Iterative Curettage is Associated with Local Control in Giant Cell Tumors Involving the Distal Tibia

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Abstract

Background The distal tibia is an unusual location for a giant cell tumor (GCT). Treatment choices are unclear because of their rarity, the anatomy of the ankle, and difficulties associated with reconstruction.

Questions/purposes We assessed: (1) the treatment modalities used by participating Canadian bone tumor centers for distal tibia GCTs; (2) the incidence of local recurrence and their management; and (3) patients' function after treatment.

Methods A prospective tumor database served to identify all 31 patients with primarily treated distal tibia GCTs between 1991 and 2010. We extracted patients and tumor

characteristics, treatment modalities for initial and recurrent tumors, and the Musculoskeletal Tumor Society (MSTS) and Toronto Extremity Salvage (TESS) scores. The median followup was 58 months (range, 24–192 months).

Results Extended curettage was the only modality of treatment for all patients including all subsequent local recurrences. Nine had local recurrence, three of which had a second local recurrence; one had a third recurrence. Ultimately all patients were in remission at last followup. The local recurrence rate was 29% and appeared higher compared with recent series of all anatomic sites. The mean final MSTS and TESS scores were 91% (range, 71%–100%) and 88% (range, 35%–100%), respectively.

Conclusions Extended curettage was the unique modality of surgical treatment for all tumors. We found the incidence of local recurrence higher than that reported for other locations but recurrences were manageable with repeated curettage. Complications and function appeared better than those reported for series of ankle fusion or reconstruction for bone tumors.

Level of Evidence Level IV, retrospective study. See Guidelines for Authors for a complete description of levels of evidence.

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Introduction

Giant cell tumors (GCTs) are benign, purely lytic, and located near joints in young adults (Fig. 1). Intralesional curettage has been preferred as it preserves anatomy and function in lieu of resection [10, 11, 13, 17, 33, 47]. However, GCTs are known for their potential to recur after curettage or incomplete resection, both of which leave microscopic residual tumor [28, 39]. The rate of local recurrence after curettage and bone grafting reportedly ranges from 25% and 50% [9, 15, 21, 26, 28, 42, 46, 51, 52, 55, 57]. These rates led

Fig. 1A–D (A) AP and (B) lateral plain radiographs of the left ankle of a 28-year-old woman show a lytic and expansile lesion in the lateral aspect of the distal tibia. A biopsy confirmed it as a benign

giant cell tumor. (C) Axial and (D) coronal CT scans of the same patient show the extent of the tumor and involvement of the subchondral area.

Fig. 2A–C Five-year followup (A) AP and (B) lateral plain radiographs of the ankle of the same patient are shown. A local recurrence occurred 2.5 years earlier and was treated similar to the initial tumor. (C) A coronal MR image shows the local recurrence in the distal and lateral edges of the tibia.

surgeons to enhance curettage with high-speed burring [3] and adjuvants such as liquid nitrogen [29, 44], acrylic cement [4, 5, 9, 36, 42], phenol [9, 19, 39, 44], hydrogen peroxide [37], locally-delivered chemotherapy [59], and radiation therapy [14, 34]. Although the latter has been associated with malignant transformation [7, 8, 47], this risk seems low with modern radiotherapy modalities [14, 30, 34]. Adjuvant liquid nitrogen reportedly [29, 31] provides the best local control, but has not gained popularity because its handling is difficult and pathologic fractures have been frequent. Although acrylic cement seemed to enhance local control [5, 42], it remains to be confirmed [6, 40], and comparably low local recurrence rates have been reported using modern surgical techniques without the addition of adjuvant [6, 38]. However, compared with autograft or allograft bone, cement is easy and inexpensive to use, provides immediate stability allowing early weightbearing, may avoid the necessity of internal fixation, and aids early detection of recurrence owing to lytic defects appearing at the bone-cement interface [43, 45]. Cement can be used when a fracture is present, either with or without metallic hardware [18]. When used adjacent to joints, the risk of joint degeneration after cementation seems to be minimal [24, 25, 48], although some

authors prefer to interpose bone chips between cartilage or the subchondral area and cement in an attempt to prevent joint degeneration [11, 38]. Wide resection is associated with better local control with recurrence rates ranging from 0% to 16% at 4 to 5 years [10, 28, 55], but it often impairs limb function because it sacrifices a substantial portion of the joint [28, 31, 58]. When feasible, local recurrences generally are treated in the same manner as if the tumors were seen primarily [28, 48, 54] (Fig. 2). It has been recognized that repeated curettage is associated with a higher risk of additional local recurrence compared with primary management [12, 46, 54, 55].

Although less extensive lesions usually are treated with curettage, there is debate regarding which is the best treatment for larger or more aggressive or recurrent GCTs [28, 40, 54, 55, 57]. A higher rate of recurrence could support an indication for resection instead of curettage, despite a higher functional loss. We suspected that the distal tibia was such an area of difficult local control but also not easily amenable to wide resection because of complications and function associated with major articular bone loss. The distal tibia is a relatively uncommon site of GCTs, and owing to its infrequency, it has not been singled out and reported outside large

Table 1. Reported complications, amputations and functional outcomes in adult distal tibial tumors

Study	Procedure	Number of patients	Followup (months)	Nononcologic complications	MSTS 1987* [22]	MSTS 1993* [23]	TESS* [16]
Campanacci et al. [8]	Arthrodesis	8	42	2 infections (1 BKA), 1 fracture		80%**	
Dieckmann et al. [17]	Arthrodesis	11	30	3 infections (1 BKA)	92%**		93%**
Ebeid et al. [20]	Arthrodesis	13	27	14 (3 infections, 1 fracture, 2 deformities, 9 length discrepancies)		80%	
Shalaby et al. [49]	Arthrodesis	6	35	2 nonunions, 1 fracture		70%	
Mavrogenis et al. [32]	Arthrodesis	8	164	1 infection		67%	
	Osteoarticular allografts	9	68	1 nonunion, 1 fracture		82%	
Ajit Singh et al.† [2]	Endoprosthesis	4	28	1 chronic septic loosening		83%	
Abudu et al. [1]	Endoprosthesis	5	74	1 infection, 1 talar loosening		65%	
Shekkeris et al. [50]	Endoprosthesis	6	60	2 infections (2 BKAs)		70%**	71%**
Lee et al. [27]	Endoprosthesis	6	64	2 infections, 1 talar collapse		81%	
Natarajan et al. [35]	Endoprosthesis	6	40	1 infection (BKA)	80%		
Current study	Joint preserved	31	58	1 infection, 1 nonunion	91%		87%

* Mean values; ** amputations excluded; †includes only distal tibia giant cell tumors; MSTS = Musculoskeletal Tumor Society score; TESS = Toronto Extremity Salvage Score; BKA = below knee amputation.

series including multiple bone segments [3, 6, 9–12, 15, 21, 26, 28, 38, 39, 51, 52, 55]. Although curettage usually is supported [41], available data have suggested that wide resection with complex reconstruction or amputation should be considered for treatment of aggressive or recurrent distal tibia GCTs with high rates of local control but limited function [1, 2, 8, 27, 41, 56] (Table 1).

The purposes of this study were to determine: (1) how primary and locally recurrent tumors were treated; (2) the rate of local recurrence following modern curettage for distal tibia GCTs compared with other locations; and (3) patient function resulting from treatment.

Patients and Methods

We identified 31 patients with a GCT of the distal tibia treated between 1991 and 2010 (16 female and 15 male patients). Prospective tumor databases containing demographic information and measures of function served to identify and provide data for all patients with distal tibia GCTs managed in six participating major Canadian bone tumor centers: Mt. Sinai Hospital in Toronto, Ontario; University of Ottawa Hospital in Ottawa, Ontario; Juravinski Cancer Centre in Hamilton, Ontario; McGill University Health Centre and Maisonneuve-Rosemont Hospital in Montreal, Quebec; and Hotel-Dieu in Quebec City. No patients were recalled specifically for this study; additional data were obtained from medical records and radiographs. The mean age of the patients at diagnosis was 34 years (range, 15–63 years). We

used the radiographic grading of Campanacci et al. [12] for these patients: three had Grade I lesions, 18 had Grade II lesions, nine had Grade III lesions, and one was undetermined. The mean greatest diameter of the tumor was 3.3 cm (range, 1–12 cm). Five patients presented with fractures; four were minimally displaced (≤ 2 mm), three of which were extraarticular. One patient had a displaced extraarticular fracture. The median followup was 58 months (range, 24–192 months). At latest followup all patients were free of disease but one had died from an unrelated cause.

From the 31 patients, preoperative 1987 version of the Musculoskeletal Tumor Society (MSTS) scores [22] were available for 22 patients with a mean initial score of 27 (range, 23–35). The Toronto Extremity Salvage Scores (TESS) [16] were available for 15 patients and the mean pretreatment value was 80% (range, 45%–100%).

Followup occurred at 2, 6, and 12 weeks, then every 3 to 4 months until 24 months after surgery. Thereafter we followed patients every 6 months until 5 years and subsequently every year. Most patients were discharged after being continuously disease free for 10 years. Plain radiographs of the ankle were performed at each visit. CT or MRI was performed occasionally as a baseline examination or to better define a suspected area of recurrence (Fig. 2C).

Results

All 31 patients were treated with intralesional curettage using high-speed burring. Pulsated lavage was recorded for

Table 2. Patients' characteristics, treatments modalities, and outcomes

Number/ gender/ age (years) at diagnosis	Campanacci grading/ fracture	Intraoperative adjuvant	Jet lavage	Filling	Plate and screw fixation	Time of recurrences (months)	Last followup (months)	Final MSTS (1987) (%)	Final TESS (%)
1/male/16	3/no	None	No	Autologous bone graft/morselized allograft	No		142	31	89
2/female/46	2/no	None	Yes	Autologous bone graft/morselized allograft	No		115	29	87
3/male/31	3/no	None	Yes	Autologous bone graft/morselized allograft	No		90	35	99
4/female/23	2/no	None	No	Autologous bone graft/morselized allograft	Yes		61	35	97
5/female/46	3/no	None	No	Autologous bone graft/morselized allograft	Yes		55	29	69
6/male/34	2/no	None	No	Autologous bone graft/morselized allograft	Yes		35		
7/male/15	3/no	None	No	Autologous bone graft	No		128	29	99
8/female/22	2/no	None	No	Autologous bone graft	No		85	27	100
9/female/49	2/no	Phenol	No	Morselized allograft	No		72	35	
10/female/46	2/no	Hydrogen peroxide	No	Morselized allograft	No		33		
11/male/32	1/no	None	Yes	Morselized allograft	No		25	35	99
12/male/20	2/yes	None	Yes	Morselized allograft	Yes		26	33	
13/male/27	2/no	Hydrogen peroxide	No	Morselized allograft	No		25	35	100
14/male/34	2/no	None	No	Morselized allograft/strut allograft	Yes		64	33	73
15/female/18	2/no	None	No	Morselized allograft/strut allograft	Yes		41	35	99
16/male/41	2/no	None	Yes	Autologous bone graft/strut allograft	No		72	35	100
17/male/46	3/no	None	No	Autologous bone graft/strut allograft	Yes		43	27	70
18/female/33	2/no	None	Yes	Cement/autologous bone graft	Yes		167	33	100
19/male/16	2/no	Phenol	No	Cement/autologous bone graft	Yes		193	35	95
20/female/34	2/no	None	Yes	Cement	Yes		108	27	56
21/male/48	2/no	None	No	Cement	No		25	35	100
22/female/38	1/no	None	Yes	Cement	No		25	35	86
23/female/44	3/no	None	Yes	Autologous bone graft/morselized allograft	Yes	97	25	33	
24/female/28	-/no	None	No	Autologous bone graft	No	37	229		
25/male/51	2/no	None	No	Autologous bone graft	No	48	58	35	97
26/male/63	3/yes	Phenol	No	Morselized allograft	Yes	14	29		
27/female/27	1/no	Hydrogen peroxide	No	Morselized allograft	No	25	64		
28/female/38	2/no	Phenol	No	Cement	Yes	36	166	35	100
29/male/21	2/no	None	No	Autologous bone graft/strut allograft	Yes	13/24	88	35	100
30/female/27	3/no	Liquid nitrogen	Yes	Cement/morselized allograft	Yes	12/48	45		
31/female/41	3/no	None	Yes	Cement/morselized allograft	No	13/25/37	46	25	

MSTS = Musculoskeletal Tumor Society score; TESS = Toronto Extremity Salvage Score.

11 patients. Adjuvant use included phenol for five patients, hydrogen peroxide in three, and liquid nitrogen for one. The cavity was filled with cement only in five patients, cement and allograft in three patients, and morselized autografts/allografts in 15, including four with additional strut allografts. Fourteen patients had supplemental internal fixation. All five patients with pathologic fractures had internal fixation with plates and screws; bone grafts were used in four of the five with three also having cement, and one had only cement as filler. No patients received radiotherapy in the initial management of their tumor. Postoperative complications overall included one infection and one nonunion. The infection resolved after surgical débridement, primary wound closure, and 6 weeks of intravenous antibiotics. The nonunion healed after addition of bone graft and revision of the internal fixation.

Nine patients (29%) had a local recurrence develop at a median of 25 months (range, 12–97 months) (Table 2). One patient originally had a Campanacci Grade I (11%) lesion, four had Grade II (44%) lesions, and four had Grade III (44%) lesions. All patients were treated with repeat curettage supplemented with cement in eight and a morselized allograft in one. None required additional internal fixation. In one of the nine patients surgery was supplemented with postoperative radiotherapy. No surgical complications were recorded in this group. Three patients had second local recurrences. They again underwent curettage without internal fixation. Cement was used in two of the three patients, one received postoperative radiotherapy, and the third patient had a soft tissue recurrence only. No complications occurred but one patient experienced a third local recurrence; the tumor was curetted and allografted, and the patient remains disease-free after 8 months. The two patients with recurrences who received radiotherapy had no further local recurrence. No lung metastases developed in the 31 patients.

The MSTS scores were recorded at last followup for 28 of the 30 patients with a mean of 32 (range, 25–35), or 91%, and the final TESS scores were available for 23 patients and averaged 87% (range, 56%–100%). Although the numbers were small and we performed no statistical analysis, it appears function was not worse after one or multiple local recurrences or after radiotherapy (Table 2). Although different filling materials were used, there were no obvious differences in the outcomes. We identified no patients who needed surgery for degenerative arthritis of the ankle.

Discussion

GCTs of long bones usually call for a balanced approach in management. Most often conservative management with

extended curettage is the preferred treatment modality. When the bone stock is too deficient or when soft tissue involvement is major then resection usually is performed. In view of the difficulties associated with resection of the distal tibia and the higher risk of local recurrence associated with a too-conservative approach to a GCT in this location, we wanted to review our experience from recent years. The goals of this study were to identify (1) the initial treatment modalities used by participating Canadian bone tumor centers for distal tibia GCTs; (2) the incidence of local recurrence and management of the recurrences; and (3) patients' function after treatment.

We recognize limitations to this study. First, the number of patients was limited despite contributions from six centers; however, it is a relatively large series for one unusual location in an infrequent tumor and none of the patients was lost to followup until being discharged. Second, owing to the retrospective and multicenter study design, we encountered variations in treatment modalities and missing data despite the existence of prospective databases, however these were limited and unlikely to alter our findings. Third, all patients were treated in expert centers with a similar joint preservation approach. This may represent a bias in treatment leading to a higher recurrence rate. Fourth, the experimental addition of denosumab may affect treatment, local recurrence, and function [53]. Although our study included no such cases, it could serve as a baseline for future comparison.

Extended curettage was the only modality of treatment attempted in all cases, even after local recurrence. Fractures were not uncommon, and all were treated conservatively at the time of tumor surgery. As some patients experienced two or three local recurrences, it could be argued they would have benefited from wide resections to minimize the burden of multiple surgeries; however, there are no easy and predictable ways of reconstructing or fusing the ankle after substantial bone resection [1, 2, 8, 17, 20, 27, 32, 35, 49, 50, 56]. Complications are common sometimes leading to below knee amputation in addition to the functional limitation after ankle arthrodesis or implantation of a massive endoprosthesis (Table 1). The role and importance of this segment of bone were such that none of our patients, including those with Grade III tumors, fractures, or those with multiple local recurrences, underwent resection. Despite this higher risk of local recurrence, all patients were free of disease without the need for resection. Authors of numerous series of GCTs of the extremities that were treated with curettage reported incidences of local recurrences ranging from 9% to 23% [3, 6, 38, 40, 48, 55]. With a local recurrence rate of 29%, our series suggests that local control may be more difficult to obtain in the distal tibia, although no valid statistical comparison can be made. No previous reports suggested

such a high failure rate for this location; other series are needed to confirm or contradict our assumption. In addition, the incidence of other complications, such as infection, nonunion, and below knee amputation were much lower than reported after distal tibia resection (Table 1).

Function was improved but not restored to normal. Nine of the 31 patients needed more than one operation and two of these patients with recurrences had added radiotherapy. By comparison, the functional scores of our patients were consistent with those published for ankle fusion or arthroplasty following tumor resection, although some studies included patients who received chemotherapy. Often these studies do not report scores from patients who ultimately underwent amputation (Table 1). None of our patients required amputation owing to complications following the reconstruction technique. At the time our study was completed all patients were free of disease following conservative management and none needed or was awaiting ankle fusion or arthroplasty. Having a GCT in the distal tibia may be similar or possibly a better location than having a GCT in another site, such as the wrist or knee, as those sometimes require resection and reconstruction.

Our experience suggests that GCTs of the distal tibia should be managed with extended curettage, with reasonably good function. The local recurrence rate appeared higher than recent experiences with other bone segments but local control ultimately can be obtained with conservative management and without the need for distal tibia resection or amputation.

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