

Original Research Article

Open sequential, open staged, and laparoscopic-assisted approaches

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ABSTRACT

Background: This retrospective study evaluates sacrectomy techniques and associated outcomes in 32 patients at our department. Sacrectomy, challenging due to complex anatomy and vascularization, has evolved from open single-stage abdomino-sacral to a staged approach and laparoscopic-assisted methods.

Methods: We examined total, subtotal, and partial sacrectomies, transitioning from a single-stage to a staged procedure (with a 1-2 day gap) and finally to laparoscopic-assisted sacrectomy. We focused on postoperative morbidity.

Results: Results show 14 partial, 8 subtotal, 8 total, and 2 laparoscopic-assisted partial sacrectomies. Giant cell tumors and chordomas were common. The staged approach was used in 16 patients, the sequential in 12, and laparoscopic in 2. The latter, despite longer surgery times, resulted in less blood loss, shorter hospital stays, less pain, and faster recovery. Wound dehiscence was the main complication, typically managed conservatively or with skin grafts. One case required a gluteal flap. Bowel and bladder dysfunctions, mostly following total and subtotal sacrectomies, improved with conservative management. The staged approach showed reduced morbidity compared to the sequential.

Conclusions: In conclusion, sacrectomy has become less morbid due to improved anatomical understanding, surgical advancements, and rehabilitation. Staged sacrectomy reduces peri-operative morbidity versus the sequential method. Laparoscopic-assisted sacrectomy, promising reduced blood loss, pain, and hospitalization, requires careful patient selection.

Key words: Sacrectomy, Laparoscopic assisted sacrectomy, Staged sacrectomy, Sequential sacrectomy

INTRODUCTION

The surgical management of sacral tumors is challenging due to the complex anatomical structures and rich blood supply. The sacrum is a site for tumors such as giant cell tumor and chordoma, which are locally aggressive and present as large masses. They respond less to chemotherapy and radiotherapy.¹⁻⁴ Wide excision is the preferred treatment approach. Consequently, various surgical approaches and techniques have been documented, taking into consideration the size, location, and extent of the tumors.

Aim and objectives

The objective of this study is to comprehensively review the evolutionary trajectory of sacrectomy techniques in our department, specifically focusing on the transition from open sequential abdomino-sacral procedures to open staged approaches and subsequently incorporating laparoscopic assistance. Additionally, we aim to retrospectively analyse postoperative morbidity and mortality rates associated with these techniques.

METHODS

Inclusion criteria

This retrospective study of 32 patients who underwent sacrectomy in our department (Surgical oncology, Government Royapettah hospital, Kilpauk medical college) between January 2002 and May 2023. The patients underwent one of three types of sacrectomy: total, subtotal, or partial. Total sacrectomy involves transection at the level of the L5-S1 disc, with complete removal of the sacrum. Subtotal sacrectomy involves transection at the body of the S1 vertebra. Partial sacrectomy is considered when the amputation level is at or below the body of the S2 vertebra. Traditionally sacrectomy was performed as single stage abdomino-sacral approach, we adopted a staged approach (a gap of one or two days between anterior and posterior approach) hoping for decrease in the post operative morbidity. The anterior approach involved trans-peritoneal access to expose the anterior aspect of tumors. The internal iliac vessels were ligated, and retrorectal dissection was performed to isolate the rectum. In the posterior approach, dissection extended to the level of S1, and osteotomy was performed to complete sacrectomy. Closure was achieved through either primary closure or gluteal advancement flap. Recently we attempted laparoscopic assisted sacrectomy in our department. None of the patients received spino-pelvic reconstruction. We analysed the patients records for postoperative morbidity. We did statistical analysis with SPSS software version 22.

RESULTS

A total of 32 patients underwent sacrectomy (16 male and 16 female), mean age of patients was 48 years (15-65 years). 14 cases underwent partial sacrectomy, 8 cases underwent subtotal sacrectomy, 8 cases underwent total sacrectomy, and 2 cases underwent laparoscopic assisted partial sacrectomy. Giant cell tumor was the most common histology in the resected specimen, followed by chordoma. Sequential abdomino-sacral approach was employed in 12 patients, while the staged approach was performed in 16 cases. 2 patients underwent laparoscopic assisted abdomino-sacral approach. For two patients with small posteriorly dominant lesions, partial sacrectomy was performed using the only posterior approach. Open staged sacrectomy was associated with shorter surgery time, less blood loss, and shorter hospital stay than open sequential sacrectomy. Although laparoscopic-assisted sacrectomy (LAS) has a longer average surgery time than open sacrectomy, it is associated with significantly less blood loss and shorter hospital stay. Patients who undergo LAS also report less postoperative pain and a faster recovery.

Of the patients, 61.1% experienced wound complications. Wound dehiscence was the most common complication, and was usually managed conservatively or with a split skin graft (SSG). One patient required a gluteal

advancement flap. Bowel and bladder dysfunction were noted in 50% of patients.

Table 1: Demographic data.

Parameters	Patient details
Total no of patients (n)	32
Sex	Males-16
	Females-16
Mean age	48 years (15-65)

Table 2: Type of sacrectomy.

Type of sacrectomy	N
Total sacrectomy	8
Subtotal sacrectomy	8
Partial sacrectomy	14
Laparoscopic assisted partial sacrectomy	2

Table 3: Pathology.

Pathology	
Giant cell tumor	16
Chordoma	11
Carcinoma rectum involving rectum	1
Others	
Haemangioendothelioma	1
Chondrosarcoma	1
Plasmacytoma	1
Myxo papillary ependymoma	1

These complications were most commonly seen after total and subtotal sacrectomy, and were managed conservatively with significant symptomatic improvement. None of the patients required a diversion stoma.

Table 4: Surgical approach.

Surgical approach	N
Single stage sequential abdomino sacral	12
Two staged abdomino sacral	16
Laparoscopic assisted abdomino sacral	2
Only posterior approach	2

Table 5: Open sequential vs. open staged.

Parameters	Open sequential	Open staged
Average surgery time (minutes)	360	300
Average blood loss (ml)	580	500
Average hospital stay (days)	20	16

A reduction in morbidity was observed with the staged approach compared to the sequential approach. Two mortalities were noted in the study.

Table 6: Open vs. Laparoscopic assisted sacrectomy.

Parameters	Open	Laparoscopic assisted Abdomino sacral
Average surgery time (minutes)	320	385
Average blood loss (ml)	550	280
Average hospital stay (days)	18	13

The first was in a patient with chondrosarcoma of the sacrum who underwent open sequential abdomino-sacral total sacrectomy, patient died of cardiac cause in the immediate postoperative period. The second was in a patient who underwent laparoscopic assisted staged abdomino-sacral total sacrectomy, mortality due to bleeding from the internal iliac vein which was not controlled during the posterior approach. One patient who underwent laparoscopic assisted sacrectomy had port site recurrence at Right iliac fossa, for which we did wide excision and it did not affect his survival.

Table 7: Morbidity.

Parameters	Single stage sequential abdomino-sacral, N (%)	Two stage abdomino-sacral, N (%)	Laparoscopic assisted sequential abdomino-sacral, N (%)	Only posterior approach, N (%)
Wound infection	3 (25)	3 (18)	Nil	1 (50)
Wound dehiscence	6 (50)	4 (25)	Nil	1 (50)
Bowel and bladder dysfunction	5 (41.6)	4 (25)	Nil	Nil
Chronic pain	7 (58.3)	5 (31)	Nil	Nil
Spinal Fluid leak	Nil	Nil	Nil	Nil

DISCUSSION

The surgical management of sacral tumors is challenging due to the complex anatomical structures and rich blood supply. Owing to their slow progression, sacral lesions are usually large at the time of diagnosis making surgical treatment more challenging. Radical and extensive resection of sacral lesions often requires the sacrifice of important structures in the pelvic area, such as the rectum, iliac vessels, and lumbosacral plexus nerves. Therefore, an understanding of the anatomy of this complex region is necessary to minimize the occurrence of sequelae from the procedure. In addition, the surgical margin should not be compromised in order to preserve structures. The morbidity and mortality outcomes of the procedure depend on which sacral roots are sacrificed to achieve a wide margin and on the level at which the procedure is performed. Surgical wound infection, flap necrosis, and sphincter and neurological dysfunction are the main complications associated with sacrectomy. These complications are related to the increased duration of surgery, the surgical approach used, the amount of blood lost during the procedure, and the sacral roots preserved.

The first sacrectomy was performed by Bowares et al. in 1948. Hays et al described the technique for total sacrectomy with preservation of lumbosacral plexus. Various approaches have been developed, including the anterior approach, posterior approach for posteriorly dominant tumors, sequential anterior-posterior approach, abdomino-lateral approach, and perineal approach. The

two-staged approach, as described by Wanebo and Marcove in 1981, is commonly performed in our institution. In this approach, the anterior dissection is completed first, followed by the posterior dissection after one or two days.⁵ In our study this approach has demonstrated advantages such as reduced blood loss, shorter operating time, shorter hospital stay and improved wound healing compared to sequential approach. Long-Term Outcomes of Staged Sacroiliac Joint and Sacral Resections in the Treatment of Sacral Chordomas by Schwab et al. Compared the outcomes of open sequential sacrectomy and staged sacrectomy in 13 patients with sacral chordoma, they concluded that both approaches were effective in achieving local tumor control, but patients who underwent staged sacrectomy had a lower rate of wound complications and a shorter hospital stay, these results are similar to our study.⁹ Recently we attempted performing laparoscopic assisted sacrectomy, where the anterior approach is performed by laparoscopic mobilisation, this approach had advantage of less blood loss, less postoperative pain and less hospital stay compared to open sacrectomy.^{6,7} In a study by Gasbarrini et al they compared laparoscopic assisted sacral tumor resection with open methods and concluded laparoscopic approach has advantage of less blood loss, less postoperative pain and shorter hospital stay, though time of surgery is longer, which is similar to our study. Future studies should investigate the use of ultrasonic bone saws for giving anterior bone cut during the laparoscopic part. Ultrasonic bone saws are able to cut bone with high precision without damaging surrounding tissue, which

makes them a promising option in sacrectomy. The foremost complication encountered in our study was wound morbidity, primarily characterized by infection and dehiscence, affecting approximately 61.1% of patients, notably, wound infection. While conservative management sufficed for most instances of wound infection and dehiscence, certain patients necessitated interventions such as split skin grafting and/or gluteal advancement flap reconstruction. In a meta-analysis by Brancho et al Of the 384 procedures performed, approximately 28% of the cases required at least one surgical procedure for debridement.¹⁰ Bowel and bladder disturbances manifested in approximately 50% of cases. Our experience indicates that bowel and bladder morbidity was more with total sacrectomy due to complete denervation of pelvic parasympathetic fibres. In a study Kim et al 57% complained of bladder and bowel symptoms, such as voiding difficulty, urinary frequency or urgency, constipation, and residual sense after urination or defecation.⁸ In order to prevent postoperative cerebrospinal fluid leakage, careful watertight ties with non-absorbable silk suture material were done. Verlaan et al reported a case of meningitis, whereas Dang et al reported cases of cerebrospinal fluid fistula.^{11,12} No meningitis or cerebrospinal fluid leakage was observed in our study. Furthermore, our institution refrains from performing spino-pelvic reconstruction, as we maintain the belief that the extensive postoperative fibrosis occurring between the spine and pelvis naturally provides stabilization.

Limitations

The primary limitation of this investigation is its retrospective nature. To obtain more precise results, a prospective randomized controlled trial with a larger sample size is warranted.

CONCLUSION

In conclusion, sacrectomy, once considered a highly morbid procedure, has evolved to be significantly less morbid due to better understanding of anatomy, advancements in surgical techniques and rehabilitation practices. The implementation of a staged sacrectomy approach has proven to be associated with reduced peri-operative morbidity when compared to the sequential approach. Further, the utilization of laparoscopic-assisted sacrectomy has demonstrated notable benefits, including decreased blood loss, less postoperative pain and shorter hospital stays, but it needs better patient selection.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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