

Case Report

The L5 Vertebrectomy Approach for the Treatment of Spondyloptosis with Reduction of L4 onto S1: Case Report

Pritsanai Pruttikul MD*,
Niwet Visetchaisee MD*, Sombat Kunakornsawat MD*

* Institute of Orthopaedics, Lerdsin General Hospital, Bangkok, Thailand

Background: Treatment of spondyloptosis is challenging. Dr. Gaines first developed and reported the L5 vertebrectomy approach for spondyloptosis with satisfactory long-term outcomes. This procedure has been rarely performed in the new era.

Objective: To report a rare and complex procedure L5 vertebrectomy (Gaines procedure, which now is a rare procedure and has been reported only by Dr. Gaines) for the treatment spondyloptosis.

Case Report: This study is case report and review of literature. We performed L5 vertebrectomy for the treatment of spondyloptosis and the results of the procedures was good.

Conclusion: Surgical treatment of spondyloptosis is difficult and complex. The L5 vertebrectomy, a rare and complex procedure, remains a predictable option, with excellent fusion rates and improved clinical alignment.

Keywords: Spondyloptosis, L5 vertebrectomy

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Spondyloptosis exists when the entire vertebra of L5 lies completely below a horizontal line drawn across the top of S1 on a lateral standing X-rays⁽¹⁾.

Spondyloptosis have crippled disability from a combination of: 1) disc-related lumbosacral pain, 2) pain, weakness, or numbness from single- or multilevel root compression and/or caudaequina syndrome, and 3) muscle weakness and thoracolumbar fatigue due to spinal imbalance of the sagittal plane⁽²⁾.

Treatment of the spondyloptosis is challenging. The L5 vertebrectomy approach for spondyloptosis was first developed by Dr. Gaines⁽³⁾ with satisfactory long-term outcomes⁽⁴⁾.

We describe L5 vertebrectomy (Gaines procedure), complex procedure, which now is a rare procedure and has been reported only by Dr. Gaines.

Case Report

A 28-year-old female (Fig. 1) presented with severe pain of her back and both legs. The back pain had started 4 years previously and gradually progressed. On examination, she had crouched gait with flattened appearance of the buttocks. The hip joint was in “apparent flexion”, and the knee joint flexed

to maintain upright stance. She also had lumbar hyperlordosis. There was no motor or sensory deficit. The radiographs and MRI showed spondyloptosis L5 on S1 with severe disc degenerative change and bulging disc causing severe spinal canal encroachment (Fig. 2, 3).

Surgical procedure

The procedure was designed in two stages. Time between the first stage and the second stage was 1 week. The first stage consisted of a vertebral body resection of L5 along with the L4-5 and L5-S1 disc. The second stage consisted of removal of the loose



Fig. 1 A 28-year-old Thai female with crouched stance and gait. Lumbar hyperlordosis was shown.

Correspondence to:

Kunakornsawat S, Institute of Orthopaedics, Lerdsin General Hospital, 190 Silom Road, Bangrak, Bangkok 10500, Thailand.
Phone: +66-2-3539835, Fax: +66-2-3539836
E-mail: batkunakornsawat@gmail.com, pritsanai.p@gmail.com

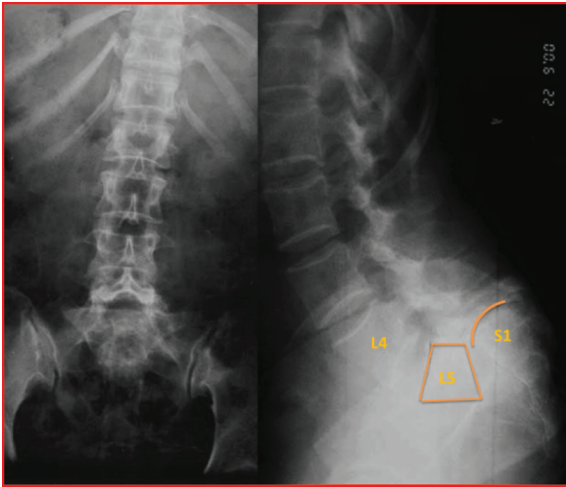


Fig. 2 Film L-S spine AP and lateral view, spondyloptosis is noted.

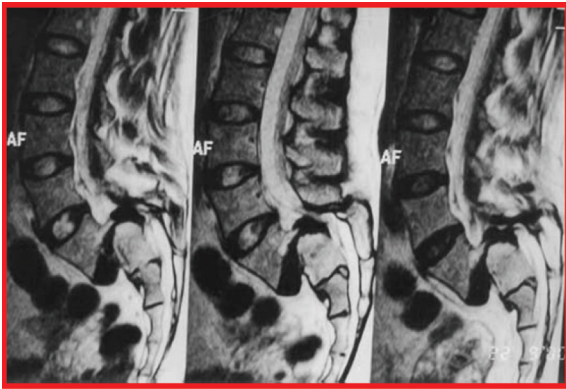


Fig. 3 T2 MRI of lumbosacral spine is shown. Disc degeneration and spondyloptosis are noted.

posterior element, the articular processes and pedicle of L5 and reduction of L4 onto the sacrum.

First-stage procedure: anterior retroperitoneal approach

The patient was placed supine on the operating table. A low transverse abdominal incision was made and completely transecting one rectus abdominus muscle and going through half of the contralateral rectus abdominus muscle. We consulted the vascular surgeon to do retroperitoneal dissection and identified bifurcation of the aorta and inferior vena cava (common iliac vessels).

The vertebral body of L5 lied caudal to the bifurcation of the vena cava, between the common iliac veins. This dissection was clearly defined the L5 pedicle and the intervertebral foramina of L4-5 and

L5-S1 bilaterally. Inferiorly, the deepest part of the L5 body was identified lying on the anterior surface of S2-3. A medium malleable retractor was placed underneath the vertebral body of L5 while it was being excised.

The L4-5 disc was removed first back to the posterior annulus. The anterior of the L5 body was then excised back to the posterior cortex of the vertebral body with osteotome in a piecemeal fashion. Bone bleeding was controlled by local pressure and surgical. As the vertebral body was removed back to the posterior cortex. Once only the posterior cortex of L5 remained, the posterior cortex was removed like a laminectomy with curettes, and Kerrison rongeurs. Once the entire vertebral body of L5 was gone, the L5-S1 disc was removed with curette.

After completing the L5 vertebrectomy, the cartilage end plate on the inferior surface of the L4 vertebral body was removed. Soft tissue bleeding was controlled with surgical and cautery. Bone bleeding was controlled with bone wax. The wound was closed. Postoperative film was shown in Fig. 5.

Second-stage procedure: posterior approach

The posterior elements of L3 to S2 were exposed subperiosteally. Gentle distraction of the L4-S1 interval was performed with Harrington outriggers between the L3 and the sacral ala. This could bring the transverse process and pedicle of L5 (underneath the ala of the sacrum in this patient) into our view so they could be removed. Once the laminae and transverse processes of L4-S1 were clearly exposed, pedicle screws were then placed bilaterally into L4 and S1 (bicortical S1 screws). When the pedicle screws were satisfactorily placed, then the posterior

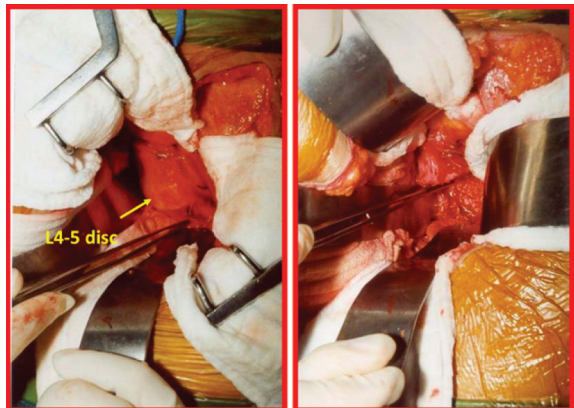


Fig. 4 Intraoperative in anterior approach. Intervertebral disc L4-5 and vertebral body of L5 were removed.

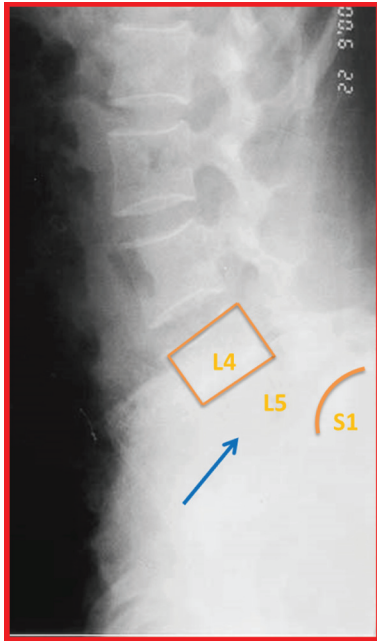


Fig. 5 Radiograph after first-stage procedure. Vertebral body of L5 was removed.

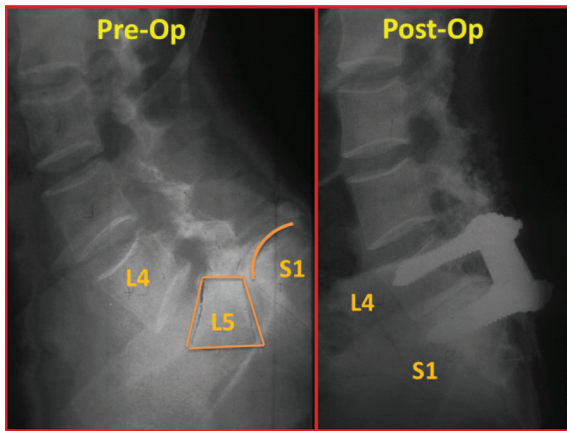


Fig. 6 Radiograph after second-stage procedure. L4 was apposed to S1 to achieve “bone-on-bone” apposition.

elements, transverse processes, and pedicles of L5 were then removed.

The L5 roots were identified and carefully protected before the L5 pedicles were removed. Once the pedicles were totally removed, then the dural tube was lifted dorsally so the cartilage end plate of S1 could be removed. This leaved the S1 subchondral bony end plate exposed and ready to dock with its similar end plate on the inferior aspect of the L4 vertebral body.

To reduce L4 onto S1, the Harrington outrigger was removed, and the L4 and S1 pedicle

screws were approximated with a Steffee plate system. L4 was apposed to the end plate of S1 to achieve “bone-on-bone” apposition. The L4 and L5 roots then proceed through the reconstructed L4-S1 foramen.

Local autologous bone graft was placed in the lateral gutter to produce an intertransverse fusion and at any intervertebral gaps between the bodies of L4 and S1. The wound was closed.

The postoperative film was shown in Fig. 6.

Postoperative care

There was no further neurological deficit postoperatively. The wound healed without any complication.

After a few days postoperative period, she began walking and started rehabilitation. A lumbosacral corset was applied when the patient was ambulating during the first month postoperative. Serial radiography was taken at 1 month, 3 months, 6 months, and 1 year, then the patient lost follow-up. Final radiograph showed interbody healing occurred between L4 and S1. Improvement was noted in the lordosis, pelvic inclination, sagittal plane alignment. One year postoperatively, she returned to normal gait with no back pain and leg pain.

Discussion

This paper reported only one case of vertebrectomy L5 in a case of spondyloptosis L5-S1. Because L5 vertebrectomy is quite a complex procedure and has only been reported in the series of Dr. Gaines⁽³⁻⁵⁾. Even now, this procedure has been rarely performed in the new era.

This case had a crouch gait, back deformity, and hamstring tightness. The plain radiograph showed spondyloptosis, spina bifida, trapezoidal L5, and rounding of proximal S1, which were commonly found in plain radiograph⁽⁵⁾, so we decided to do L5 vertebrectomy. The goals of surgical treatment for this patient aimed to relieve pain as well as to prevent progression of deformity.

Fusion in situ, partial reduction and fusion or posterior decompression and spanning/dowel fibular are another treatment options that can be performed in spondyloptosis. These have advantage of the low incidence of neurological deficit but the abnormal posture and balance cannot be fully restored^(6,7).

Fusion in situ has been reported of high complication rate in spondyloptosis patients such as high progression rate (25%), high pseudarthrosis rate (60%) and lumbosacral kyphosis (45%)⁽⁶⁾.

The Gaines procedure was the first described in 1985 with satisfactory long-term outcomes and being consecutively reported up to 35 patients in 2005. The L5 resection with reduction of L4 onto S1 for fixed spondyloptosis remains a predictable surgical approach, over 30 years after its development. Relief of back pain, leg pain, and functional rehabilitation (and for several, marked, and gratifying cosmetic improvement) uniformly occur and have been permanent over the follow-up of the study. They also reported improvement in the “spinal performance” of the patients, in particular the resolution of the “crouch gait”⁽⁴⁾.

The healing of the osteotomy is usually predictable and the surgical complications are manageable. The longevity of the reconstruction, once it has healed, may provide a life-long solution for the patients.

Since spina bifida is a common finding in these patients, we must be careful during the posterior approach⁽⁵⁾.

There is report that, mild to moderate clinical deficit in the L5 nerve root occurs to many patients. Mostly it occurs after the second stage procedure. The problems from L5 root dissection generally recover, however, and only very rarely leave the patient with permanent need for bracing. There have been no reoperations for any reason, specifically, there have been no reoperations for “junctional” problems⁽⁴⁾. Fortunately, no neurological deficit or others complication was reported in our patient and she could perform normal daily activity.

Conclusion

Surgical treatment of spondyloptosis is difficult and complex. As seen in our particular patient, the L5 vertebrectomy, a rare and complex procedure, remains a predictable option for patients with spondyloptosis. The L5 resection with reduction of L4 onto S1 has proved to provide excellent fusion rates and improved clinical alignment. However, vascular injury and major neurologic deficit should be considered carefully.

What is already known on this topic?

Optimal management for spondyloptosis is still a subject of controversy. The known treatment (L5 vertebrectomy approach) for spondyloptosis was first developed by Dr. Gaines, described in 1985 with mixed long-term outcomes. Up to 35 patients was consecutively reported until 2005. Aside from Gaines’

procedure, there has been no other known research pertaining to this kind of spondyloptosis treatment.

What this study adds?

We describe L5 vertebrectomy (Gaines procedure) as a complex procedure which is now an extremely rare procedure and only one that has been reported by Dr. Gaines. The last published report of this procedure was more than a decade ago. Furthermore, there is no other supporting report about this technique. This will be the first report of such procedure in Thailand, if not in Asia, and this will also be the first time that someone other than Dr. Gaines reporting it. We want to present and affirm that the L5 vertebrectomy approach with reduction of L4 onto S1 for the treatment of spondyloptosis is an option that is safe and effective for Thai patients.

Potential conflicts of interest

None.

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การผ่าตัดในผู้ป่วยที่เป็น Spondyloptosis โดยวิธี L5 vertebrectomy (Gaines procedure): รายงานผู้ป่วย

ปฤศนัย พฤฉนิกุล, นิเวศน์ วิเศษไชยศรี, สมบัติ คุณากรสวัสดิ์

ภูมิหลัง: การรักษาผู้ป่วยที่เป็น *spondyloptosis* เป็นสิ่งที่ท้าทาย *Dr. Gaines* เป็นคนแรกที่คิดค้นและรายงานการรักษาโดยการผ่าตัด *L5 vertebrectomy* ในการรักษาโรคนี้ ซึ่งได้ผลเป็นที่น่าพอใจ และมีผลการศึกษาในระยะยาว ปัจจุบันการผ่าตัดโดยวิธีนี้หาคนทำได้ยาก

วัตถุประสงค์: เพื่อที่จะรายงานถึงการผ่าตัดที่มีความซับซ้อน โดยการตัดกระดูกสันหลังส่วนเอวข้อที่ 5 ออก (*L5 vertebrectomy*, *Gaines procedure*) ซึ่งปัจจุบันมีรายงานคนที่รักษาโดยวิธีนี้ในรายงานของ *Dr. Gaines* เท่านั้น สำหรับการรักษาผู้ป่วยที่มีกระดูกสันหลังข้อต่อที่ *L5-S1* เลื่อนแบบสมบูรณ (spondyloptosis)

รายงานผู้ป่วย: เป็นการรายงานผู้ป่วยและทบทวนวรรณกรรม โดยทำการผ่าตัดโดยวิธี *L5 vertebrectomy* ในผู้ป่วยที่เป็น *spondyloptosis* และได้ผลการรักษาที่ดี

สรุป: การรักษาผ่าตัดในผู้ป่วยที่เป็น *spondyloptosis* มีความยากและซับซ้อน การผ่าตัดโดยวิธี *L5 vertebrectomy* ก็มีผู้ทำได้น้อย และมีความซับซ้อน แต่ก็ยังเป็นทางเลือกหนึ่งที่ได้ผลดี กระดูกเชื่อมติดดี และมีแนวกระดูกสันหลังที่ดีขึ้น
