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Journal of the Chinese Medical Association 80 (2017) 178–182

www.jcma-online.com

Original Article

Intralesional curettage of central low-grade chondrosarcoma: A midterm follow-up study

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Received June 2, 2016; accepted August 18, 2016

Abstract

Background: The aim of this study was to review the experience of surgical treatment of low-grade chondrosarcoma and to assess the long-term oncological and functional outcomes between intralesional curettage and wide excision.
Methods: We included 11 patients with central low-grade chondrosarcoma lesions treated with intralesional curettage or wide excision from 1998 to 2013. Seven patients were treated with intralesional curettage and local adjuvant treatment (Group A), and four patients were treated with wide excision and reconstructive surgery (Group B). The mean age of patients was 43.8 ± 17.6 years (range, 20–71 years), and the mean duration of follow-up was 84.4 ± 47.6 months (range, 48–194 months).
Results: Group A had a significantly lower complication rate than Group B; three complications were documented in Group B (0% vs. 75%, $p = 0.024$). The operative time (177.1 hours vs. 366.3 hours, $p = 0.010$) and the hospital stay (6.6 days vs. 12.5 days, $p = 0.010$) were significantly shorter in Group A. There was one local recurrence in Group A without statistical significance. Also, there were no differences between intralesional curettage and wide excision with respect to the blood loss. No metastasis disease occurred in either group during the follow-up period. The Musculoskeletal Tumor Society (MSTS) scores in Groups A and B were 99.0 ± 2.5 and 94.2 ± 4.2, respectively, with statistically significant difference ($p = 0.048$).
Conclusion: Extended intralesional curettage has the benefits of good MSTS score, shorter operative time, shorter hospital stay, and lower complication rate without increasing local recurrence in central low-grade chondrosarcoma. For central low-grade chondrosarcoma, we suggest extended curettage to decrease soft tissue damage and surgical risk.
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Keywords: extended curettage; low-grade chondrosarcoma; wide excision

1. Introduction

Chondrosarcoma is the second most common type of malignant bone tumor and usually appears between the ages of 30–60 years.[1] The tumor is characterized by cartilage formation. The pelvis, femur, and shoulder girdle are the most common sites of chondrosarcoma; the incidence at spine was reported at about 12%.[2,3] Central chondrosarcoma may grow primarily in the medullary cavity of bone. The prognosis of central chondrosarcoma is related to its pathophysiology grading. The histologic classification of Evans et al[4] depends on cellularity, cellular atypia, and mitosis. Grade 1 chondrosarcoma is classified as low-grade lesions, and grade 2 and grade 3 are classified as high-grade neoplasms. The principle modality of treatment for chondrosarcoma is en bloc surgical

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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http://dx.doi.org/10.1016/j.jcma.2016.10.002
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resection because these tumors are resistant to chemotherapy and radiation treatment.[5,6] Recently, low-grade chondrosarcoma of long bones has increasingly been treated with intralesional curettage and local adjuvant therapy due to its slow growth and low metastatic tendency.[5,7] However, some authors argued that inadequate local treatment with an intralesional management results in higher local recurrence.[8–10] We hypothesized that advanced intralesional treatment, using chemical agents and cryoablation, for central grade I chondrosarcomas would have similar rates of local recurrence and metastasis as wide excision treatment. The aims of this retrospective study were to review the experience of surgical treatment of central low-grade chondrosarcoma, to assess the long-term clinical and oncological outcomes between intralesional curettage and wide excision, and to compare the results of the two surgical managements.

2. Methods

A retrospective search of our departmental database identified 48 patients with low-grade chondrosarcoma from 1998 to 2013. We excluded 3 patients with locally recurrent or metastatic disease at present and 22 patients diagnosed with so-called borderline, Grade 1–2 chondrosarcoma from preoperative biopsy. In addition, we excluded three patients with secondary chondrosarcoma, two with extraosseous lesions, and seven with stage IB chondrosarcoma.[11] The final cohort included 11 patients whose medical records, histological sections, and radiography were reviewed.

The patients were divided into two groups; patients in Group A ($n = 7$) were treated with extended intralesional curettage, whereas patients in Group B ($n = 4$) were treated with wide excision and reconstructive surgery (Table 1). The tumors affected appendicular bone in eight patients (75%) and axial bone in three patients (25%). There were three distal femurs (two in Group A and one in Group B), one proximal femur (Group A), three proximal humerus (two in Group A and one in Group B), one humeral shaft (Group B), and three acetabulums (two in Group A and one in Group B).

In our database, low-grade chondrosarcoma represented 48.5% (48/99) of all chondrosarcoma patients, and stage IA chondrosarcoma accounted for 22.9% of low-grade patients. There were six male and five female patients with a mean age at surgery of 43.8 ± 17.6 years (range, 20–71 years), with a significant difference ($p = 0.006$) in age between treatment cohorts (Table 2). The average duration of follow-up for the patients was 68.7 ± 50.9 months (range, 19–194 months). The average lesion size was 8.9 ± 2.7 cm (range, 3–18cm, $p = 0.216$).

The surgical indication in our institution was painful lesion with aggressive radiologic patterns. All the patients had preoperative pathology, either needle biopsy or excisional biopsy, with the specimen reviewed by two experienced pathologists. Imaging study, computed tomography (CT) scan, or magnetic resonance imaging (MRI) was also obtained to evaluate bone expansion, tumor length, and active periostitis. Depending on the site and size of the tumor, we explained the surgical management options, extended curettage and wide excision, and their respective disadvantages and advantages to the patient and/or their family. The surgeon and patient together made the final surgical management decision. For the acetabulum lesion, two of the three patients chose intralesional curettage to minimize the surgical risk. For the periarticular chondrosarcoma, we performed reconstructive surgery after wide excision to restore the function of the patient. In some

Table 2
Summary of the outcome data.

	Group A[a] ($n = 7$)	Group B[b] ($n = 4$)	Total	p
Sex (M/F)	3/4	1/3		
Age (y)	34.0 ± 13.3	61.0 ± 7.7	43.8 ± 17.6	0.001
Lesion size (cm)	6.9 ± 5.1	12.5 ± 3.1	8.9 ± 2.7	0.216
Operative time (mins)	177.1 ± 83.5	366.3 ± 98.4	245.9 ± 127.3	0.010
Blood loss (mL)	428.6 ± 485.5	1162.5 ± 1164.3	695.5 ± 827.8	0.151
Follow-up (months)	72.9 ± 63.1	61.3 ± 23.2	68.7 ± 50.9	0.336
Local recurrence	1	0	1	0.636
Complication	0	3	3	0.024
Metastasis or death	0	0	0	
Hospital stay (d)	6.6 ± 2.8	12.5 ± 3.1	8.7 ± 4.1	0.010
MSTS scores (%)	99.0 ± 2.5	94.2 ± 4.2	97.3 ± 3.9	0.048

F = female; M = male; MSTS = Musculoskeletal Tumor Society.
[a] Group A = patients treated with intralesional curettage.
[b] Group B = patients treated with wide excision.

Table 1
Demographic data of the patients in the study.

Patient	Sex	Age (y)	Location	Follow-up time (months)	Size (cm)	Treatment	Additional treatment	MSTS score
1	F	36	Acetabulum	140.0	5	Curettage	Allograft	93%
2	M	36	Distal femur	48.0	8	Curettage	Liquid nitrogen, allograft	100%
6	M	20	Distal femur	58.0	18	Curettage	Liquid nitrogen, tibia allograft	100%
4	F	21	Acetabulum	49.0	6	Curettage	Autograft, total hip arthroplasty	100%
10	F	24	Proximal humerus	119.1	4.6	Curettage	Allograft	100%
11	F	55	Proximal humerus	194.1	4	Curettage	Allograft	100%
7	M	46	Proximal femur	60.4	3	Curettage	Allograft, DCP	100%
8	F	54	Distal femur	71.3	7.5	Wide excision	Nitrogen, total knee arthroplasty	90%
9	M	71	Proximal humerus	88.2	10	Wide excision	Extracoporeal irradiation, broad DCP, cement	93%
5	M	63	Humeral shaft	50.4	6	Wide excision	Liquid nitrogen, philus locking plate	100%
3	F	56	Acetabulum	50.0	12	Wide excision	Total hip arthroplasty, extracoporeal irradiation	93%

DCP = dynamic compression plate; F = female; M = male; MSTS = Musculoskeletal Tumor Society.

Fig. 1. Adjuvant treatment with cryotherapy. Liquid nitrogen was sprayed out from the can toward the remaining cavity. The soft tissue was protected with warm gauzes.

patients with large bone defect after excision, we used recycled bone prepared by extracorporeal irradiation with 20,000 rad or liquid nitrogen soaking. For the patients of curettage, we removed the lesions macroscopically using curets and high-speed burr when the margin was well protected with warm gauze to prevent contamination by spray (Fig. 1). The margin of the lesion was determined by both the cortical border and intramedullary canal, which were mapped by MRI or CT scan preoperatively. A solution of phenol was applied to the remaining bone cavity for 3 minutes with a surgical swab, and then the cavity was rinsed with 95% ethanol solution. Subsequently, massive normal saline (> 2000 mL) irrigation was performed. Cryotherapy with liquid nitrogen was used in selected patients who could be safely applied without injury of surrounding soft tissues. Finally, the defect that was made by curettage was filled with allograft bone chips, and if necessary, internal fixation was applied to reinforce the affected bone. For Patients 3, 4, and 8, arthroplasty was also performed to address destruction of articular surface (Fig. 2).

The primary outcome was local recurrence or metastasis. The secondary outcome included functional outcome based on Musculoskeletal Tumor Society (MSTS) score. Data for the study were retrieved from hospital records, maintained oncological files, surgical files, and clinical examination at the most recent outpatient clinic. These data included surgical time, blood loss, complications, incidence of local recurrence, and distant metastases. Approval for the study was obtained from the Institutional Review Broad. We analyzed the resulting data using Student t test, Fisher's exact test, and analysis of variance, with a significance threshold of $p < 0.05$ using STATA software version 12.1 (STATA, College Station, Texas, USA).

3. Results

The average amount of intraoperative blood loss was 428.6 ± 485.5 mL in Group A and 1162.5 ± 1164.3 mL in Group B ($p = 0.151$). There was a significant difference in the operative time ($p = 0.010$) between Group A (177.1 ± 83.5, range 60–320 minutes) and Group B (366.3 ± 98.4, range 300–510 minutes). Additionally, the hospital stay was significantly shorter ($p = 0.048$) in Group A (6.6 ± 2.8, range 4–12 days) than in Group B (12.5 ± 3.1, range 9–16 days).

3.1. Complications

There were three complications in Group B, including one nonunion at distal femur (Patient 8), one hip dislocation at

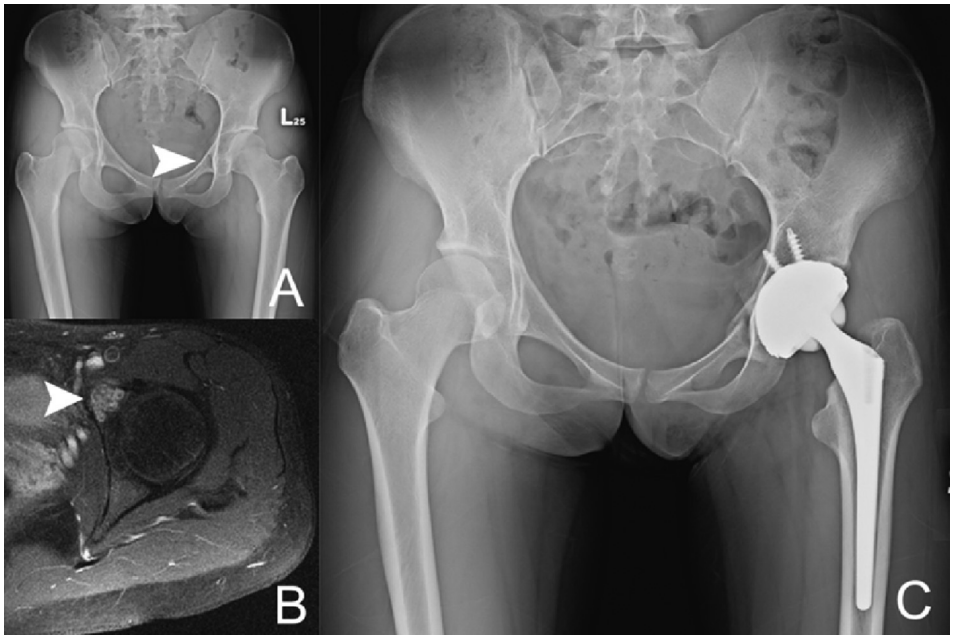

Fig. 2. (A) Patient 4 had the tumor lesion at left acetabulum (arrow); (B) T2-weighted MRI showed periarticular involvement (arrow); (C) total hip arthroplasty was done after intralesional treatment with adjuvant therapy. MRI = magnetic resonance imaging.

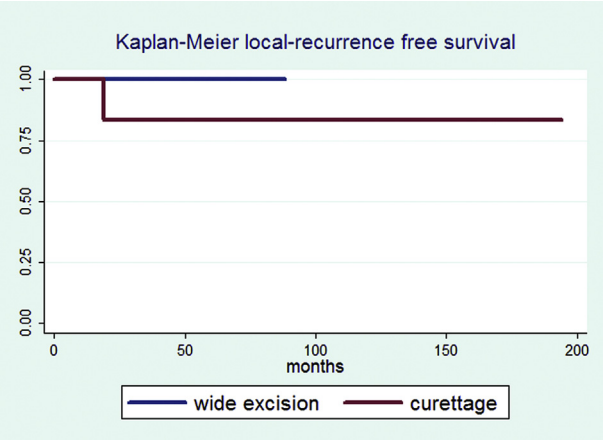

Fig. 3. The local recurrence-free survival was 85.7% in Group A, patients treated with intralesional curettage, versus 100% in Group B, patients treated with wide excision ($p = 0.638$).

acetabulum (Patient 3), and one periprosthetic fracture at proximal humerus (Patient 9). No complication was documented in Group A. The complication rate was significantly higher in Group B than in Group A (0% vs. 75%, $p = 0.024$).

3.2. Outcomes

The MSTS score was significantly better ($p = 0.048$) in Group A ($99.0 \pm 2.5\%$) than in Group B ($94.2 \pm 4.2\%$).

3.3. Local recurrence

There was one local recurrence at distal femur in Group A (Patient 6), and the duration of local recurrence was 19 months. There was no difference ($p = 0.636$) in local recurrence rate between the study cohorts (Fig. 3). The local recurrence-free survival estimate was $90.0 \pm 9.5\%$ (95% confidence interval = 0.4730–0.9853). The overall recurrence rate in our study was 9.1%.

3.4. Metastasis and survival

There was no metastasis in either group. Patient 9 died of another disease (pneumonia) during the follow-up, at 88 months. No patient died due to chondrosarcoma during the follow-up in both the groups.

4. Discussion

The principle of surgery for high-grade sarcoma is to obtain a wide margin including amputation and wide excision with reconstruction. However, the surgical management of low-grade chondrosarcoma has remained under debate in recent years due to its low potential metastasis and local recurrence. These characteristics of low-grade chondrosarcoma provide the possibility of a more conservative approach with less soft tissue damage. Therefore, some studies are advocated using extended intralesional curettage, which was an option for benign aggressive tumors of bone, for patients with low-grade chondrosarcoma.[12–15] There are several adjuvant methods for extended intralesional curettage, such as phenol application,[13] cauterization,[12,15] or cryotherapy[16] followed by either cementation[17] or bone grafting. Previous studies have demonstrated that these adjuvant treatments are necessary for control of local recurrence.[14,18] In our patients, cauterization with phenol and alcohol was routinely launched in the curettage technique. However, liquid nitrogen was used in selected patients due to comorbid condition or location of the tumor lesion. Also, the surrounding soft tissue with warm gauze was well covered for protection when applying liquid nitrogen. Under this condition, we performed cryotherapy in two patients (28.6%), and we suggest that long bone was good indication for adjuvant cryotherapy due to its anatomy and the ease of application.

We believe either wide excision or extended intralesional curettage could be used for low-grade chondrosarcoma only if the tumor lesion would be totally removed. There was one patient of recurrence treated with curettage in our study. That case had cortical breakthrough which was noted intraoperatively. Meftah et al reported that soft tissue extension was strongly associated with local recurrence after curettage and cryotherapy.[19] In our patients, we regarded cortical breakthrough and soft tissue extension of low-grade chondrosarcoma as adverse factors for local control.

Some authors reported that local treatment led to higher local recurrence rates due to an inadequate surgical margin.[8–10] Some others reported that intralesional curettage wound not increase the recurrence rates.[12,17,19,20] The discrepancy of the results may be related to the extent of the curettage. The overall recurrence rate of low-grade chondrosarcoma after treatment in our study was 9.1%, and the respective recurrence rate was 14.3% in the Group A. There was no recurrence in Group B, and there was no statistically significant difference ($p = 0.636$) in the study cohort. However, some studies suggested that axial lesion of central low-grade chondrosarcoma was an adverse factor for local recurrence after curettage.[19,20] In our experience, axial lesions are difficult to approach on anatomy, and the local adjuvant treatment may be difficult to achieve. We agreed that long bone was good indication for extended intralesional curettage with adjuvant local treatment.

In our study, the patient and the surgeon decided on the index surgery after evaluating surgical risk and possibility of local recurrence. The patient age was significant lesser in the Group A ($p = 0.001$). The young patients might prefer host bone restored and less soft tissue damage in order to reserve function even though they had to take the risk of local recurrence. Tumor size showed no statistically significant difference ($p = 0.177$) between the groups. We expected that patients treated with extended curettage would have less blood loss; however, our study showed no significant difference ($p = 0.151$). It might be easy bleeding of bone marrow which resulted in increasing blood loss during curettage. The surgical time was shorter in Group A ($p = 0.01$). Also, Group A had a significantly short hospital stay ($p = 0.010$). This result was encouraging and implied less soft tissue damage and more rapid recovery.

The overall MSTS score in our study was 97.3%. The MSTS score after curettage treatment was 99%, better than that in previous studies, which ranged from 90% to 93%.[7,16,21] Two cohort studies showed higher MSTS scores for patients who underwent intralesional curettage than those who underwent wide resection (98% vs. 84% and 89% vs.72%);[12,22] in our study, we had similar results with 99% vs. 94%. Additionally, the MSTS score was significantly different ($p = 0.048$) between the two groups.

Previous studies have reported lower complication rates after intralesional treatment than those after wide resection.[12,13,23] In our study, there was no complication in the Group A; on the contrary, in Group B, three complications were documented, including nonunion of recycled bone, dislocation of hip prosthesis, and periprosthetic fracture, after minor trauma. Several studies also reported high complication rates after major endoprosthetic or allograft reconstructions.[24,25] Due to the small sample size of our study, the difference between complication rates had no statistical significance. We believe that management with wide excision and reconstruction led to a higher complication rate. On the contrary, extended curettage might have lower complication rate and reduce subsequent surgical procedure in central low-grade chondrosarcoma.

Our study had several limitations. First, this was a retrospective analysis. Second, the study group sample size was small. The rarity of this pathology makes it difficult to enroll a large number of patients in a short period; therefore, multi-institution study should be considered in the future. Third, comparison of different treatments (curettage vs. wide excision) was not randomized and had no firm protocol. Finally, the length of follow-up of our patients was considerable, but still not long enough to make definitive conclusions about oncological outcomes.

In conclusion, we found that extended curettage treatment provided safe procedure for central low-grade chondrosarcoma and had the benefits of shorter hospital stay, shorter operative time, lower complication rate, and good functional score without increasing local recurrence. For central low-grade chondrosarcoma, extended curettage may be the first choice in long bone and may be a good elective management in the axial skeleton.

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