



Surgical management of Grade I chondrosarcoma of the long bones

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The aim of this study was to compare the rates of local recurrence according to surgical treatment options in low-grade chondrosarcomas of the long bones. A retrospective review was made of 30 consecutive patients (12 male, 18 female) with a mean age of 40.7 years (range : 16-69 years) with intramedullary low-grade chondrosarcoma of the long bones treated either by intralesional curettage or wide resection at our institution between 1995 and 2011. The mean overall follow-up was 74 months (range : 24-186 months). There was no difference in local recurrence rates between patients treated with intralesional resection or wide resection ($p = 0.98$). Intralesional curettage seems to be feasible in selected cases to reduce the patient's postoperative morbidity in Grade I chondrosarcoma cases.

Keywords : chondrosarcoma ; neoplasm recurrence ; intralesional resection ; wide resection ; treatment outcome.

INTRODUCTION

Chondrosarcoma is the second most frequent bone sarcoma ; it is characterized by the production of a cartilaginous matrix by malignant cells. It has a slight male predominance (7,20) and predominantly affects middle-aged individuals with the most common locations being the proximal femur and the pelvis (6). It can be divided into two main groups : primary and secondary lesions (20). The treatment of chondrosarcoma is surgical ; radiotherapy and

chemotherapy are ineffective because its growth is mainly due to matrix production and not so much to DNA replication (10,15). However, there is debate regarding the definition of adequate surgical margins in the treatment. The importance of adequate resection margins is well established and accepted in high-grade chondrosarcomas (9), but in low-grade chondrosarcoma, there is a need for the margin of resection to be re-defined to take into account scientific reports emerging from retrospective clinical series. The purpose of this study was to evaluate the

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oncological outcomes of patients with Grade I chondrosarcomas according to the type of surgery performed, in order to evaluate the safety of less aggressive procedures.

PATIENTS AND METHODS

Records were extracted from the database of 126 patients with Grade I chondrosarcoma who were treated between January 1995 and September 2011. From these, 30 patients with Grade I chondrosarcoma of the long bones were included in the study. These patients were divided into two main groups: patients in Group 1 (n = 13) were treated with intralesional curettage and patients in Group 2 (n = 17) were treated with wide resection. Overall, there were 12 male (6 in Group 1 and 6 in Group 2) and 18 female patients (7 in Group 1 and 11 in Group 2) with a mean age of 40.7 years (range: 16-69 years). Seventeen lesions were in the femur (7 in Group 1 and 10 in Group 2), 7 in the humerus (3 in Group 1 and 4 in Group 2), 4 in the tibia (3 in Group 1 and 1 in Group 2) and 2 in the fibula (2 in Group 2). Pre-operative imaging included plain radiographs, Magnetic Resonance Imaging (MRI) and Chest Computed Tomography (CT). Needle and/or open biopsies were obtained in all cases. The diagnosis of Grade I chondrosarcoma was made on surgical material examination by experienced musculoskeletal consultant histopathologists on the basis of the criteria proposed by Mira *et al* (18). All patients with Stage IB lesions (n = 11) underwent wide resection, as well as 6 patients in Group 2 with Stage IA lesions or with a tumour size over 8 cm. None of the 13 patients (Stage IA) selected for intralesional curettage had cortical disruption or soft tissue extension. They were treated with aggressive curettage and local adjuvant, Polymethylmethacrylate (PMMA) or bone autograft/allograft. Two patients in the intralesional group had prophylactic internal fixation with plate and screws. Seventeen patients were treated with wide resection with reconstructions, including PMMA, allograft/autograft, endoprostheses, intramedullary nailing, or Ilizarov external fixator. Generally all the patients who underwent lower extremity surgery were limited to partial weight-bearing on the involved extremity for the first 6 weeks, then to weight-bearing as tolerated. Physical examination was made, plain radiographs, MR images of the surgical area, and CT scans of the chest were taken, and patients were specifically questioned about symptoms and complications at each follow-up visit. They were followed up postoperatively at regular intervals of 3 months in the

first year, 6 months between 1 and 3 years, and on an annual basis thereafter. Statistical analysis was performed using SPSS (Version 13.0; SPSS Inc, Chicago, IL). Fisher's exact test, Student's t test and Mann-Whitney U test were used for analysis of differences between groups. The significance level was set at $p < 0.05$.

RESULTS

There was no difference between the treatment groups in terms of age and gender ($p > 0.05$). The follow-up time was longer in Group 2 (75 months, range: 24-186 months) than in Group 1 (73 months, range 26-124 months) ($p = 0.03$). The mean tumour size was significantly larger in Group 2 than in Group 1: 12 cm (range 5-25 cm) versus 6 cm (range 3-12 cm) ($p = 0.02$).

All recurrences in both groups developed within four years following the diagnosis. There was no difference in local recurrence rates between groups ($p = 0.98$) (Table I). However, the power of the study was only 0.4 because of the small number of patients.

In Group 1, local recurrence occurred in 3 patients:

- A 46-year-old female patient (Stage IA) had local recurrence on her right distal femur two months after the index surgery; it was treated with intralesional curettage, plate fixation and PMMA filling. She was alive and free of disease 87 months after the second procedure (Fig. 1a-1c).
- A 52-year-old male patient (Stage IA) had local recurrence on his left proximal femur 8 months after surgery; it was treated with intralesional curettage and cauterization. He was free of disease 28 months after the second procedure.
- A 61-year-old male patient (Stage IA) had recurrence on his left proximal tibia 26 months after the first procedure. This was treated with intralesional curettage, cauterization and PMMA application and the patient was free of disease 26 months after the second procedure (Fig. 2a-2c).

There were also 3 local recurrences in Group 2:

- A 56-year-old female patient (Stage IB) had a pathologic fracture on admission and was treated

Table I. — Summary of outcome data

	Intralesional curettage (n = 13)	Wide Resection (n = 17)	p value
Mean lesion size (cm)	6	12	0.02
Mean patient age (years)	46	37	0.35
Local recurrences	3 (23%)	3 (17.6%)	1
Number of patients with complications	0 (0%)	1 (5.9%)	0.84
Follow-up (months)	73	75	0.03
Metastasis or death	0 (0%)	2 (11.7%)	0.02

with wide resection and endoprosthesis replacement. Four years after the index surgery, there was recurrence on the left proximal humerus. Wide resection was performed and treated with open reduction and internal fixation using a vascularized fibula graft. She was free of disease 79 months after the second procedure.

- A 68-year-old female patient (Stage IB) had recurrence on the left femur diaphysis after 11 months, which was treated with wide resection, PMMA application and intramedullary nailing. She was alive, 29 months after the second procedure.
- A 24-year-old female patient (Stage IA) had recurrence on the left proximal tibia 8 months after the index surgery. The patient refused amputation and died from unrelated causes 38 months after the recurrence date.

The only complication noted was a transient radial nerve palsy in one patient in Group 2. The complication rates were not significantly different between the groups ($p > 0.05$).

There was a statistically significant difference between the groups with respect to the metastasis rate ($p = 0.02$). There was no metastasis in Group 1. In Group 2, two patients who had local recurrence were also found to have lung metastasis at that time. A 68-year-old female patient (Stage IB) had lung metastasis 11 months after the initial surgery. She was alive with the disease 29 months after the recurrence date. A 24-year-old female patient (Stage IA) who had local recurrence 8 months after the index surgery also had lung metastasis. Amputation was refused and the patient died from unrelated causes 38 months after the recurrence date.

DISCUSSION

Surgery is the gold standard treatment for low-grade chondrosarcoma of long bones. Grade I chondrosarcoma is usually associated with a less aggressive clinical course and a lower recurrence rate, resulting in survival rates over 85% after 5 years and from 79% to nearly 100% after 10 years (3,4,8,13,15). Available treatment methods are intralesional curettage, alone or combined with local adjuvants, marginal resection, and en bloc resection with biological or endoprosthesis reconstructions (3,6,16,19,22). The outcome of the treatment is related to the anatomic site, histological grade, tumour size and the adequacy of surgery (3,10). Achieving an adequate surgical margin is the most important factor for successful treatment.

Several studies have suggested that intralesional resection with or without adjuvant therapy may be adequate for Grade I chondrosarcomas (3,14,16), although some authors have reported that intralesional treatment leads to higher local recurrence rates (4,10,15,19,21,22,23). However, some studies reporting local recurrence and poor prognosis have included mixed, low, intermediate and high-grade lesions. They have also included lesions of the pelvis, foot, hand and axial skeleton which have proven biological aggressiveness and for which intralesional treatment is generally considered inappropriate. As a result, these studies have pointed out high local recurrence rates and poor prognosis (1,19,25).

Intralesional resection consisted of simple curettage or curettage combined with a local adjuvant (cauterization and use of polymethylmethacrylate).

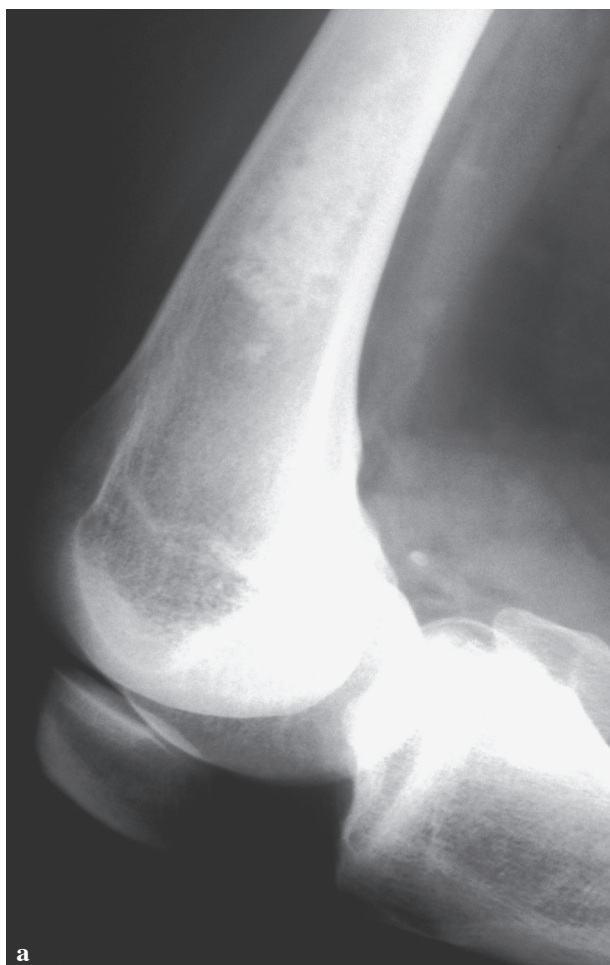


Fig. 1a. — Lateral knee radiograph of a 46-year-old female patient showing an irregular calcification area at the distal diaphyseo-metaphyseal region of the right femur.

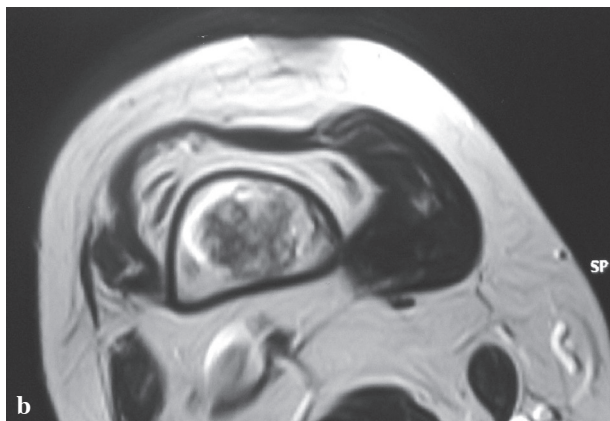


Fig. 1b. — Coronal T2-weighted MR image of the right distal femur, showing an intramedullary, lobulated heterogeneous lesion with high and low signal intensities.

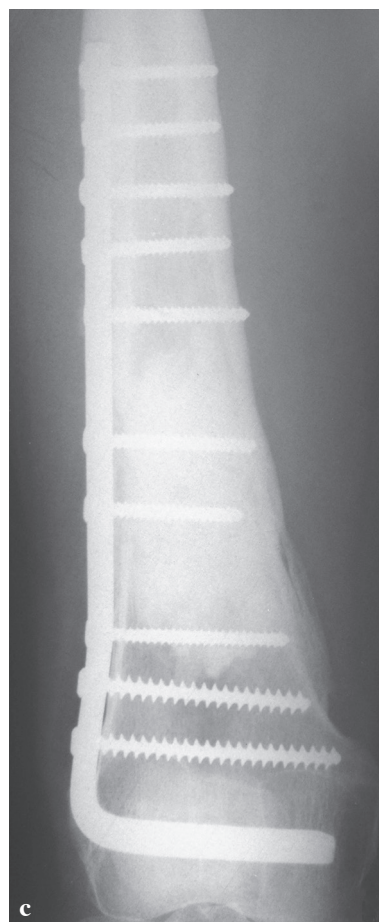


Fig. 1c. — Postoperative AP radiograph of the right distal femur showing filling with PMMA cement and reinforcement with a blade plate and screws.

Several authors have underlined the need for adjuvants after curettage to achieve local tumour control (2,22,27). Conservative surgery for special indications with adjuvant use of PMMA has been found to offer satisfying local tumour control in the long bones (25). In the current study, three patients in the intralesional group had local recurrence ; two of them had been treated without PMMA. In another study, patients who had undergone intralesional curettage without application of PMMA developed a local recurrence within a mean of 36 months (25).

En bloc resection with wide surgical margins and skeletal reconstruction has been advocated, often resulting in morbidity and functional deficits (10,19). After local recurrence, limb salvage procedures



Fig. 2a. — AP knee radiograph of a 61-year-old male patient demonstrating a mildly sclerotic expansile lesion in the left proximal tibia.

may become difficult and complications may occur (19). Several studies have reported lower complication rates after intralesional treatment versus wide resection (1,3,16,22). The findings of the current study, as well as the literature support the view that intralesional treatment provides the potential for improved functional outcomes and decreased complications compared with resection and reconstruction. In the current study there was only one non-specific complication, which was a transient radial nerve palsy in the wide resection group. Several studies have reported high complication rates after major endoprosthesis or allograft reconstructions (2,17,26), but in the current study no complications were seen related to the reconstructions.

Previous studies have shown that the majority of patients who have inadequate surgery will experience local recurrence within 2 years (5,12). Some authors have claimed that a follow-up of 2 years is adequate, while others consider 5 years as a minimal

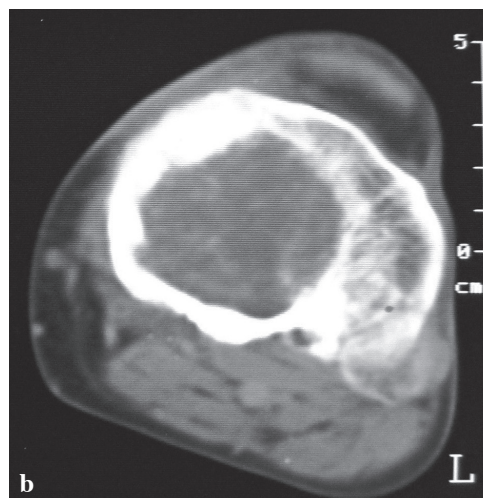


Fig. 2b. — Axial CT view of the proximal tibia, showing an expansile lucent lesion with sclerotic margins.



Fig. 2c. — Post-operative lateral radiograph of the knee showing PMMA cement filling in the proximal tibia after curettage.

requirement (3,11,24). The follow-up in the current study was mean 74 months (range : 24-186 months).

Local recurrences do not always result in metastases and/or death (19). Lee *et al* did not find correlation between resection margins and overall survival,

local recurrence rate or rate of metastases (15). In another study, Streithürger *et al* concluded that intralesional curettage increased the rate of local recurrence, although the resection margins had no influence on the overall survival or on the rate of metastasis (25). Sometimes however, local recurrence may influence survival. Schwab *et al* found that 29% of patients with local recurrence died of the disease (23). In the current study, two patients (Stage IB/Stage IA) in the wide resection group had lung metastasis, versus none in the other group. The metastasis rates were significantly different in the two groups.

However, none of the patients died because of the chondrosarcoma ; only one of the patients who had lung metastasis died in the wide resection group, but from unrelated causes.

In this study, no difference was observed in the local recurrence rates, between patients treated with intralesional resection or wide resection.

This retrospective study had a major weakness : the relatively small number of patients gave it a low statistical power. Multicentric, prospective studies with larger series are needed to confirm and show the effectiveness and safety of intralesional treatment for low grade chondrosarcomas of the appendicular skeleton.

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