Curettage and allograft reconstruction for giant cell tumours

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ABSTRACT

Purpose. To evaluate treatment outcomes in patients with giant cell tumours after curettage and allograft reconstruction and to identify the risk factors for poor oncological and functional outcome.

Methods. 29 patients with giant cell tumours of bone who underwent curettage and allograft reconstruction were retrospectively reviewed. The adjuvants used were heat treatment by electrocautery and hot water. Types of allograft used, time to bone union, complications, functional outcomes, and risk factors for poor function were analysed.

Results. The mean time to bone union was 2.8 (range, 1–5) months. In 7 patients the tumours recurred (6 within 2 years); the 5-year recurrence-free survival rate was 77%. Three recurrences were classified as grade III and 4 as grade II; recurrence and the Campanacci grade showed a trend towards association (p=0.06). Tumour in the distal femur was a risk factor for postoperative fracture (p=0.02). Functional outcomes were excellent in 20 patients, good in 6, fair in 2, and a failure in one. The risk factors for poor function were recurrence (p=0.002) and joint instability (p=0.008) but not the Campanacci grade (p=0.10) or postoperative fracture (p=0.76). Lung metastasis, infection, and non-union were not encountered.

Conclusion. Despite a relatively high recurrence rate (24%), 26 (90%) of the 29 patients had excellent/good functional outcomes. We recommend the use of adjuvants and allografts for the management of giant cell tumours.

Key words: giant cell tumor of bone; reconstructive surgical procedures; transplantation, homologous

INTRODUCTION

Giant cell tumours (GCTs) are locally aggressive and prone to recur.1,2 The choice of treatment and reconstruction remains controversial. Wide resection with prosthesis reconstruction provides advantages in terms of local control. The risk of recurrence is high after curettage alone,3,4 and therefore adjuvants such as cryosurgery, cement, phenol or a combination of these are recommended.5–10 Various reconstructions using cement, autograft, allograft,11–14 and hydroxyapatite...
have been proposed. However, recent studies suggest that reconstruction and adjuvants are not needed after careful, intensive curettage for intra-osseous GCTs because of low recurrence rates and fine bone formation in the cavity.\(^{15}\)

In our hospital, the most popular reconstruction material selected for GCT patients was allograft. Its benefits include reduction in operating time, unlimited supply, and no donor-site morbidity. However, the risk of contamination by viral diseases and rejection should be considered. Besides, allografts have no adjuvant cementing effect.

We aimed to evaluate treatment outcomes in patients with GCTs, after curettage and allograft reconstruction and to identify the risk factors for poor oncological and functional outcomes.

**MATERIALS AND METHODS**

Of 50 patients with GCTs of bone treated in our hospital over the past decade, 29 who underwent curettage and allograft reconstruction with at least 2 years of follow-up (mean, 4.3 years; range, 2–10 years) were retrospectively reviewed (Table 1). Curettage was performed through a large cortical window. The cavity was then burred, washed, and brushed to remove all visible tumour tissue. Heat treatment included electrocautery and filling the cavity with hot water (60ºC) for 5 minutes. The donor bone was sterile and preserved in a deep freezer at -80ºC for at least 3 months. It was then thawed in hot water at 60ºC for 10 hours.

The types of allograft used, times to bone union, complications, functional outcomes, and risk factors for poor function were analysed. Oncological complications included recurrence and distant metastasis. Surgery-related complications included fracture, non-union, joint instability, and infection. Bone union was defined as integration of the allograft with surrounding host bone with disappearance of the demarcation border (Fig. 1). Tumours were evaluated based on the Campanacci grading system.\(^{4}\)

![Figure 1](image_url) Radiographs of a patient with giant cell tumour in the proximal tibia: (a) preoperation, (b) after curettage and allograft reconstruction showing sharp graft margins, and (c) 11 weeks later showing disappearance of the sharp line.
Functional outcome was evaluated based on Mankin’s method.\textsuperscript{14}

Kaplan-Meier survival analysis, log-rank tests, Spearman’s rank correlation coefficients, Chi squared tests, and Mann-Whitney \textit{U} tests were used. Differences were considered significant when a \textit{p} value was <0.05.

\section*{RESULTS}

The mean time to bone union was 2.8 (range, 1–5) months. In 7 patients the tumours recurred (6 within 2 years); the 5-year recurrence-free survival rate was 77\% (Fig. 2). Two recurrences were in the distal femur, 2 in the proximal tibia, one each in the proximal humerus, sacrum, distal radius, and ilium. In one patient the recurrence in the proximal humerus was resolved with wide resection and prosthetic reconstruction. All others underwent repeat curettage and allograft reconstruction. Three recurrences were classified as grade III, and 4 as grade II; recurrence and the Campanacci grade revealed a trend towards association (\textit{p}=0.06, Log-rank test, Fig. 3).

Tumour in the distal femur was a risk factor for postoperative fracture (\textit{p}=0.02, Chi squared test), because all 3 postoperative fractures (one fixed internally, and 2 conservatively) occurred in the distal femur. Salvage surgery for the unstable joint was not performed as the patient refused.

Functional outcomes were excellent in 20 patients (including the 2 with postoperative fracture treated conservatively), good in 6, and fair in 2 with joint instability (after repeat surgery). In one who underwent wide resection and prosthetic reconstruction for recurrence, it was a failure (Table 2). The risk factors for poor function were recurrence (\textit{p}=0.0005, Mann-Whitney \textit{U} test) and joint instability (\textit{p}=0.008, Mann-Whitney \textit{U} test) but not according to the Campanacci grade (\textit{p}=0.10, Spearman’s rank correlation coefficient) or presence of postoperative fracture (\textit{p}=0.76, Mann-Whitney \textit{U} test). Lung metastasis, infection, and non-union were not encountered.

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Function (No. of patients)</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
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<tr>
<td>Campanacci grade (\textit{p}=0.10)</td>
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<tr>
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<tr>
<td>II</td>
<td>12</td>
<td>4</td>
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<tr>
<td>III</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Recurrence (\textit{p}=0.0005)</td>
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<td></td>
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<td></td>
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<tr>
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<td>2</td>
<td>4</td>
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<td>2</td>
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<td>Fracture (\textit{p}=0.76)</td>
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<tr>
<td>No</td>
<td>18</td>
<td>6</td>
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<td>Joint instability (\textit{p}=0.008)</td>
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<tr>
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DISCUSSION

Tumour- and intervention-related variables determine the choice of treatment. Tumour-related variables such as tumour size, tumour site, biologic activity, bony cortex destruction (i.e. Campanacci grading), and pathologic fracture are uncontrollable. Whether interventions such as the use of adjuvants or reconstruction options can improve treatment outcome remains controversial.

Adjuvants reduce the risk of recurrence. Patients with curettage alone have higher recurrence rates than those with combined adjuvant treatment (45% vs 18%). In patients treated with curettage without adjuvants, the recurrence rate varies from 33 to 47%. The rate decreases to 5% to 8% when cement is used, and to 2.3% after cryosurgery. Yet in recent studies, recurrence rates of 12% and 0% have been reported in patients with curettage alone. A multicentre study by a Canadian Sarcoma Group has reported an overall recurrence rate of 17% and claimed that the filling material or type of adjuvant has no significant impact on recurrence. It has been suggested that adjuvant is not needed for intraosseous GCTs, as the recurrence rates of Campanacci grade-I/II and grade-III GCTs were only 7% and 29%, respectively.

Such variation in recurrence rates is attributed to: (1) development of cross-sectioned computed tomographic scanning and magnetic resonance imaging enabling accurate preoperative assessment of the lesion, (2) concerns over recurrence leading surgeons to undertake more aggressive curettage, (3) variations in the grade and site of tumour among different series, and (4) differences in surgical protocol between hospitals and/or surgeons.

Our choice of treatment for recurrence is repeat curettage, with a goal to preserve the joint and function, although en bloc resection offers better local control. Failure to salvage the joint is due to incomplete initial surgery, delay in diagnosis of the recurrence (>6 months), and subcondral recurrence. The success rate of repeat curettage is 79 to 100%. Our primary goal of treatment is to enhance the quality of life of patients rather than reduce the recurrence.

The difference in functional outcomes after 2 or more surgical procedures has been reported. In patients treated with cryosurgery, overall function was good to excellent in 92%, moderate in 7%, and poor in 1%, based on the American Musculoskeletal Tumor Society (MSTS) system. In patients treated with allografts, it was excellent/good in 78% and fair/poor in 22%, based on a categorical scoring system. Nonetheless, these single-arm studies lack controls. The Enneking functional scores were similar in patients treated with curettage or resection. Based on the MSTS system, the only risk factor for poor function was displaced fracture; there was no significant difference between patients treated with cement or other types of filler. Pathologic fractures affect the score for bodily pain in the Short Form-36 health survey. The functional outcomes using the MSTS system, the Short Form-36, and the Toronto Extremity Salvage Score were similar in the cement and curettage groups. Although these studies were not randomised control trials, they suggested that surgical procedures do not correlate with the functional outcomes/quality of life.

Other risk factors for poor function include infection, fracture, recurrence, specific tumour sites, joint instability, and metastases. In our study, recurrence and joint instability were significant risk factors, suggesting that prevention of recurrence may improve function. Nonetheless, the latest functional evaluation may not be affected by recurrence, owing to the salvage effect. Removal of the graft was considered a failure despite acceptable function after salvage operations. In our study, although joint instability after repeat curettage correlated with poor function, it was because patients refused salvage operations; had proper surgical intervention been performed, functional outcomes of the 2 patients may have been improved. Moreover, co-existence of joint instability and recurrence may cause bias. Despite relatively high recurrence rates (24%), 26 (90%) of 29 patients had excellent/good functional outcomes. We recommend the use of adjuvants and allograft for the management of GCT.

Our study lacked an adequate number of patients and controls, which is common in GCT studies. Moreover it was a retrospective review from one hospital and limited by referral bias. A randomised controlled trial is required to identify independent risk factors for recurrence and poor function, and to validate the efficacy of each adjuvant and reconstruction method.

REFERENCES