Conservative Surgery for Giant Cell Tumors of the Sacrum

The Role of Cryosurgery as a Supplement to Curettage and Partial Excision

Ralph C. Marcove, M.D., Dhiren S. Sheth, M.D.,* Earl W. Brien, M.D.,* Andrew G. Huvos, M.D.,† and John H. Healey, M.D.**

Background. **Giant cell tumors (GCTs) of the sacrum are a difficult clinical problem. Wide excision (total sacrectomy) is associated with high morbidity and pelvic/spinal instability. Curettage with or without supplemental radiotherapy is associated with a high recurrence rate. In view of the proven effectiveness of cryosurgery as an adjunct to curettage for extremity GCT, cryosurgery was used for treatment of GCTs of the sacrum.**

Methods. **Seven patients with GCTs of the sacrum were treated at our institution by conservative surgery from 1973 to 1992. Four patients presented with recurrent tumors after failing previous radiation treatment (dose, 5040 cGy). Four patients were treated with curettage with cryosurgery and three with limited excision with cryosurgery. In the latter procedure after limited excision of the caudal (below S2) part of the tumor, the upper sacral segments were treated with curettage and cryosurgery. This spared the important upper sacral roots and maintained the skeletal integrity.**

Results. **At a median follow-up of 12.25 years (range, 2–14.2 years), all patients were disease free. Local recurrence developed in two patients. Both of these underwent repeat curettage and cryosurgery and have since remained disease free. Two patients had positive second look biopsy with microscopic tumor. Both of these were treated with repeat cryosurgery and have remained disease free. Two patient who developed solitary pulmonary metastases, underwent wedge resection and are alive without disease. No patient suffered neurologic deterioration.**

Conclusion. **Conservative surgery (curettage or partial excision) with adjunct of cryosurgery is our preferred technique for the treatment of GCT of the sacrum. Satisfactory local control could be obtained by close observation, second look biopsy and repeat cryosurgery. The chief advantages of this method include preservation of pelvic and spinal continuity, speed and ease of surgical procedure and less potential blood loss. We recommend it over more radical sacrectomy due to low morbidity and less resultant neurologic deficits. *Cancer* 1994; 74:1253–60.**

Key words: giant cell tumor, sacrum neoplasm, cryosurgery, radiation, metastasis.

Giant cell tumor of the sacrum is a difficult clinical problem. Because most giant cell tumors in the sacrum involve the upper sacral segments[1] often crossing the midline, treatment by marginal or wide excision would necessitate a total sacrectomy. Though many investigators have claimed satisfactory results after total sacrectomy,[2,3] massive bleeding, infection, neurologic deficit with sphincter disturbance, and pelvic and spinal instability are common problems of this procedure.[3] Due to associated complications and morbidity, the experience with total sacrectomies at our institution, particularly if applied for a benign tumor, has been unsatisfactory. This was an important reason for application of conservative surgery with adjunct of cryosurgery for the treatment of giant cell tumors of the sacrum.

The purpose of the current paper is to present our experience in treating giant cell tumor of the sacrum with a comprehensive program involving conservative surgery (intralesional procedures, i.e., curettage or limited excision) with an adjunct of cryosurgery and a follow-up program that used routine and sometimes repeated second-look biopsies.

Material and Methods

During the period 1973–1992, 13 cases of sacral giant cell tumors were treated at our institution. Six cases ini-

From the *Orthopaedic Surgery Service and the †Department of Pathology, Memorial Sloan-Kettering Cancer Center, New York, New York.

Address for reprints: John H. Healey, M.D., Chief, Orthopaedic Surgery, Memorial Sloan-Kettering Cancer Center, 1275 York Avenue, Suite A 675, New York, NY 10021.

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Table 1. Clinical and Radiographic Features

Patient no.	Previous treatment		Clinical features	Level	Radiographic features, characteristics
	Surgery	*Radiation*			
1	Biopsy	No	Pain, radiation, pressure symptoms, incontinence, motor deficit	S2–3	Central lesion with anterior mass
2	Curettage	No	Pain, swelling	S1–3	Eccentric with equidirectional growth
3	Curettage	Yes (?dose)	Pain	S1–3	Eccentric crossing SI joint, equidirectional growth
4	Nil	No	Pain, swelling, incontinence	S1–5	Central, equidirectional growth
5	Nil	No	Pain	S1–3	Eccentric with anterior mass
6	Excision	Yes (5040 cGy)	Pain, pressure symptoms	S3–5	Central with anterior mass
7	Excision	Yes (5040 cGy)	Pain, radiation	S1–5	Eccentric with anterior mass

tially treated in a variety of fashions other than combined intralesional surgery with adjunctive cryosurgery were excluded for relative uniformity of approach. These eliminated cases involved total sacrectomy (n = 1), simple curettage (n = 3), palliative embolization (n = 1), and chemotherapy (n = 1). Iliac lesions that crossed into the sacrum were also excluded.

At the time of presentation, the age of the patients ranged from 14 to 48 years (mean, 20 years). There were five females and two males.

Four of the seven patients presented to us with local recurrence. All four had either an excisional or an intralesional procedure and three of these had also received radiation (5040 cGy) that failed to prevent recurrence.

Pain was the most common symptom at the time of presentation. In addition to localized backache, radiation to the lower extremity was present in two patients. Pressure symptoms of constipation and urinary hesitancy were present in two patients. Neurologic involvement in the form of urinary incontinence and lower extremity weakness and numbness were present in two patients. Five of the seven patients were neurologically intact at presentation.

Of the seven patients, three had isolated involvement of the upper sacral segments (S-1–2), one had isolated involvement of the middle sacral segment (S-2–3), one had predominant involvement of the lower sacral segments (S-3–5), and two had the entire sacrum involved. Four patients had eccentrically located tumors, and in one it crossed the sacroiliac joint to secondarily involve the neighboring ilium. Three were centrally located. An anterior presacral mass was present in four patients (see Table 1).

All histologic material was reviewed, including the submitted pathologic slides from the original institutions where the first surgical procedures were performed. This histologic material was then compared with that removed at the subsequent surgical interventions. In one patient, the conventional giant cell tumor was associated with a secondary aneurysmal bone cyst (Patient 6). All tumors were conventional (Grade 1 or 2)[4] tumors, and there were no malignant (Grade 3) giant cell tumors. During the study period, none of the histologic grades progressed as the tumors recurred and no revision in grades was necessary (see Table 2).

Treatment

The operative procedure can be divided into two types: curettage with cryosurgery (4 patients) and planned translesional (limited) excision with cryosurgery (3 patients). In the latter procedure, after limited excision of the caudal part of the tumor, the upper sacral segments were treated by curettage and cryosurgery.

The type of surgical procedure selected was based on the location of the tumor (S-1 and S-2 sacral segments were spared) and presence of an extraosseous mass. When the tumor was confined within expanded sacrum, gross tumor was removed by curettage (Patients 2, 3, and 4). In the presence of anterior or caudal extraosseous mass, this portion of the tumor was excised again, sparing S-1 and S-2 sacral segments (Patients 1, 6, and 7).

All seven patients had intralesional procedures

Table 2. Histologic Grading of Giant Cell Tumor of Bone[4]

Patient no.	Grade
6	1
	Stroma inconspicuous
	Giant cells plentiful
1, 2, 3, 4, 5, 7	2
	Stroma prominent
	Giant cell decrease
None	3
	Stroma overtly sarcomatous
	Giant cells sparse

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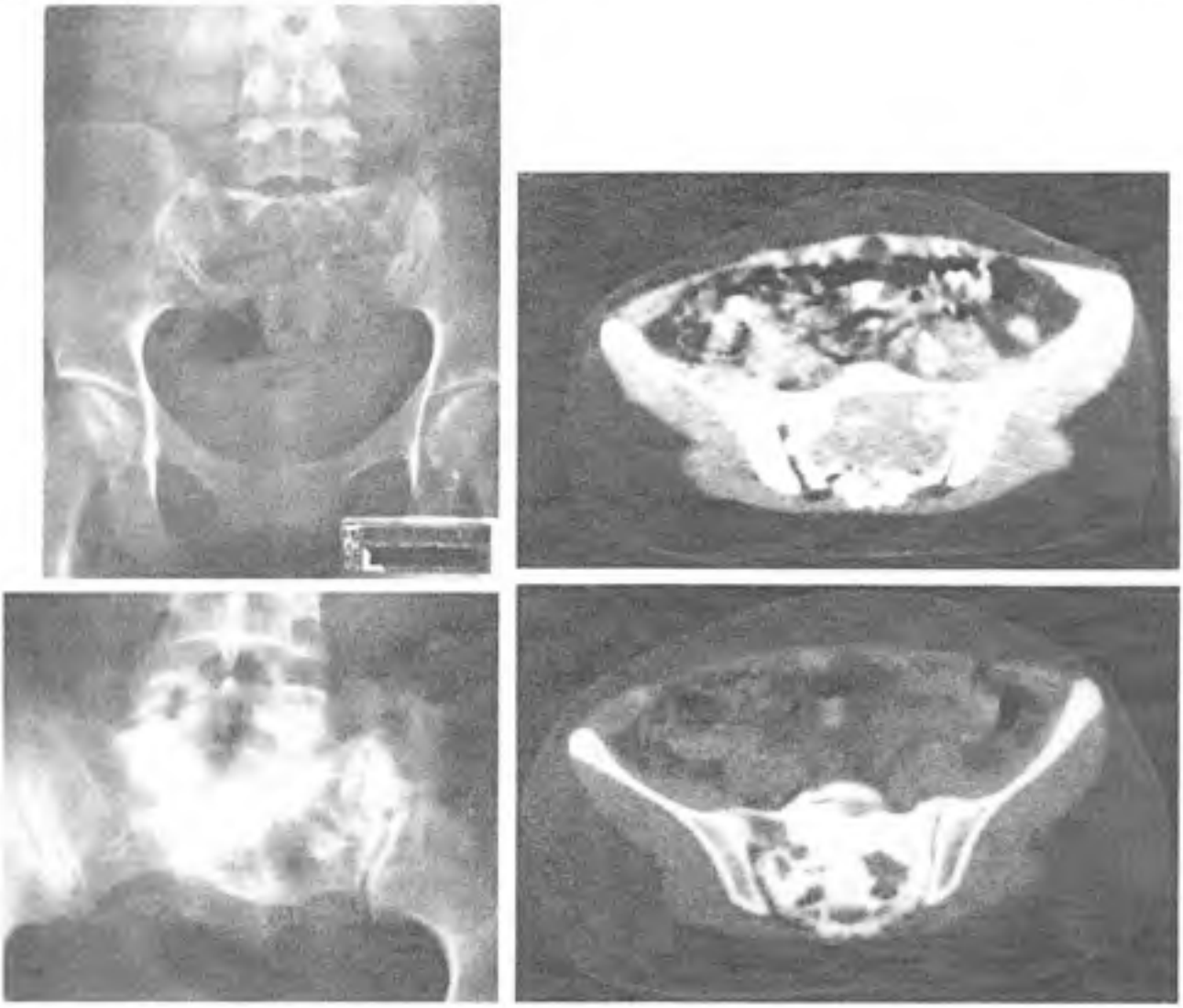

Figure 1. (Top left) Plain anteroposterior (AP) radiograph showing a centrally located sacral tumor involving the entire sacrum. The tumor was exposed through a central midline approach and treated with curettage and cryosurgery. (Top right) Preoperative computed tomography scan. (Bottom left) Follow-up AP radiograph showing healing with peripheral sclerosis. (Bottom right) Follow-up computed tomography scan demonstrating healing (no evidence of disease at 147 months, Patient 4).

with cryosurgery. A dorsal midline incision was used in centrally located sacral tumors. We obtained sufficiently wide exposure to minimize tension, while retracting skin from the planned site of freeze in an effort to prevent cryonecrosis of the skin. Care was taken to preserve as much of the fascial attachment to the spinous processes as possible to facilitate a secure wound closure without tension. Taylor retractors impacted subperiosteally in the posterior iliac wing helped in obtaining wide exposure. A wide laminectomy was then performed at S-1–3 levels. The sacral roots were identified and spared (see Figure 1).

In the presence of a predominantly eccentric alar lesion, a modified Smith-Petersen's approach (as for arthrodesis of the sacroiliac joint) was used.[5] A rectangular window made in the posterior part of the ilium provided access to the sacral ala without disturbing the sacral roots (see Figure 2).

In patients who presented to us with recurrence, the type of surgical approach selected was determined by the location of the recurrent tumor. In Patient 3, though the tumor was originally approached through a dorsal midline route, due to the eccentric alar location it was exposed through the Smith-Petersen approach.

After gross tumor removal, the resultant cavity was treated with liquid nitrogen. The liquid nitrogen was

Figure 2. (Top) Anteroposterior (AP) tomogram demonstrating an eccentric alar giant cell tumor that presented to us with local recurrence. At our institution, the lesion was treated by a thorough curettage followed by cryosurgery through the Smith-Petersen approach. (Bottom) Follow-up AP plain radiograph showing healing with peripheral sclerosis (no evidence of disease at 170 months, Patient 3).

poured directly or with the aid of a funnel. In the absence of residual bony shell, as after partial sacral excision, the defect formed a crucible that contained the liquid nitrogen without spillage. The presacral tissue and the posterior rectal wall were included in the freeze, because they were areas of potential tumor involvement. The entire cauda equina and nerve roots were frozen as they coursed through the tumor bed. When tumor involved the upper sacrum or was eccentrically located, the S-1 root of the sciatic nerve was included in the freeze. The iliac vessels were not isolated, however, they are not prone to freezing due to high blood flow rate and heat exchange mechanism. In the presence of an anterior soft tissue mass, a partial excision was sometimes performed through the sciatic notch area. We used three complete freeze-thaw cycles for the optimum benefit (see Figure 3).

Wound complications were anticipated due to the site (sacrum) and necrotizing effect of cryosurgery. We must emphasize that these were minimized by using wide exposure, soft tissue retraction, irrigation of the skin and surrounding soft tissue during the application of cryosurgery, multilayer closure without tension, and prolonged antibiotic therapy at least until the wounds healed securely.

In the immediate postoperative period and during subsequent follow-up, detailed neurologic evaluation was performed to elicit any loss in function from cryosurgical damage to the sacral roots.

None of three patients who had received radiation before presentation received any additional radiation. All patients with recurrent disease either at the time of presentation or subsequent to treatment received postoperative supplemental radiotherapy (except Patient 2 due to wound problems).

Follow-up Evaluation

All patients had repeated evaluation with chest and sacral radiographs and cross-sectional study using computed tomography scan or magnetic resonance imaging. Twelve second-look biopsies were performed in five patients. In general, second-look biopsies were performed in the presence of a high index of suspicion for recurrence, such as clinical symptomatology or possibility of recurrence on imaging. They were also performed to histologically establish cure. They were performed repeatedly (if the patient was willing) at least until the last biopsy was negative. All second-look biopsies were open operative procedure and consisted of generous multiple sampling of suspicious areas. Cryosurgery was performed if frozen section revealed tumor.

Results

Estimated Blood Loss and Duration of Surgery

The data on estimated blood loss and duration of surgery were obtained in six patients from the operation report and anesthesia chart. The average estimated blood loss in the entire series was 2014 ml (range, 500–7000 ml). The average duration of surgery was 2.4 hours. The average estimated blood loss in curettage

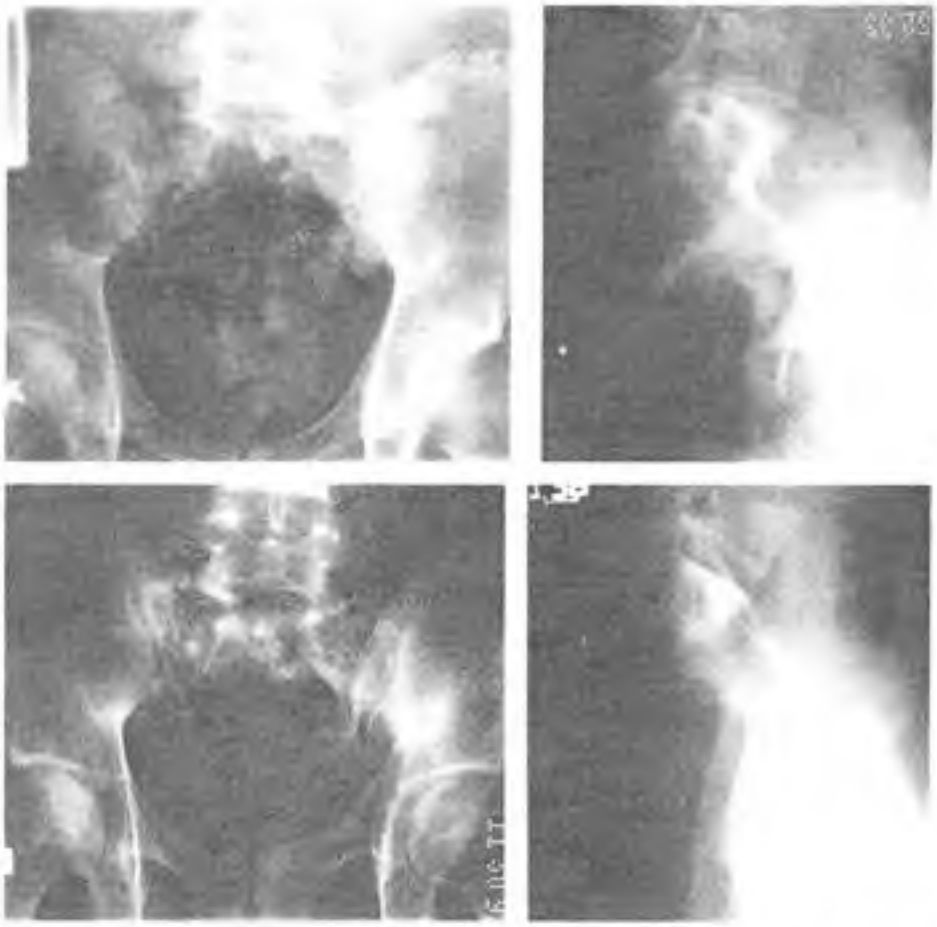

Figure 3. (Top) Plain AP and lateral radiographs showing a centrally located sacral tumor involving almost the entire sacrum. This lesion was treated with intralesional excision of the lower sacrum, sparing S-1 and S-2 nerve roots. The upper sacral segment was treated by curettage and cryosurgery. (Bottom) Postoperative AP and lateral radiographs demonstrating the extent of resection and early healing (no evidence of disease at 25 months, Patient 7).

with cryosurgery was 733 ml, whereas the average estimated blood loss in excision with cryosurgery was 4000 ml.

Follow-up Information

The follow-up period ranged from 13 months to 14.2 years, with a median follow-up of 12.3 years and an average follow-up of 10 years. Currently, all patients are disease free with an average disease free interval of 9.3 years (range, 13 months–14.2 years). Three patients (43%)—Patients 3 (170 months), 5 (94 months), and 7 (13 months)—have been continuously free of disease. The details of treatment and the results are presented in Table 3.

Local Recurrence

Two patients developed radiologically detectable local recurrence (Patients 1 and 4). The period from the initial treatment to recurrence was 7 months and 10 months. Both of these patients underwent repeat curettage and cryosurgery and have remained disease free thereafter (13.3 years and 9.7 years).

Twelve planned second-look biopsies were performed in five patients where there was no clinical or radiologic evidence of recurrence. Two patients (Patients 2 and 6) had positive second-look biopsies showing microscopic tumor. Both of these patients were treated with repeat cryosurgery at the time of second-look biopsy and had subsequent rebiopsies that showed negative results. They both have remained disease free (11.4 years and 4.3 years).

Distant Relapse

Two patients (Patients 1 and 6) developed a solitary pulmonary metastasis. The interval to distant relapse was 7 and 12 months from first surgery. Both of these patients also had local recurrence 2–4 months before detection of pulmonary metastasis. They both underwent pulmonary wedge resections and have remained alive and disease free (13.2 years and 3.9 years).

The histologic findings of both primary and meta-

Table 3. Treatment and Outcome

Patient no.	Level	Treatment: Surgery	Treatment: Postoperative radiation therapy	Treatment: Rebiopsy (mo)	Relapse: Local recurrence: Months	Relapse: Local recurrence: Treatment	Relapse: Pulmonary metastasis: Months	Relapse: Pulmonary metastasis: Treatment	Status at last follow-up	DFI (mo)	Complication and outcome	Follow-up (mo)
1	S2–3	E + C	Nil	Nil	Yes (10)	C + C RT (4000 cGy)	Yes (12)	Wedge resection	NED	156	Infection and skin necrosis requiring wound revision	168
2	S1–3	C + C	Nil	Neg(9) Pos(30) Neg(50)	Pos SLB (30)	C + C	No		NED	138	Skin necrosis requiring wound revision	168
3	S1–3	C + C	Nil	Neg(7) Neg(73) Neg(135)	No		No		NED	170	Nil	170
4	S1–3	C + C	Nil	Neg(21) Neg(78)	Yes (7)	C + C RT (3100 cGy)	No		NED	140	Nil	147
5	S1–3	C + C	Yes (3000 cGy)	Neg(7)	No		No		NED	94	Infection resolved with antibiotics	94
6	S3–5	E + C	Nil	Pos(2) Pos(6) Neg(7)	Pos SLB (2)	C + C	Yes (7)	Wedge resection	NED	68	Rectal fistula, flap closure, colostomy	75
7	S1–5	E + C	Nil	Nil	No		No		NED	25	Nil	25

C + C: curettage with cryosurgery; E + C: intralesional excision with cryosurgery; RT: radiation therapy; Pos: positive; Neg: negative; SLB: second look biopsy; NED: no evidence of disease; DFI: disease-free interval.

static lesions looked alike, supporting the clinical impression of a benign metastasizing giant cell tumor.

Complications

All complications followed initial surgery. Four of seven patients had early postoperative complications. Two patients had minor skin necrosis that was treated with debridement and secondary wound closure (Patients 1 and 2). One patient (Patient 6), who was previously irradiated, developed a rectal fistula that required flap closure and a permanent colostomy. All patients without prior radiation therapy healed spontaneously (n = 3). One patient had low grade infection requiring prolonged antibiotic treatment. None of the patients had loss of existing neurologic function. None of the patients developed transient nerve dysfunction. Neither of the patients with preexisting incontinence and weakness recovered normal function. Patient 7 experienced resolution of his S-1 sensory neuropathy 1 year after surgery. No delayed fractures have been seen.

Discussion

The earlier report by Marcove et al. and subsequent investigations by Gage et al. and Malawer et al. have indicated that cryosurgery is an effective adjunct to intralesional procedures in the treatment of giant cell tumors.[6-8] In the current series of giant cell tumor of the sacrum, we have used cryosurgery as an adjunct to intralesional procedures and have ultimately achieved local control in all seven patients. The success of this approach can be attributed partially to the program of second-look rebiopsy and application of repeat cryosurgery in the presence of microscopic recurrence. Because the tumor is eliminated without resection of the first sacral segment, the stability of the pelvic ring and the continuity of the spinal column are maintained. This minimizes morbidity and facilitates early rehabilitation.[3] Because the architecture of the peripheral nerves remains intact, cryosurgical damage to the nerves is potentially reversible (based on our experience at other sites). Compared with en bloc sacral resection, the shorter operative time, ease of surgery, and avoidance of massive blood loss are also factors in favor of more conservative cryosurgery (see Figure 4).

In the current series, four of seven patients (57%) had radiologic or microscopic evidence of recurrence (at the time of second-look biopsy) after the initial procedure. However, all of these were eventually controlled. The two cases of radiologically evident recurrences were well localized and were treated with repeat cryosurgery. We believe this to be an important consideration. Failure of initial cryosurgery can be recouped with repeated attempts, even at a difficult anatomic site as the sacrum.

An additional two patients had microscopic evidence of residual or recurrent disease detected at the

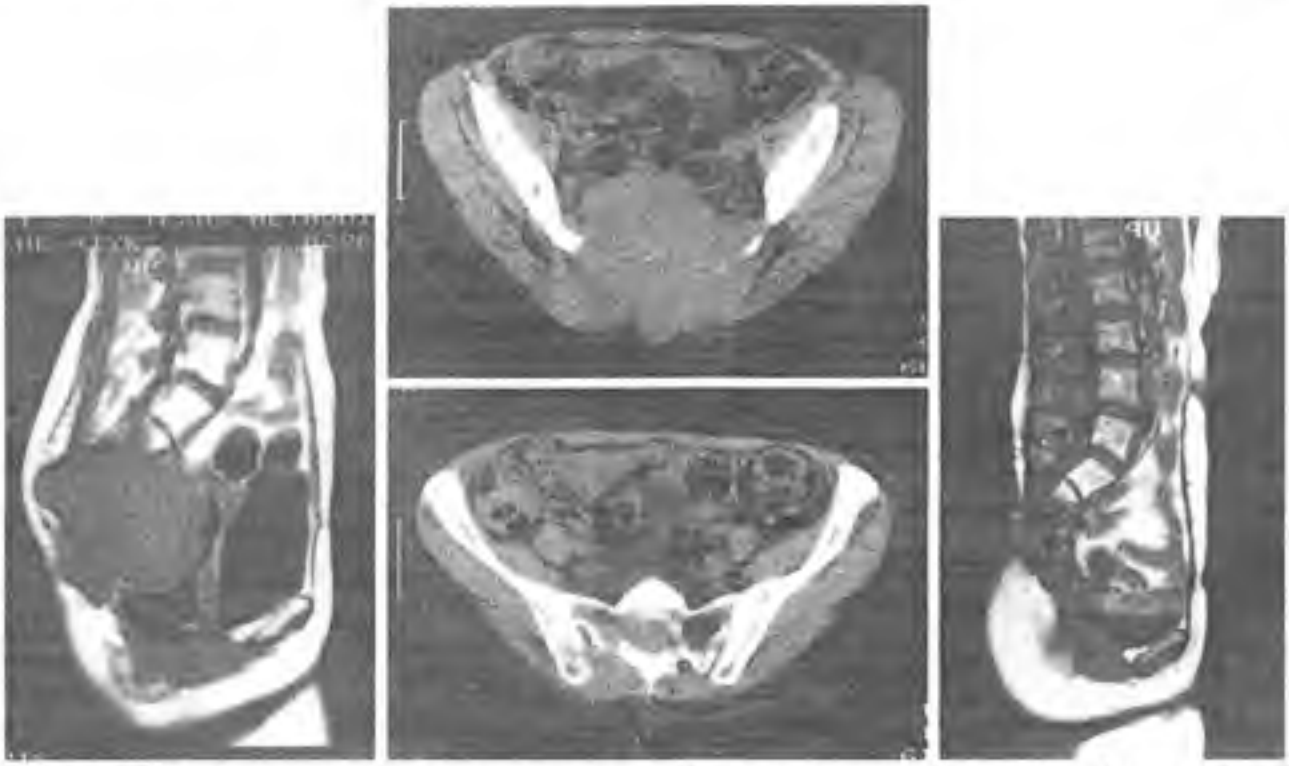

Figure 4. (Left) Sagittal T 1 weighted magnetic resonance imaging image of a huge giant cell tumor predominant involving the sacrum below S-1 level. (Middle top) Axial computed tomography scan section demonstrating the large lower tumor mass. (Middle bottom) Axial computed tomography scan section at the level of S-2 vertebra showing its involvement. The patient was treated with intralesional excision of the caudal mass and curettage with cryosurgery of retained S-2. She underwent two second-look biopsies and had microscopic tumor. In both these instances, the area of positive biopsies were treated with cryosurgery. She had a subsequent negative rebiopsy and has remained disease free. (Right) Follow-up magnetic resonance imaging showing no evidence of disease (follow-up period, 75 months).

time of second-look biopsy. Both these patients had repeat cryosurgery of the suspicious areas. They have since remained disease free. Although the recurrent microscopic foci were likely to progress, we do not know the clinical significance of these microscopic positive foci. It is possible that a vigilant attitude with second-look biopsies and consequent early detection and prompt treatment was responsible for local control in these patients. In an earlier study, second-look biopsy was part of an overall approach in treating giant cell tumor with cryosurgery.[8] It was performed to histologically establish the effectiveness of cryosurgery as an adjunct to intralesional procedures. It is particularly useful at sites such as the sacrum due the difficulties in interpretation of radiographic studies. Imaging modalities often fail to differentiate postoperative changes from tumor recurrence. Although we strongly recommended rebiopsy, there were multiple variables, including the patients' willingness to undergo biopsy in the absence of symptoms, clinical symptomatology, and follow-up interval, that were responsible for the inconsistency in number and timing of second-look biopsies.

The chief complications of cryosurgery are wound necrosis and possible secondary wound infection. Previous surgery and radiation therapy are predisposing factors. In the current series, this occurred in four patients and is of concern. It is possible that meticulous attention to sparing surrounding soft tissue and skin can help minimize these complications.

Very few papers have discussed the surgical treatment of giant cell tumor of sacrum.[9,10] In a recent publication,[1] the clinical recurrence rate after curettage was reported as 33%. Further treatment in this group of patients with failure of initial curettage was not alluded to. Our criteria of recurrence are more stringent (second-look biopsy), and it was possible to salvage all our recurrences with repeat cryosurgery. Many investigators have suggested supplemental radiation for residual disease after surgery[1,11] without supportive data. The best results of surgical treatment so far reported have been following wide excision.[2,3,11,12] Because giant cell tumor occurs predominantly in upper sacral segments, wide excision necessitates total sacrectomy with pelvic and spinal destabilization. Many investigators have re-

ported their experience of total sacrectomy, including data on local recurrence, need for spinal stabilization, resultant neurologic deficits, and need for prolonged rehabilitation.[2,3,13,18] In the series reported by Tomita and Tsuchiya,[3] the average estimated blood loss was 11,000 ml, the average duration of operation was 14 hours, and the rehabilitation period ranged from 6 to 10 months. Therefore, though total sacrectomy is oncologically sound and gives the best initial control, it is an extremely demanding procedure. In terms of blood loss, duration of surgery, and postoperative morbidity, the conservative surgery with adjunct of cryosurgery compares favorably with total sacrectomy.

Reported efficacy of radiation for giant cell tumors varies considerably.[15-17] These reports have indicated its usefulness at "difficult" sites. Radiation therapy did not control bulk disease in any of our patients. Radiation has been used effectively in combination with tumorectomy in malignant tumors. Removal of gross tumor "both displaces the sigmoid curve to lower radiation doses and makes it change more steeply with dose."[18] This had been our rationale in using radiation for residual disease. It may have helped to reduce local recurrence among patients treated by conservative surgery, but this question cannot be answered by the study design. Radiotherapy did not control microscopic disease in the patients previously treated by curettage or excision alone in the absence of cryosurgery (none of three).

Finally, though we are encouraged by the results of this series, there are certain deficiencies in the current study. This is a retrospective study, and though most of the cases were done in a consecutive fashion, a few cases were managed differently by other surgeons in our institution, hence there is a possibility of selection bias. Though we would like to suggest that the ultimate results are due to the proposed method of treatment that included a program of conservative surgery, vigilant follow-up, second-look biopsy, and repeat cryosurgery, we must mention that most of the patients received radiation, hence it is a mixed treatment group.

Summary

At our institution, we recommend conservative surgery in the form of intralesional curettage or limited excision with adjunct of cryosurgery, diligent radiographic, and second-look follow-up and repeat cryosurgery in the presence of clinical or microscopic recurrence as the treatment for giant cell tumors of the sacrum. The chief advantages of this method are good local control rate, speed and ease of surgical procedure, diminished blood loss, and preservation of the pelvic and spinal continuity. We recommend this method over more radical sacrectomy due to the low morbidity and less resultant neurologic deficits. We reemphasize the role of second-look biopsy, particularly at this site, because the sacrum is difficult to evaluate clinically and radiographically. Radiation was used postoperatively after cryosurgery in three patients. However, the role of postoperative radiation remains undefined.

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