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CLINICAL RESEARCH

Surgical Treatment of Grade I Central Chondrosarcoma

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Abstract The grade of chondrosarcoma relates to the likelihood of local recurrence and metastases. Many Grade I chondrosarcomas behave benignly if aggressively, and the question arises regarding whether wide resection is essential to control the disease. We therefore asked whether intralesional surgery also could be extended to Grade I chondrosarcomas without an increase in recurrence. We retrospectively reviewed 31 patients with Grade I chondrosarcomas of the limbs. The minimum followup was 66 months (mean, 157 months; range, 66–296 months). None of the 16 patients treated by resection had recurrences during the followup and two of the 15 patients with intralesional excision had recurrences, both of which resolved with resection of the site involved by the recurrence without progression of the disease. The Musculoskeletal Tumor Society scores averaged 72% in patients treated with wide resection compared with 89% in the 15 patients treated by intralesional surgery. The two recurrences occurred in patients whose radiographs showed thinning of the cortex combined with bone enlargement and marked endosteal scalloping; histologic examination in these two patients also showed a correlation between radiographic aggressiveness and the presence of myxoid areas and hypercellularity.

Level of Evidence: Level II, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

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Introduction

Central chondrosarcoma (CS) is the fourth most common primary malignant tumor of the skeleton, typical of adult age [4]. It grows slowly inside the medullary canal of a long bone for years before producing mild pain or a pathologic fracture [18, 22, 23]. A pathologic fracture usually is caused by a sudden progression of the local disease that is often a sign of transformation into high malignancy (dedifferentiation) [21].

CS is divided histologically into three grades according to the characteristics of its intercellular scaffold: cellularity, characteristics of its nucleus, and the presence of mitotic activity [6]. The benign counterpart of CS is enchondroma, which by its nature grows during infancy and typically has little clinical importance in adulthood [8, 21]. The differential diagnosis between enchondroma and Grades I and II CS is a challenge for the anatomic pathologist and is often the object of studies to determine certain parameters such as permeative infiltration with encapsulation of host bone trabeculae as proposed by Mirra et al. [16] and Schiller [21] or the presence of hypercellularity combined with cellular atypia and myxoid areas [1, 3, 10, 16, 19, 20]. Furthermore, this tumor can have different histologic grades in different areas of the tumor [19]. In fact, a needle biopsy does not always allow a correct diagnosis of grade [23, 24]. For this reason, it is particularly important to combine the radiographic interpretation with the histologic finding. Nevertheless, histologic grade is a good prognostic factor [3, 16, 17, 19].

Grading and staging are fundamental to establish the most appropriate type of surgery for CS [18]. Standard radiography often is sufficient to assess the extent of the tumor in the medullary canal and its relation with the cortex [5, 9, 14, 15]. CT [24] and MRI can show whether there is endosteal involvement or breakthrough in the cortex [4, 11, 17]. The radiographic and histologic elements that allow clear distinction between enchondroma and Grade I central CS remain controversial. Grade I CS, in fact, shows such a harmless clinical pattern that it can be mistaken for an enchondroma [8]. Grade I CS can recur even after 10 to 20 years, whereas Grade II CS recurs within 5 years and Grade III CS often recur within 1 year [4, 11, 19, 23]. Grade II CS can have fewer pulmonary metastases than Grade III; however, the 5-year overall survival for Grades II and III CS ranges from 40% to 50% [4, 11, 12, 19, 23].

Therefore, the question regarding whether to consider Grade I central CS an aggressive benign tumor rather than a low-grade malignancy tumor has led some authors to extend the indication of intralesional surgery to these patients [2, 13]. Although enchondroma can be treated by curettage, or in case of inactive lesions, even nonsurgically [6], Grade I CS usually is treated with en bloc resection with wide margins. The adequacy of intralesional surgery is advocated by some surgeons [2, 13] and opposed by others [17–19, 23].

We therefore asked whether (1) intralesional surgery would lead to greater numbers of local recurrence, late relapses, and subsequent surgical procedures compared with resections performed in patients with Grade I CS; (2) radiographic signs and histologic findings of aggressiveness would predict aggressive behavior; (3) intralesional surgery and resection would provide similar functional scores; and finally, we (4) report the complications of these procedures.

Patients and Methods

We reviewed retrospectively all 67 patients with Grade I central CS in the long bones treated surgically from 1977 to 1998. We excluded patients with Ollier's disease (nine cases), with inadequate radiographic documentation (11 cases), and with less than 60 months followup (five cases); we also excluded patients with CS of the short bones and those seen for consultation only. That left 31 patients with a minimum followup of 66 months (mean, 157 months; range, 66–296 months). There were 13 male and 18 female patients with a mean age of 35 years (median, 33 years; range, 13–67 years). Sixteen patients were treated by wide resection and 15 by intralesional curettage. The location of CS was the femur in 13 patients, nine proximal, and four distal; the tibia in 11 patients, eight proximal, two distal, and one diaphyseal; and the humerus in seven patients, six proximal and one diaphyseal (Fig. 1). The onset symptom was pain in 27 of the 31 patients (87%) with a mean duration of 25 months (range, 2–120 months). Two patients were diagnosed after a pathologic fracture, and in two the disease was discovered as an incidental radiographic finding. We found bone enlargement by palpation of a deep hard mass in 11 of the 31 (35) patients.

An initial biopsy had been performed elsewhere in 13 patients; we repeated a biopsy in four of these 13 patients. In 17 patients, the initial biopsy (13 incisional, three extemporaneous, and one needle) was performed in our hospital. In one patient, a biopsy was not performed, and diagnosis was based on radiographic evaluation. Of the 31 patients, four had been treated surgically, three with curettage and one by resection, before referral to us. All four had local recurrence and therefore were treated again at our institute, three by wide resection and one by curettage. Fourteen of the other 27 patients were treated by curettage and 13 by resection (Table 1).

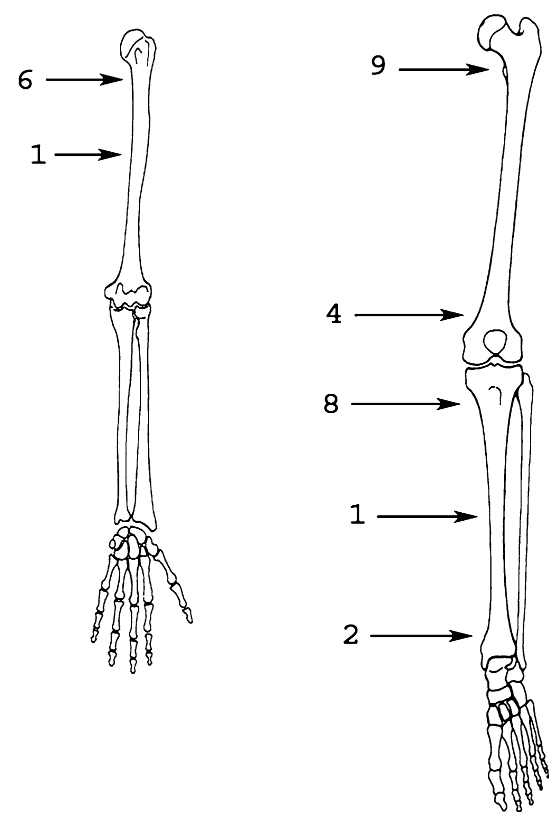

Fig. 1 Distribution of the lesions is seen in these illustrations.

Table 1. Radiographic characteristics of the lesions

Patient number	Gender	Age (years)	Lesion site	Size (cm^2)	Involvement	Enlargement	Scalloping	Type of operation
1	F	17	Distal femur	25	Cortical interruption, thinning	Yes	Deep	Resection
2	F	44	Proximal humerus	19	Irregular surface	No	Slight	Resection
3	M	58	Distal femur	5.5	No	No	No	Resection
4	F	14	Proximal femur	7.4	Thickening	Yes	No	Resection
5	M	47	Proximal femur	15.8	Irregular surface, thinning	Yes	Moderate	Resection
6	M	31	Proximal humerus	44.5	Irregular surface, thinning	Yes	Deep	Resection
7	M	19	Tibial diaphragm	9.4	No	Yes	Moderate	Curettage
8	M	19	Proximal tibia	6.4	Interruption, thinning	Yes	No	Resection
9	F	41	Proximal humerus	15.8	No	No	Slight	Curettage
10	M	15	Proximal tibia	3.2	Interruption, thinning	Yes	No	Curettage
11	F	29	Distal femur	4.7	Interruption	No	No	Resection
12	M	64	Proximal femur	11	Irregular surface, thinning	Yes	Moderate	Resection
13	M	41	Proximal tibia	10	No	No	No	Curettage
14	M	22	Proximal femur	57.2	Irregular surface, thinning	Yes	Moderate	Curettage
15	F	33	Humeral diaphragm	15.9	No	Yes	Moderate	Curettage
16	F	46	Proximal tibia	8.5	Thinning	No	Moderate	Resection
17	F	23	Distal tibia	4.7	Thinning	Yes	Moderate	Curettage
18	F	13	Proximal tibia	10.5	No	Yes	Slight	Curettage
19	M	27	Distal tibia	4.7	No	Yes	Slight	Curettage
20	F	45	Proximal femur	23.5	No	Yes	Deep	Resection
21*	F	32	Proximal femur	12.7	Irregular surface, thinning	Yes	Moderate	Curettage
22	F	62	Proximal. humerus	28.2	Thinning	Yes	Moderate	Resection
23*	F	34	Proximal femur	9.6	No	No	No	Curettage
24	F	45	Proximal humerus	35.7	No	No	Slight	Curettage
25	F	42	Proximal humerus	8.4	No	No	Slight	Curettage
26	F	49	Proximal tibia	23.5	Thickening	Yes	No	Resection
27	M	13	Proximal tibia	5.9	No	No	No	Curettage
28	F	67	Distal femur	19.6	Interruption, thinning	Yes	Moderate	Resection
29	F	51	Proximal femur	44.3	Interruption	Yes	Deep	Resection
30	M	25	Proximal femur	13.5	No	Yes	Slight	Curettage
31	M	58	Proximal tibia	37.6	Interruption, thinning	Yes	Deep	Resection

* Patients with local recurrence; F = female; M = male.

In all 15 patients treated by curettage, the surgical technique involved removal of the newly formed tissue by opening a cortical window and cleaning the cavity using different sized curettes and a high-speed burr. Local adjuvants were used in 12 patients: phenol and/or acrylic cement in nine and liquid nitrogen in three. After curettage, the defects were filled with cement in five patients, allografts in three, and autografts in one. In four patients, the bone was stabilized with fixation devices without the use of other filling material. In the last two patients with metaphyseal location of the proximal femur, the metaphysis was removed together with the epiphysis; therefore, after performing curettage in the operating field, the bone was reused to obtain a cemented composite prosthesis in the resected bone and uncemented in the residual diaphysis.

Of the 16 patients treated by resection, a joint, or part of it, was sacrificed in eight. The joint was reconstructed by a standard prosthesis of the proximal femur in three, HMRS Stryker Howmedica-type modular resection prosthesis (Kiel, Germany) in two, and Wagner-type revision prosthesis (Sulzer, Winterthur, Switzerland) in one, whereas the remaining two were reconstructed by patella procondyle for the distal femur. The other eight patients treated by resection underwent reconstruction owing to an intercalary defect using autologous grafts in four, whereas in the others, one had temporary reconstruction with a plate and cement, which was replaced after 7 months by a homoplastic graft combined with a vascularized fibula, two by a plate and homoplastic graft, and in the last patient, after the resection, an Ilizarov device was applied.

Wide margins were achieved in 14 patients treated by resection, a marginal margin was achieved in one, and an intralesional margin was achieved in one. In seven patients, the cortex initially was interrupted; six were treated with surgical resection and one by curettage (extension of the lesion 3.2 cm^2). Bone enlargement was observed in 21 patients; 12 were combined with other signs of aggressiveness (interruption of the cortex, invasion of the soft tissues detected by CT, and moderate-deep scalloping) and all were treated by resection; nine with simple enlargement were treated by curettage. Scalloping was present in 22 patients: mild in seven, moderate in 10, and deep in five; in the latter patients, surgical resection was performed.

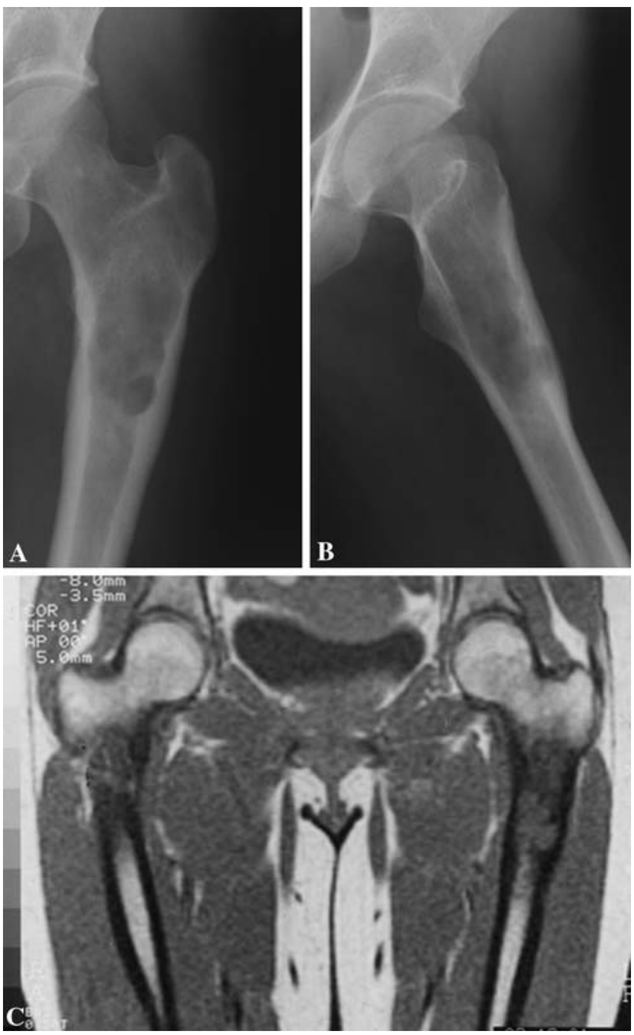

Fig. 2A–C A CS of the left proximal femur in seen in these radiographs. In the (**A**) AP and (**B**) lateral projections, the inner lateral and posterior cortex is invaded (moderate scalloping) by the tumor. The cortical augmentation (enlargement, Grade I) is also evident. (**C**) The definition of the intramedullary tumor involvement is enhanced by MRI.

The patients usually were followed up in our outpatient clinic every 4 to 6 months during the first 5 years and, then yearly for at least 10 years. During each visit, we obtained Musculoskeletal Tumor Society scores [6]. This system assigns numeric scores from 0 to 5 for each of the six considered parameters with a maximum score of 30 points.

One of the four authors (DD, SC, MC, DBC) determined radiographically the site, shape, and size (measured on the AP projection in centimeters in two dimensions and calculating a 10% mean radiographic enlargement) of the osteolysis, the occurrence of popcorn, ring, or spot-like calcification, and the presence and type of cortical reaction with particular reference to the presence of bone enlargement. We classified endosteal resorption (scalloping) as mild if it involved one-third of the cortical thickness, moderate if it involved two-thirds of the cortex, or deep if there was penetration of the cortex (Fig. 2). On the CT scan, we measured the same

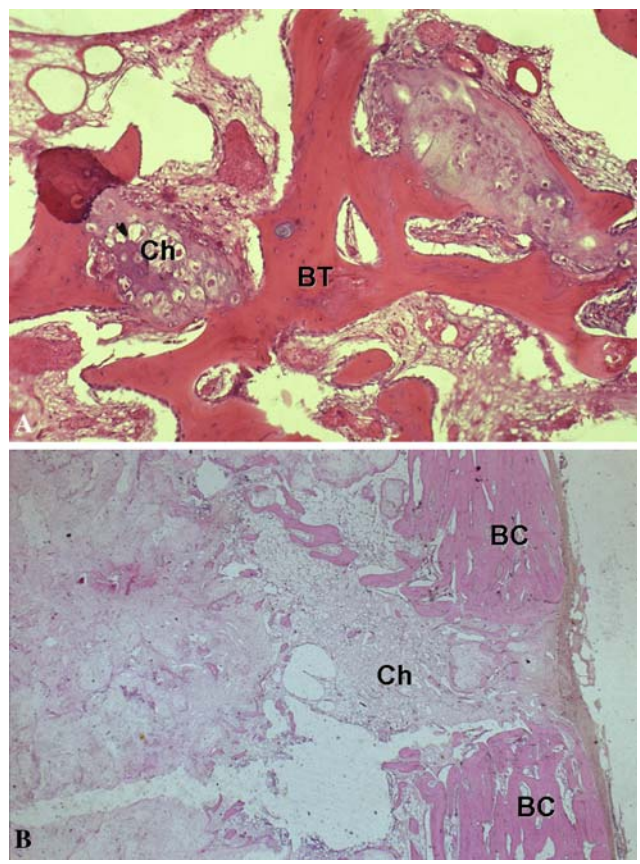

Fig. 3A–B The photomicrographs show the histologic presentation of Grade I CS. (**A**) A pattern of permeative infiltration is seen, with encasement of host bone trabeculae (BT) by the progression of the tumor (Ch) at high magnification (Stain, hematoxylin and eosin; original magnification, ×20). (**B**) The chondrosarcoma (Ch) invaded the host bone cortex (BC) (Stain, hematoxylin and eosin; original magnification, ×10).

parameters as those of the radiographs plus the presence of soft tissue mass, distribution of contrast media, and presence of levels.

One of the three authors (FB, DD, SC) reviewed each of the histologic slides of the biopsy and slides of the specimen. Histologic analysis was performed by evaluating five parameters characterizing the aggressiveness of the tumor: (1) permeative infiltration with encapsulation of host bone trabeculae as proposed by Mirra et al. [16] and Schiller [21]; (2) presence of host bone trapped in the front of growing cartilage as a sign of permeation versus presence of bone circumferentially surrounding the islands of cartilage as a sign of tissue reaction and therefore of lesion differentiation; (3) cortical erosion combined with the presence of tumor cells in the Haversian canals; (4) hypercellularity combined with cellular atypia; and (5) myxoid areas, bands of perilobular fibrosis, necrosis, and swelling of the nuclei (Fig. 3). Permeative infiltration with the inclusion of host bone trabeculae was present in 25 patients (80.6%) (Table 2). This pattern of aggressiveness differentiates Grade I CS from chondroma. Hypercellularity was scarce (four patients), although it was found in both patients with recurrence. We observed myxoid areas in 10 patients. There were myxoid areas in six of the 12 patients in whom radiographs showed enlargement combined with thinning of the cortex. We observed bands of perilobular fibrosis in four patients and swelling of the nuclei in three patients. Consistent with the low aggressiveness of the lesions, we did not observe signs of necrosis.

Table 2. Histologic parameters assessed

Patient number	Biopsy	Operation	Infiltration	Hypercellularity	Myxoid areas	Perilobular fibrosis	Swollen nuclei	Local recurrence
1	Yes	Resection	Yes	No	No	No	No	No
2	Yes	Resection	Yes	Yes	No	Yes	Yes	No
3	Yes	Resection	No	No	No	No	No	No
4	Yes	Resection	Yes	No	No	No	No	No
5	Yes	Resection	Yes	No	Yes	No	No	No
6	Yes	Resection	Yes	No	No	No	No	No
7	Yes	Curettage	Yes	No	No	No	No	No
8	Yes	Resection	Yes	No	No	No	No	No
9	Yes	Curettage	Yes	No	No	No	No	No
10	Yes	Curettage	Yes	No	Yes	No	No	No
11	Yes	Resection	Yes	No	Yes	No	No	No
12	Yes	Resection	Yes	No	Yes	No	No	No
13	Yes	Curettage	Yes	No	No	No	No	No
14	Yes	Curettage	Yes	No	Yes	No	No	No
15	No	Curettage	Yes	Yes	Yes	No	No	No
16	Yes	Resection	No	No	No	No	No	No
17	Yes	Curettage	Yes	No	Yes	No	No	No
18	Yes	Curettage	Yes	No	No	No	No	No
19	Yes	Curettage	No	No	No	No	No	No
20	Yes	Resection	Yes	No	Yes	No	No	No
21	Yes	Curettage	No	Yes	Yes	No	No	Yes
22	Yes	Resection	Yes	No	No	Yes	No	No
23	Yes	Curettage	Yes	Yes	No	No	Yes	Yes
24	Yes	Curettage	Yes	No	No	No	Yes	No
25	Yes	Curettage	Yes	No	No	No	No	No
26	Yes	Resection	Yes	No	No	No	No	No
27	Yes	Curettage	Yes	No	No	No	No	No
28	Yes	Resection	No	No	No	No	No	No
29	Yes	Resection	No	No	No	No	No	No
30	Yes	Curettage	Yes	No	Yes	Yes	No	No
31	Yes	Resection	Yes	No	No	Yes	No	No

Results

Two of the 15 patients treated by intralesional curettage and none of the 16 patients treated by resection had local recurrences (Figs. 2 and 4). Both patients with recurrences had lesions in the proximal femur and both recurrences occurred 31 months after the operation. One of these patients had been treated at another hospital by curettage. In both cases, histologic examination of the recurrence did not show progression of the grade. Surgical treatment of the local recurrences consisted of resection and reconstruction, one with a modular HMRS (Stryker and Wagner) prosthesis and the other with an allograft-prosthetic composite (Fig. 4). At the last followup (114 and 153 months), there were no additional oncologic relapses in the patients with recurrences. Concerning the radiographic presentation (Table 3), 16 patients treated by surgical resection had a greater mean extension (20.3 cm^2) than the patients treated by curettage (14.5 cm^2). Calcifications were present in 22 patients but without correlation with other elements of aggressiveness.

None of the patients of the series had metastases and no deaths were caused by the disease. We could discern no differences in radiographic or histologic aggressiveness in patients treated by intralesional surgery versus resection. We observed hypercellularity in both patients with recurrences and one of the 10 patients with myxoid areas had a local recurrence.

In patients treated by intralesional surgery, the mean functional score was 90% of normal function (range, 77%–100%), whereas in patients treated by resection, the mean score was 73% (range, 47%–90%). In this group of patients, four of six scored 50% or less in comparison to zero of 15 in patients treated by curettage.

In the 16 patients treated by curettage, only one had complications: a fracture of the proximal humerus 6 years after surgical treatment, which was treated by bone fixation. Complications occurred in two patients treated by resection: in one, atrophic nonunion occurred after treatment with an Ilizarov's device and was treated after 9 months by fibula-protibia and the other patient had loosening of the prosthetic stem 9 years after resection and was treated by revision of the implant.

Discussion

The grade of CS reportedly corresponds to the likelihood of local recurrence and metastases. Many Grade I CS behave benignly if locally aggressive. Therefore the question arises regarding whether wide resection is essential to control the disease. We asked whether (1) intralesional surgery would lead to greater numbers of local recurrences, late relapses, and subsequent surgical procedures compared with resections performed in patients with low-grade CS; (2) radiographic signs and histologic findings of aggressiveness would predict subsequent aggressive behavior; (3) intralesional surgery and resection would provide similar functional scores.

There are several limitations to our study. First, because it is a retrospective analysis with patients treated over 21 years, diagnostic approaches and surgical technical skills have changed. Second, a consistent number of patients were referred thereby making the adequacy of the

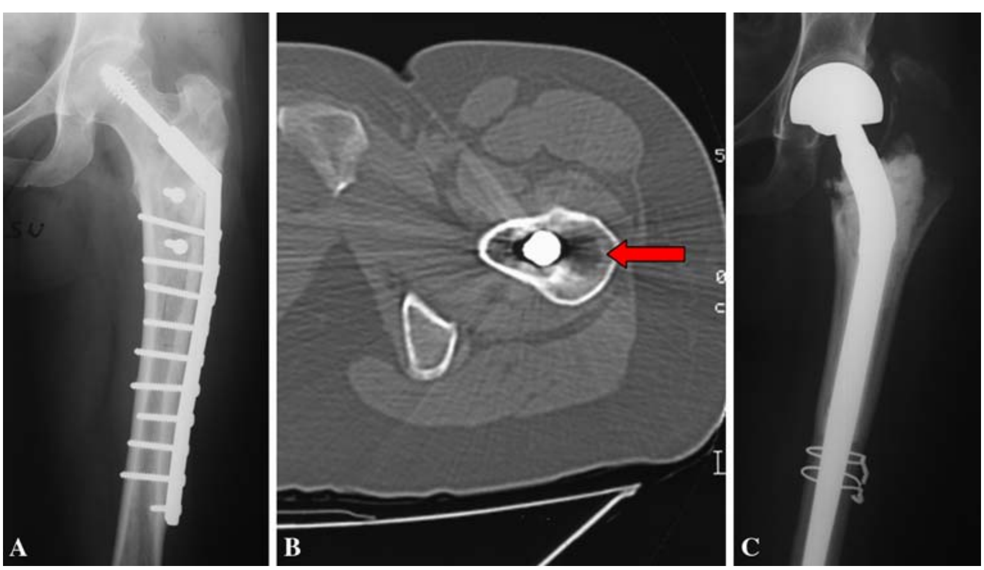

Fig. 4A–C (**A**) A local recurrence located in the greater trochanter is evident on this radiograph. (**B**) Although there were metal artifacts, CT confirmed the radiolucent area close to the bone fixation device (arrow). (**C**) The proximal end of the femur was resected and substituted with an allograft-prosthetic composite.

Table 3. Radiographic characteristics of the lesions

Patient number	Lesion site	Size (cm^2)	Cortical involvement	Enlargement	Scalloping	Type of operation
1	Distal femur	25	Interruption, thinning	Yes	Deep	Resection
2	Proximal humerus	19	Irregular surface	No	Slight	Resection
3	Distal femur	5.5	No	No	No	Resection
4	Proximal femur	7.4	Thickening	Yes	No	Resection
5	Proximal femur	15.8	Irregular surface, thinning	Yes	Moderate	Resection
6	Proximal humerus	44.5	Irregular surface, thinning	Yes	Deep	Resection
7	Tibial diaphragm	9.4	No	Yes	Moderate	Curettage
8	Proximal tibia	6.4	Interruption, thinning	Yes	No	Resection
9	Proximal humerus	15.8	No	No	Slight	Curettage
10	Proximal tibia	3.2	Interruption, thinning	Yes	No	Curettage
11	Distal femur	4.7	Interruption	No	No	Resection
12	Proximal femur	11	Irregular surface, thinning	Yes	Moderate	Resection
13	Proximal tibia	10	No	No	No	Curettage
14	Proximal femur	57.2	Irregular surface, thinning	Yes	Moderate	Curettage
15	Humerus diaphragm	15.9	No	Yes	Moderate	Curettage
16	Proximal tibia	8.5	Thinning	No	Moderate	Resection
17	Distal tibia	4.7	Thinning	Yes	Moderate	Curettage
18	Proximal tibia	10.5	No	Yes	Slight	Curettage
19	Distal tibia	4.7	No	Yes	Slight	Curettage
20	Proximal femur	23.5	No	Yes	Deep	Resection
21*	Proximal femur	12.7	Irregular surface, thinning	Yes	Moderate	Curettage
22	Proximal humerus	28.2	Thinning	Yes	Moderate	Resection
23*	Proximal femur	9.6	No	No	No	Curettage
24	Proximal humerus	35.7	No	No	Slight	Curettage
25	Proximal humerus	8.4	No	No	Slight	Curettage
26	Proximal tibia	23.5	Thickening	Yes	No	Resection
27	Proximal tibia	5.9	No	No	No	Curettage
28	Distal femur	19.6	Interruption, thinning	Yes	Moderate	Resection
29	Proximal femur	44.3	Interruption	Yes	Deep	Resection
30	Proximal femur	13.5	No	Yes	Slight	Curettage
31	Proximal tibia	37.6	Interruption, thinning	Yes	Deep	Resection

* Patients with local recurrence.

first treatment performed elsewhere difficult to assess. Third, patients treated by curettage had radiographically less aggressive disease than those treated by resection. This should bias patients with recurrences in favor of those with wide resections, yet the recurrences were in patients with intralesional treatment and therefore we do not believe biases the outcomes. However, we included only patients with Grade I central CS of the long bones ultimately treated and followed by the same group of surgeons. We also included patients with more than 5 years of followup. A couple published reports of patients affected by CS include various locations of bone involvement, tumor grades, and followup times [17, 19].

Only two previous studies attempted to address the same issue of whether curettage was reasonable in Grade I CS (Table 4). In 23 patients with Grade I CS treated with curettage, Bauer et al. [2] reported three local recurrences without metastases or progression of the disease. One local recurrence after resection of a phalanx eventually healed (19 years followup), and two recurrences after curettage healed after repeated curettage. Although the reported series are more heterogeneous (any site included, short followups), our findings are consistent with theirs. These authors concluded CS of long bones can be treated by curettage and filling the cavity with either autogenous bone or methylmethacrylate cement. Distal destructive lesions required en bloc resection to prevent local recurrence. The recently published experience of the Mayo Clinic [13] was more controversial; in a group of 13 patients treated by curettage, they had one recurrence followed by death

Table 4. Data for oncologic results among three comparable studies

Study	Number of cases	Resection	Curettage	Local recurrence after resection	Local recurrence after curettage	Metastasis	Mean followup in months (minimum–maximum)
Current study	31	16	15	0	2*	0	157 (66–296)
Leerapun et al. [13]	70	57	13	1†	1‡	1 after resection§ 1 after curettage‡	102 (2–273)
Bauer et al. [2]	38	14	24	1‖	2¶	0	84 (24–300)

* Both healed after resection and prosthetic substitution, no upgrading in both cases; †healed after new resection, no upgrading; ‡the same patient, 51 years old, had local recurrence and lung metastasis develop 4 months after surgery with a new diagnosis of dedifferentiated chondrosarcoma, he died 9 months after; §patient with lung, abdomen, and deltoid muscle metastasis occurred after 3.5 years, upgraded to Grade II chondrosarcoma; ‖foot phalanx chondrosarcoma, soft tissue recurrence excised and eventually healed (followup 19 years); ¶both healed after one or more curettage, no upgrading in both cases.

consequent to metastases of the disease. In this patient, the diagnosis of recurrence was dedifferentiated CS. In that series, although there were no details regarding the radiographic and histologic characteristics of the cases, they concluded that in selected patients, less radiographically aggressive Grade I CS could be treated safely by intralesional curettage without compromising the outcome.

We found the most important marker of aggressiveness of the lesion was bone enlargement combined with thinning of the cortex as previously suggested [4]. The only case of recurrence of the disease after initial curettage at our hospital had such a radiographic profile; the other recurrence was in a patient already treated before coming to us for the second curettage. Radiographic signs of aggressiveness (enlargement + cortical thinning) are combined with the histologic observation of myxoid areas and, in patients with recurrence, hypercellularity of the lesion also is associated. Scalloping was not considerably correlated with an increase in histologic aggressiveness, although in the five patients with deep scalloping, resection was always the method of treatment. It has been argued that the size of the lesion is important [7, 20] to differentiate Grade I CS from enchondroma. Owing to the low number of patients in the series, we could not observe correlation between size and radiographic and histologic aggressiveness. The presence, type, and distribution of calcifications also were of secondary importance.

The rationale of using intralesional curettage is strengthened by the better functional results achieved in this group of patients compared with the group treated by resection (Table 5). Despite the small number of patients, based on a series from one center and homogeneous for the type of lesion (Grade I CS of the long bones in all patients) with sufficient followup, our data suggest Grade I CS is a tumor with low potential aggressiveness that can be treated by curettage combined with the use of adjuvant therapies. We found recurrence could be treated by resection without subsequently risking recurrence or metastases. However,

Table 5. Functional evaluation with Musculoskeletal Tumor Society score

Patient number	Gender	Age (years)	Surgery	Score (%)	Result	Followup (months)
1	F	17	Resection	76	Good	296
2	F	44	Resection	46	Poor	265
3	M	58	Resection	90	Excellent	228
4	F	14	Resection	80	Good	219
5	M	47	Resection	50	Poor	164
6	M	31	Resection	76	Good	166
7	M	19	Curettage	80	Good	251
8	M	19	Resection	76	Good	194
9	F	41	Curettage	76	Good	168
10	M	15	Curettage	100	Excellent	154
11	F	29	Resection	76	Good	180
12	M	64	Resection	76	Good	204
13	M	41	Curettage	96	Excellent	160
14	M	22	Curettage	93	Excellent	201
15	F	33	Curettage	90	Excellent	151
16	F	46	Resection	76	Good	135
17	F	23	Curettage	76	Good	126
18	F	13	Curettage	100	Excellent	168
19	M	27	Curettage	100	Excellent	123
20	F	45	Resection	50	Poor	179
21*	F	32	Curettage	76	Good	114
22	F	62	Resection	76	Good	66
23*	F	34	Curettage	76	Good	153
24	F	45	Curettage	76	Good	94
25	F	42	Curettage	100	Excellent	139
26	F	49	Resection	90	Excellent	87
27	M	13	Curettage	100	Excellent	81
28	F	67	Resection	76	Good	127
29	F	51	Resection	50	Poor	72
30	M	25	Curettage	100	Excellent	87
31	M	58	Resection	90	Excellent	110

* Patients with local recurrence; F = female; M = male.

we suggest selecting patients on the basis of radiographic appearance and avoiding curettage in patients presenting with bone enlargement associated with thinning of the cortex and deep scalloping.

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