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Giant-cell tumors of bone: an analysis of 87 cases

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Abstract We reviewed 87 patients with giant-cell tumor treated between 1992 and 2001. The mean follow-up was 62 (28–138) months. Fifty-six lesions were treated with intralesional curettage with adjunctive phenol treatment and reconstructed with autograft and allograft. Thirty-one lesions were treated with wide resection and reconstructed with prosthesis, osteochondral allograft, or alloprosthetic composite. Overall recurrence was 12%. Recurrence rate after curettage was 18% and 3% after wide excision. Complication rate after wide excision was higher than that after curettage. Functional outcome was evaluated using the Enneking scoring system. Average rating was 86% for the lower extremity and 83% for the upper extremity. The overall satisfactory rate was 88%.

Résumé Nous avons examiné 87 malades atteints de tumeur à cellules géantes, traitée entre 1992 et 2001. Le suivi moyen était de 62 mois (28–138). Cinquante-six lésions ont été traitées par curetage avec traitement adjuvant par du phénol et reconstruites avec autogreffe et allogreffe. Trente et une lésions ont été traitées par résection large et reconstruction avec prothèse, allogreffe ostéochondrale ou en composite « alloprothèse ». Le taux de récurrence global était de 12%. Le taux de récurrence après curetage était de 18% et de 3% après résection large. Le taux de complication après résection large était plus élevé qu'après curetage. Le résultat fonctionnel a été évalué avec

le score de Enneking. L'estimation moyenne était 86% pour le membre inférieur et 83% pour le membre supérieur. Le taux de satisfaction global était de 88%.

Introduction

Giant-cell tumor, one of the most common benign bone tumors, is well known for its locally aggressive behavior and tendency to recur [21, 22]. Although there are some progress in identification of histopathological factors and genomic expression to correlate the tumor's aggressiveness, it is still hard to predict its clinical behavior [2, 10].

The object in the treatment of giant-cell tumors is to eradicate the tumor tissue, reconstruct the bone defect, and restore a functional limb. The recurrence rate after intralesional curettage without adjuvant therapy is reported to be up to 50% [5, 9, 12–14]. Patients treated with en bloc excision or wide resection have lower recurrence rates but also poorer functional results [8, 17, 21, 24]. The aim of this study is to report our experience.

Materials and methods

Eighty-seven patients with giant-cell tumor of bone were treated from January 1992 to July 2001 at the authors' institution (Fig. 1). There were 46 men and 41 women. Mean age at diagnosis was 35 (18–71) years, and mean follow-up was 62 (28–138) months. Medical records, image studies, operation notes and pathological reports were reviewed.

All surgery was performed by experienced surgeons using contemporary technique. The operative procedures were chosen generally according to the extent of bony destruction, soft tissue involvement, anatomic sites, as well as the surgeons' preference. When long bones were affected, such as the distal femur, proximal tibia, and proximal femur, the first priority was to preserve the natural joint, since the majority of patients were young adults. In these cases, intralesional curettage followed by combined bone grafting was executed. We unroofed the lesion and evacuated the tumor with a hand-held curette. Lesion walls were then treated by high-speed burr followed by chemical debridement with phenol. The bone defect neighboring the subchondral bone was primarily filled with morcellized autograft and then allograft. When the cortical

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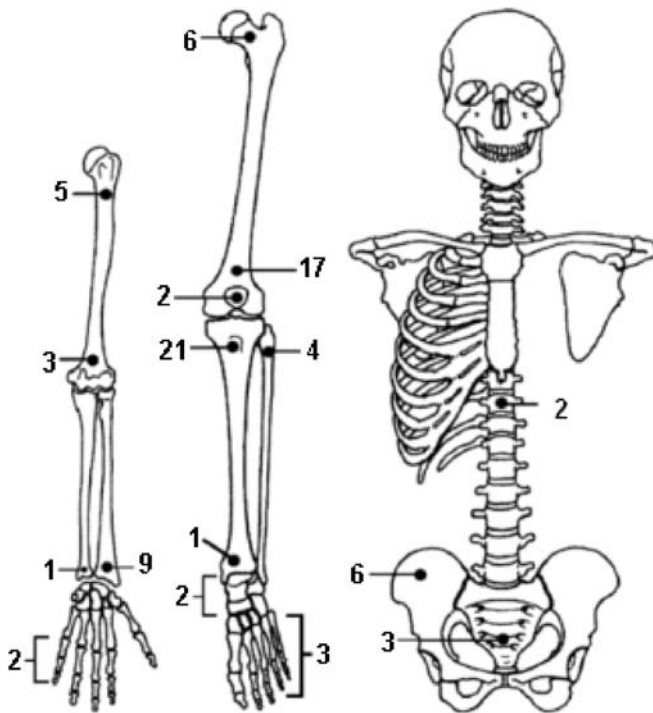


Fig. 1 Location distribution of the 87 giant-cell tumors

destruction was too extensive for morcellized bone grafting to establish a biomechanically sound construct, cement was used to fill the defect under the autograft with or without the use of an internal fixator.

In cases when the yielded joint areas were considered too large to be preserved, the authors performed en bloc or wide resection and then reconstructed them with osteoarticular allograft, tumor prosthesis, or alloprosthetic composite. For expendable lesions such as the proximal fibula, distal ulna, phalanx or metatarsals, en bloc resection was first considered unless the lesion was small and well contained. All the recurrent lesions were considered as primary cases and treated according to the same principles. Functional outcomes were evaluated using the system of Enneking et al. [7]. Factors related to tumor recurrence, such as pathologic fracture, referral for recurrence, Campanacci grading, and gender were analyzed by chi-square test.

Results

Using Campanacci's staging system [5], four cases were classified as grade I, 36 as grade II, 34 as grade III, and 13 were unknown. Of the 13 patients having a pathological fracture on the first visit, nine fractures were located in the lower extremity and four in the upper extremity. Fourteen patients were referred because of recurrence, and 73 patients were primary cases. Ninety-nine oncological procedures were performed for these 87 patients, including 63 curettages and 36 wide resections including one hemipelvectomy (Table 1).

There were 11 patients who had recurrence after our treatment. Overall recurrence rate was 12.6% (11/87), and average time to recurrence was 14.9 (3–40) months. The recurrence rate for primary cases was 9.6% (7/73) and 28.6% (4/14) for patients referred with recurrence. Patients treated with curettage had an average recurrence rate of

Table 1 Treatment modality and surgical complications

	Curettage (n=63)	Wide excision (n=36)
Void filler		
Autograft only	5	
Allograft only	3	
Combined bone graft	50	
Cement	4	
Reconstruction		
Osteochondral allograft		13
Prosthesis		7
Alloprosthetic composite		3
Fibular autograft		1
None		12
Complications		
Infection	1	4
Allograft fracture	0	1
Delayed union	0	2
Intercondylar fracture	1	0
Neurovascular injury	1	1
Others	1	1
Rate	6.2% (4/63)	25.0% (9/36)

17.9% (10/56) in comparison with 3.2% (1/31) for patients with wide resection as the initial treatment. The recurrence rate for patients treated for recurrence with another intralesional curettage was 46.1% (6/13).

Recurrent lesions were located in the proximal tibia and proximal humerus ($n=2$ each), and further in the distal femur, distal tibia, sacrum, thoracic spine, proximal femur, wrist ($n=1$ each), as well as one at the rectus femoris muscle 10 cm proximal to the primary lesion at the patella. Although the recurrence rate for patients referred for recurrence was much higher than that for primary cases, there was no statistical significance. Neither was there any statistical significance in the figures of the other factors, including pathologic fracture, Campanacci staging, and gender (Table 2).

Only one patient had pulmonary metastases, which were detected 6 months after the initial curettage. A CT scan revealed multiple nodules over both lungs not feasible for resection. The pulmonary condition is still stable after a follow-up of 18 months. There were numerous complications (Table 1). There were five cases of infection, including three total knee infections, one bipolar hip prosthesis infection, and one wound infection over the pelvis. An allograft fracture was seen in a 28-year-old man at 15 months after a wide resection and bulk osteochondral allograft for a left proximal humeral tumor. Excluding osteoarthritis, prosthesis loosening, and allograft resorption, complications directly related to surgery were 6.2% (4/63) after curettage and 25% (9/36) after wide excision. The average functional rating score was 86.7% (range, 53.3–100%) for the lower extremity and 83.3% (range, 60–93.3%) for the upper extremity. The overall satisfaction rate was 88%.

Table 2 Factors related to recurrence

		Recurrence	No recurrence	<i>P</i> value
Surgery	Curettage/adjuvant	10	46	0.039
	Wide excision	1	30	
Gender	Male	4	42	0.395
	Female	7	34	
Referral for recurrence	Fresh	7	66	0.072
	Referred	4	10	
Pathologic fracture	No	8	66	0.359
	Fractured	3	10	
Campanacci grading	I	1	3	0.715
	II	4	32	
	III	5	29	

Discussion

The demographics of the current study are similar to previous studies [5, 9, 13]. In our series, the most common site of predilection was also around the knee joint (43.7%), and most patients were in their third and fourth decade; men slightly outnumbered the women. Overall recurrence rate after our treatment modality was 12.6%, which was comparable to or even better than other series [13, 15, 16, 21, 23]. There are numerous factors correlated to recurrence rate. In the current study, tumor site, gender, Campanacci grading, and presence of pathologic fracture had no apparent correlation to recurrence, which coincides with other studies [1, 6, 13–15]. The only significant factor was the completeness of surgical removal of tumor. The recurrence rate after wide resection (3.2%) was much lower than after curettage (17.9%). Furthermore, in our series, the recurrence rate of primary cases (9.6%) was lower than the rate for cases referred with recurrence (28.6%), although it did not reach statistical significance ($p=0.072$). This may be due to the tumor's natural

aggressiveness, but difficulties to address the current tumor margin after bone grafting and the potential soft tissue contamination from previous surgery may also have influenced the results. This may also explain the much higher recurrence rate in our series for cases referred with recurrence and treated with repetitive curettage. Many authors favor repeated intralesional curettage for recurrent lesions, and others prefer more extensive surgery [4, 19, 22]. With our treatment modality, the recurrent lesion can be judged and treated as a primary one. Two thirds of the recurrent lesions (13/20) were treated with curettage and one third with resection. The former had a recurrence rate of 46.1% and the later none. However, we think that the choice of surgery should be based not only on considerations of recurrence rate but also on possible complications and on the ability to salvage the joint.

The complication rate after curettage was 6.2% (4/63), which was lower than the 25% (9/36) after resection. Most of the complications after resection were prosthesis infection, which may result from a wider exposure, longer operation time, difficult reconstruction, and the use of

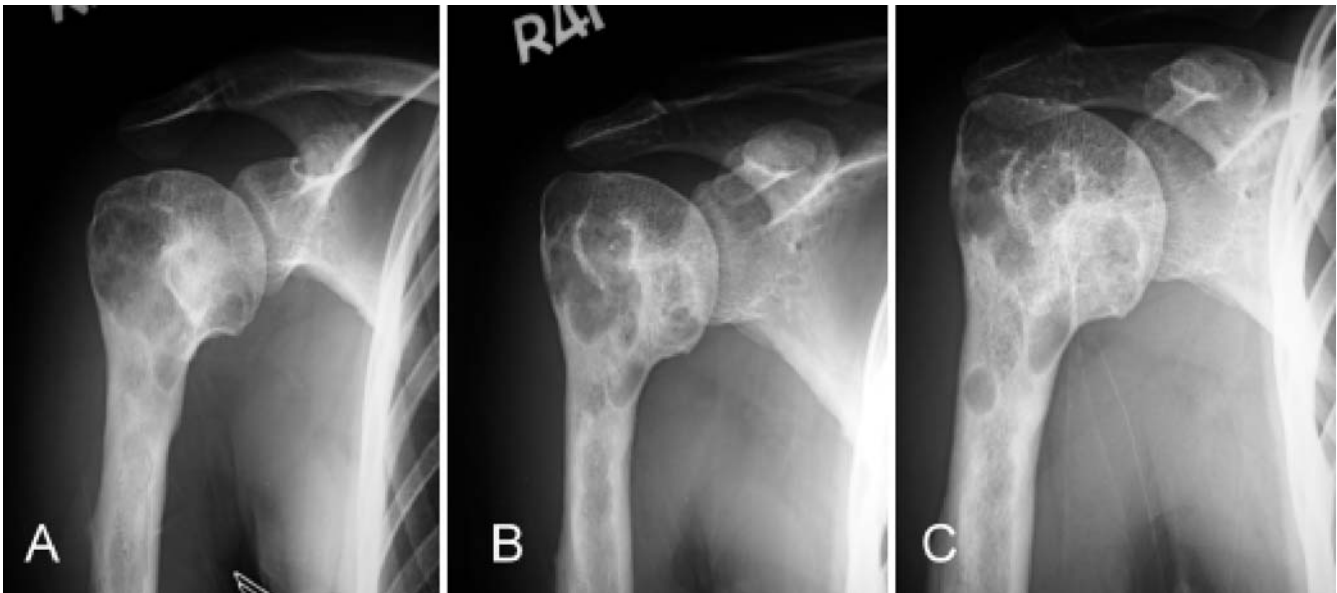


Fig. 2 a A giant-cell tumor over the right proximal humerus treated with curettage and bone graft. b Four months after surgery. Focal resorption of the allograft resulted in osteolytic lesions. c Twenty-six months after surgery. The osteolytic lesions showed no progression

allograft. However, it should be pointed out that seven out of the nine patients who had complications after a wide resection had received curettage at least once before the resection. Osteoarthritis was usually seen on the medial tibial plateau in which the subchondral plate had been widely invaded by the tumor and where treatment with curettage and bone grafting was used. It also developed in knees reconstructed with bulk osteochondral allografts after resection. It is not uncommon to find focal osteolytic lesions on the follow-up radiographs resulting from focal absorption of the bone graft but mimicking a recurrent lesion (Fig. 2). The way to differentiate between them is by conducting a regular follow-up.

The knee joint is a weight-bearing joint, and the integrity of the subchondral bone is critical to the salvageability of the natural joint. For the limited lesions, curettage and bone grafting provides the best functional result. However, we also experienced that extensive lesions initially treated with intralesional curettage had more complications and poorer results. The main reasons were tumor recurrence and joint surface collapse, which needed further salvage procedures. The functional outcomes were even worse than those of patients initially treated with wide resection and intensive reconstructions.

Giant-cell tumors over the proximal femur were usually misdiagnosed as fresh femoral neck fractures or avascular necrosis of the femoral head and thus treated with internal fixator or core decompression. The soft tissue contamination was widely spread and required wide resection. At the hip joint, it was difficult to completely remove tumor tissue by curettage without endangering the joint's mechanical strength. All but one patient in our series were treated with resection and endoprosthetic reconstruction, and all felt satisfied with the functional result.

The distal radius and proximal humerus are predilection sites for giant-cell tumors. Unlike the knee or hip joint, they tolerate a longer period of immobilization and repetitive intralesional curettage. Shoulders receiving resection and complex reconstruction, such as prosthesis or alloprosthetic composite, had problems with stiffness and weakness. Most lesions of the wrists in our series were aggressive, necessitating wide resection and bulk allografting. Functional results were not as good as those after conservative treatment, but most patients felt satisfied. Aithal [1] used nonvascularized fibular autograft for reconstruction after excision of the distal radius and found no graft-related complications. Others have advocated vascularized autograft to prevent graft absorption and nonunion [18]. In our series, the wrists after fibular allografting showed more or less radiographical fibulocarpal degeneration and fibuloulnar diastasis but no graft absorption or nonunion.

Radiotherapy has been used to improve local control when the completeness of removal was doubtful. However, malignant transformation or radiation-induced cancer has been reported in the past [4, 5]. Five lesions in our series received radiotherapy after surgery, including two over the pelvis, two over the thoracic spine, and one over the proximal femur. The most common dose regimens

were 48–62 Gy totally in duration of 4 weeks. There was one recurrence. With periods of follow-up ranging from 5 to 20 years, no related malignancy has been seen.

Although histologically benign, giant-cell tumors can occasionally metastasize to the lung. The rate of pulmonary metastases has been ranging from 2 to 9.2% [4, 5, 13]. Although some cases with spontaneous regression have been reported, most authors recommended surgical excision [3, 11, 16, 20]. The aim of treating giant-cell tumor is to avoid recurrence, preserve as much of the original joint as possible, avoid complications, and optimize functional outcome. Sometimes, these aims cannot all be achieved at the same time. With the rational algorithm and modern surgical technique, the majority of patients treated at our institution obtained good functional results.

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