A improved posterior approaches in treating benign primary spinal tumor: a preliminary retrospective report.

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Research article

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Abstract

Background: Primary spine tumors are rare, accounting for fewer than 5% of all tumors of the spine. Unlike metastatic spine tumors, primary tumors localized to a single location offer the potential for true cure, so a minority of the primary benign lesions will require surgical treatment. Although the development of surgical techniques and instrumentation, few literatures had reported transpedicluar lateral debridement ,bone grafting ,and posterior instrumentation for primary spinal tumors. In the current study, we evaluate the efficacy of posterior instrumentation after transpedicular lateral debridement and bone grafting in patients with primary spinal tumors at a single institution.

Methods: 21 patients (13 males and 8 females; average age 30 years) with primary spinal benign tumor underwent transpedicular lateral debridement, bone grafting, and instrumentation. The average follow-up period was 29.5 months (range 12–48months). The medical records and radiographic findings of the patients were reviewed.

Results: all patients who had involvement of one vertebra. Before surgery, there were one patients with Frankel grade B, three with grade C, six with grade D, and eleven with grade E. During the last follow-up examination, in ten patients with neurological deficit, one patients improved one grade, seven patients improved two grades, and the neurologic status remained unchanged in two patients. Stable bone union was observed in all cases and the average time required for fusion was 6.5 months. The kyphosis Cobb angle improved from the preoperative average of 18.61 (range 0–48) to a average of 3.9(range 13 to 0) during the follow-up period. During the follow-up period, there were no grafts or instrumentation-related stabilization problems. There was no other recurrence of tumors

Conclusions: transpedicluar lateral debridement ,bone grafting ,and posterior instrumentation are safe and effective methods in the surgical management of primary spine benign tumors.

Introduction

Primary spine tumors are rare, accounting for fewer than 5% of all tumors of the spine[1]. Unlike metastatic spine tumors, primary tumors localized to a single location offer the potential for true cure[2]. Over the past several decades, the survival of patients with spinal tumors has trended toward improvement. Furthermore, the improvement in medical and stereotactic radiotherapy for the treatment of tumors within the vertebral column has led to a decrease in surgery for spinal tumors. However, surgery continues to play a critical role in the treatment of primary benign tumors with aggressive. Over the period of -20 years, surgical capability in the treatment of spinal tumor has been considerably enhanced by advances in anesthesia[3]. Depending on the location of the tumor and the goal of the operation, an anterior, posterior, or lateral approach, or a combination of them, may be used. Although the anterior approach often supply the most direct route to the lesion, it carry a high morbidity risk. Now most spine surgeons have greater familiarity with the posterior approach to the spine, and then the posterior approach represents the most commonly used route for spinal decompression and stabilization. But few literatures have reported transpendicular lateral debridement ,bone grafting, posterior instrumentation and fusion in the treatment of primary spine tumors. The study reported our experience on transpendicular lateral debridement ,bone grafting, posterior instrumentation and fusion in the treatment of primary spine tumors.

Methods

Patient population

From January 2007 to December 2014, 21 patients with primary spine benign tumors at the first affiliated xiangya hospital of central south university of china formed the study group. The patients with the any following conditions were excluded: cervical lesion, tumor involving the posterior elements, destructed the vertebral cortex. Among them, There were 13 males and 8 females with an average age of 36.6 years (range 10–65 years). These patients' hospital medical records as well as radiographs were reviewed, and the demographic data were recorded. The preliminary diagnosis of primary spinal tumors was based on medical history, clinical symptoms, radiologic imaging (plain radiograph, computed tomography and magnetic resonance imaging),and pathological examination[4,5].

Symptoms and signs

All the patients exhibited back and waist pain,. Other symptoms ,such as limb weakness and diminished sensation below the sensory level of the tumor was evident in 10 patient at presentation. The back and waist pain was evaluated by visual analog scale. The neurologic status was graded according to the Frankel scoring system[6]. Before surgery, there were one patients with grade B, three with grade C, six with grade D, and eleven with grade E (Table 2).

Preoperative management

Radiologic imaging (plain radiograph, computed tomography and magnetic resonance imaging) of the spine had been performed before surgery for all patients. The angle between the first normal vertebra above the lesion and the first normal vertebra below the lesion on the lateral radiographs was used to evaluated Kyphosis angle (cob angle)[7]. all patients who had involvement of one vertebrae, The average preoperative kyphosis angle was 18.61(range0–48). three-dimensional reconstruction computed tomography of the spinal lession was obtained to confirm the extent of bony destruction. Routine laboratory procedures including chest radiograph, blood complete count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), tuberculin test, blood sugar, urine analysis, liver, and renal function tests were performed. Concurrent disease were routinely controlled, anemia and hypoproteinemia were rectified completely .then ,the surgery was carried out.

Operation indication

The indications for surgery were radiological demonstration of vertebral lesion, bone destruction with progressive kyphotic deformity and severe pain, poor response to medical treatment, deterioration in neurological status and mechanical instability

Operative technique

The operation was performed under general endotracheal anesthesia., the patients was placed at prone position. A midline longitudinal incision was made over the spinous process of the destructed vertebra. The posterior spinal construction was exposed, including the spinous processes, lamina, facet joints. In most cases, the screws could not be placed into the affected vertebra, the two superior and one inferior levels were incorporated into the instrumentation system with C-arm fluoroscopy assistance. The vertex reconstruction system (sofamor Danek, Medtronic, USA) was used in all 21 patients. The screws were fixed to a temporary rod on one side where neurological and radiological manifestation was lesser to distract of the involved level. Then the other transverse and lateral pedicle was bited, and the inner side of the pedicle was reserved (Fig.1A). Curettes of various sizes and angles were used from transpedicular lateral approach to remove lesions.completely (Fig.1B). A locking plate-and-screw system of appropriate length was used to achieve posterior fixation in all the patients. After washing with 20ml hydrogen peroxide and a large amount of physiological saline, Allograft bone (NO. SPSZGKDG/SD; Aorui Biological Material Co. Ltd., Shanxi, China) transplantation was used to reconstruct the Vertebral defect and maintain spinal integrity. The 8W units gentamicin was routinely used in the surgical area as local antibiotic therapy. At last,a local drainage tube was inserted from the incision to normal tissue, then closed the operative incision. Specimens from each patient were taken during the operation and subjected to pathologic examination.

Postoperative management

When the volume was <20ml per 24h, the drainage tube was pulled out. And intravenous antibiotic drugs were administered to all patients after surgery for three to five days. Patients remained in bed for 2 weeks and then walk around under the effective support of a spinal brace for 3-6months. According to the general condition, all patients were asked to take nutritional support and performed early application of physical therapy and rehabilitation training after surgery. When the patients were discharged from our hospital, all patients were asked to reexamine at a month interval for the first 3 months, then every 3 months until 12 th month, and every 6 months up to 24 months after treatment ,and thereafter, once a year to the final follow-up. The follow-up care include radiographic examinations ,an assessment of neurologic status and pain.

Statistical analysis

A paired t test was used for comparison between preoperative and postoperative period on kyphotic angle, and VAS score. SPSS for Windows (version 15.0; SPSS, Inc., Chicago, IL, USA) was used for the analysis. A p value of less than .05 was customarily considered as statistical significant

Results

The surgeries were performed by the same surgeons, and all patients withstood surgery well. Operating time ,bleeding amouts, and hospitalization time of each patients were recorded after surgery (table 1).The operation time ranged from 90 to 150 minutes (mean 117.6 minutes) and the bleeding during operation was between 500 and 1300 ml (mean 809.5 mL). The average hospitalization time was 18.5 days (range 10–26days). one patients developed superficial infection after surgery, which were successfully resolved by systemic antibiotic. Three patients reported harvest site pain, but the symptom disappeared 1 week postoperatively. No injury to neurological or vascular structures was encountered during the operation. The histopathological of the operative specimen revealed 1 aneurysmal bone cyst, 2 giant cell tumor, 1 osteoblastoma, 6 osteofibrous dysplasia, 7 hemangioma and 4 Langerhans cell histiocytosis. The follow-up period ranged from 12 to 48months (mean 30.9). The kyphotic Cobb angles improved from preoperative average of 18.61 (range 0–48) to average of 3.9(range 13–0)($p<0.05$ vs.preoperative) at the last follow-up.. After surgery, pain was evaluated by VAS score in all patients. The average preoperative VAS scale was 8.7 (range7–10), and decreased to an average of 1 (range 0–3) at the last follow-up ($p<0.05$). For patients with neurological deficit, neurologic recovery occurred within 3 days postoperatively. During the last follow-up examination, one patients improved one grade, seven patients improved two grades, and the neurologic status remained unchanged in two patients. (Table 2). Follow-up radiographies showed that solid fusion was achieved in all patients. Average fusion period was 6.38 months (range 3–10 months). None of the patients had radiologic findings of internal fixation failure. No patients showed recurrence of tumors.

Case presentation

Case 1

This 33-year old woman was admitted to the hospital for back pain and progressive weakness. Neurologic examination showed grade D according to the Frankel scoring system. Radiologic studies showed the destruction of L1 vertebral bodies and compression of the spinal cord (Figs. 2). The kyphotic deformity was 20 at the start of treatment. After finished all preoperative examinations, the patient then underwent posterior debridement, decompression, allograft bone transplantation, and fixation (Figs. 3). Pain relief was observed immediately after surgery. The neurologic deficit improved immediately after surgery and was recovered gradually in 1 month. The postoperative kyphosis correction was satisfactory, and no significant loss of correction was identified at the final follow-up examination (Figs. 4)

Case 2

This patient was a 10-year-old man with moderate back pain for 3 months. Neurologic examination revealed grade E according to the Frankel scoring system. Preoperative Radiologic studies showed destruction of T9 vertebrae (Fig. 5). The patient underwent transpedicluar lateral debridement ,bone grafting ,and posterior instrumentation (Fig. 6). Pain relief was observed immediately after surgery .No recurrence of tumor was noted in this patient during the follow-up period (Figs.7).

Discussion

primary spinal tumors represent 5% of all primary bone tumors, and the latter occur in 0.8 to 8.0 per 100,000 population[8, 9]. The more frequently encountered benign spinal tumors in surgical practice are osteoid osteoma and osteoblastoma, neural sheath tumors, aneurysmal bone cyst, benign fibrous tumor, giant cell tumor, and aggressive hemangioma. Although the most common primary benign lesions can be controlled by conservative treatments, unlike metastatic spine tumors, primary tumors localized to a single location offer the potential for true cure. A minority of the more common primary benign lesions will require surgical treatment. For the primary spinal tumors, the main surgery treatments included intralesional resection and en bloc resection. Then, benign primary tumors, such as aneurysmal bone cyst, giant cell tumor, and osteoblastoma, may be safely treated with intralesional resection, radiotherapy, or both to reduce the risk of surgical morbidity[10–12]. So for benign but aggressive lesions in the spine, intralesional resection is generally recommended[13, 14]. Depending on the location of the tumors and the goal of the operation, some surgery approaches may be used, including an anterior, posterior, or lateral approach, or a combination of them. The most of primary benign tumors often only invade the vertebral body. ;therefore, the anterior, or lateral approach often can supply the most direct route to the lesion. But, the literatures reported that the anterior and lateral approaches often carry a high risk of the intraoperative or postoperative complications, such as adjacent organ and vascular injury, cerebral spinal fluid leak, or wound healing impairment. By contrast, the posterior approaches allows direct access to spinal cord and obviated the extensive bone resection generally required with anterior approaches [15]. As the meanwhile, most spine surgeons were greater familiarity with the posterior approach, thus, the spine surgeons were prefer to select the posterior approach for spinal decompression and stabilization.

Although posterior approach has some advantages compared with other approaches, it often sacrifice the parapophysis, facet joints, pedicle, or lamia for providing better operating field. So that it may don’t maintenance of the spinal posterior column structural stabilization; meanwhile extension bone resection for providing greater intraoperative visualization will increase the amount of blooding loss. Furthermore, the blood pressure level don’t maintain spinal cord perfusion and worse neurological injury. In addition, the integrity of spinal canal can be destructed for lamia and pedicle resection. So it was easy to injury the spinal cord or nerve root. And the complications of neurological injury and cerebral spinal fluid leak may happened.

In our study, the treatment of primary spine tumor focus on a balance between the aggression of complete tumor excision and maintenance of the axial structural integrity. From the view of the anatomical structure, the pedicle and vertebral body connected directly and form a complexity, No important blood vessels and nerves on the lateral of complexity besides the muscle tissue. Based on the anatomical study, we try to bite the bone outside of pedicle and reserve the inner side of pedicle. Then, the muscle tissue which is at the lateral of the complexity was stretched to opposite as much as possible, exposing a large enough field of view, and along the pedicle into the vertebral body, carried debridement. By using tanspendiclular lateral approach to cure primary spinal tumors., we can achieve adequate visualization ,only sacrifice the outside of pedicle and a part of facet joints. From our experiences, three reasons will induce us to select this approach. First of all, compared with other approaches, we can keep the stability of the spine posterior column to a greatest extent. Secondly, little bone resection can achieve adequate vislulization, Further, the amount of blooding loss will decrease. Then the circulation system can maintain stable and the blood pressure level can keep spinal cord perfusion. Last, by preserved the inside of the pedicle, we didn't destructed the integrity of the spinal canal. The spine cord still be protected by integral spinal canal. So we don't worry to injury spine cord, and the complication of the neurological injury and cerebral spinal fluid leak will decrease. Of course, there are also some limitations on this approach. Primary malignant tumors, metastatic tumors, multiply spinal tumors were not suitable to use this approach.

Conclusion

This preliminary study indicates that transpedicluar lateral debridement ,bone grafting ,and posterior instrumentation are safe and effective techniques with good clinical and radiologic outcomes for patients with primary spine tumor, especially for those who had benign tumor affecting one vertebrae. The procedure has the advantage of minor surgical invasion, less complications.

Abbreviations

CRP:C-reactive protein; CT: Computed tomography; ESR: Erythrocyte sedimentation rate; MRI: Magnetic resonance imaging;; VAS: Visual analogue scale; SPSS: Statistical package for the social sciences; FFU, final follow-up; preop, preoperative.

Declarations

Acknowledgements

Not applicable.

Authors' contributions

P.L contributed significantly to analysis and wrote the manuscript, Y.C performed the data analyses, ZS.D contributed to the conception of the study. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Xiangya Hospital and the written informed consent was obtained from all patients.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1: Summary of clinical data obtained in the 21patients with primary spinal tumor

Case no.	Sex	Age	Operating time	Bleeding amouts	Hospitalization time
1	F	33	96	500	17
2	M	55	142	1000	20
3	M	11	120	700	14
4	F	25	100	650	25
5	M	39	90	600	10
6	M	15	108	800	17
7	F	63	115	750	19
8	M	58	150	750	26
9	M	14	142	1300	16
10	M	46	132	700	17
11	F	54	98	500	18
12	F	42	100	800	19
13	M	36	125	750	21
14	M	65	112	1200	20
15	M	42	90	900	16
16	M	10	130	1000	18
17	F	46	123	650	17
18	M	28	150	700	16
19	F	34	100	1000	20
20	F	40	119	900	24
21	M	14	128	850	20

Table 2 : Summary of clinical data obtained in the 21patients with primary spinal tumor

Case no.	Fusion time	Neurologic status		VAS		Kyphosis(°)		Follow-up(mo)
		Preop	FFU	Preop	FFU	Preop	FFU	
1	6	E	E	9	2	0	0	12
2	7	B	D	9	3	48	12	18
3	10	E	E	10	2	10	0	33
4	5	D	D	9	1	36	10	27
5	6	E	E	10	3	0	0	24
6	3	E	E	8	0	24	5	36
7	7	C	D	7	0	30	7	45
8	9	D	D	9	1	10	0	36
9	8	E	E	9	0	25	3	41
10	6	C	E	8	0	8	0	48
11	5	D	E	10	3	0	0	19
12	10	D	E	8	1	0	0	28
13	4	E	E	9	0	40	10	22
14	6	C	E	10	2	42	13	24
15	8	E	E	10	1	28	7	38
16	4	D	E	9	0	35	5	37
17	9	E	E	8	1	5	0	39
18	3	D	E	7	0	12	2	30
19	7	E	E	9	1	0	0	26
20	6	E	E	8	1	18	3	24
21	5	E	E	7	0	20	5	42

FFU, final follow-up; preop, preoperative.

Figures

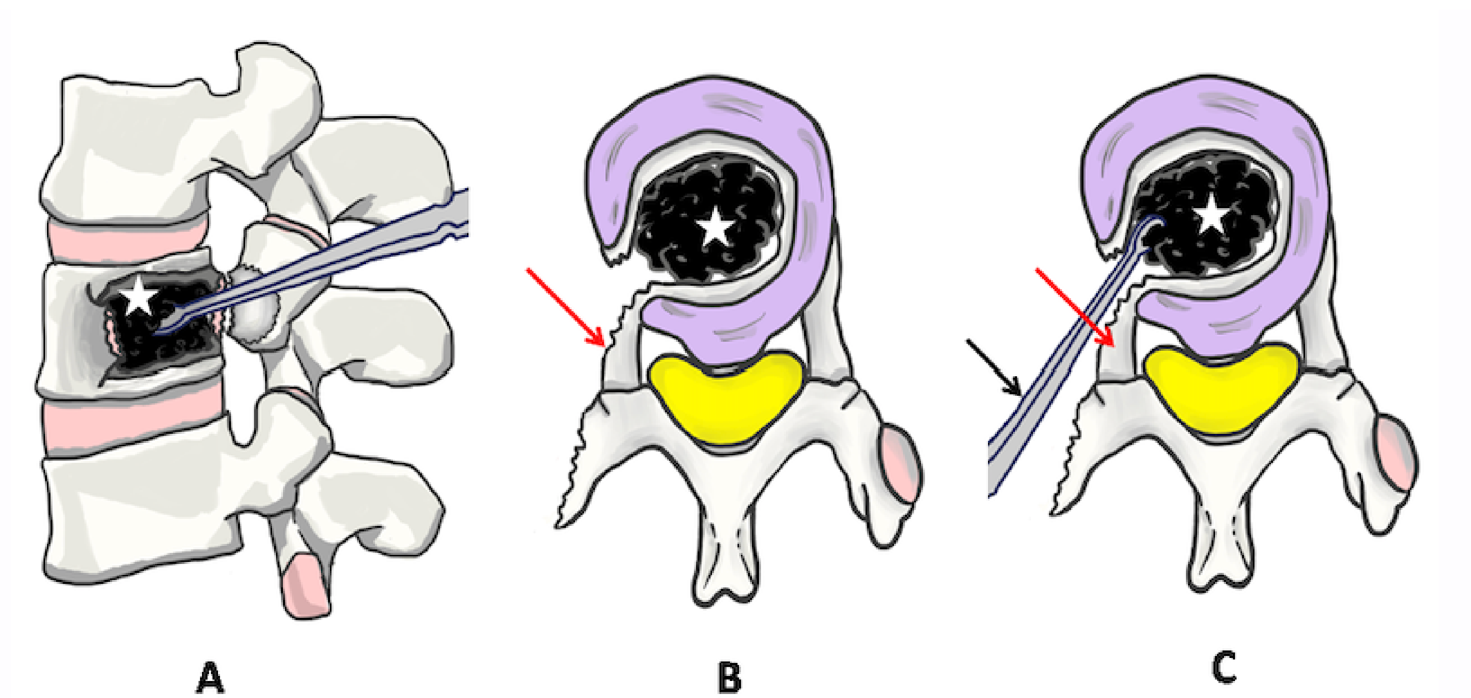

Figure 1

This is the surgery schematic. (A) show lateral view of the surgical site; (B) show the important step of exposing lesion. (B) show the routine of clearing lesion. Red arrow indicate the remaining pedicle, black arrow indicate the routine, white star indicate the Lesion.

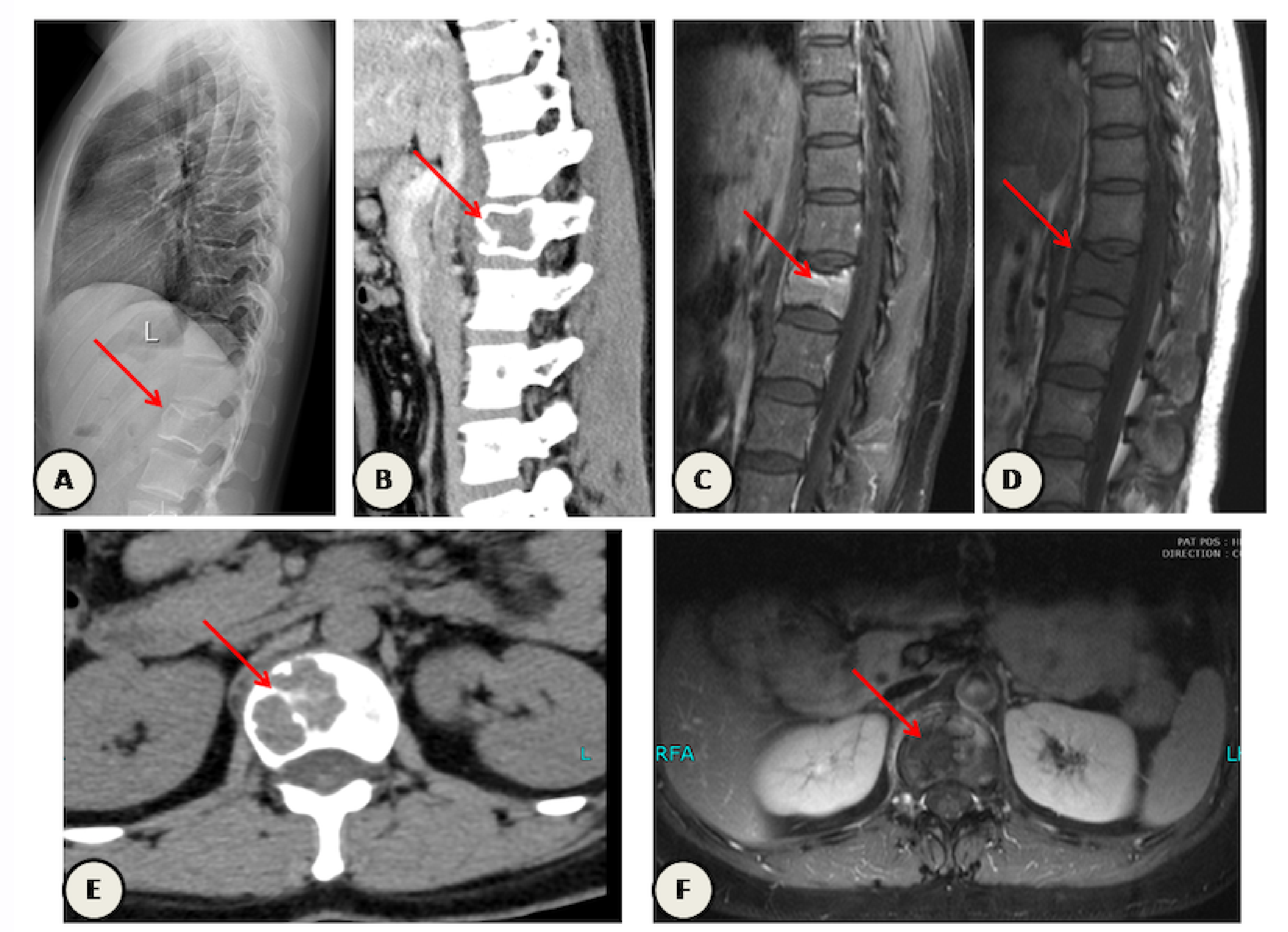

Figure 2

In a 33-year-old female patient, Preoperative radiographs(A), computed tomography(B) and magnetic resonance imaging(C, D) revealed obvious destruction of L1. The red arrow indicates lesion.

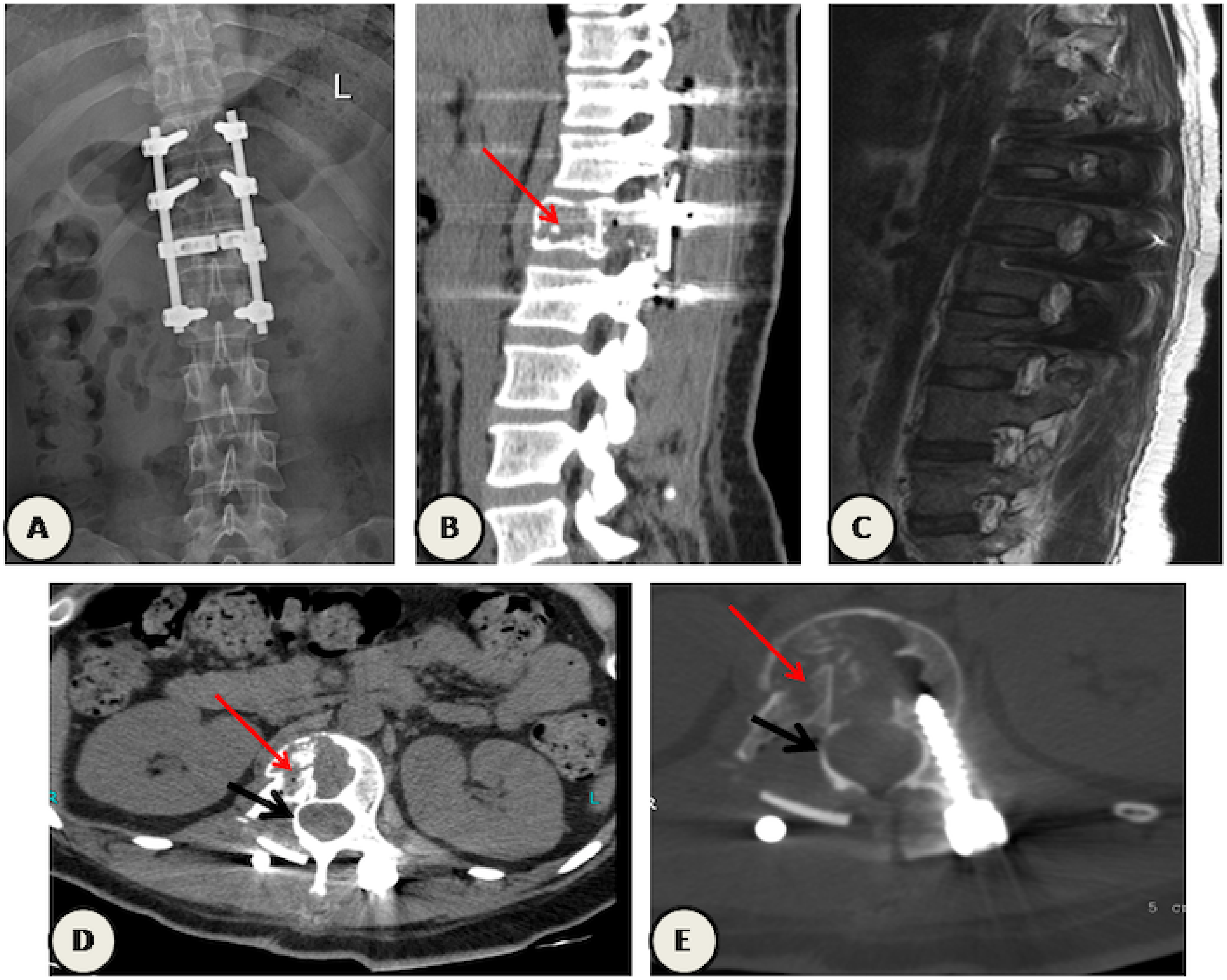

Figure 3

Immediate postoperative radiographs(A) and computed tomography demonstrating(B, D) and magnetic resonance imagin(C, E) demonstrating transpedicular lateral debridement, bone graft, and posterior fixation. The red arrow indicates the allograft bone and the black arrow represents the inner side of pedicle.

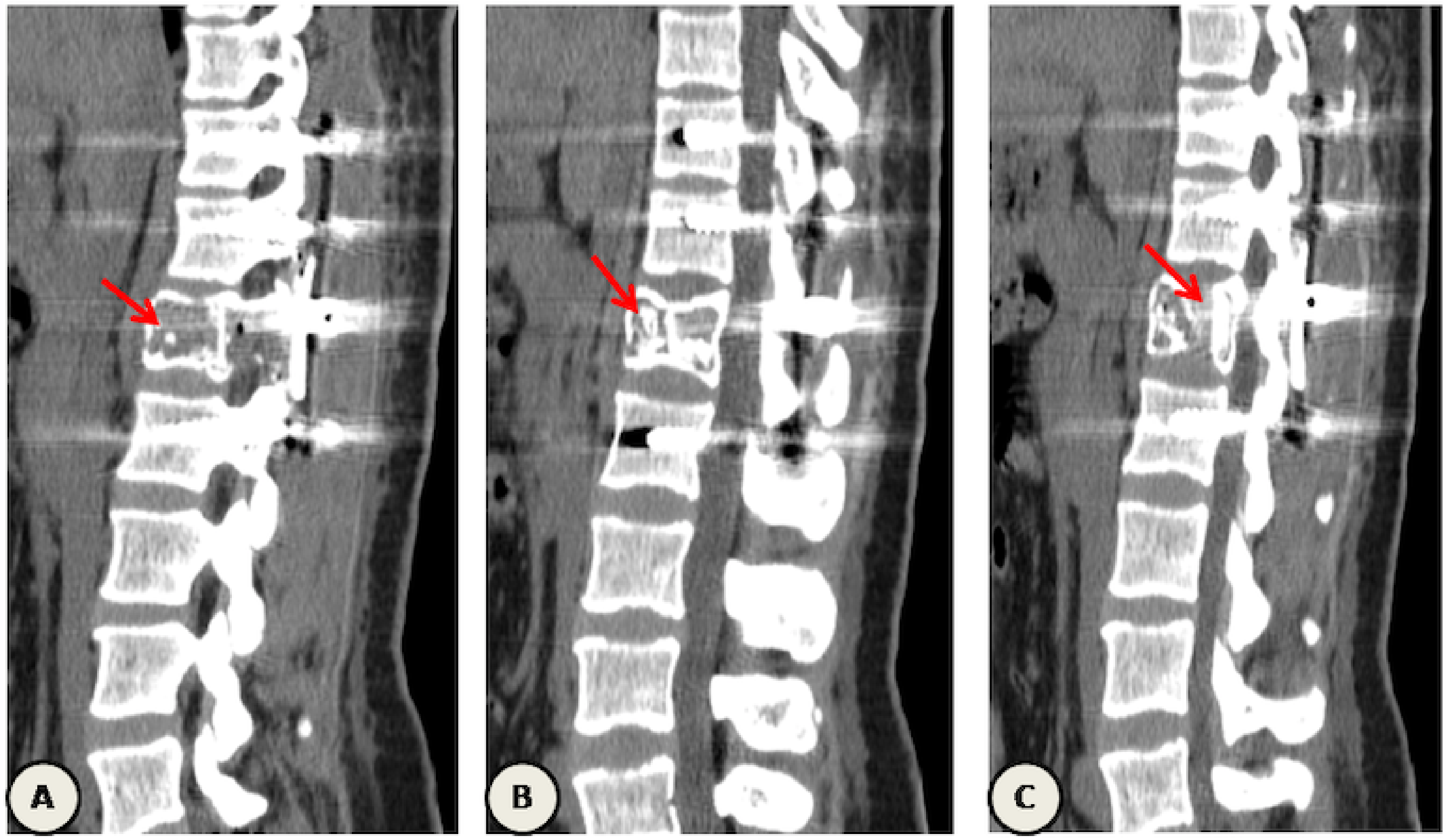

Figure 4

At the 3-month(A), 6-month(B), one-year(C) follow-up, the CT shows perfect position of the strut grafts, and a solid fusion with continuous bridging of the trabecular bone.

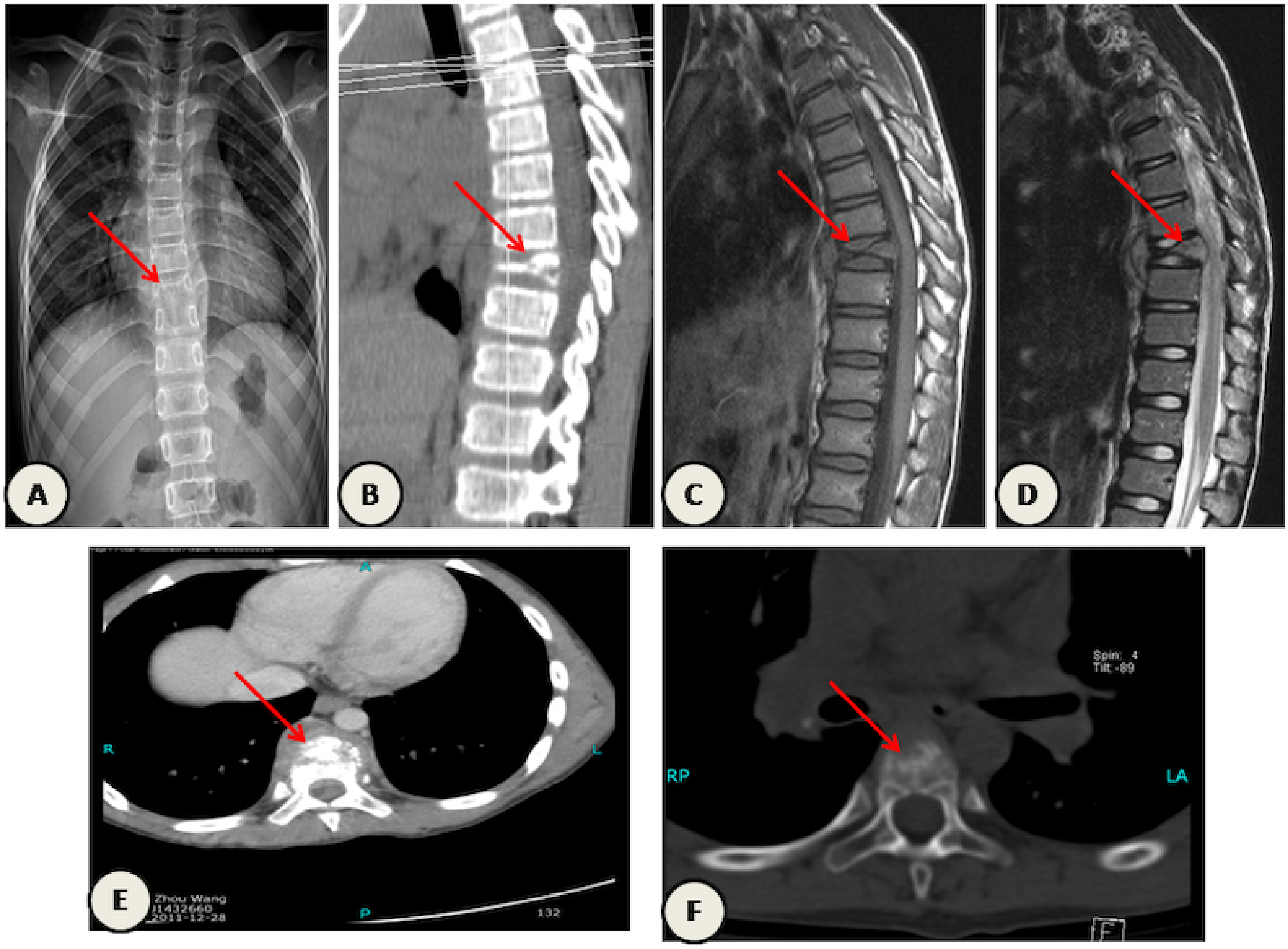

Figure 5

In a10-year-old male patient, preoperative radiographs(A), computed tomography(B) and magnetic resonance image(C, D) shows destruction of T9 vertebrae , the red arrow indicate the T9 vertebrae.

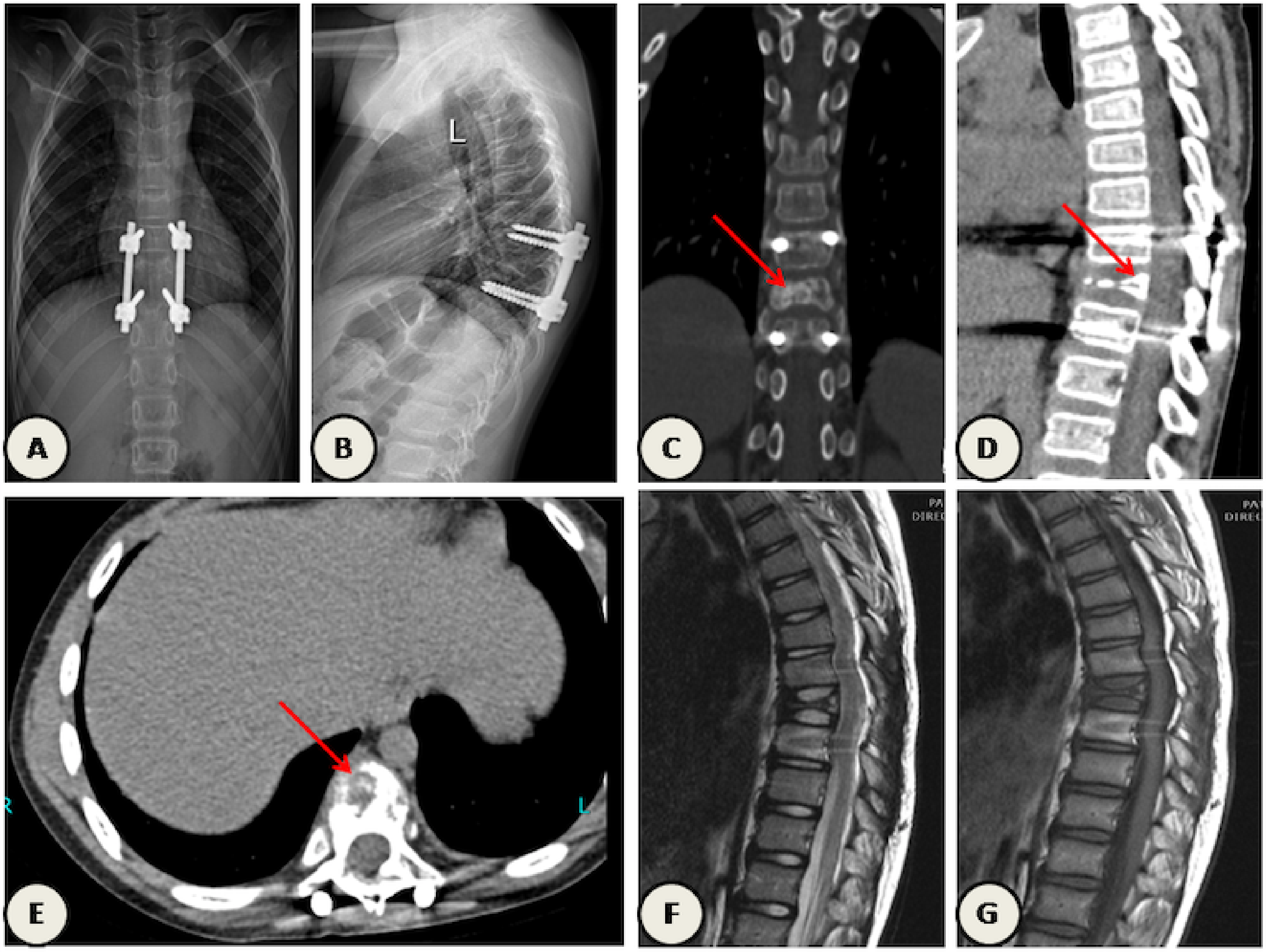

Figure 6

Immediate postoperative radiographs(A、B) ,computed tomography(C, D, E) and MRI(F, G) demonstrating transpedicular lateral debridement, bone graft, and posterior fixation. The red arrow indicate the allograft bone.

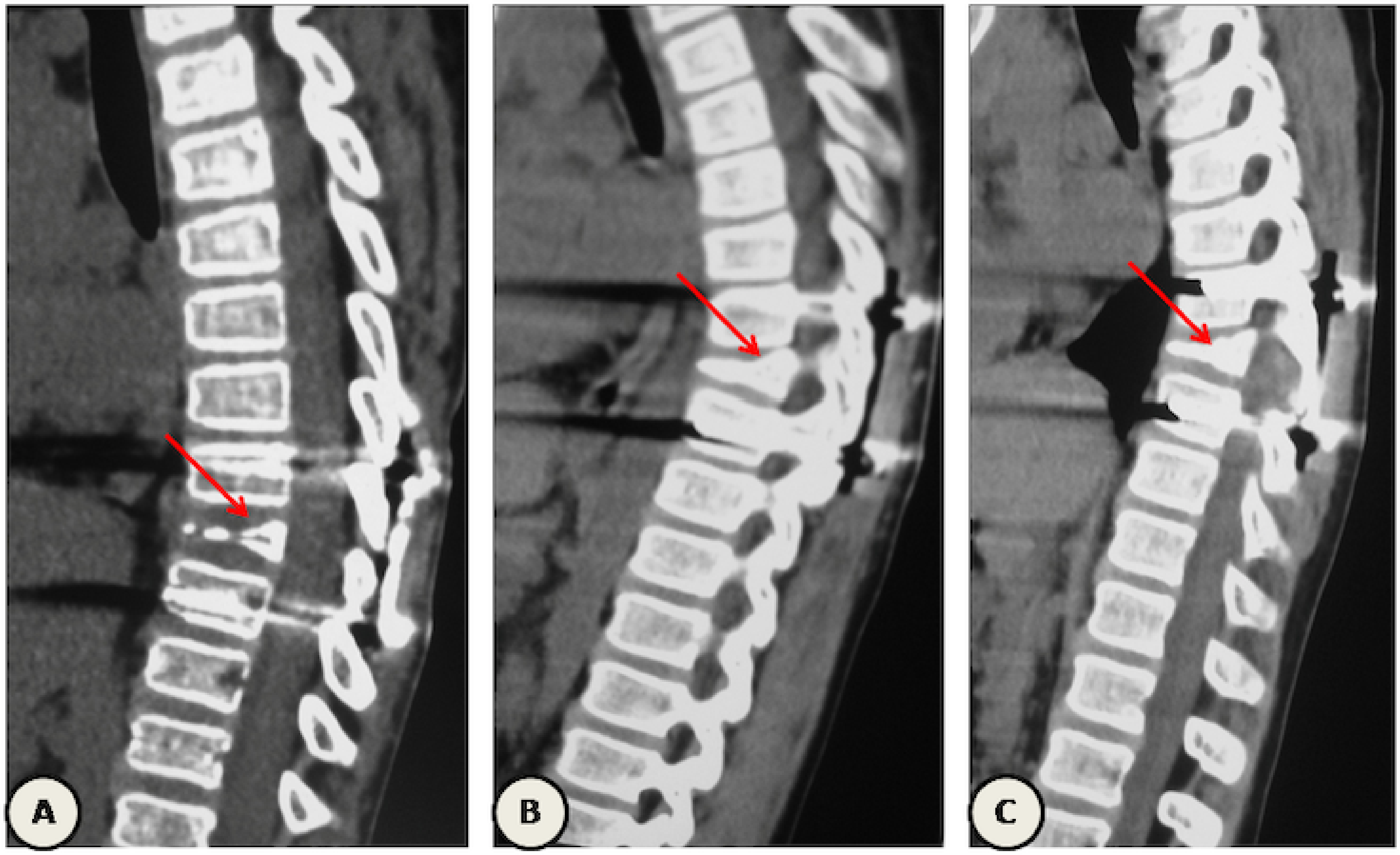

Figure 7

computed tomography taken at 3 months(A), 6 months(B), 12 months(C) of follow-up showed bone fusion and maintenance of the correction and good healing. As the meanwhile no tumor shows recurrence. Red arrow indicate the destructed bone is repairing.