CLINICAL RESEARCH

Intralesional Excision versus Wide Resection for Giant Cell Tumor Involving the Acetabulum

Which is Better?

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Abstract

Background Because of the anatomic complexity of the pelvis, there is no standard surgical treatment for giant cell tumors (GCTs) of the pelvic bones, especially in the periacetabular region. Treatment options include intralesional curettage with or without adjunctive techniques and wide resection. The best surgical treatment of a pelvic GCT remains controversial.

Questions/purposes We compared wide resection and intralesional excision in terms of (1) local control, (2) function, and (3) complications.

Methods We retrospectively identified 27 patients with periacetabular benign GCTs who underwent surgery from July 1999 to July 2009. Intralesional surgery was performed in 13 patients and wide resection in 14 patients. We determined surgical complications, local disease control, and Musculoskeletal Tumor Society (MSTS) 93 functional score. The minimum followup was 18 months (mean, 50 months; range, 18–121 months).

Results Four of 13 patients who had intralesional surgery and none of 14 who had wide resection had local recurrence. The mean functional score was 24 for the 13 patients who underwent intralesional surgery and 22 for the 14 patients who had wide resection. One minor and one major complication occurred among patients who underwent intralesional surgery and one minor and six major complications occurred among patients who underwent wide resection.

Conclusions Even with a higher complication rate with wide resection and prosthetic reconstruction, we believe the lower local recurrence rate makes wide resection a reasonable option for patients with extensive and/or aggressive GCTs involving the acetabulum.

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

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Introduction

Pelvic giant cell tumors (GCTs) are rare, accounting for only 1.5% to 6.1% of bone GCTs [31, 35, 44]. The relatively few articles on GCTs of the pelvis report only five to 19 cases [5, 14, 23, 25, 30, 34, 37]. Owing to their infrequency, the best treatment of pelvic GCTs is controversial. Although a GCT is benign, the aggressiveness of the tumor leads to local recurrence in 7% to 75% of patients [8, 26, 27, 29]. If the tumor is located in a complex region, such as the periacetabular region and spinal column, recurrence of the tumor often makes it unresectable. The risk of malignant transformation ranges from 7% to 25% [13, 22, 33], and 2% to 9.1% metastasize either after radiation therapy [8, 32] or after several local recurrences [15, 24, 32].

Because of the complex anatomy of the pelvic region and the variable aggressiveness of GCTs, there is no standard treatment procedure for pelvic GCTs, especially in the periacetabular region. Treatment options include radiation therapy [11, 12], intralesional curettage with or without adjunctive techniques [5, 14, 23, 25, 30, 34], and wide resection [5, 14, 25, 30, 34]. Radiation eliminates surgical complications but may cause local injuries such as early and late skin changes, late pathologic fractures, and neuritis [11, 12, 25, 36]. Although curettage preserves the integrity of the pelvis, the local recurrence rate in this region ranges from 6.3% to 43% [5, 14, 25, 30, 34], especially in the acetabulum. Wide resection is intended to prevent local recurrence [5, 14, 25, 30, 34], but it increases surgical morbidity with complications such as superficial infections (skin sloughs and fistulas), deep infection, hematoma, functional deficits, and problems resulting from reconstruction for iliofemoral stability [16, 18, 21, 28]. The scarce literature on this topic provides limited guidance for surgeons to achieve maximum local control and low surgical morbidity in patients with pelvic GCTs.

We compared intralesional excision and wide resection in terms of local control, function, and complications.

Patients and Methods

We retrospectively reviewed the records of all 47 patients who had a primary benign GCT involving the acetabulum and who were treated with surgery from July 1999 to July 2009. The indications for surgery were: (1) no pelvic neurovascular involvement; (2) no visceral organ involvement; and (3) the ability to tolerate surgery. The relative contraindications for surgery were: (1) pelvic neurovascular involvement; (2) visceral organ involvement; and (3) inability to tolerate surgery. For this study we included patients with the following criteria: (1) those with lesions greater than 5 cm in maximum dimension measured by CT or MRI; (2) no prior treatments of the tumor; (3) complete clinical, radiographic, and pathologic records; and (4) minimum followup of 12 months after surgery. We excluded 20 of the 47 patients for the following reasons: five because their tumor sizes were smaller than 5 cm; 10 who had previous surgery in other hospitals and transferred to our hospital for treatment of local recurrence; four owing to insufficient clinical information; and one who was lost to followup. This left 27 patients for study. There were nine males and 18 females with a mean age of 29.2 years (range, 15–47 years) (Table 1). Thirteen patients were treated with intralesional surgery and 14 underwent wide resection. The minimum followup was 18 months (mean, 50 months; range, 18–121 months) for all 27 patients. Followup was 18 months (mean, 55 months; range, 18–121 months) for

patients treated with intralesional surgery and 18 months (mean, 45 months; range, 18–120 months) for patients undergoing wide resection. We had prior approval of our Institutional Review Board.

The diagnosis of GCT was established based on the clinical information and imaging studies and confirmed by needle biopsy or open biopsy before surgery and pathology examination after surgery. The GCTs were staged radiographically according to the system of Campanacci [7]. Grade I indicates an intraosseous lesion; Grade II, an intraosseous lesion with cortical thinning and expansile borders; and Grade III, a lesion extending extraosseously forming a soft tissue mass. There were eight patients with Grade II lesions and 19 with Grade III lesions included in this series. The size of the tumors was estimated by measurement of its largest dimension from imaging studies. Median tumor size was 9.6 cm (range, 7–21 cm). According to the classification of pelvic tumors of Enneking and Dunham [16], tumor location and resection were classified as Type I (ilium), Type II (acetabulum), and Type III (pubis/ischium), and their combinations. The current series included Type II lesions in one patient, Type I + II in nine patients, Type II + III in 15 patients, and Type I + II + III in two patients. Patients were considered candidates for wide resection if they met all of the following criteria: (1) lesions extended into the neighboring soft tissue (Campanacci Grade III, aggressive); and (2) the medial and superior walls of the acetabulum were destroyed and there was no place left to hold the cement after curettage estimated by imaging studies.

All surgeries were performed by one surgeon (GW). The intralesional surgery group had two subtypes: one where curettage was planned and performed and the other where wide resection was planned but was not possible intraoperatively, resulting in partial resection and intralesional curettage. The intralesional group included the 13 patients treated with curettage and with partial resection and curettage. We performed curettage in eight patients with periacetabular lesions who underwent curettage, cementation, and THA. In the curettage group, a high-speed burr drill was used to remove the bony crest inside the tumor cavity after extensive curettage. We performed partial resection and curettage in five patients, including two young patients who underwent reconstruction by hip fusion and the other patients by modular pelvic prostheses. Fourteen patients underwent wide resection, including three who received wide resection and recycled tumor bone implantation with cemented THA (Fig. 1) and 11 patients who received wide resection and modular pelvic prosthetic reconstruction (Fig. 2). For the three patients who underwent wide resection and recycled tumor bone implantation, the resected tumor bone was immersed in preheated 10% saline at 65° for 20 minutes after eliminating the tumor tissue [9, 38, 40].

Table 1. Clinical data and surgical results for 27 patients with CGTs involving the acetabulum

Patient number	Gender/age (years)	Location*	Grade†	Treatment	Margin	Reconstruction	Complication	Followup (months)	Function‡	Recurrence or metastasis
1	M/25	II + III	III	Resection	Wide	Recycled + THA		120	21	
2	F/25	II + III	III	Resection	Wide	Hemipelvic		61	16	Multiple lung metastases
3	F/20	II + III	III	Resection	Wide	Hemipelvic	Delayed infection	52	16	
4	F/29	I + II	II	Curettage	Intra-lesional	THA		48	24	
5	F/36	II + III	III	Resection + curettage	Intra-lesional	Hip fusion		121	20	
6	M/40	I + II	III	Resection	Wide	Recycled + THA	Wound healing disturbance	47	22	
7	F/27	I + II	III	Resection	Wide	Hemipelvic		64	23	
8	F/28	II + III	III	Resection	Wide	Recycled + THA	Bone nonunion	75	23	
9	F/42	I + II	III	Resection	Wide	Hemipelvic		40	25	
10	M/27	I + II	II	Curettage	Intra-lesional	THA		80	25	
11	F/21	II	II	Curettage	Intra-lesional	THA	Thrombosis	119	24	Recurrence
12	F/31	II + III	II	Curettage	Intra-lesional	THA		45	29	Recurrence
13	M/32	II + III	III	Resection	Wide	Hemipelvic	Dislocation	44	24	
14	F/15	II + III	III	Resection + curettage	Intra-lesional	Hip fusion		113	18	Recurrence
15	M/35	I + II + III	III	Resection + curettage	Intra-lesional	Hemipelvic	Wound healing disturbance	41	24	
16	F/47	I + II	II	Curettage	Intra-lesional	THA		30	24	
17	M/26	II + III	III	Resection + curettage	Intra-lesional	Hemipelvic		31	24	
18	F/15	II + III	III	Resection	Wide	Hemipelvic	Would healing disturbance	24	25	
19	F/16	II + III	III	Resection	Wide	Hemipelvic		24	23	
20	F/47	II + III	III	Resection	Wide	Hemipelvic		23	22	
21	M/32	I + II	II	Curettage	Intra-lesional	THA		22	23	Recurrence
22	F/28	I + II	III	Resection	Wide	Hemipelvic		19	22	
23	M/26	II + III	II	Curettage	Intra-lesional	THA		21	23	
24	F/18	I + II + III	III	Resection	Wide	Hemipelvic	Would healing disturbance	21	23	
25	F/29	II + III	III	Resection + curettage	Intra-lesional	Hemipelvic		18	24	
26	F/45	II + III	III	Resection	Wide	Hemipelvic	Would healing disturbance	18	22	
27	M/27	I + II	II	Curettage	Intra-lesional	THA		20	26	

* According to the classification system of Enneking and Dunham [16]; † according to the Campanacci grading system [7]; ‡ according to MSTS 93 [17]; M = male; F = female.

Fig. 1A–C (**A**) A plain film shows an osteolytic lesion in the left pubis, ischium, and peri-acetabular region of a 28-year-old female patient. This large lesion clearly involved the hip. (**B**) A CT scan shows the tumor involvement in the acetabulum where it produced a huge soft tissue mass. (**C**) The pelvic defect was reconstructed using recycled tumor bone implantation and a cemented THA was performed after tumor resection.
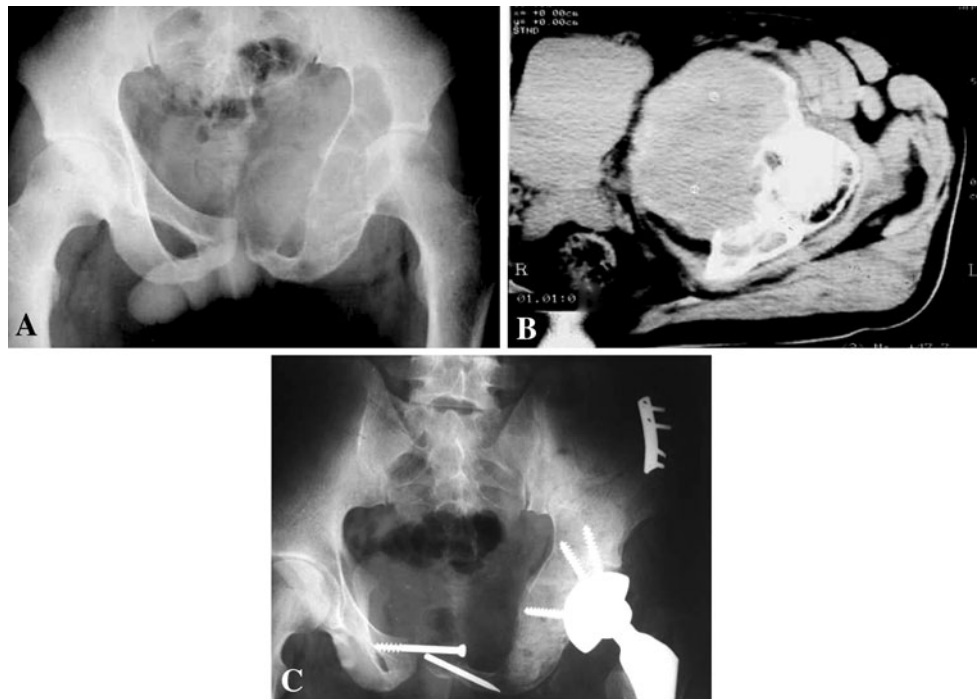
We did not use an embolization procedure because the tumor side of the common iliac artery was temporarily blocked with a vascular clamp to control bleeding in all patients during surgery. The common iliac artery was mobilized and encircled with nylon tape for temporary occlusion during removal of the tumor [19, 39]. Adjuvant therapy such as chemotherapy or radiotherapy was not used in 26 patients; one patient refused additional surgery for the recurrent tumor and was treated with radiotherapy.

In one patient who presented with multiple benign lung metastases confirmed by biopsy with the assistance of thoracoscopy at the time of surgery, the number and size of the lung foci after the tumor resection were reduced and the patient remained stable with no progression of lung foci at the last followup.

We obtained followup information during regular examinations and imaging of the patients every 3 months, and questionnaires were sent to the patients. At each visit, we assessed complications and local disease control. Local recurrence was established by evidence of new bone involvement assessed by radiographs or CT. If we suspected a tumor on radiographs or CT, we performed a biopsy. At the last followup, we obtained MSTS 93 scores [17]. The MSTS 93 score measures patient activity, including pain, function, emotional acceptance, supports, walking ability, and gait. Each of these six variables was assessed on a five-point scale, giving a maximum score of 30 points. A major complication was defined as one that necessitated additional surgical procedures. A minor complication was defined as a problem that necessitated nonoperative management.

Results

Four of the 13 patients who had intralesional surgery had local recurrences 10 to 17 months after surgery whereas none of the 14 patients treated with wide resection had recurrences during the followup period. Of the four patients with recurrences, one initially had a partial resection and curettage and the other three underwent curettage and cementation. One of these four patients who had previously undergone hip fusion refused additional surgery after the local recurrence and received radiation therapy; the other three patients underwent wide resection after recurrence. The patient treated with radiation was free of disease 113 months after the latest treatment. The other three patients were free of disease 6, 22, and 103 months after the latest treatment.

The mean MSTS functional score at last followup was 23 (range, 16–29) for all patients. The mean functional score was 24 for the 13 patients who underwent intralesional surgery and 22 for the 14 patients treated with wide resection.

Nine of the 27 patients had complications (Table 2). One minor and one major complication occurred in the group of patients who underwent intralesional surgery and one minor and six major complications occurred in the group of patients who underwent wide resection. Of these nine patients, seven underwent additional surgery to treat the complications. One patient with a deep infection eventually had the prosthesis removed because of uncontrolled infection after wound débridement and drainage. Five patients with wound healing problems were treated by
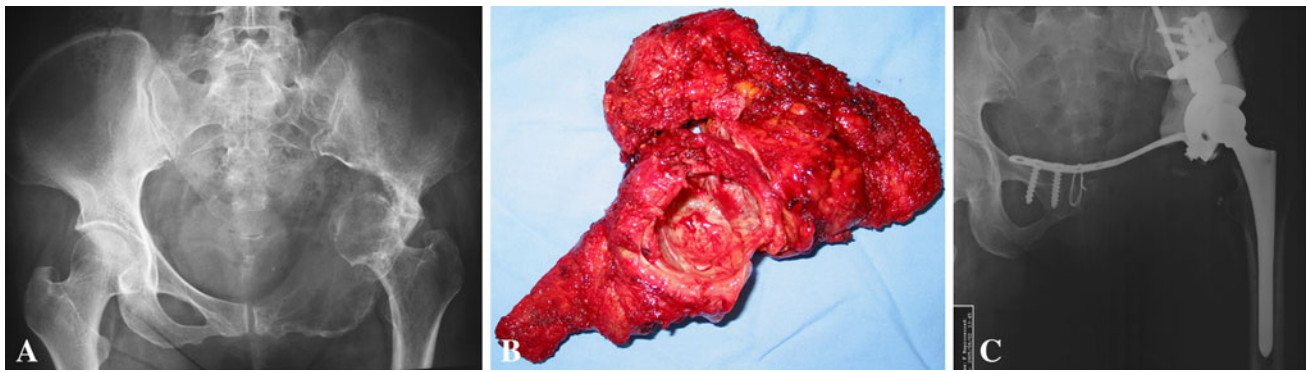
Fig. 2A–C (**A**) The image of the hip of a 32-year-old man whose main complaint was left hip area pain for 6 months that was more severe over the previous 3 days is shown. Osteolytic lesions can be seen in the left pubis, ischium, and periacetabular region on the plain film. The femoral head was dislocated and protruded into the pelvic cavity. (**B**) The tumor was resected wide, including the whole pubis and ischium, and the superior cut line was at the normal bone above the acetabulum. (**C**) A hemipelvic prosthesis was used for reconstruction of the defect after tumor resection. The prosthesis was fixed at the residual ilium, and bone cement was placed around the periacetabular prosthesis to reinforce the stability. The pubic plate was fixed between the acetabular and contralateral pubis.

Table 2. Complications and outcomes at the last followup

Patient number	Initial treatment group	Complication	Retreatment	Outcome	Followup (months)
3	Wide	Delayed infection	Prosthesis removal	Infection controlled	52
6	Wide	Wound healing disturbance	Débridement	Healing	47
8	Wide	Bone nonunion	No	Bone nonunion	75
11	Intralesional	Thrombosis	Anticoagulant drugs	Complete DVT resolution	119
13	Wide	Dislocation	Open reduction	Stability achieved	44
15	Intralesional	Wound healing disturbance	Débridement	Healing	41
18	Wide	Wound healing disturbance	Débridement	Healing	24
24	Wide	Wound healing disturbance	Débridement	Healing	21
27	Wide	Wound healing disturbance	Débridement	Healing	18

DVT = deep vein thrombosis.

débridement with eventual healing between 3 and 4 weeks. Dislocation of the hip occurred in one patient with hemipelvic prosthetic reconstruction and an open reduction was performed in this patient, with stability achieved by the 2-month followup. One patient had nonunion of the recycled tumor bone and remaining ilium junction; the nonunion was not treated further because no infection or fracture occurred and the patient could walk with crutches at the last followup. One patient had a distal deep vein thrombosis and was treated with anticoagulant drugs for 6 months with resolution.

Discussion

A pelvic GCT is rare, accounting for only 1.5% to 6.1% of GCTs of the bone [31, 35, 44]. Pelvic GCTs are usually large by the time they are found because of the complexity of the anatomic site. There is no standard treatment procedure for a GCT involving the acetabular bone. The treatment options include radiation therapy [11, 12], intralesional curettage with or without adjunctive techniques [5, 14, 23, 25, 30, 34], and wide resection [5, 14, 25, 30, 34]. It is difficult for surgeons to achieve balance between the local control and surgical morbidity in patients with pelvic GCTs. We therefore compared intralesional excision and wide resection in terms of local control, function, and complications.

Readers should be aware of the limitations of our study. First, because pelvic GCTs are rare, we can report only on a small number of patients and therefore cannot make any definitive statements regarding the differences in recurrences and complications between intralesional surgery and wide resection. However, our data are consistent with a lower recurrence rate in patients with wide resection. Second, treatment was not randomized between different

Table 3. Comparison of local control of various treatment studies

Study	Number of patients	Methods of surgical treatment	Adjuvant procedures	Local recurrence rate (%)	Mean followup (months)
Kattapuran et al. [23]	7	Intralesional surgery (curettage in two patients and excision-curettage in five)	None	43	36
Sanjay et al. [34]	17	Intralesional surgery in 15 patients (curettage in six and excision-curettage in nine); wide resection in two patients	Phenol; radiation	17.6 (20% for intralesional surgery; 0% for wide resection)	226
Osaka & Toriyama [30]	5	Intralesional surgery in one patient; wide resection in four patients	None	0	163
Donati et al. [14]	10	Intralesional surgery in five patients; wide resection in five patients	Drill burring; phenol; ethanol; radiation; bone cement	20 (40% for intralesional surgery; 0% for wide resection)	102
Balke et al. [5]	19	Intralesional surgery in 16 patients (curettage in nine and excision-curettage in seven); wide resection in three patients	Drill burring; cryosurgery; radiation; bone cement; arterial embolization	5.3 (6.3% for intralesional surgery; 0% for wide resection)	49
Leggon et al. [25]	6	Intralesional margins in two patients (curettage in two); wide margins in four patients	Radiation	16.7 (20% for intralesional margins; 0% for wide margins)	102
Current study	27	Intralesional surgery in 13 patients (curettage in eight and excision-curettage in five); wide resection in 14 patients	Drill burring	14.8 (30.8% for intralesional surgery; 0% for wide resection)	50

patient groups that might not comparable. Nevertheless this comparative study made the advantages and disadvantages of different treatment methods more clear which might be helpful for surgeons in the decision-making process. Third, we limited patients to those initially treated at our center. The findings therefore might not be generalizable. Fourth, the minimum followup is short and additional local recurrences might occur with longer followup. Nevertheless, 70% of local recurrences occur within 2 years [6].

Few publications have specifically addressed pelvic GCTs [5, 14, 23, 25, 30, 34, 37]. The local recurrence rate can be as much as 43% for therapeutic options other than wide resection [5, 14, 23, 25, 30, 34]. Donati et al. [14] reported that two of five patients with pelvic GCTs had local recurrence develop after intralesional surgery. Leggon et al. [25] reported 17 cases of GCTs of the pelvis and sacrum and performed a literature review of pelvic lesions treated with surgery, which revealed 41% of patients who had surgery with an intralesional margin had a local recurrence whereas 0% of patients who had surgery with a wide margin had a local recurrence (Table 3). In our study, none of the patients who underwent wide resection

had a local recurrence, whereas four of 13 patients who underwent intralesional surgery had a local recurrence. Wide resection can minimize the recurrence rate because adjacent muscles can be resected with the tumor to ensure an adequate resection margin. Considering the local aggressiveness of GCTs, initial surgical treatment is important because recurrence of the tumor often makes it unresectable. If the medial and superior walls are destroyed by the tumor, there is no place to hold the cement after curettage. In this situation, we believe wide resection is a reasonable choice. Tumors with extensive cortical destruction and a large soft tissue mass are indications for wide resection to ensure achieving a safe margin.

During the past few years, various adjuvant modalities have been used to decrease the local recurrence rate after curettage. The adjuvant modalities included the use of cytotoxic agents such as phenol [34], zinc chloride [45], ethanol [14], and physical adjuvants such as polymethyl-methacrylate [5, 14], cryosurgery [5], and a high-speed burr drill [5, 14]. We used a high-speed burr drill to deal with any residual GCT cells that may have remained on the surface of the curettage cavity. We did not use nitrogen or

other chemicals because we rarely had a complete bone shell and wanted to avoid the chemical injury to surrounding tissues from leaking adjuvants. The role of radiation for treating pelvic GCTs is controversial. The review of the literature of pelvic and sacral GCTs by Leggon et al. [25] revealed that local recurrence rates were similar with curettage alone and curettage combined with radiation therapy. Increasing the radiation dosage may not decrease the local recurrence rate but could increase surgical complications and the sarcoma transformation risk [25]. The sarcoma transformation rate after radiation ranges from 11% to 25% in the pelvic region [25, 34]. Considering the risk of development of a sarcoma, 26 of the patients in our study did not undergo radiation therapy; only one patient who refused additional surgery for the recurrent tumor received radiation therapy.

Compared with intralesional excision, however, function of the periacetabular resection appears worse. Many approaches can be used to reconstruct the defect after acetabular bone resection: iliofemoral arthrodesis, ischiofemoral arthrodesis, arthroplasty, and saddle prosthesis. Arthroplasty achieves the best function if the internal cortex of the acetabulum is continuous and the integrity of the pelvic ring remains intact after tumor curettage. Arthrodesis after hip resection was seldom used in our patients because it limits ambulation and there is a high risk of nonunion. The mean functional scores for patients treated with intralesional excision were higher than those of patients who had wide resection. For GCTs involving the periacetabular region, hemipelvic prostheses have been used to reconstruct the integrity of the pelvis [43]. There are various reconstructive methods for acetabular bone, but we prefer to use a modular hemipelvic prosthesis based on our experience [20]. The modular hemipelvic prosthesis was designed by our department and produced by a local company (ChunLi Co, Beijing, China). The length of the prosthesis can be adjusted based on the defect after tumor resection. The prosthesis can be fixed to the remaining ilium after Type II + III resection and to the sacrum after Type I + II resection. The results of prosthetic reconstruction show favorable hip function. Most of the patients could resume their routine activities within 3 months after surgery.

Wide wound exposure, extensive soft tissue stripping, local hematoma formation, and poor skin flap blood supply are adverse factors affecting wound healing. As reported in the literature, the overall infection rate in several series varied from 12% to 47% after internal hemipelvectomy [1–3, 10]. We had one major complication in the group undergoing intralesional excision whereas six of the 14 patients who underwent wide resection had major complications. Facing the goal of better local control, a certain number of complications is acceptable. Protection of the skin flap, soft tissue closure without tension, adequate drainage, and careful wound care should be emphasized during postoperative care.

There have been some recent reports of bisphosphonate [4, 42] and denosumab [41] for treatment of GCTs of bone. The rationale for bisphosphonate treatment is that these compounds reduce osteoclast numbers and inhibit osteoclastic destruction [4]. Denosumab is a fully human monoclonal antibody that specifically inhibits RANKL, thereby inhibiting osteoclast-mediated bone resorption [41]. Balke et al. [4] studied 25 patients with bone GCTs who were treated with bisphosphonate and found that the disease was stabilized in most cases that had been refractory to conventional treatment, and most inoperable sacral and pelvic tumors did not increase in size. Lung metastases did not increase in size or number after the treatment. Thomas et al. [41] reported their results of denosumab treatment in 35 patients with bone GCTs and found 30 of 35 patients had a tumor response assessed by histology or radiology. As was reported [4, 41, 42], bisphosphonate and denosumab could be used for treatment of recurrent or metastatic disease or for primary inoperable pelvic and sacral tumors.

Treatment of GCTs involving the periacetabular region remains a challenge. The major issues are the resection methods to reduce local recurrence and reconstruction techniques to maintain hip function after tumor resection. Even with a higher complication rate with wide resection and prosthetic reconstruction, we believe the lower local recurrence rate makes wide resection a reasonable option for selected patients. The balance between recurrence of a benign (although locally aggressive) tumor and higher complications with wide resection should be discussed thoroughly with the patient during the decision-making process.

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