

## Surgical Treatment for Giant Cell Tumor of the Thoracolumbar Spine

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- Background:** Giant cell tumor (GCT) of the bone has historically been regarded as an extremely unpredictable bone tumor. The anatomical characteristics of spinal GCT still present challenges to surgeons. Controversy remains regarding the proper treatment of patients with grade III tumors.
- Methods:** Eleven patients with grade III GCT of the thoracolumbar spine were treated between 1992 and 2002 at a medical center by the authors. Three patients were initially treated at other institutions. Adjuvant radiotherapy was employed for local recurrence in these three patients. The other eight patients were initially treated with marginal excision. The site, size, and extent of each lesion dictated the surgical approach.
- Results:** Five patients had tumor recurrence. One patient, who received radiotherapy, had local relapse with malignant transformation and finally died due to disease-related complications. One patient had a recurrent tumor with multiple metastases throughout the lung. Neurological status, measured using the American Spinal Injury Association scale, of one patient was worse after undergoing the procedure than preoperatively and three patients showed improvement. The other seven patients were classified as with the same grade postoperatively.
- Conclusion:** Wide excision of GCT of the thoracolumbar spine is difficult and there is a risk of neurological deficit and spinal instability. Meticulous marginal excision with associated reconstruction may obtain good local control and preserve functional spine. Early detection of recurrent GCT during intensive follow-up can allow for treatment using en bloc excision which has achieved favorable prognoses.  
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**Key words:** giant cell tumor, thoracolumbar spine, surgical treatment.

Giant cell tumor (GCT) of the bone has historically been regarded as an extremely unpredictable bone tumor. It is a benign but potentially aggressive lesion with high rates of local recurrence and metastases.<sup>(1-4)</sup> A spinal tumor typically exhibits localized

pain or neurological disturbances as its initial symptoms. Delayed diagnosis for months or years is common; the radiographic findings of spinal GCT usually present as a grade III lesion upon the first clinical visit.<sup>(5-8)</sup> Controversy remains regarding the proper

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treatment of patients with grade III tumors with destruction or expansion of the cortical bone and soft tissue or natural boundary extensions.<sup>(9-11)</sup>

Spinal GCT is a challenging clinicopathological entity. Treatment goals are as follows: tumor removal; reduction of the likelihood of local recurrence; pain elimination; preservation of spinal neural function; and restoration or maintenance of spinal alignment and stability. Surgical treatment consists of either curettage or en bloc resection of the lesion with subsequent reconstruction. It is generally agreed that radical resection achieves the best results; however, radical resection is often difficult in patients with spine lesions.<sup>(5,12-15)</sup>

In this study we investigated surgical treatment and outcomes for 11 patients with GCT of the thoracolumbar spine. We presented the clinical experiences and offer a suitable treatment for Grade III GCT and recurrent GCT of the thoracolumbar spine.

## METHODS

Eleven patients with GCT of the thoracolumbar spine were treated between 1992 and 2002. The medical records, preoperative and postoperative radiographs, computed tomography (CT), or magnetic resonance imaging (MRI) scans of the patients were reviewed. All tumors were initially diagnosed using results of frozen section histological analysis. Permanent histological sections for each patient were available and reviewed.

The therapy chosen was based on results of preoperative radiographic examination of the osseous

and extraosseous extent of the tumor, and discussion with the patients regarding oncological risks and anticipated functional outcome for various treatments and reconstruction therapies. All patients had Grade III lesions and underwent surgery for persistent symptoms of intractable back pain or progressive neurological deficit due to destructed spine with instability (Table 1).

Three patients were initially treated at other institutions. They were referred to our medical center because of recurrent tumors with deteriorated symptoms. These three patients underwent surgery for tumor resection and received associated adjuvant radiotherapy. One tumor was treated as a primary GCT with marginal excision. The other two lesions broke through the cortex with multiple surrounding soft tissue extension. One of these two patients presented with progressive neurological deficit and intractable back pain at 72 months after her first operation. The exact interval between primary treatment and recurrence could not be ascertained. The other patient had involvement of three adjacent vertebrae. Intralesional curettage could only be done for these two lesions.

The other eight patients were initially treated with marginal excision in our department. The surgical approach employed was based on the site and extent of the lesion. Lesions involving the anterior body necessitated an anterior approach for marginal excision and were reconstructed by bone grafting and associated anterior or posterior instrumentation. Lesions extending into the posterior elements required an additional posterior approach for as com-

**Table 1.** Patient Demographic Data

Case	Age (years)	Gender	Site	Involved area	Clinical symptoms	Duration (months)
1	18	F	T5	Body	Weakness	2
2	22	F	T9-11	Body and posterior element	Weakness and radicular pain	1
3	24	F	T9	Body	Local pain	5
4	27	F	L5	Body and posterior element	Radicular pain	6
5	26	F	T2	Body and posterior element	Weakness and radicular pain	3
6	38	M	T9	Body	Local pain	2
7	29	F	T7	Body	Weakness and radicular pain	1.5
8	21	F	T7-8	Body and posterior element	Weakness and radicular pain	18
9	66	M	T11	Body and posterior element	Weakness and radicular pain	6
10	20	F	L2	Body	Local pain	3
11	34	M	L4	Body	Local pain	9

**Abbreviations:** F: female; M: male; T: thoracic spine; L: lumbar spine.

plete of a tumor removal as possible. Adequate stability indicated whether to apply fusion and/or instrumentation.

All patients received follow up for at least 3 years. Patients were assessed at 3-month intervals for local recurrence and distal metastases (using plain radiographs of the spine and chest), surgical complications including neurological status, infection, implant failure, and pain and ability to work or perform daily activities.

## RESULTS

The study population comprised of 11 patients, eight female and three male, with an average age of 30 years (range, 18-66 years). Five patients had tumor recurrence. Two of 8 patients treated primarily at our medical center had tumor recurrence. One of the three patients who had initial therapy elsewhere and presented with recurrent lesions had further recurrence with malignant transformation. Table 2 shows a summary of the surgical procedures and clinical outcomes.

Three of the patients who were referred for further treatment of local recurrence underwent intralesional or marginal excision combined with adjuvant radiotherapy. Of these patients, one was asymptomatic with no evidence of local recurrence during 9 years of follow up. One of the referred patients with a T2 lesion had a local relapse with malignant transformation. The preoperative neurological status staged as Frankel D progressed postoperatively to Frankel A. The patient died as a result of disease related complications after 5 years of follow up. The third patient had a recurrent tumor with multiple metastases throughout the lung. For fear of compromising lung function, lobectomy was not performed based on the recommendation of a chest surgeon. The patient's previous spinal implants were removed. A recurrent T7-8 tumor was resected marginally, and the T6-9 region was reconstructed using an allograft and instrumentation fixation. Bone cement was incorporated to provide immediate stability. The patient did not show postoperative neurological improvement, however, her pain decreased.

The other eight patients were treated with mar-

**Table 2.** Surgical Procedure and Clinical Outcome

Case	Approach	Initial procedure	ASIA scale	Local recurrence site	Interval of recurrence (months)
1	A	Marginal excision	C->E	(-)	
2	A + P	Unknown	D->D	(+) T9-11	3
3	A	Marginal excision	E->E	(-)	
4	A + P	Marginal excision	E->E	(-)	
5	P	Unknown	D->A	(+) T2	72
6	A	Marginal excision	E->E	(-)	
7	A	Unknown	D->D	(+) T7-8	2
8	A + P	Marginal excision	D->E	(-)	
9	A + P	Marginal excision	C->E	(+) T11	16
10	A + P	Marginal excision	E->E	(-)	
11	A + P	Marginal excision	E->E	(+) L4	11

Case	Treatment for recurrence	Duration of follow-up (years)	Status
1		12	NED
2	Intralesional curettage and radiotherapy	9	NED
3		8	NED
4		6	NED
5	Intralesional curettage and radiotherapy	5	Malignant transformation (death)
6		5	NED
7	Marginal excision and cementation and radiotherapy	4	Pulmonary metastasis
8		4	NED
9	Wide excision and cementation	4	NED
10		3	NED
11	Wide excision	3	NED

**Abbreviations:** A: anterior; P: posterior; A + P: anterior and posterior; T: thoracic spine; L: lumbar spine; NED: no evidence of disease.

ginal resection. Of these, two patients had recurrent tumors at 11 and 16 months post-resection, respectively. These two patients underwent their second operations for wide excision for recurrent tumors and subsequent reconstruction. Strut bone graft reconstruction following wide excision achieved adequate stability and acceptable alignment (Figs. 1-8). No surgical complications, such as major neurovascular injury, implant failure, or deep infection, occurred during the operations or follow-up period.

The neurological status of one of the 11 patients, determined using the ASIS scale, was worse than before the operation, whereas three patients showed improved status. The other seven patients were classified postoperatively with the same grade as that preoperatively. Eight patients returned to their previ-

ous jobs without restricted daily activities.

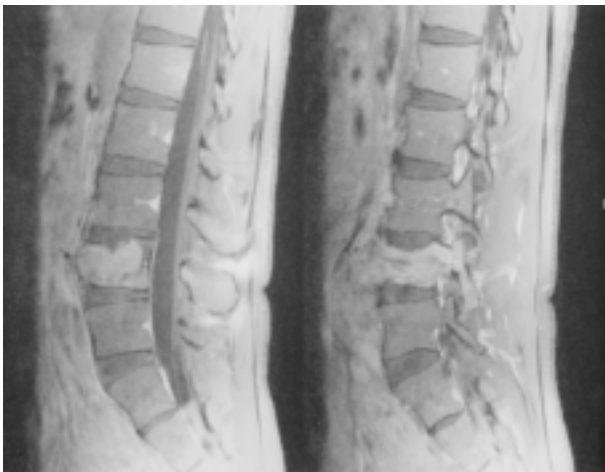
## DISCUSSION

Several treatment strategies have been developed for GCT, including surgery, radiotherapy, embolization, cryosurgery, cementation, and chemical adjuvant such as phenol or liquid nitrogen. Surgical management remains the mainstay of the treatment processes.<sup>(16,17)</sup> When using either the Campanacci or Enneking grading system, the higher the radiographic grading, the more radical the required surgery.<sup>(9,10)</sup> Eckardt and Grogan recommended intralesional curettage with adjuvant therapy for stage I and II lesions and en bloc resection for most stage III lesions.<sup>(18)</sup> The anatomic characteristics of spinal GCT still present challenges for surgical excision. Surgeons and patients must choose between radical resection with potentially devastating morbidity or subtotal excision with potentially higher rates of recurrence.<sup>(5,12-15)</sup>

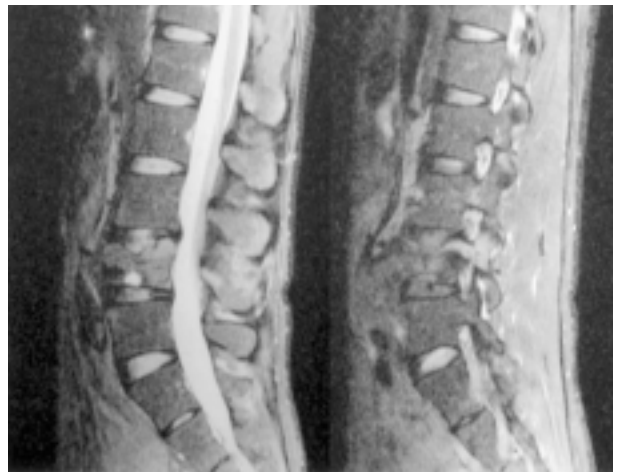
In this study, all patients had primary stage III GCT and were treated with marginal excision without any adjuvant therapy regarding the uncertain therapeutic value and associated complications. With careful attention to the surgical margin and soft tissue and bone excision as wide as possible, the rate of recurrence may be decreased. However, complete wide excision of spinal lesions is often not possible and usually results in excision with marginal or intralesional margins. Two of the eight primarily treated tumors had local recurrence. McDonald et al.

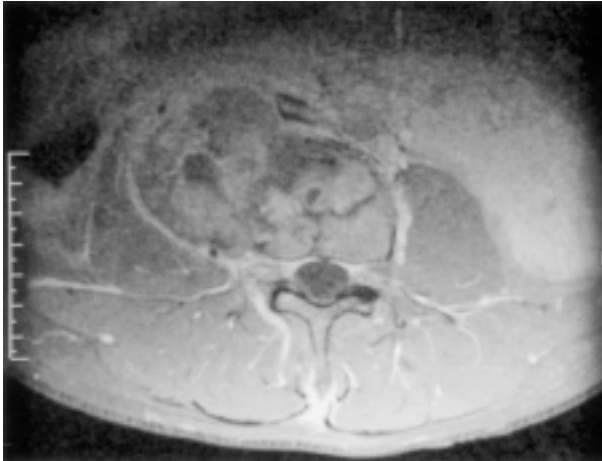


**Fig. 1** Radiography showed a L4 vertebral body GCT with cortex breakthrough.

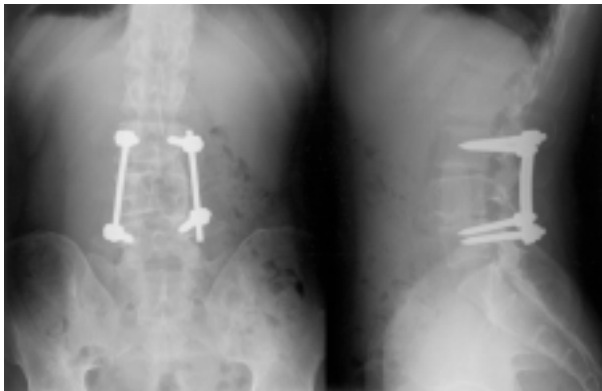


**Fig. 2 (left) and Fig. 3 (right)** Sagittal T1-weighted and sagittal T2-weighted MRI revealed the L4 vertebral body GCT with retroperitoneal extension.

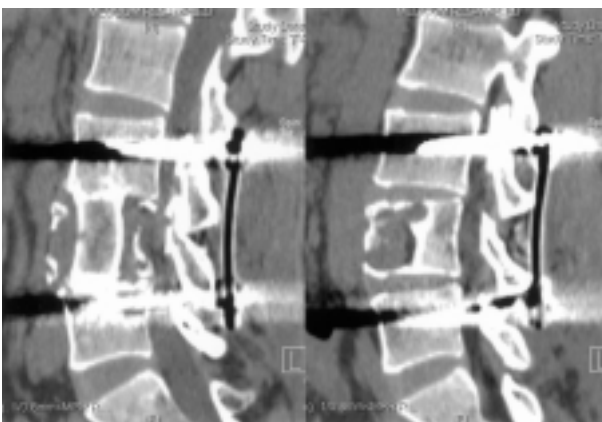




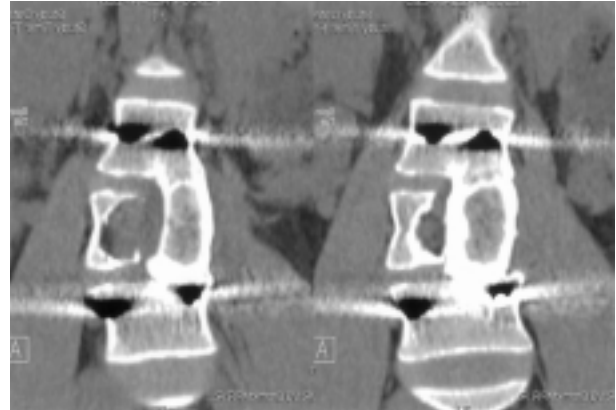
**Fig. 4** Axial MRI demonstrated the extent of the tumor.



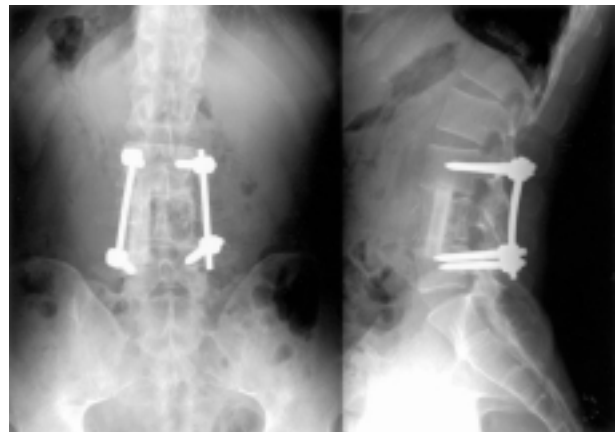
**Fig. 5** After marginal excision of the GCT through an anterior approach, anterior interbody fusion with autograft supplemented by posterior instrumentation was employed.



**Fig. 6** Sagittal CT view showed a reconstructed autograft at the right L4 vertebral body and a recurrent GCT at left L4 vertebral body.



**Fig. 7** Coronal CT view revealed a reconstructed autograft and recurrent GCT at the L4 vertebral body.



**Fig. 8** Left-side anterior approach with wide excision and accompanying fibula allograft reconstruction was used for the recurrent GCT.

reported that recurrent lesions were probably not more biologically aggressive lesions and, in all likelihood, represented a less than complete initial curettage.<sup>(19)</sup> Under careful physical examination and use of improved imaging tools at regular follow-up intervals, recurrent tumors can be detected early. Therefore, during the earlier stages the lesions may possibly be treated using en bloc resection. Two recurrent tumors were successfully diagnosed at one of the regular follow-up examinations. Wide excision combined with a reconstruction procedure for recurrent tumors achieved good results and prognoses after a minimum of 25 months of follow-up.

Most patients incurring GCT of the bone are young and active with normal life expectancies. The treatment goal is not only to remove the tumor com-

pletely, but also to preserve spinal function. After surgery, the anterior defects were reconstructed using structural autografts or allografts in most cases in this study. The advantage of the structural bone graft is that it can provide an initial load-sharing capacity for the anterior strut and aid in biological fusion. Functional spines allowed for normal daily activities in eight patients of this study. Curettage followed by bone cementing as a surgical technique for GCT of the extremities has widely been used.<sup>(20-22)</sup> Based on incomplete excision of tumors with pulmonary metastasis and old age, cement was used in two patients to supplement chemical adjuvant and offer immediate fixation and stability. Although cementation may help eradicate residual tumor tissue and produce local stability, it has no biological loading capacity.

Three patients were transferred to our hospital due to tumor recurrence. Adjuvant radiotherapy was employed for incomplete excision of the tumors in these three patients. However, dose response data failed to identify optimal regimens. The risk of spinal cord myelitis, bone graft complications, and malignant transformation has been reported.<sup>(23,24)</sup> Radiotherapy of 5000 cGy in 25 fractions allowed local control in two patients. No radiation-induced malignancy or complications were noted after 4 and 9 years of follow up, respectively. The third patient, treated by laminectomy supplemented with radiotherapy, developed a sarcoma.

Generally, site and extent of the lesion dictate which surgical approach is employed. In a lesion which involves the arch, a laminectomy with tumor removal and posterior fusion is performed as necessary. A lesion involving the anterior body requires an anterior approach with tumor removal and associated strut bone grafting with anterior stabilization. In common circumstances, combined anterior and posterior reconstruction is necessary for adequate stability. Radiotherapy is reserved for patients with incomplete excision and for those with local recurrence as it carries a risk of sarcomatous transformation.<sup>(23,24)</sup>

The principal predictor of prognosis is the adequacy of tumor resection. However, the variability of methods and length of follow up in different series make comparison among the study results difficult. There are still no absolute clinical, radiographic, or histological parameters that indicate one correct method of treatment to reduce the likelihood of

recurrence. Thus, intensive clinical follow up is a critical and controllable step for the treatment of recurrent GCT. Improvements in imaging studies and surgical techniques allow physicians to improve detection of tumors during the early stages. Two patients who were initially treated at our hospital presented with localized symptoms and deterioration of daily activities during regular follow up. Early diagnosis allowed for en bloc excision and accompanying reconstruction, thereby, providing good prognosis. Nevertheless, our analytical results can only be used to generate hypotheses due to the small number of patients in this study. Further investigation with more cases with long-term follow up is required to determine the rate of late recurrence.

The typical staging classifications used to evaluate and compare the treatment results for GCT were developed by Campanacci and Enneking.<sup>(9,10)</sup> However, the staging appropriate for extremities may not be suited to the spine. The definition of grade III GCT still retains some distinct variation and differentiation, especially for spinal lesions. The anatomy of the spine and the difficulty of surgical resection require specific consideration and modification.<sup>(25)</sup> Furthermore, primary tumors of the spine are rare. A single institution does not have a sufficient number of patients to assess treatment protocols. There is certainly a need for a simple, reproducible staging system which can facilitate scientific communication and carry out reliable multicenter studies on spinal lesions.

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## 胸腰椎巨大細胞瘤的外科手術治療

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- 背景：** 骨骼巨大細胞瘤是一種很難預測的骨腫瘤。在脊椎的巨大細胞瘤，其解剖特性對外科醫師仍是一種挑戰，對於第三級腫瘤的治療也還有爭議。
- 方法：** 共有 11 位胸腰椎第三級的巨大細胞瘤於 1992 年到 2002 年間，在一所醫學中心接受治療。其中有 3 位曾經在其他醫療機構治療的病患，我們安排輔助性的放射線，來治療腫瘤的復發，另外 8 位患者則是施行邊緣性的腫瘤切除。並以腫瘤的位置、大小及侵犯之範圍，來決定手術方式。
- 結果：** 共有 5 位病患發生腫瘤復發。其中一位患者接受放射線治療後，腫瘤再度復發，並合併惡性轉移，最後因為併發症而死亡。還有一位患者腫瘤復發，合併肺部轉移。以 ASIA scale 來評估神經狀態，其中一位患者術後比術前還差，有 3 位患者術後比較進步，另外 7 位患者手術前後結果相同。
- 結論：** 胸腰椎的巨大細胞瘤要作廣泛性的腫瘤切除很困難，而且容易造成神經損害及脊椎不穩定。謹慎地將腫瘤作邊緣性的切除，同時合併脊椎重建，仍然可以達到很好的局部控制，並且保留有功能性的脊椎。復發的腫瘤若能在仔細的定期追蹤下，早期發現，可以將腫瘤整個切除，以達到不錯的癒後。  
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**關鍵字：** 巨大細胞瘤，胸腰椎，外科手術治療。

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