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Comparison of outcomes of 2 surgical treatments for proximal humerus giant cell tumors: a multicenter retrospective study

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Background: The incidence of giant cell tumors in the proximal humerus is low. We evaluated 2 surgical treatments for giant cell tumors of the proximal humerus and postoperative upper-extremity function.

Methods: This study retrospectively analyzed the clinical data of 27 cases of giant cell tumors of the proximal humerus at 4 Chinese medical centers specializing in bone oncology collected between January 2002 and June 2015. All patients were followed up for more than 2 years. The surgical procedures performed for treatment included curettage in 14 patients and segmental resection in 13. The Campanacci grade, occurrence of pathologic fracture, surgical method, complications, and Musculoskeletal Tumor Society score were recorded for each cohort.

Results: The recurrence rate was 7.1% in the curettage group and 15.4% in the segmental resection group. Other postoperative complications occurred in 4 patients with segmental resection, including resorption of the osteoarticular allograft in 2, subluxation of the glenohumeral joint in 1, and prosthetic loosening and exposure in 1. A significant difference in postoperative upper-extremity function was noted between the 2 groups ($P < .001$).

Conclusions: Postoperative upper-extremity function in the curettage group was significantly better than that in the segmental resection group. Segmental resection and reconstruction with a large segmental osteoarticular allograft were considered unadvisable. We suggest that extensive curettage should be selected to treat proximal humerus giant cell tumors as much as possible.

The Ethical Committee of the 960th Hospital of the People's Liberation Army approved this study (ethical review of scientific research No. 27 [2018]).

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Giant cell tumor (GCT) is a primary invasive bone tumor, which is commonly observed in the long bone metaphysis of young adults. One of its distinguishing clinical features is formation of osteolytic lesions. GCTs of the proximal humerus have no symptoms during the early stage, but osteolytic lesions that have grown to a moderate or large size reduce the bone strength and cause pathologic fractures and pain, seriously affecting the quality of life of patients.

GCTs mainly occur around the knee joint, and the incidence of GCTs in the proximal humerus is low, accounting for about 4.1% to 8.3% of GCTs in all parts of the body.[22,25] It is important to note that GCTs are not sensitive to adjuvant therapy such as radiotherapy and chemotherapy. The use of denosumab is controversial and may increase the risk of local recurrence in patients with GCTs treated with curettage.[7] Surgery is the main treatment for GCTs, but local recurrence is common; the recurrence rate of intralesional surgery is 25%.[10,16] Distant metastases and malignant lesions may also occur after the first operation, but they are rare. The incidence of lung metastasis in patients with GCTs is about 1% to 9%.[26] It is generally believed that although curettage can retain the patient's joint, the postoperative recurrence rate is relatively high. To reduce the local recurrence rate, en bloc resection and reconstruction have been examined, but the postoperative limb function of the patient was diminished. In this case, there would be many problems such as the prosthesis service life and revision for young patients with long-term survival.[21]

Owing to the low incidence of GCTs of the proximal humerus and few relevant publications, the treatment principles and surgical efficacy for this disease are still unclear. In clinical practice, surgical treatment mostly refers to surgical procedures on lower-limb GCTs that have been studied widely. However, there is a significant difference between GCTs of the proximal humerus and GCTs of the lower limb, reflected mainly in terms of function. The main function of the shoulder joint is flexible movement, whereas the main function of the lower limb is weight bearing. Taking into account the complex mechanical environment of the proximal humerus and the different functions, the postoperative rehabilitation protocols have different requirements. Therefore, a multicenter retrospective study of GCTs of the proximal humerus has been conducted. This study describes the largest case series with an extensive treatment experience.

It is critical to recognize the specificity of GCTs of the proximal humerus, provide a more accurate reference for the selection of the optimal surgical treatment, and prevent complications. The main purpose of our study was to compare postoperative upper-extremity function after segmental resection and reconstruction with function after curettage.

Materials and methods

Inclusion and exclusion criteria

The patient inclusion criteria were (1) GCTs of the proximal humerus (which were pathologically confirmed and consistent before and after primary surgery), (2) patients who were initially treated and received their first surgical treatment at an included specialized bone oncology treatment center, and (3) a postoperative follow-up period of at least 24 months. The exclusion criteria were (1) primary or secondary malignant GCTs, (2) hospitalization for a local recurrence or complications after treatment in another hospital, (3) a follow-up period of less than 24 months, and (4) a postoperative pathologic diagnosis that was not a GCT.

Patient characteristics

Data on patients with proximal humerus GCTs with complete clinical information and long-term follow-up were collected from January 2002 to June 2015 at 4 specialized bone oncology treatment centers. We performed a retrospective comparative study. According to the aforementioned criteria, 27 patients were included in this study (Table I), including 15 men and 12 women. The patients had a mean age of 33.1 ± 12.2 years (range, 18-55 years) at diagnosis. We recorded the Campanacci grade[3] and the occurrence of pathologic fractures. Campanacci grading was divided as follows: grade II in 17 patients and grade III in 10. There were 17 cases of pathologic fractures, among which 14 had displacement and 3 had a fracture line and no displacement. Regarding the methods of diagnosis, 5 patients received an intraoperative rapid pathologic diagnosis and 20 patients received a diagnosis by preoperative biopsy, whereas 2 patients received a diagnosis by a combination of these methods. All patients provided written informed consent for this study.

Surgical treatments

The surgical methods in this study included curettage and segmental resection. According to the different surgical methods,

Table I General data and postoperative follow-up results of 27 patients

Case No.	Patient age, yr/sex	Fracture	Campanacci grade	Surgical treatment	Reconstruction method	Follow-up, mo	Complication	Further treatment	MSTS subscore						MSTS score
									Pain	Function	Emotional acceptance	Hand position	Manual dexterity	Lifting ability	
1	18/F	Y	II	IC	Allograft bone with IF	89	—	—	5	5	5	5	5	5	30
2	43/F	Y	II	IC	Allograft bone with IF	61	—	—	5	5	5	5	5	5	30
3	38/M	N	II	IC	Autograft bone	156	Recurrence	EPR	4	2	1	3	4	2	16
4	27/M	Y	III	EC	Autograft and allograft bone	112	—	—	5	5	4	4	4	4	26
5	20/M	Y	II	EC	PMMA with IF	104	—	—	5	4	5	5	5	4	28
6	20/M	N	II	EC	Autograft bone with IF	85	—	—	5	4	5	5	5	5	29
7	28/M	Y	II	EC	PMMA	68	—	—	4	4	2	4	4	4	22
8	27/F	Y	II	EC	PMMA with IF	65	—	—	5	4	5	4	4	4	26
9	22/F	N	III	EC	PMMA with IF	62	—	—	5	5	5	5	5	5	30
10	27/M	Y	II	EC	PMMA	59	—	—	4	5	4	5	4	4	26
11	46/F	N	II	EC	PMMA with IF	48	—	—	5	5	5	5	4	4	28
12	49/F	N	II	EC	PMMA with IF	45	—	—	3	4	2	4	4	4	21
13	21/M	Y	II	EC	PMMA with IF	38	—	—	4	4	5	4	4	4	25
14	36/F	Y	II	EC	PMMA with IF	36	—		5	5	5	5	4	5	29
15	22/M	Y	III	SR	OA with IF	97	Recurrence and allograft resorption	EPR	3	3	3	4	4	2	19
16	36/M	Y	III	SR	OA with IF	95	Allograft resorption	EPR	2	3	1	4	4	2	16
17	45/M	Y	II	SR	OA with IF	90	—	—	3	4	3	4	4	3	21
18	21/M	N	II	SR	EPR	180	—	—	3	3	2	4	4	2	18
19	20/M	N	II	SR	EPR	143	—	—	4	2	2	4	4	2	18
20	33/M	Y	III	SR	EPR	142	—	—	3	3	3	3	3	2	17
21	55/F	N	II	SR	EPR	138	—	—	2	3	1	4	4	2	16
22	45/M	N	III	SR	EPR	126	—	—	3	2	2	3	3	2	15
23	35/M	Y	II	SR	EPR	115	—	—	4	3	3	4	4	3	21
24	55/F	Y	III	SR	EPR	110	Subluxation	—	3	2	0	3	3	1	12
25	55/F	Y	III	SR	EPR	100	—	—	3	3	1	3	3	2	15
26	22/F	N	III	SR	EPR	36	Recurrence	Revision	3	3	0	3	3	2	14
27	27/F	Y	III	SR	EPR	96	Prosthetic exposure	Revision	3	2	0	3	3	1	12

MSTS, Musculoskeletal Tumor Society; *F*, female; *Y*, yes; *IC*, intralesional curettage; *IF*, internal fixation; *M*, male; *N*, no; *EPR*, endoprosthetic replacement; *EC*, extensive curettage; *PMMA*, polymethyl methacrylate; *SR*, segmental resection; *OA*, osteoarticular allograft.

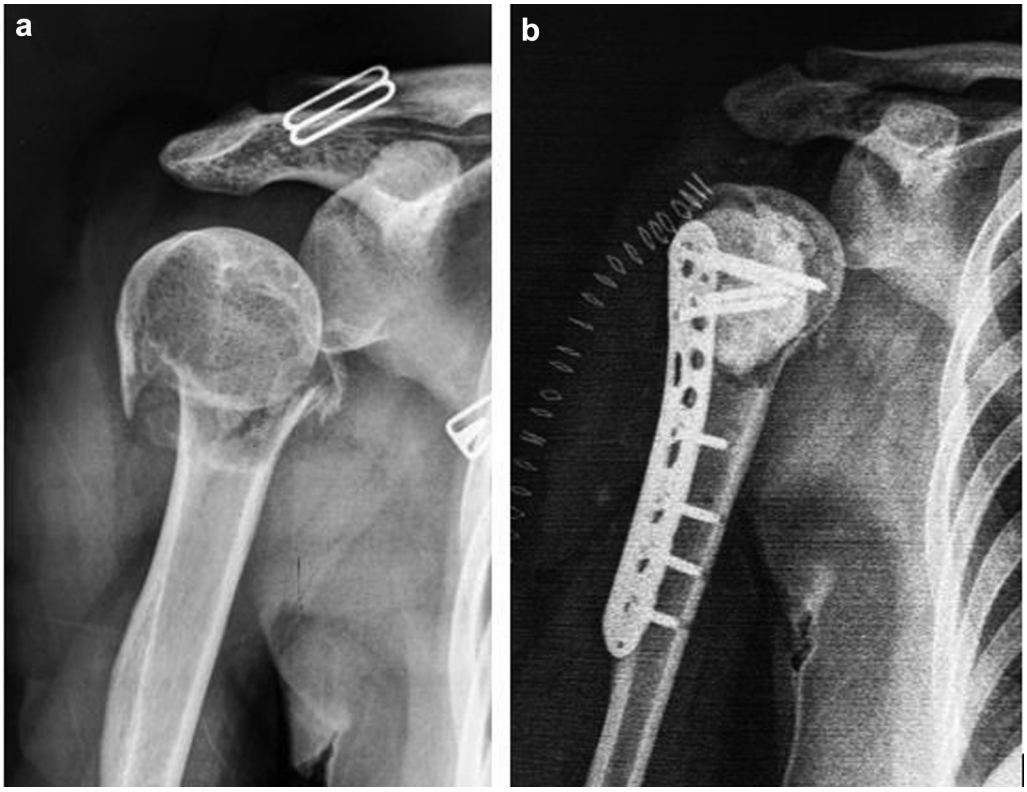

Figure 1 Right-sided Campanacci grade II proximal humerus giant cell tumor in a 36-year-old woman (case 14 in Table I). (**a**) A preoperative radiograph shows fracture displacement. (**b**) A postoperative radiograph shows that the bone cement and internal fixation are in good position.

27 patients with GCTs of the proximal humerus were divided into 2 groups: the curettage group and the segmental resection group.

Curettage (intralesional and extensive curettage)

According to the position of the lesion, we chose an approach addressing the front of the proximal shoulder and upper arm or an anterolateral approach. The surgical procedure was performed with the patient under general anesthesia. After conventional disinfection and draping of the surgical site, the skin, hypoderm, and deep fascia were incised via the planned approach. In the region of tumor invasion with thin cortical bone, we made an enlarged fenestration and gained adequate exposure and then curetted the macroscopic tissue of the tumor. After performing washing with normal saline solution, we used adjuvant therapy including physical auxiliary measures (eg, high-speed burring and electrocautery) and chemical auxiliary treatment (eg, hydrogen peroxide and alcohol) to further remove and clean the remaining tumor cells to achieve extensive curettage. Intralesional curettage was performed without adjuvant therapy. Different types of internal fixation devices were implanted according to the different intraoperative situations. Finally, the tissue was sutured layer by layer, and a drain was inserted as necessary. In the curettage group, 3 patients underwent intralesional curettage, accounting for 21.4% (3 of 14 patients), and 11 patients underwent extensive curettage, accounting for 78.6% (11 of 14 patients). After curettage, various bone defect treatments were performed. Bone autograft was used in 2 cases; autograft and allograft bone, 1 case; allograft bone, 2 cases; and bone cement filling, 9 cases (6 cases with pathologic fracture). In the curettage group, 10 cases were treated with a steel plate and screw fixation (Figs. 1 and 2).

Tumor segmental resection

An extensile approach based on the standard deltopectoral approach was performed. We made a wide excision with a 2- to 3-cm safety margin confirmed by preoperative magnetic resonance imaging. The reconstruction methods included tumor-type endoprosthetic reconstruction and a large segmental osteoarticular allograft. This study comprised 10 cases of endoprosthetic reconstruction in the tumor segmental resection group, accounting for 76.9% (10 of 13 patients), and 3 cases of large segmental osteoarticular allograft with intramedullary nail fixation, accounting for 23.1% (3 of 13 patients).

Methods of follow-up and efficacy evaluation

Outpatient follow-up was performed every 3 months for the first year after surgery, every 6 months in the second year, and every year thereafter, mainly including physical examination and imaging examination. Some patients with poor compliance were followed up by WeChat (Tencent Holdings, Shenzhen, China), being asked whether they had surgical-site abnormalities, underwent continued treatment, or had a change in limb function. Postoperative radiographic evaluations were completed and were mainly used to observe whether bone destruction, resorption, looseness, and/or fracture of internal fixation occurred in the curettage group. In the case of osteolytic lesions, computed

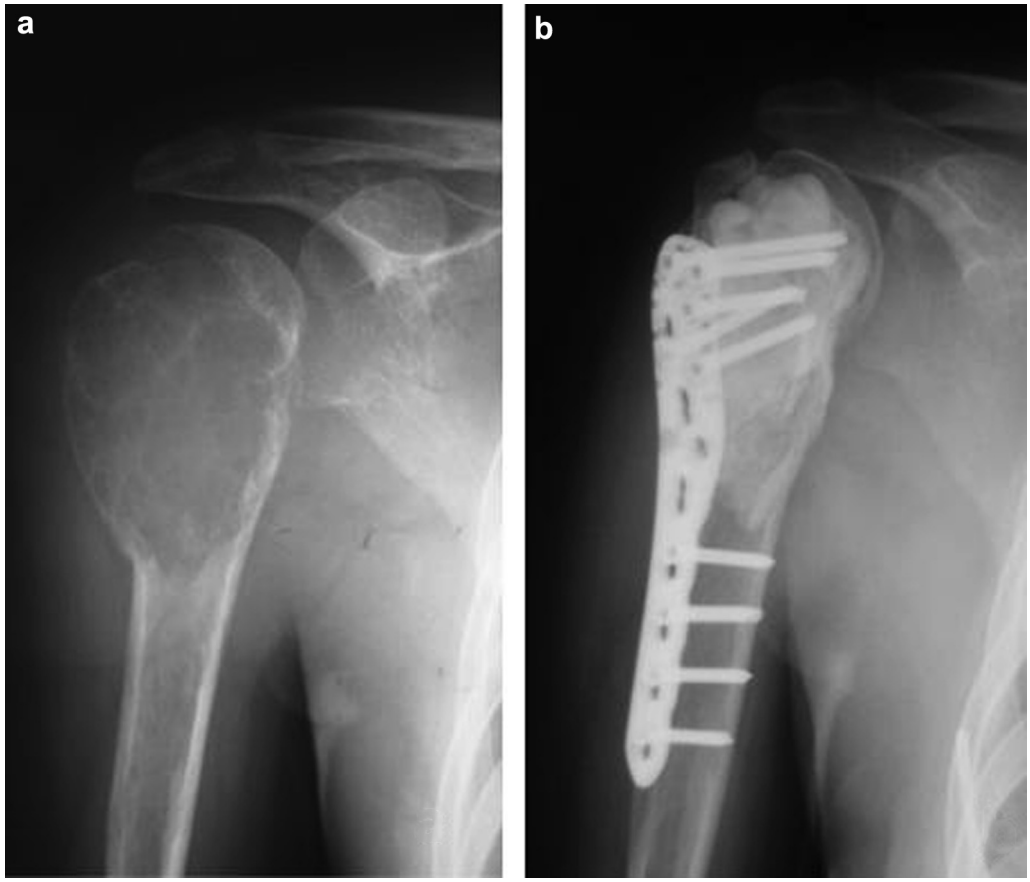

Figure 2 Right-sided Campanacci grade III proximal humerus giant cell tumor in a 22-year-old woman (case 9 in Table I). (**a**) A preoperative radiograph shows no fracture displacement. (**b**) A postoperative radiograph shows that the bone cement and internal fixation are in good position.

tomography and magnetic resonance examinations, as well as dynamic observation, are required. For patients undergoing segmental resection and reconstruction, the main purpose of postoperative radiographic examination was to observe whether the prosthesis was loosened or broken, whether the large allograft bone had been absorbed, and whether a soft-tissue mass was present. The soft-tissue mass did not follow the contour of the bone.[3] The Musculoskeletal Tumor Society (MSTS) score[5] was used at final follow-up to assess upper-limb function.

Statistical analysis

Data were analyzed using SPSS software (version 22.0; IBM, Armonk, NY, USA). The recurrence rate between the 2 groups and the factors influencing surgical methods and recurrence were assessed using the Fisher exact test. To compare MSTS scores between the 2 groups, *t* tests were used. Kaplan-Meier survival analysis was used for each surgical treatment.

Results

As of June 2018, of the 36 patients with GCTs of the proximal humerus with initial surgery, 27 were followed up, 2 were lost to follow-up, and 7 did not meet the inclusion criteria. The follow-up time ranged from 36 to 180 months, with a median time of 95 months; the mean follow-up time was 92.4 ± 38.9 months. No cases of metastasis or death occurred (Table I).

Postoperative complications

Of the 27 cases, 3 (cases 3, 15, and 26) had a recurrence at 2 years, 8 years, and 1 year after surgery. The total recurrence rate was 11.1% (3 of 27 patients). There was 1 local recurrence in the curettage group and 2 in the segmental resection group, and the recurrence rates within the groups were 7.1% (1 of 14 patients) and 15.4% (2 of 13 patients), respectively. The average time to recurrence was 2 years in the curettage group and 4.5 years in the segmental resection group. Two patients who underwent segmental resection and reconstruction with large segmental osteoarticular allograft bone and intramedullary nail fixation had resorption of the allograft 8 years and 2 years after the operations. Subluxation of the glenohumeral joint was noted in 1 patient. Prosthetic loosening and exposure appeared at 5 years postoperatively in 1 patient;

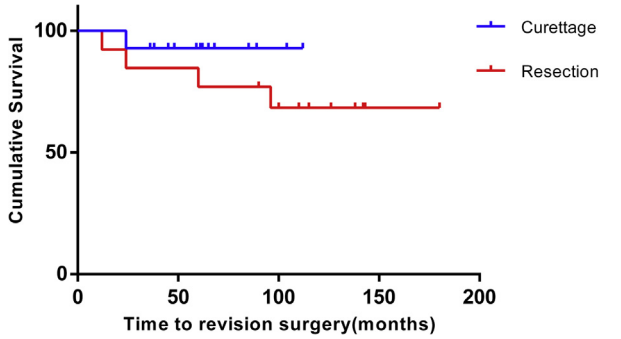

Figure 3 Kaplan-Meier survival analysis for the 2 groups with revision surgery as the endpoint.

this was followed by revision with reconstruction using a bone cement prosthesis. The 10-year relapse-free survival rates of the curettage group and segmental resection group were 92.9% and 69.2%, respectively. According to the log-rank test, no statistically significant difference was found between the 2 groups ($P = .257$, Fig. 3). Kaplan-Meier survival analysis of the 2 groups was performed with revision surgery as the endpoint. The average time to failure was 4 years in the segmental resection group.

Factors influencing choice of surgical treatment

Among the patients without pathologic fractures and those with Campanacci grade II, 50% and 70%, respectively, adopted curettage. Among the patients with pathologic fractures and those with Campanacci grade III, 47.1% and 80.0%, respectively, underwent segmental resection (Table II). Through statistical analysis, we found no significant difference between the 2 surgical treatments on the factor of pathologic fracture ($P > .05$, Table II). However, the Campanacci grade showed a statistically significant difference regarding the choice of surgical treatment for GCTs of the proximal humerus ($P = .02$, Table II).

Factors affecting postoperative function

The average MSTS score was 21.5 ± 6.0, and the rate of good to excellent findings was 59.3% (16 of 27 patients). In the curettage group, the average MSTS score was 26.1 ± 4.1 and the rate of good to excellent findings was 92.9% (13 of 14 patients). The mean MSTS score in the segmental resection group was 16.5 ± 2.9, with a rate of good to excellent findings of 23.1% (3 of 13 patients). Pathologic fracture, Campanacci grade, surgical method, and postoperative function (MSTS score) were included in the statistical analysis. Our results showed that patients with Campanacci grade II or with curettage achieved higher postoperative MSTS scores than patients with Campanacci grade III or with segmental resection. The postoperative function of patients undergoing segmental resection was relatively poor (Table III). Assessment of the MSTS score in patients with vs. without pathologic fractures showed no statistical significance ($P = .53$). However, the Campanacci grade showed a statistically significant correlation with postoperative function ($P = .01$, Table III).

Table II Analysis of related factors affecting surgical treatment of proximal humerus giant cell tumors

Related factor	Surgical treatment with curettage, n (%)	Surgical treatment with tumor section resection, n (%)	*P* value
Pathologic fracture			
No	5 (50.0)	5 (50.0)	
Yes	9 (52.9)	8 (47.1)	>.99
Campanacci grade			
II	12 (70.6)	5 (29.4)	
III	2 (20.0)	8 (80.0)	.02

Discussion

Most studies of GCTs of the proximal humerus have focused on other body parts such as the distal femur, proximal tibia, and distal radius, but several case reports on GCTs of the proximal humerus have been published. Lackman et al[12] reported on 6 cases undergoing treatment for Campanacci grade III proximal humerus GCTs via curettage. In addition, Leung et al[13] reported on 1 case of a GCT of the humeral head with curettage treatment, and Emori et al[4] reported on 1 case of a proximal humerus GCT treated by curettage combined with preoperative selective arterial embolization. There is a gap in the literature regarding comparative studies of the postoperative function

Table III Analysis of risk factors affecting recurrence and postoperative shoulder function

Risk factor	Postoperative shoulder function: MSTS score, mean ± SD	*P* value
Pathologic fracture		
Yes	20.5 ± 6.2	.53
No	22.1 ± 6.1	
Campanacci grade		
II	23.8 ± 5.0	.01
III	17.6 ± 5.9	
Surgical treatment		
Curettage	26.1 ± 4.1	<.001
Resection	16.5 ± 2.9	

MSTS, Musculoskeletal Tumor Society; *SD*, standard deviation.

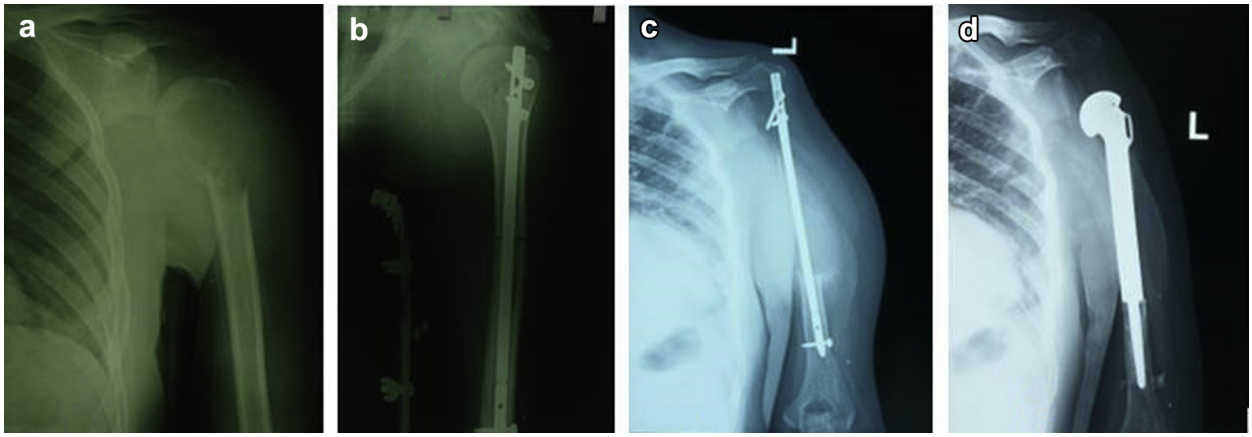

Figure 4 Left-sided Campanacci grade III proximal humerus giant cell tumor in a 22-year-old man (case 15 in Table I). (**a, b**) Preoperative and postoperative radiographs are shown; the reconstruction used a large segmental osteoarticular allograft and intramedullary nail fixation. (**c**) A postoperative radiograph shows the recurrence with resorption of the osteoarticular allograft. (**d**) A postoperative radiograph shows the endoprosthesis used for revision. *L*, left.

of different surgical treatments for proximal humerus GCTs. As such, no multicenter retrospective study has been performed to provide clinical guidance on this disease. Our study, as a multicenter retrospective study, investigated the surgical efficacy of proximal humerus GCTs from multiple perspectives including recurrence, complications, and shoulder function.

In this study, there were 17 cases with pathologic fractures, accounting for 63% of the total cases. Because of the special anatomy of the proximal humerus and its biomechanics, such as contact with more torsional force, it is prone to pathologic fracture after being invaded by GCTs. The existing literature has made it clear that intralesional curettage with different means of adjuvant therapy presents different recurrence rates. Early reports indicated that the postoperative tumor recurrence rates with intralesional curettage are very high.[9,27] Although intralesional curettage can maximally retain the host bone, this procedure cannot completely eliminate tumor cells, which have a risk of recurrence. The recurrence rate has declined after curettage with different means of adjuvant therapy. Among 359 cases of GCTs reported by Niu et al,[17] the recurrence rate after intralesional curettage was 56.1%. However, after they adopted intralesional curettage combined with high-speed burring and adjuvant treatment of the tumor cavity, this rate was reduced to 8.6%. Balke et al[1] reported that the recurrence rate following treatment of the tumor cavity with high-speed burring after curettage and filling the tumor cavity with polymethyl methacrylate (PMMA) was 12%. Data from other authors showed that the recurrence rate for treatment of the tumor cavity with high-speed burring and phenol cauterization was 12.5% after curettage and filling the tumor cavity with PMMA.[6,18]

An inadequate surgical margin may be a risk factor for local recurrence. Recurrences seem to reflect inadequate removal of tumors. In this study, an early case in the

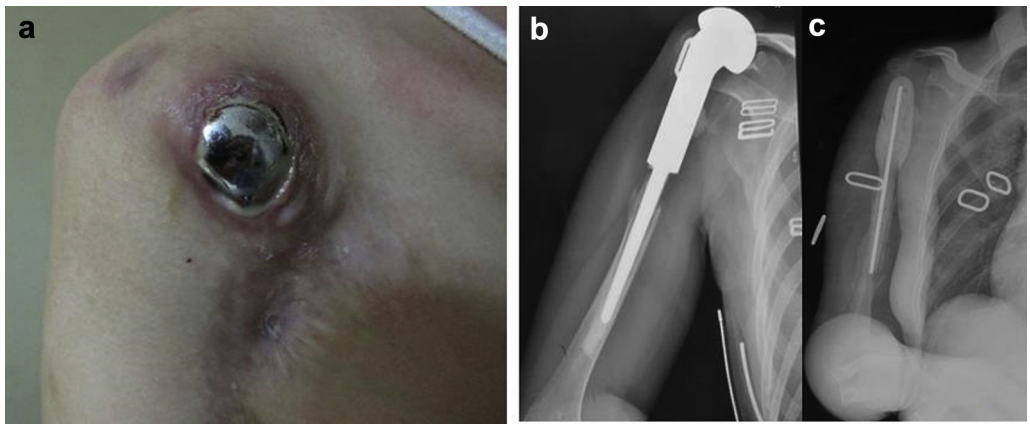

Figure 5 Right-sided Campanacci grade III proximal humerus giant cell tumor in a 27-year-old woman (case 27 in Table I). (**a**) The prosthesis was exposed 5 years after surgery involving endoprosthetic replacement. (**b**) A postoperative radiograph shows the loosened endoprosthesis. (**c**) A postoperative radiograph shows the revision with reconstruction using a bone cement prosthesis.

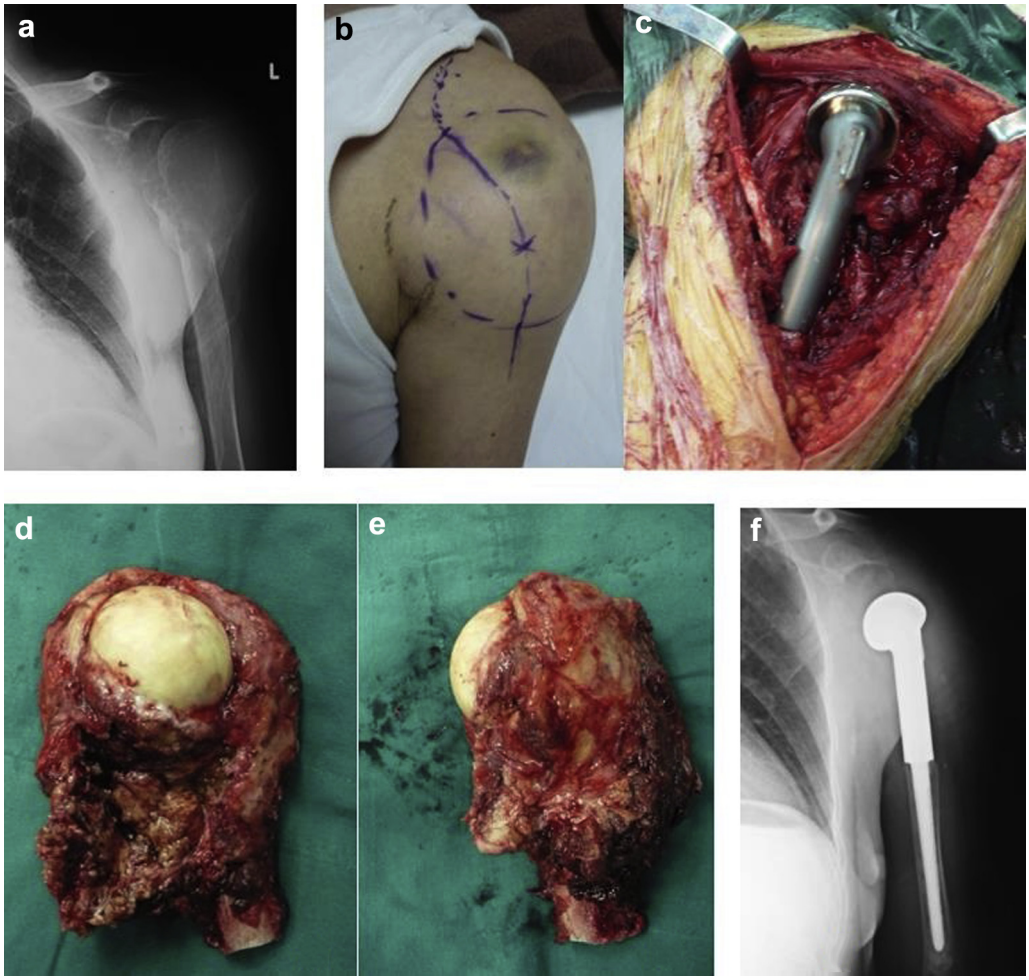

Figure 6 Left-sided Campanacci grade III proximal humerus giant cell tumor in a 55-year-old woman (case 24 in Table I). (**a**) A preoperative radiograph shows fracture displacement. (**b, c**) Surgical approach and intraoperative endoprosthesis. (**d, e**) Resected tumor segment. (**f**) A postoperative radiograph shows subluxation of the glenohumeral joint. *L*, left.

curettage group had a recurrence only 2 years after intralesional curettage, which was related to incomplete curettage (case 3 in Table I). No recurrences were found among the 11 cases treated with extensive curettage. We believe that proximal humerus GCTs of non–weight-bearing joints are special. We can treat the tumor cavity with extensive curettage and fill the cavity with bone cement to inactive the residual tumor tissue to reduce the recurrence rate. The literature has reported that the postoperative local recurrence rate for tumor segmental resection is between 0% and 12%.[24] In our study, the recurrence rate in the segmental resection group was 15.4% (2 of 13 patients), which is higher than that reported in the literature. Similarly, we observed 1 case of soft-tissue recurrence (case 26 in Table I), as well as 1 case of resorption of the osteoarticular allograft (case 15 in Table I, Fig. 4). There has been much research on the association between influencing factors and the recurrence of GCTs, including the surgical method, pathologic fracture (with or without displacement), Campanacci grade, soft-tissue mass, and anatomic site, but the findings have been inconsistent. We suggest that the use of PMMA may provide a solution for the firm fixation of GCTs with pathologic fractures.

In the tumor segmental resection group, 2 patients who underwent segmental resection and reconstruction with a large segmental osteoarticular allograft and intramedullary nail fixation appeared to have resorption of the allograft, accounting for 66.7% of the intramedullary nail fixation cases. These cases subsequently underwent endoprosthetic replacement. A major long-term complication with a high incidence was resorption of the osteoarticular allograft. Getty and Peabody[8] reported a resorption rate of 81% and found that 13 of the 16 patients who underwent resection and reconstruction of the proximal humerus with a mean follow-up period of 48 months had medium to severe resorption of the osteoarticular graft. The complications after osteoarticular allograft mainly include infection, nonunion, pathologic fracture, and resorption.[15,19] Owing to a lack of weight bearing, the rate of complications related to prosthesis loosening and periprosthetic fracture

after proximal humerus tumor resection was also lower than that for the proximal tibia and proximal femur.

In this study, 1 case of postoperative prosthetic loosening and exposure through the skin was observed; this may have been caused by excessive resection of normal soft tissue and lack of sufficient soft-tissue coverage[14] and was followed by revision surgery (case 27 in Table I, Fig. 5). Subluxation of the glenohumeral joint may easily occur after endoprosthetic replacement especially as the tumors invade the soft tissue. The instability of the shoulder joint is caused by the excessive resection of normal soft tissue.[23] In this study, subluxation developed after surgery in 1 case (case 24 in Table I, Fig. 6). Kumar et al[11] reported that the long-term results of endoprosthetic replacement of the proximal humerus showed a prosthesis survival rate of 86.5% at 20 years. Another study reported that the endoprosthetic survival rate was 69% at 10 years,[10] which is similar to our findings for the segmental resection group.

The main purpose of shoulder joint reconstruction is to retain the normal patient appearance and hand function, as well as to keep the shoulder joint as flexible as possible. Curettage yields good postoperative function because of less damage to the rotator cuff and surrounding soft tissue. Among the 6 patients with Campanacci grade III proximal humerus GCTs treated by Lackman et al[12] using curettage, the average postoperative MSTS score was 26. However, after proximal humeral resection, the attachment point of the rotator cuff is lost and the reconstruction effect of the rotator cuff is poor. Therefore, it is difficult to obtain satisfactory shoulder joint function after segmental resection and reconstruction, especially with severe abduction loss. Camnasio et al[2] used prosthesis replacement to treat 154 patients with metastatic tumors, and the rate of good to excellent findings after surgery was only 30.6%. Teunis et al[20] reported that the MSTS score ranged from 50% to 78% in the osteoarticular graft group and ranged from 61% to 77% in the prosthesis group. In this study, the average MSTS score was 53% in the osteoarticular graft group and 62% in the prosthesis group, which corresponded with the literature. Treatment for GCTs, including curettage, osteoarticular allograft, and endoprosthetic replacement, has continually improved with time. The basic and classic treatment for GCTs is curettage. In this study, the MSTS score of patients who underwent curettage was 26.1 ± 4.1, significantly higher than that of patients who underwent tumor segmental resection (16.5 ± 2.9). This finding indicates that shoulder joint function after curettage was superior to that after segmental resection.

Our study has some limitations that should be noted. First, although this was a retrospective study of 4 specialized treatment centers, the sample size and the numbers of recurrent cases and complications were relatively small, which may bias our statistical results. Second, it was unavoidable that all operations were not performed by the same chief surgeon at a single institution. Finally, this study did not explore clinical outcomes using other reconstruction methods such as allograft prosthetic composites that were seldom used at the 4 included treatment centers.

Conclusion

A GCT of the proximal humerus remains a rare clinical challenge. It is a relatively uncommon tumor that is mostly accompanied by a pathologic fracture. Surgery is still the main treatment, and the choice of surgical method for proximal humerus GCTs is mainly a trade-off between joint function and postoperative complications. We found that more complications occurred in the segmental resection group. The postoperative shoulder joint function of patients after segmental resection was much poorer than that in the curettage group. On the basis of our findings, the method using segmental resection and reconstruction with a large segmental osteoarticular allograft is considered unadvisable. We suggest that extensive curettage should be used in the treatment of proximal humerus GCTs as much as possible.

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