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*Case Report*

# Giant cell tumor of thoracic spine misdiagnosed as hemangioma: report of a case and review of literature

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**Abstract:** Giant cell tumors (GCTs) of the bone are neoplasms that may be locally aggressive and are located primarily in the epiphysis or meta-epiphysis of long bones. GCTs of the thoracic vertebra are rare, easily misdiagnosed, and infrequently reported; therefore, it is essential to improve the awareness of clinicians with respect to the occurrence of GCTs in thoracic vertebra. Herein, we describe a case involving a 39-year-old man who was diagnosed with hemangioma of the T12 vertebra and who underwent percutaneous kyphoplasty (PKP). Three weeks post-surgery, he experienced progressively worsening weakness and numbness in both lower extremities, with gait instability. He was subsequently admitted to our hospital. Posterior spinal cord decompression of the T11-T12 vertebrae, bone graft fusion and pedicle screw fixation were performed. The patient recovered from the operation. The patient's pathology results were suggestive of a GCT. No recurrence of symptoms was observed during the subsequent 12 months. We reviewed 15 cases (including ours) of GCTs of the thoracic spine in English language studies published beginning in 2005. GCTs exhibited a 1.5:1 female predominance and primarily affected individuals in their thirties. The T8-T12 vertebrae were the most common sites of GCTs of the thoracic spine. One case was a misdiagnosis. Two cases were missed diagnoses because biopsies were not performed. A biopsy must be performed to reduce the rates of misdiagnosis and missed diagnosis of GCTs of the thoracic spine. Fine needle aspiration cytology (FNAC) is an effective method of diagnosing bone lesions and has become more widely accepted.

**Keywords:** Giant cell tumor, thoracic vertebra, hemangioma, imaging examination, fine-needle aspiration cytology, en bloc resection

## Introduction

Giant cell tumor (GCT) is an aggressive neoplasm that typically develops after maturity [1]. Most GCTs of bone occur in the epiphysis or meta-epiphysis of long bones and are rarely found in the spine [2, 3]. GCTs have a female predominance of 70.8% and present primarily during the fourth decade of life [4-7]. GCTs in the spine (excluding the sacrum) constitute less than 2% of all vertebral tumors and less than 1% of all GCTs [8]. GCT affects the cervical, thoracic, and lumbar regions equally [4]. The main clinical manifestation of GCT in the spine is back pain [4, 9-11]; however, this symptom is typically not in the initial clinical presentation [3, 7]. Because of the low incidence and atypical symptomology of GCT in the thoracic spine, this tumor can easily be misdiagnosed. An incorrect initial diagnosis can result in delayed treatment and inappropriate therapy. Surgery is the main therapeutic strategy for GCT in the thoracic spine and consists of en bloc resection and intralesional excision [12]. It is difficult to correctly diagnose GCT in the thoracic spine based on clinical symptoms; therefore, the imaging and pathological characteristics of this disease should be well known by clinicians.

In this report, we present a case of GCT of the T12 vertebra; however, the patient was initially misdiagnosed with hemangioma and treated with percutaneous kyphoplasty (PKP). Cases of GCT of the thoracic vertebrae that occurred within the last ten years were reviewed and analyzed to enhance our understanding of GCTs and to determine the appropriate methods for the diagnosis and treatment of this disease.

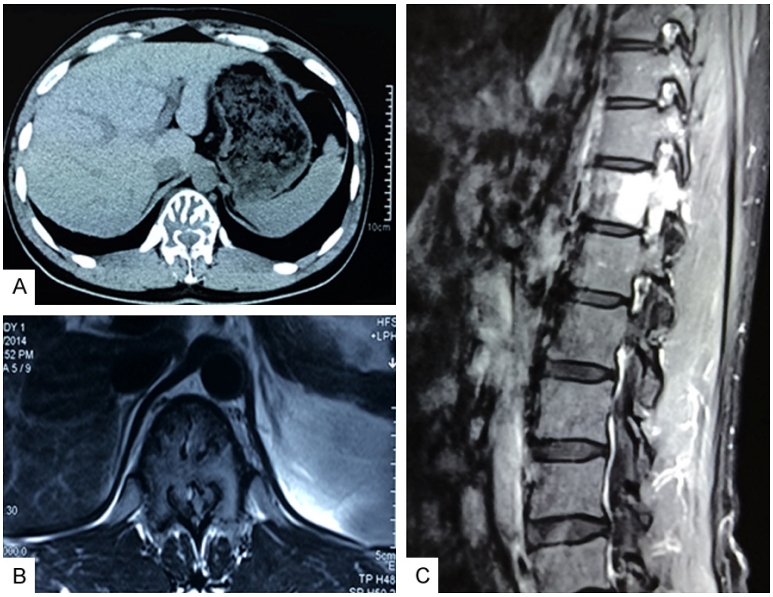


**Figure 1.** CT scans and MRI ten weeks before admission. A. A transverse CT image of T12 depicts coarse vertical striations and trabecular bone. B. An axial T2-weighted MRI depicts high signal intensity within the centrum of T12. C. A sagittal T2-weighted MRI depicts a bony lesion of high signal intensity within the centrum of T12.

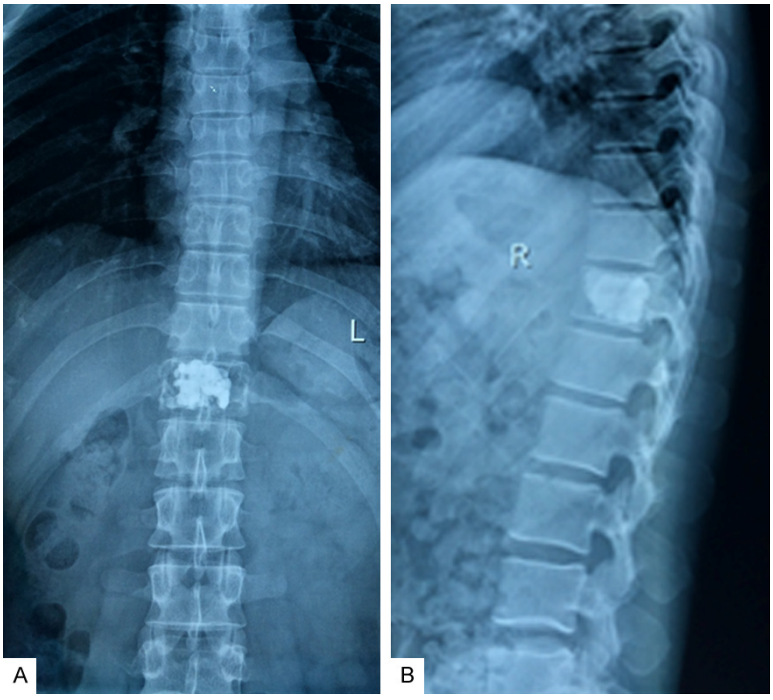


**Figure 2.** An anterior-posterior (A) and a lateral (B) plain radiograph demonstrating an irregular high density within the centrum of T12.

## Case presentation

A 39-year-old man presented to our hospital complaining of progressively worsening weakness and numbness in both lower extremities, with gait instability, for more than 1 month. Ten weeks before admission, the patient experienced back pain and presented to an outside hospital. CT scans obtained at that time revealed coarse vertical striations in the vertebral body of T12 (**Figure 1A**). MRI demonstrated a bony lesion of high signal intensity inside the centrum of T12 (**Figure 1B**, **1C**). Based on these findings, the patient was diagnosed with hemangioma and underwent percutaneous kyphoplasty (PKP). After three weeks, the patient developed weakness and numbness in both lower extremities, particularly the left leg, as well as gait instability; the patient subsequently presented to our hospital.

On admission, the patient's vital signs were normal, and his chest and abdominal exams were normal. His spinal mobility was restricted. The muscle power of the quadriceps femoris and bilateral biceps femoris were grade 3/5 and grade 4/5, respectively. The straight leg raising test (SLRT) was negative; sensation was diminished beneath the midportion of the groin bilaterally. The cremasteric reflex was noted. The patient's ankle examination was positive for clonus. No additional pathologic reflexes were noted. An X-ray demonstrated an irregularly high density inside the centrum of T12 (**Figure 2**). A CT demonstrated a high density lesion inside the centrum of T12 causing compression of the dural sac (**Figure 3**). MRI demonstrated a low density lesion at T12, as well as bone cement leakage into the vertebral canal (**Figure 4**). The patient received

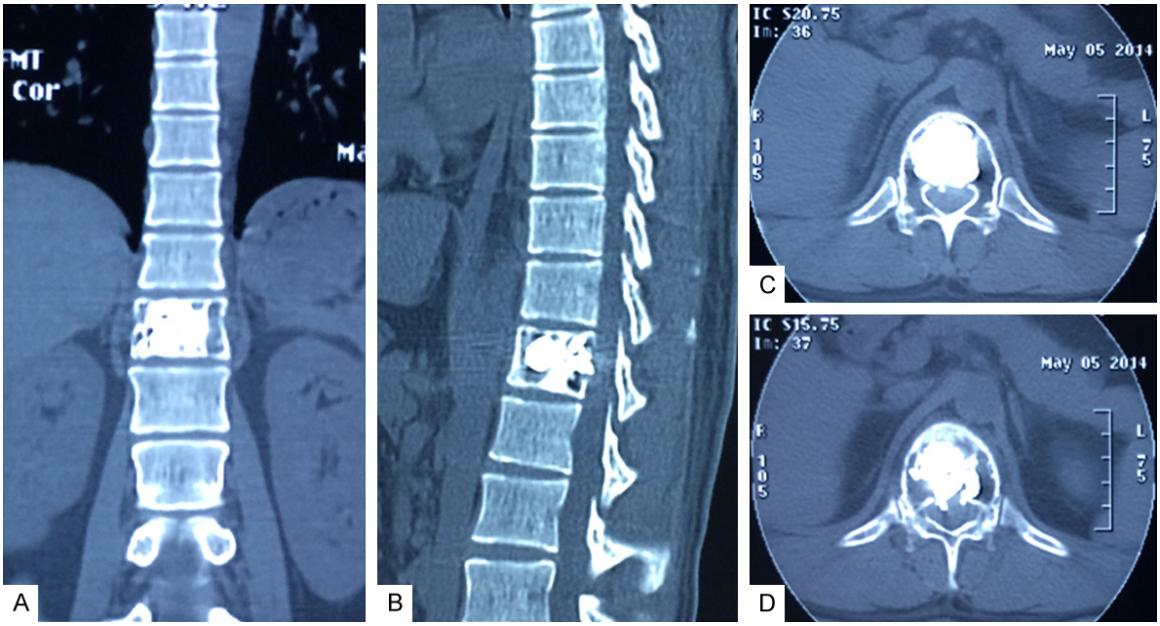


**Figure 3.** CT scans after admission. An anterior-posterior (A) and a lateral (B) CT image depicting a high density lesion within the centrum of T12. Axial CT images (C and D) depict a high density lesion within the centrum of T12; the lesion extends into the vertebral canal and causes compression of the dural sac.

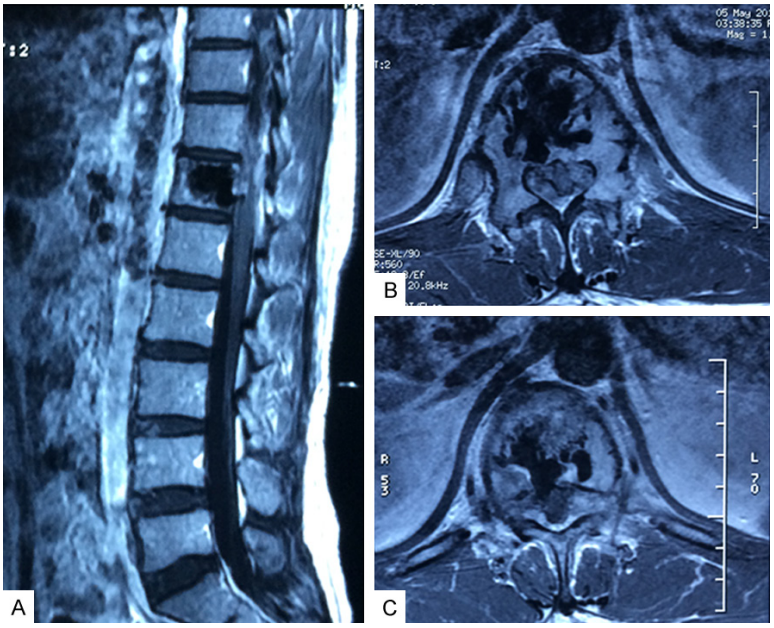


**Figure 4.** MRI after admission. A. A sagittal T1-weighted MRI depicts a low intensity signal within the centrum of T12; the lesion extends into the vertebral canal; there is a high intensity signal in the dural sac and the peripheral soft tissue. B and C. Axial T1-weighted MRI depicts a low density lesion within the centrum of T12 that extends into the vertebral canal.

twice-daily oral neurotrophin treatments and daily mouse nerve growth factor via intramuscular injections. We also taught the patient lower limb exercises to prevent muscle atrophy. However, the patient's neurologic symptoms did not improve despite the aforementioned drug treatments. Therefore, the patient underwent posterior spinal cord decompression of T11-T12, bone graft fusion and pedicle screw fixation at 4 weeks following admission. His pathology results were suggestive of a grade 1-2 giant cell tumor (GCT) (**Figure 5**).

Postoperatively, the patient's lower extremity numbness resolved, and his muscle power improved. Both X-ray and CT images confirmed that the pedicle screws were at the correct locations and that the partial vertebral lamina was removed (**Figures 6** and **7**). Repeat MRI demonstrated complete bony fusion at the reconstruction site (**Figure 8**). The patient was released from the hospital 23 days following surgery. No local

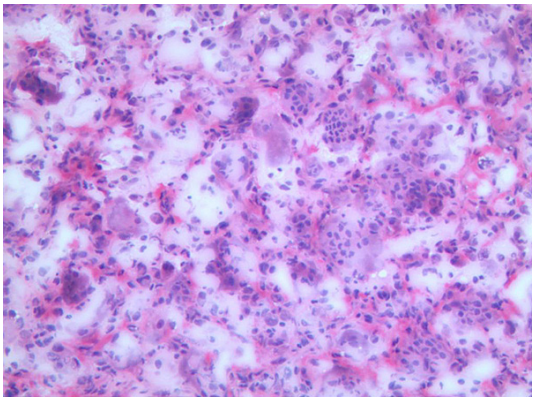

**Figure 5.** The hematoxylin and eosin stained biopsy demonstrated multinucleated giant cells with little stroma.

recurrence was observed during the subsequent 12 months.

## Discussion

Giant cell tumors (GCTs) are aggressive neoplasms that typically develop following skeletal maturity [1]. Most GCTs of the bone occur in either the epiphysis or meta-epiphysis of long bones; they are rarely found in the spine [2, 3]. GCTs of the spine constitute 6.5% of all bone GCTs [4]. GCTs involving the vertebrae above the sacrum are extremely rare [3], as only 2% to 5% of vertebral GCTs involve the vertebrae above the sacrum [4, 13]. GCTs affect the cervical, thoracic, and lumbar regions equally [4]. GCTs have a female predominance of 70.8% and present primarily during the fourth decade of life [4-7].

We reviewed the English language studies published beginning in 2005 and identified 15 cases (including ours) of GCTs involving the thoracic spine (**Table 1**). The continuous data were expressed as means ± standard deviations (means ± SDs). The age range of these patients was 16 to 64 years with a mean (± SD) of 34.47 (± 14.91) years, which was consistent with the findings of a previous study that demonstrated that GCTs present primarily during the fourth decade of life [6]. For these 15 cases, the ratio of men to women was approximately 1:1.5. According to these data, the incidence of GCT involving the thoracic vertebra is higher among females than among males, which was also consistent with the results of previous studies [4, 5, 7]. Among the GCT cases reviewed herein, approximately 70% were located in the T8-T12 region, the most common site of GCTs involving the thoracic spine.

The primary clinical manifestation of GCTs involving the spine is back pain [4, 9-11]. Of the 15 cases that we reviewed, the most frequent complaint was pain (12 of 15 cases, 80.0%), which was consistent with the results of previous studies. The initial symptoms of GCTs of the thoracic spine are variable and nonspecific and may be easily misinterpreted, resulting in either a delayed or an incorrect diagnosis [3, 7].

X-ray films of spinal GCTs demonstrate expansile lytic lesions [20]. CT scans demonstrate destructive, osteolytic lesions with sclerotic rims lacking a mineralized matrix [4, 20, 21]. MRI demonstrate heterogeneous signal intensities, irrespective of the pulse sequence used [22]. T2-weighted images of GCTs demonstrate an expansile mass of a heterogeneous low to intermediate signal intensity, and T1- and T2-weighted images of GCTs demonstrate curvilinear areas of low signal intensity [23]. In our case, the patient was misdiagnosed with hemangioma. Hemangiomas are the most common primary neoplasm affecting the thoracic spine and may be observed in 11% of all postmortem examinations [24]. In hemangioma cases characterized by spinal cord compression similar to that observed with GCTs, the hemangiomas are often either atypical or locally aggressive [25]. Vertebral hemangiomas present as a single osteopenic vertebral body with coarse vertical striations on radiography and a “polka dot” appearance on CT [7, 20]. On MRI, hemangiomas exhibit predominant homogeneous high signal intensity on both T1- and T2-weighted images [20]. In our case, although the final diagnosis was GCT, the CT and MRI findings were indistinguishable from those of hemangioma. Therefore, in addition to clinical examinations, imaging examinations may also result in the misdiagnosis of GCTs of the thoracic spine; therefore, a biopsy is necessary to make an accurate diagnosis.

Of the cases reviewed here (including ours), 13 included discussions of biopsies. In 10 of these cases, a biopsy was performed before the diagnosis, resulting in a correct diagnosis. However, for the remaining 3 patients, a biopsy was not performed, resulting in 1 misdiagnosis and 2 missed diagnoses. Therefore, biopsy is effec-

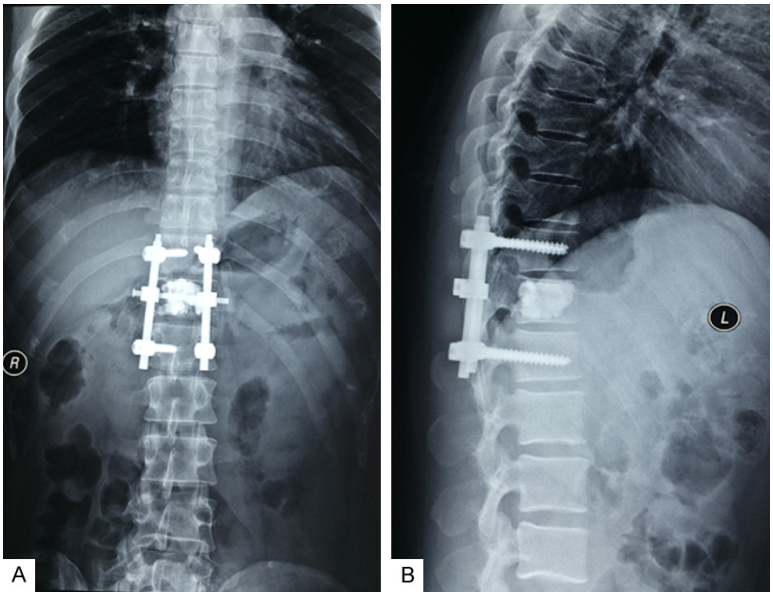


**Figure 6.** An anterior-posterior (A) and a lateral (B) plain radiograph depicting pedicle screws at the correct locations.

tive in reducing the rates of misdiagnosis and missed diagnosis. Fine needle aspiration cytology (FNAC) is an easy, sensitive, and specific procedure for the diagnosis of bone lesions; the spine is the most frequently aspirated site [26]. FNAC has been utilized routinely since 1972 and may be performed at unusual sites. It has gradually become widely used as a substitute for core needle and open biopsies because of its safety and its lower rate of trauma; therefore, FNAC has become more widely accepted by patients [27, 28]. Among the patients discussed herein, 17 underwent a biopsy. FNAC was used in only two cases [29, 30]; a finding that most likely resulted from our evaluating only GCTs of the thoracic spine, resulting in a sample size that was not sufficiently large to accurately reflect the frequency of FNAC. GCTs are benign tumors consisting of the following three cell types: mononuclear histiocytic cells, multinucleated giant cells and neoplastic stromal cells [2]. The cytodiagnosis of GCT is dependent on the presence of a cellular aspirate. FNAC of GCTs demonstrates a double population of giant cells and mononuclear spindle round cells, both with uniform distributions; most of the giant cells are often attached to the periphery of the spindle cells, and fibrogenesis is not present [31]. However, other bone tumor lesions, such as aneurysmal bone cysts (ABCs), chondroblastomas, and brown tumors associated with hyperparathyroidism, also contain osteoclast-like giant cells, which necessitates cytological differential diagnoses [8, 27, 30]. ABCs present as blood with limited cellular material, including occasional osteoclasts, osteoblasts and fibrous strands [30]. Chondroblastomas present as a chondroid matrix surrounding individual mononuclear cells with cell calcifications and multinucleate osteoclasts [32]. Brown tumor smears often exhibit scattered mononuclear and giant cells [30]. Cytological characteristics may be used to exclude other bone lesions.

Surgery is the primary treatment for GCTs of the spine and primarily entails an en bloc resection and an intralesional excision [12]. The clinical goals of surgical treatment are to relieve pain, preserve or recover neurological function and stabilize the spinal column; en bloc resection with either marginal or wide margins lowers the recurrence rate of GCTs to less than 20% [12, 33-35]. The recurrence rate following intralesional excision is 40-50% because of the higher risk of local contamination by tumor cells and the difficulty of completely resecting the lesion [36, 37]. Among the patients that we reviewed, 13 underwent en bloc resections with either marginal or wide margins [14-17, 19, 21, 29, 38-41], and the recurrence rate for these patients was 7.7% (1/13 cases). Furthermore, one patient underwent intralesional excision and recurrence occurred after 2.5 years [42]. Moreover, denosumab is effective in the management of GCT; it may negate the need for surgery or reduce the morbidities associated with surgery. Therefore, denosumab should be considered a treatment option for GCTs of the bone [43, 44].

We described a rare case of GCT of the thoracic spine that was misdiagnosed as a hemangioma. To achieve a specific diagnosis, clinical and imaging examinations are not sufficient; a biopsy is necessary. FNAC is a rapid and safe meth-

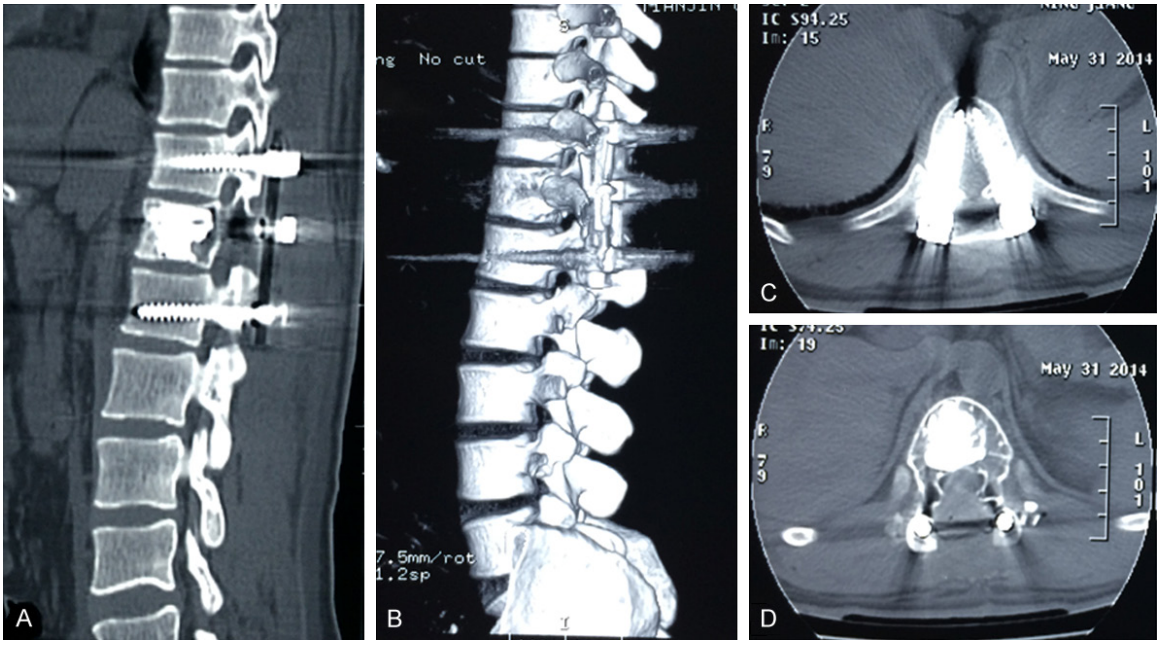


**Figure 7.** CT images after the surgery. A lateral CT image (A), a three-dimensional reconstruction of a chest CT image (B) and axial CT images (C and D) demonstrating that the pedicle screws are at the correct locations and that the partial vertebral lamina is removed.

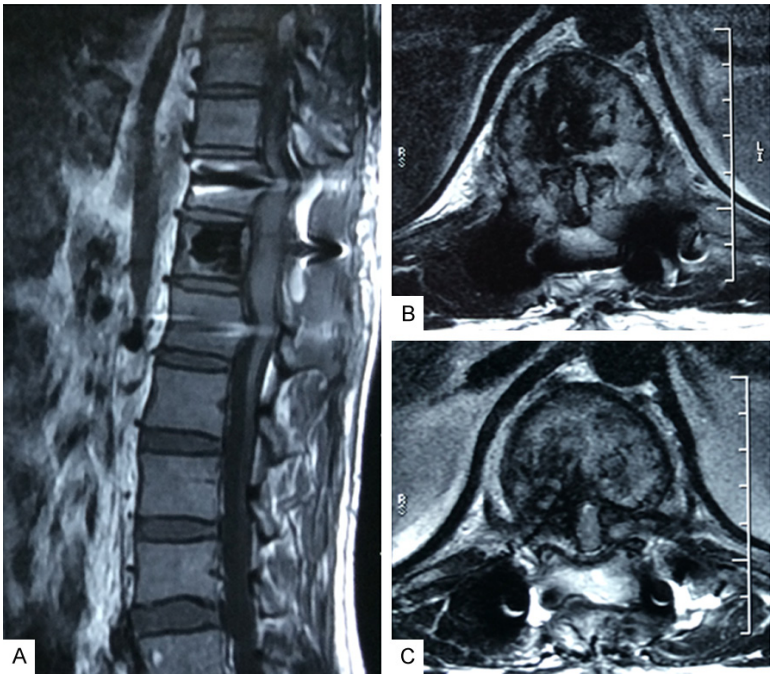


**Figure 8.** A sagittal T1-weighted MRI (A) and axial T1-weighted MRI (B and C) depicting complete bony fusion at the reconstruction site.

od that assists in the diagnosis of bone lesions and is becoming more widely accepted. Surgery is the primary treatment method for GCTs of the thoracic spine, and en bloc resection with wide margins may result in a lower recurrence rate.

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## Disclosure of conflict of interest

None.

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**Table 1.** 15 cases of GCTs involving in thoracic spine

| Case No./ref | Age/ Sex | Site | Clinical manifestation | Biopsy before diagnosis | Misdiagnosis or missed diagnosis/Time until diagnosis | Treatment | Follow-up/ Outcome |
|---|---|---|---|---|---|---|---|
| 1/[14] | 36/M | T12 | Back pain and dyspnea | Yes | No/- | Separation of the tumor from the anterior vital structures; 2 weeks later, en bloc spondylectomy | 7 years/Recurrence |
| 2/[15] | 26/M | Left facet joint between T7 and T8 | Left back pain | Yes | No/- | Complete facetectomy and excision of the lesion, followed by posterior arthrodesis between T5 and T9 | 2 years/NED |
| 3/[16] | 64/M | T12-L1 | NA | NA | NA/NA | Preoperative embolization, laminectomy, corpectomy, stabilization and reconstruction | 3 months/Death (complications of preoperative embolization) |
| 4/[17] | 24/F | T9 | Lower back pain, bilateral lower extremity weakness, numbness, and bowel and bladder incontinence | No | Missed diagnosis/14 4/7 weeks | Laminectomy, posterior spinal decompression, and instrument fusion; two days later, corpectomy of the vertebral body and anterior tumor debulking | NA/NA |
| 5/[18] | 20/M | T4 | Upper thoracic pain | Yes | No/- | Laminectomy, posterior spinal decompression and posterolateral fusion followed by PMM2A injection | 7 years/NED |
| 6/[19] | 32/F | T8 | Back pain in the mid-dorsal region and weakness in the lower limbs | Yes | No/- | Total en bloc spondylectomy, spinal reconstruction, and stabilization | 9 months/NED |
| 7/[21] | 30/F | T10 | Back pain, weakness in both lower limbs and bladder and bowel incontinence | Yes | No/- | En bloc resection, stabilization and reconstruction | 1 year/NED |
| 8/[29] | 19/F | T7 | Back pain | Yes | No/- | Embolization, corpectomy with spinal stabilization, reconstruction and radiation therapy | 1 year/NED |
| 9/[30] | 25/M | T9 | Upper back pain with lower extremity weakness | Yes | No/- | NA | NA/NA |
| 10/[38] | 31/F | T6 | Back pain and progressive motor weakness of both lower limbs | Yes | No | Posterior lesionectomy with T6 laminectomy | 5 years/NED |
| 11/[39] | 64/F | T11 | Back pain | Yes | No/- | Resection | 4 years/NED |
| 12/[40] | 16/F | T2 | Upper back pain, hypoesthesia below the T1 dermatome, and lower extremity weakness | No | Missed diagnosis/5 days | Tumor resection and laminectomy with stabilization and radiation therapy | 2 years/NA |
| 13/[41] | 44/F | T6-8 | NA | NA | NA/NA | En bloc resection, stabilization, and chemotherapy | 5 years/Complication (spinal cord herniation) |
| 14/[42] | 47/F | T5 | Back pain, lower extremity weakness | Yes | No/- | Laminectomy with stabilization, curettage of the tumor and reconstruction | 2.5 years/Recurrence |
| 15* | 39/M | T12 | Back pain, weakness and numbness in both lower limbs | No | Misdiagnosis/3 months | Tumor resection, posterior spinal cord decompression, bone graft fusion and pedicle screw fixation | 1 year/NED |

M = male; F = female; T = thoracic; NA = not available; NED = no evidence of disease; * = present case.

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