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Hip Arthroplasty Following Subtotal Sacrectomy for Chordoma

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Abstract. *Background/Aim: Chordomas often affect the sacrum with a high predilection for local-regional recurrence. Patients typically retain their ability to ambulate, and the development of metastatic disease in the periacetabular region can have significant morbidity and pain with ambulation. The purpose of the study was to describe the outcome of patients undergoing a hip arthroplasty following resection of a sacral chordoma. Patients and Methods: From 1990 to 2015, 84 patients underwent sacrectomy for chordoma, while four of these (5%) patients underwent hip arthroplasty. The most common level of nerve root sacrifice was S2-5 (n=2). The mean time between sacrectomy and hip arthroplasty was 7 years. Indications for arthroplasty included metastatic disease (n=3) and coxarthrosis (n=1). Results: Postoperatively two patients ambulated with a gait aid, and no patient had a Trendelenburg gait. The mean Harris Hip Score significantly improved from 49 to 80 postoperatively (p=0.02). Conclusion: The results of this study indicate that hip arthroplasty is a durable treatment option for patients with metastatic disease or coxarthrosis following subtotal sacrectomy for chordoma.*

Sacral chordomas are tumors of notochord origin that traditionally show poor responsiveness to chemotherapy and low-dose radiotherapy. As such, wide local resection via *en-bloc* sacrectomy is a mainstay in their management (1-5). Sacrectomy is associated with significant morbidity, however, most patients retain their ability to ambulate postoperatively (4, 6-8). High rates of local-regional recurrence remain a challenge postoperatively (1, 4, 5, 9). In particular, metastatic disease affecting the periacetabular region can result in significant morbidity and pain with ambulation; however, this can be successfully treated with total hip arthroplasty (THA) (10-12).

With most patients ambulating after a sacrectomy for chordoma (4, 6-8), THA is a tempting endeavor to help alleviate a painful hip whether it is for metastatic disease to the acetabulum or coxarthrosis. To our knowledge there have been no studies on outcomes of THA in these patients. The purpose of this study is to investigate the outcome of patients undergoing THA following sacrectomy for chordoma. We specifically sought to retrospectively analyze indications for THA, arthroplasty complications and reoperations, as well as functional outcomes.

Patients and Methods

All institutions participating in this study approved the human protocol for this investigation and all investigations were conducted in conformity with ethical principles of research and under an Institutional Review Board approval (Protocol: 16-000637) we conducted a retrospective review of records of patients undergoing THA following sacrectomy for chordoma at our institution between 1990 and 2015. Eighty-four patients underwent sacrectomy for chordoma. Of these, 4 (5%) patients underwent a subsequent THA and were included in the study (Table I). Electronic medical records were used to gather data on patients' demographics, complications, reoperations, and radiographic evidence of implant survival. Harris Hip Score (HHS) and ambulatory status were used to analyze functional outcomes following THA (13) using Student's *t*-tests with a *p*-value of <0.05 set as statistically significant.

The group consisted of two males and two females with a mean age of 61 years (range=43-77 years) and a mean body mass index (BMI) of 25.2 kg/m^2 (range=17.6-33.7 kg/m^2) at the time of THA. All patients (n=4) had previously gone under a subtotal sacrectomy through a combined anterior and posterior approach (n=2) or posterior only approach (n=2). Negative margins were obtained for all patients at the time of sacrectomy. Nerve roots sacrificed during resection included: i) S2-5 (n=2), ii) S3-5 (n=1), and iii) S4-5 (n=1). The mean time between sacrectomy and THA was 7 years (range=2-11 years). Prior to THA, the mean HHS score was 49 (range=25-62). All patients ambulated prior to THA, with three requiring a gait aid (Table I).

Hybrid fixation consisting of an uncemented acetabular component and cemented femoral components was used in two patients. One patient went under a hemiarthroplasty with a cemented femoral stem and the other patient went under THA with uncemented femoral and acetabular components. General indications for hip

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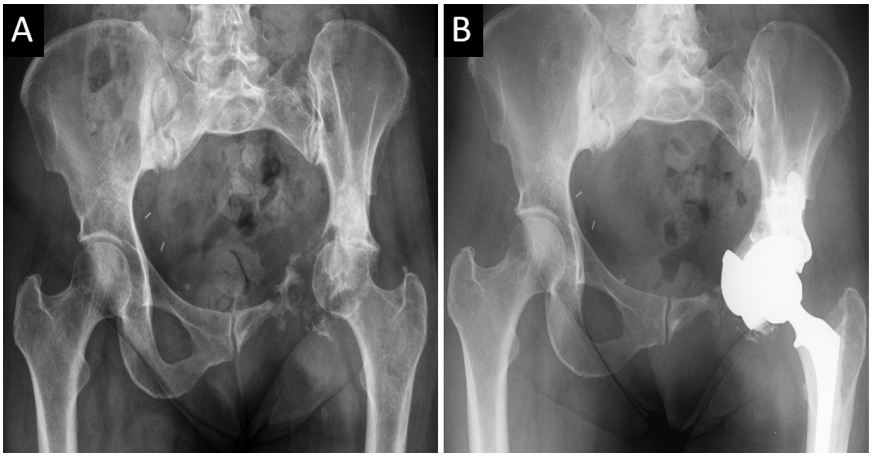

Figure 1. *Radiography images. Preoperative (A) and postoperative radiograph (B) of a patient with a history of periacetabular metastatic disease, causing pain and functional limitation after a previously performed subtotal sacrectomy for chordoma. Improvement in Harris Hip Score was achieved following total hip arthroplasty.*

Table I. *Patients undergoing hip arthroplasty following sacrectomy.*

Patient	Gender	Indication	Sacrectomy to arthroplasty	Nerves resected	Preop HHS	Postop HHS	Gait aid	Follow-up
1	Female	Coxarthrosis	2 Years	S2-5	62	88	None	9 Years
2	Male	Metastasis	5 Years	S3-5	54	74	None	2 Years
3	Male	Metastasis	10 Years	S4-5	56	79	Cane	4 Years
4	Female	Metastasis	11 Years	S2-5	25	77	Walker	7 Years

Preop: Preoperative; Postop: postoperative; HHS: Harris Hip Score.

arthroplasty included metastatic disease to the periacetabular region (Figure 1, n=3) and coxarthrosis secondary to osteonecrosis of the femoral head (n=1). Mean follow up after THA was 6 years (range=2-9), with all patients achieving at least two years of postoperative follow up.

Results

Following THA, all patients reported that they felt "much better" than before they underwent THA. All patients ambulated after THA- two with a gait aid and the other two without. No patient had a Trendelenburg gait following the THA. The mean HHS significantly improved from 49 (range=25-62) preoperatively to 80 (range=74-88) postoperatively (p=0.02).

During the follow-up period, there were no reoperations, however, it should be noted that three out of four patients were deceased. Postoperative complications occurred in one patient experiencing a deep vein thrombosis. No patients experienced a dislocation postoperatively.

Discussion

Chordoma treatment commonly involves total or subtotal sacrectomy. Patients typically retain their ability to ambulate after resection (4, 6-8); as such, THA may be later indicated in select cases. There is a paucity of data describing outcomes of THA in patients having previously gone under sacrectomy for chordoma. The current study indicates that THA is a reliable treatment option following subtotal sacrectomy for chordoma.

Periacetabular metastases and osteoarthritis of the hip are notorious for pain and functional limitations (10-12, 14-16). THA is the treatment of choice for advanced osteoarthritis and can provide pain relief and functional improvement in the setting of a metastatic disease (10-12). All patients in this series achieved significant pain relief and functional improvement, while HHS values improved postoperatively for all of them. All patients successfully ambulated following THA, with an improvement in gait aid requirement, even

though it is often necessary for ambulation after sacrectomy in the absence of periacetabular disease (7).

Of all the patients at our institution that went through a sacrectomy during the study period, 5% underwent THA. The level of sacrectomy and sparing of L5 and S1 nerve roots correlates with the preservation of the sciatic nerves motor function (17, 18). Subtotal sacrectomy and sparing of L5 and S1nerve roots occurred in all patients in this group, which likely explains the prevalence of the ambulatory status post-sacrectomy and the subsequent indication for THA.

Thankfully, this small cohort of patients enjoyed a relatively complication-free post-operative course. There were no instances of dislocation, infection, and re-operation, while the only medical complication relating to the arthroplasty was a deep vein thrombosis in one patient. Despite these results, caution is warranted with regards to the surgical management of periacetabular metastases, as high rates of postoperative complications and perioperative deaths have been reported (11, 12). This may be likely due to comorbidities in this patient population. Our cohort size is too small to show the true risk of post-operative complication rates that could be seen in this patient population.

Our study has several limitations. The cohort size is small as a result of the rarity of THA after sacrectomy for chordoma. In addition, the retrospective study design inherently limits the outcomes included as well as the data available for analysis. Operations were performed by multiple surgical teams at a single institution, for varied indications, and using vastly different fixation techniques and methods.

Despite these limitations, the results of this series indicate that hip arthroplasty following subtotal sacrectomy for chordoma was reliable and safe for our small cohort. All patients had a significant improvement in pain and function, without any cases of revision, reoperation or dislocation.

Conflicts of Interest

The Authors declare no conflicts of interest.

Authors' Contributions

MRC and MBS: Drafting of initial and final manuscript, data collection, data analysis. JDJ, KIP, and PSR: Review and editing of final manuscript. MTH: Drafting of initial and final manuscript, data analysis, supervision.

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