Journal of Plastic, Reconstructive & Aesthetic Surgery (2014) 67, 1257—1266

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Reconstruction following partial and total sacrectomy defects: An analysis of outcomes and complications

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Received 13 November 2013; accepted 3 May 2014

KEYWORDS
Sacrectomy;
Acellular dermal matrix;
Rectus abdominis;
Flap;
Reconstruction

Summary *Background:* Reconstruction of sacrectomy defects following ablative surgery remains a challenge, with high complication rates in the reported literature. The size of the defect is the primary consideration for flap choice; however, the cause of intra-abdominal and flap complications remains unclear. The aim of the study was to evaluate our results for sacrectomy flap reconstruction in order to determine predictive or protecting factors for complications.
Methods: A 13-year retrospective review was performed of all patients who had reconstruction for partial and total sacrectomy defects at the Mayo Clinic in Rochester, MN, USA. Demographics, flap choice, and complications were analyzed. Multivariate analysis was used to determine factors causing flap and intra-abdominal complications.
Results: Fifty-four patients underwent reconstruction. Partial sacrectomy was performed in 38 (70.4%) patients, while total sacrectomy was performed in 16 (29.6%) patients. The average wound defect volume was 2136 cm^3 (range 196—13,980 cm^3). Flaps used included gluteal ($n = 15$; 27.8%), rectus abdominis myocutaneous (RAM) ($n = 37$; 68.5%), and combined gluteal/RAM ($n = 2$; 3.7%). Obesity was significantly associated with intra-abdominal complications ($p < 0.05$) while preoperative radiotherapy and chemotherapy were not. Flap and wound healing complications were not significantly associated with any factors.
Conclusions: Gluteal advancement and vertical RAM or transverse RAM flaps are both reliable options for reconstruction of sacrectomy defects. The use of acellular dermal matrix (ADM) for

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http://dx.doi.org/10.1016/j.bjps.2014.05.001

reconstructing the posterior abdominal wall provides a barrier between the intra-abdominal contents and flap, preventing bowel adhesions/obstruction and fistulas as well as prevents sacroperineal hernia.

Introduction

Sacrectomy defects following wide resection for sacral tumors remain a challenge for the reconstructive surgeon. The complex sacral neuroanatomy, its proximity to the intestinal tract, the frequent ligation of the gluteal vessels, previous radiation therapy, and requirement for hardware bone reconstruction add additional difficulties to soft-tissue reconstruction.[1] Reconstructive options reported for sacrectomy defects include local flaps (gluteal, thigh), transabdominal pedicled rectus abdominis muscle (RAM) flaps, and free flaps.[2–5] Algorithms for the best reconstructive approach after sacrectomies have been discussed in only a few series in the literature.[2–9] Miles et al., in 2000 proposed the first algorithm for total sacrectomy reconstruction based on history of radiotherapy, patency of gluteal vessels, and previous abdominal surgery.[2] Diaz et al., in 2003 concluded that local flaps alone might be inadequate to provide appropriate soft-tissue coverage in immediate reconstruction after total sacrectomy.[3] Glatt et al., in 2006 reported vertical rectus abdominis muscle (VRAM) flap as the most reliable choice for reconstruction after partial or total sacrectomy, even in patients with ostomies or previous abdominal surgery.[4] The use of the VRAM pedicled flap for coverage of pelvic defects, especially after radiotherapy, has been encouraged and supported by other authors.[6–9] Most recently, Garvey et al. proposed a new algorithm for partial sacrectomy flap reconstruction based on wound defect size in addition to history of radiotherapy, patency of gluteal vessels, and presumed frozen abdomen.[5] Despite all the efforts, there are still high rates of complications following sacral tumor resection.

The use of acellularized dermal matrix (ADM), specifically Alloderm (LifeCell Corp, Bridgewater, NJ, USA) to reconstruct the posterior abdominal wall during sacrectomy flap coverage in our institution was first performed in 2005 and triggered by an iatrogenic enterotomy while reoperating for hardware failure. At that time, the small bowel was found to be herniated through and densely adhered to the metallic hardware. We also started using ADM after noticing potentially preventable complications in other patients. Another patient developed a small bowel obstruction with transition point at the sacrectomy osteotomy site, while a parasacral hernia was diagnosed on follow-up magnetic resonance imaging (MRI) in a patient with total sacrectomy and pedicled RAM reconstruction with no ADM. We believe that ADM serves to provide a barrier between the intraperitoneal contents and the reconstruction, preventing adhesions and bowel complications, while also preventing sacral herniation of intra-abdominal contents. Sacral herniation of abdominal contents after sacrectomies is an uncommon but challenging complication.[10–17] The exact incidence of sacroperineal hernia is unknown, but small series have reported a 1–10% incidence after sacrectomies, abdominoperineal resections, and pelvic exenteration.[15,17]

The aim of this study was therefore to evaluate our results for partial and total sacrectomy flap reconstruction in order to determine predictive or protecting factors for complications. Identifying high-risk patients will help individualize the surgical approach and improve outcomes.

Material and Methods

This study was approved by our Institutional Review Board at the Mayo Clinic in Rochester, MN, USA. Medical records of all patients who had flap reconstruction after sacrectomy at our institution between January 1998 and June 2011 were reviewed. Only sacrectomies for primary resection of sacral malignancies were included. We excluded patients with previous sacral surgery and patients who had associated hemipelvectomy. Informed consent of all patients was obtained preoperatively. The operation was performed by a multidisciplinary team: spine surgeons (orthopedics/neurosurgery), general/colorectal surgeons, plastic surgeons, and, often, vascular surgeons and urologists in one or multiple stages. All our patients required rehabilitation before discharge. Demographics, risk factors, preoperative diagnosis, wound size, type of sacrectomy and flap, procedural data, use of ADM, postoperative complications, and final outcomes in each patient were obtained.

The size of the sacrectomy wound defect was estimated based on the surgical pathology specimen measurements and divided into three classes: small ($<$400 cm^3), medium (400–2000 cm^3), and large ($>$2000 cm^3).[5] Postoperative complications were divided into three groups (flap, intra-abdominal, and donor site) in order to distinguish among complications related to the soft-tissue reconstruction, to the oncological resection, and specific to the abdominal wall from pedicled RAM flaps. Postoperative functional outcome was divided into non-ambulatory and ambulatory, which included ambulation with assistance of walkers, canes, or crutches.

Statistical analysis was performed using the JMP® 9 software. Continuous variables were summarized using the mean and standard deviation. Categorical data were summarized using frequencies and percentages. The association of clinical and postoperative complication or other variables was done via the Fisher's exact test or Pearson chi-square test. Logistic regression models were also fit to test for factors associated with complication outcomes. First, a univariate logistic model was performed, and those showing any signal ($p < 0.05$) were carried forward into a