmic spondylolisthesis who need a rapid return to competitive sport. Although it is common that high-grade isthmic spondylolisthesis should be treated by fusion surgery for preventing progression of the slip in the future, it may be an effective strategy for athletes that the endoscopic decompression surgery without fusion is initially conducted, and if spinal instability appears at a later date, spinal fusion is subsequently performed.

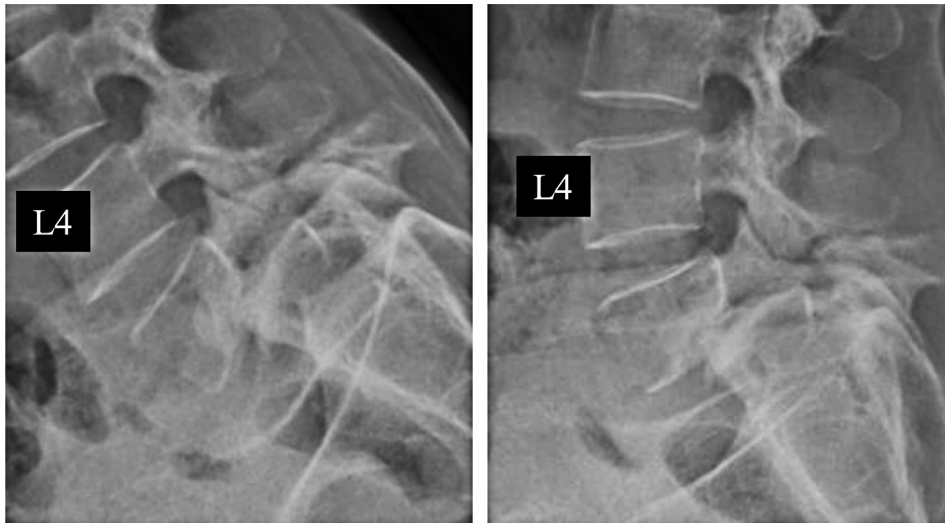


Fig. 4 Flexion and extension radiographs of lumbar spine acquired 1 year after surgery demonstrate slightly progression of the slip and instability.

Conflicts of Interest Disclosure

The authors declare no conflicts of interest associated with this manuscript.

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