

Subtotal En Bloc Resection of the Fourth Lumbar Vertebra for Giant Cell Tumor Using Combined Posterior and Lateral Retroperitoneal Approach

Kosei Ono, Bungo Otsuki, Shunsuke Fujibayashi, Takayoshi Shimizu, Koichi Murata and Shuichi Matsuda

Department of Orthopaedic Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan

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A 24-year-old man had 4 months' history of low back pain and left leg pain. Lumbar X-ray (Fig. 1a, b) and computed tomography (CT) (Fig. 1c, d) showed an osteolytic lesion at the L4 vertebral body. Magnetic resonance imaging showed that the tumor extended to the spinal canal (Fig. 1e, f). Percutaneous needle biopsy revealed a giant cell tumor (GCT), and 120 mg of denosumab was injected 5 times before surgery; however, the tumor was slightly enlarged. On the day before surgery, embolization of the bilateral L4 segmental arteries was performed. We planned subtotal en bloc spondylectomy of L4, as shown in Fig. 2.

In the surgery, instrumentation using pedicle screws with four rod constructs was done using a conventional posterior approach in the prone position. The L4 lamina was removed en bloc (Fig. 3a) according to Tomita's method¹⁾ using a threaded saw. The left side psoas major muscle was bluntly dissected from the side wall of the L4 vertebra (Fig. 3a). The dura mater and bilateral L4 nerve root were carefully abraded from the posterior aspect of the vertebra and tumor surface, and the annulus fibrosus of the upper and lower discs were incised using an osteotome (Fig. 3a). Finally, osteotomy of the right side of the vertebral body was performed using osteotome with a preoperative CT-based navigation system to leave a thin cortex at the anterior and right sides of the vertebra (Fig. 2, 3a). A Kirschner wire with a diameter of 1 mm was placed inside the osteotomy site for the fluorescent marker and fixed with bone wax (Fig. 4a). Bone graft from the posterior was not performed. Next, an anterior retroperitoneal approach was used for subtotal vertebral body resection in the true right lateral decubitus position. A skin incision of approximately 10 cm was made at the left

abdomen, 3 cm anterior to the anterior border of the L4 vertebra. Three layers of abdominal muscles were bluntly dissected, and the retroperitoneal space was exposed. The psoas major muscle was exposed and abraded completely from the vertebra, and the cutting of the annulus fibrosus of the upper and lower level discs was completed (Fig. 3b). The left L4 segmental artery was ligated (Fig. 3b), and the anterior osteotomy was performed using an osteotome toward the tip of the Kirschner wire from the anterior margin of the psoas major muscle guided by fluoroscopy (Fig. 2c, 4a). After the resected vertebra was removed en bloc (Fig. 4b, c), the Kirschner wire was then removed, and an expandable cage filled with lamina bone free from tumor contamination was fixed. The operation time was 9 h and 45 min, and the estimated blood loss was 2620 mL. Postoperative CT and X-rays showed accurate resection as planned (Fig. 4d, e), and a pathological diagnosis revealed a negative margin. The preoperative symptoms had completely disappeared, and a soft brace was used for a postoperative period of 3 months. No adjuvant therapy such as radiation or chemotherapy other than denosumab was used before and after surgery. The postoperative course was uneventful without any complications, and he did not have any trouble in his daily life without recurrence at the last follow-up 14 months after the surgery (Fig. 4f).

In spinal GCT, a high rate of recurrence has been reported in cases of intralesional curettage^{2,3)}. Also, adjuvant therapies have risks of iatrogenic injuries of the spinal cord and major vessels; therefore, en bloc resection has been recommended^{2,3)}. Although total en bloc spondylectomy (TES)¹⁾ might be the best strategy to avoid recurrence, surgical tech-

Corresponding author: Bungo Otsuki, bungo@kuhp.kyoto-u.ac.jp

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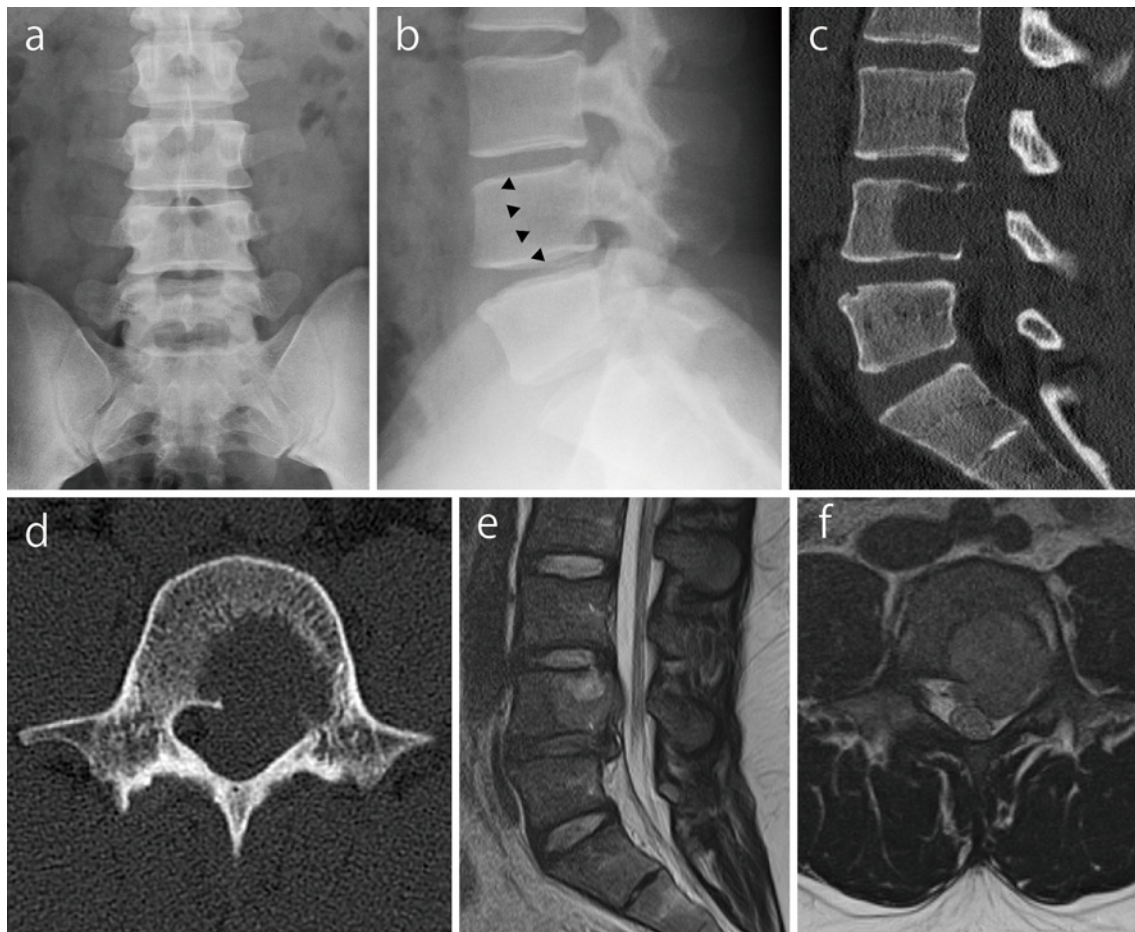


Figure 1. Image analysis of a patient with an L4 giant cell tumor. Anteroposterior X-ray does not show any abnormalities (a); however, the lateral X-ray shows an osteolytic lesion (b, arrow heads), which is confirmed by computed tomography with disruption of the cortex bone around the tumor (c and d). Magnetic resonance images show that the tumor extends to the epidural space and compresses the left L4 nerve root (e and f).

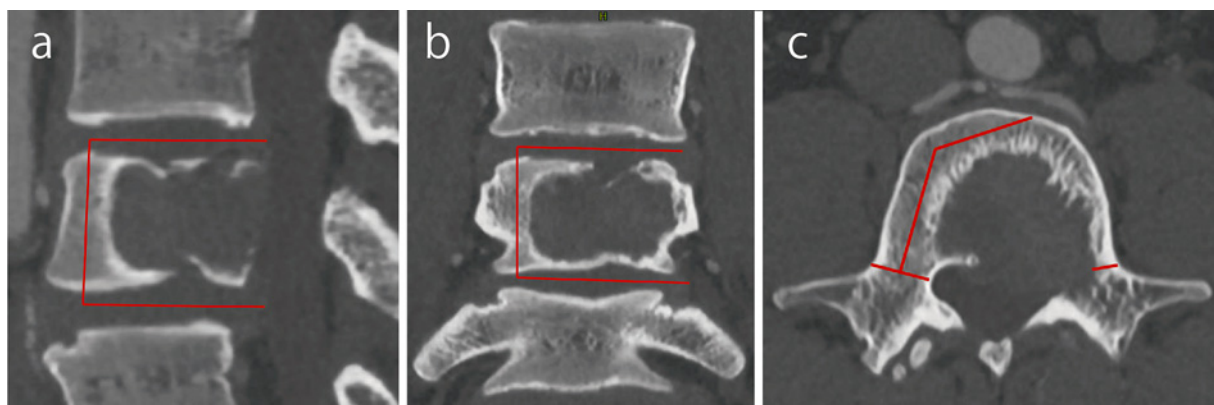


Figure 2. Planned osteotomy line on the sagittal (a), coronal (b), and axial views (c) of computed tomography.

nique is challenging with the possibility of severe complications especially in the lumbar spine, including damage to the major vessels, ureter, or nerve roots^{4,5}. Therefore, in a case with enough tumor margin, subtotal spondylectomy shown in this study might be an appropriate surgical method for aggressive benign tumors with less risks of intraoperative complications. Although the tumor margin was negative in this case, the cutting surface of the vertebra was in close

proximity to the tumor margin (Fig. 4d), TES should have also been considered. Although most of the left side of the vertebra was removed in this case, it is also possible to remove the right side by approaching from the opposite side. This technique might be applied not only for GCT but also for aggressive benign tumors or low-grade malignant tumors, such as osteblastoma or grade I chondrosarcoma. Although the short-term clinical outcome was satisfactory in

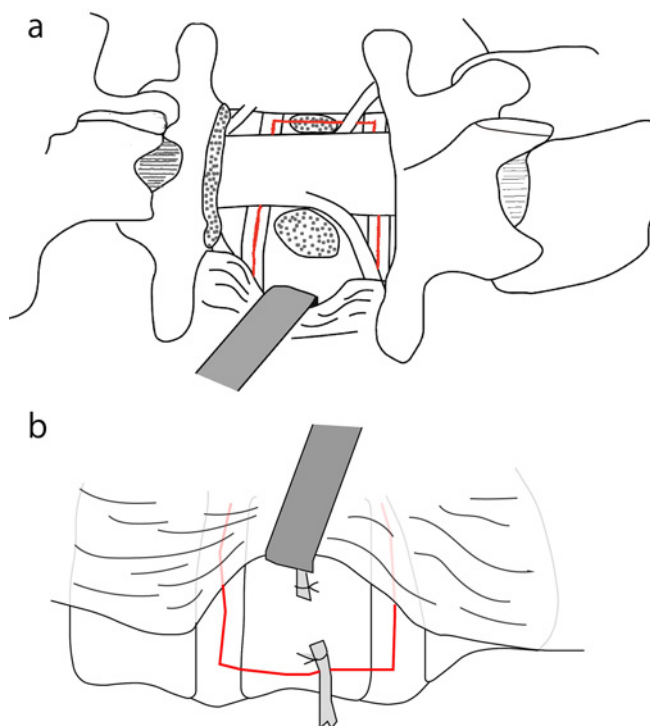


Figure 3. Schematic of the surgical procedure. (a) Posterior elements of the L4 vertebra were removed *en bloc* with bilateral pediculotomy. The left psoas major muscle was abraded from the side wall of the L4 vertebra and upper and lower discs. The red-colored line shows osteotomy and discectomy lines. (b) The L4 segmental artery was ligated. The left psoas major muscle was then abraded from the anterior, and discectomy of the upper and lower discs was added to connect the posterior discectomy line (red line). Anterior osteotomy was connected to the posterior osteotomy line (red line).

this patient, careful long-term follow-up of at least 3-5 years is needed.

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Ethical Approval: unnecessary

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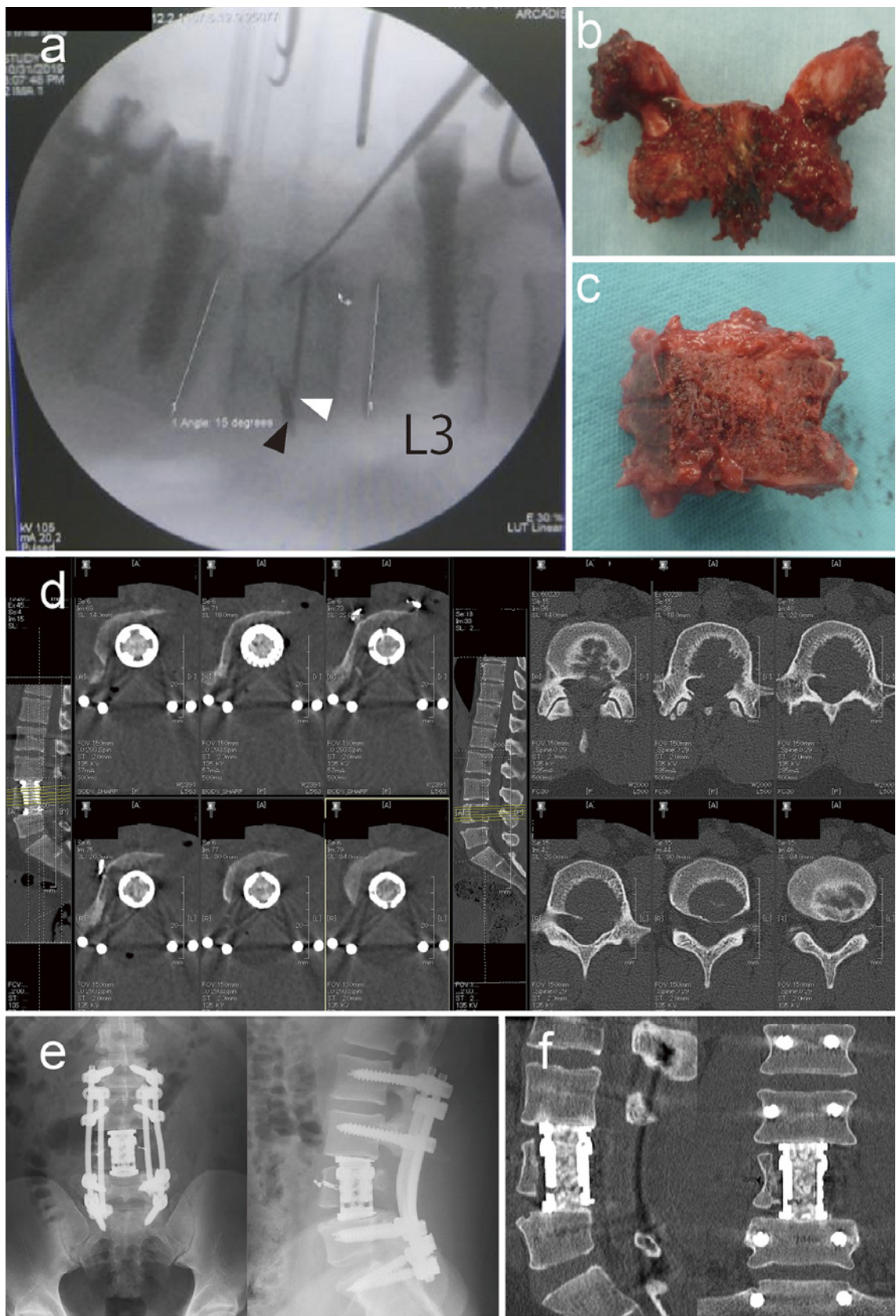


Figure 4. (a) Anterior osteotomy was performed as the tip of the osteotome heading to the tip of the Kirschner wire (white arrowhead). The black arrowhead shows the left L4 segmental artery with embolization. (b and c) The resected L4 vertebra. (d) Comparative computed tomography views before and after surgery show accurate osteotomy as planned. (e) Anteroposterior and lateral X-rays soon after the surgery. (f) Reconstructed sagittal and coronal computed tomography views show no screw or cage loosening at 14 months after the surgery.