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Case and Review
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Posterior Pelvic Reconstruction: A Case and Review of the Literature

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Abstract

Introduction: Enbloc tumor resection of the sacrum can leave the posterior pelvis devoid of structural support and soft tissue coverage, putting patients at risk of postoperative complications and sacral herniation. Compared to total sacrectomies, partial sacrectomy defects can often be managed without instrumentation to reconstruct the structural support of the spino-pelvic junction. However, lack of skeletal support and often large soft tissue defects lead to challenges in decision-making for posterior pelvic reconstruction (PPR).

Objective: The objective of this paper is to share a reconstructive method for posterior pelvic reconstruction following a partial sacrectomy and present a systematic review of the current literature.

Material and Methods: A systematic review identified relevant studies published through Medline Ovid until July 2015. Search terms focused on (1) Reconstruction (2) Primary sacral tumors. Data collection included the following: (1) Patient demographics (2) Sacral resection (3) Reconstruction of defect (4) Tumor pathology (5) Patient outcome - complications and follow-up.

Result: A total of twenty-three articles highlight soft-tissue reconstruction in posterior sacral defects following partial sacrectomies. Fifty-nine patients met our inclusion criteria. Age ranged from 23 – 71 years old. There were 28 male and 28 female (3 unknown sex) patients. The most common pathology was chordoma (n=49, 83%). Other pathology included giant cell tumor, myxopapillary ependymoma, and chondrosarcoma. Follow-up time ranged from 6-96 months. Eighteen articles highlighted the use of soft tissue flaps. Gluteal-based and vertical rectus flaps were most common. Other closures included omental, paraspinous, gluteal thigh and free latissimus flaps. Five articles showcased the use of synthetic mesh materials and 31 patients had acellular dermal matrix in their reconstruction. Complications included infection, deep vein thrombosis, flap necrosis, wound dehiscence, seroma and rectal perforation secondary to mesh.

Discussion: Partial sacrectomy reconstruction is varied in its approach. Few published case reports and series are available to guide the reconstructive surgeon.

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Introduction

Enbloc tumor resection of the sacrum can leave the posterior pelvis devoid of structural support and soft tissue coverage, putting patients at risk of postoperative complications and sacral herniation [1]. Compared to total sacrectomies, partial sacrectomy defects can often be managed without instrumentation to reconstruct the structural support of the spino-pelvic junction [2]. However, lack of skeletal support and often large soft tissue defects lead to challenges in decision-making for posterior pelvic reconstruction (PPR) [3]. A variety of tissue flaps have been previously described including gluteal muscle flaps, rectus abdominis myocutaneous flaps, paraspinous flaps and omental flaps [4]. Other support includes the use of synthetic materials and acellular dermal matrices [5,6]. The objective of this systematic review was to examine the current literature on PPR of partial sacrectomy defects involving soft tissue reconstruction.

Case Presentation

A retrospective review of the chart was initiated. A 75-year-old male presented with a one-year history of lower back pain. Computed tomography imaging demonstrated an 8 x 12 x 7cm destructive lesion in his upper sacrum later confirmed by biopsy to be a classic-type chordoma

Figure 1: Computed tomography axial view of sacral chordoma.

Figure 2: Inferiorly based vertical rectus flap harvested anteriorly. Deep surface of flap is seen.

(Figure 1). The procedure began with the reconstructive team raising an inferiorly-based vertical rectus abdominis myocutaneous (VRAM) flap and the general surgery team accessing and releasing the anterior portion of the tumor (Figure 2). In the second stage of the procedure, the spinal surgery team resected the remaining tumor requiring sacrifice of superior and inferior gluteal artery perforators (SGAP and IGAP) obviating gluteal-based flaps as a potential reconstruction (Figure 3). The resultant defect measured 20 x 20cm. To isolate the small bowel from herniating posteriorly, a 16 x 20cm acellular dermal matrix (ADM) was secured to remaining bone and gluteus muscle residuum, leaving a superior opening for the pedicled VRAM flap (Figure 4). The VRAM flap was de-epithelized and positioned over the ADM thus obliterating dead space (Figure 5). Primary closure was achievable. The patient was reassessed at 13 months post-operation and had no evidence of sacral herniation. The patient passed away 15 months post-operation.

Methods

Search strategy and Selection criteria

A systematic review identified relevant studies published through Medline Ovid from 1970 until July 2015. Search terms focused on (1) Reconstruction (2) Primary sacral tumors (Appendix). All study types were included in the initial search, including abstracts and pending publications available. Non-electronic versions were requested. Inclusion criteria required the publications to be pertaining to reconstruction of partial sacral defects from a primary sacral lesion. Articles were excluded if they had no reconstructive data or were not clinical cases. Two authors (J.S. and R.H.) independently reviewed

Figure 3: Enbloc specimen including colon and partial sacrum (sparing of SI joints).

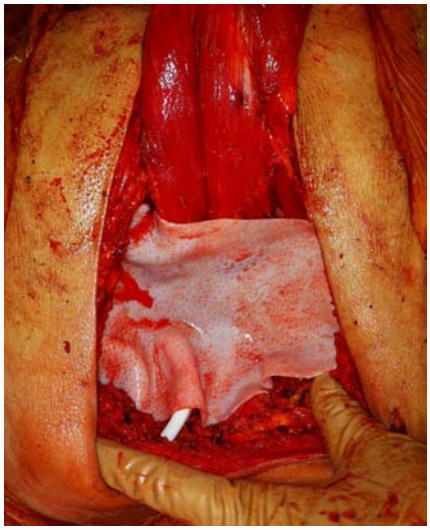

Figure 4: Placement of acellular dermal matrix in posterior defect.

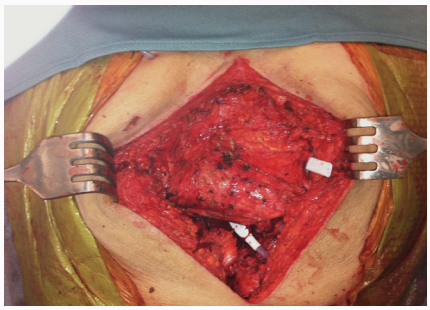

Figure 5: Placement of transpelvic vertical rectus flap posterior to acellular dermal matrix.

the articles. Disagreements on consensus of inclusion or exclusion were arbitrated by a third author (M.B.).

Data extraction and Outcomes

Title, author, journal, publication year and study type were recorded. Data collection included the following when available: (1) Patient demographics (2) Sacral resection (3) Reconstruction of defect (4) Tumor pathology (5) Patient outcome – complications and follow-up.

Results

Study selection

Using the previously described search method, 1371 articles were identified. After articles were screened by title and abstract using our

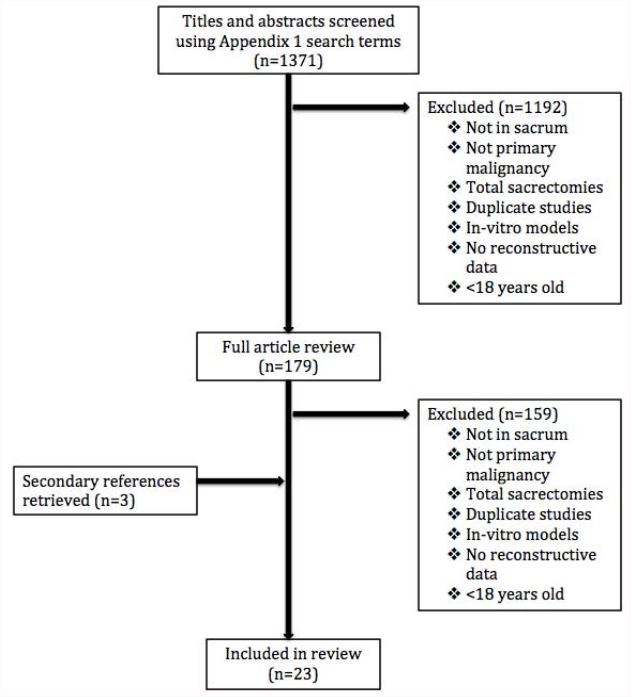

Figure 6: Study selection flow diagram.

exclusion criteria, 1192 articles were removed from the search. The remaining 179 articles were reviewed in full, further excluding 159. Secondary resources revealed an additional three studies (Figure 6).

Demographics

A total of twenty-three articles highlight soft-tissue reconstruction in posterior sacral defects following partial sacrectomies. Articles included case reports (n=9) and case series (n=14) highlighting a variety of reconstructions for sacral defects. A total of 59 patients met our inclusion criteria (Table 1). Eight articles reported on patients undergoing partial and total sacrectomies for primary neoplasms. Five of these, include reconstructive data for secondary neoplasms of the sacrum. Papers recording total sacrectomy and partial sacrectomy patients and/or secondary pathology of the sacrum in total numbers (specific data for partial sacrectomy patients could not be extracted) were excluded from the demographic calculations (denoted with * &). The remaining 15 articles accounted for 28 male and 28 female who underwent soft tissue reconstruction for partial sacrectomies (3 not recorded). Patient age ranged from 23 – 71 years-old. The most common pathology was chordoma (n=49, 83%). Other pathology included giant cell tumor, myxopapillary ependymoma, and chondrosarcoma. The most common pathology reported in all articles was chordoma (18 of 23 articles) (Table 1). Follow-up time ranged from 6 - 96 months.

Soft tissue reconstruction

Soft tissue reconstruction was commonly utilized in partial sacrectomies. Eighteen articles used soft tissue flaps. Gluteal-based and vertical rectus flaps were most common (11 articles & 7 articles, respectively). Other closures included omental, paraspinous, gluteal thigh and free latissimus flaps. Five articles highlighted use of synthetic materials including Dacryl© mesh, Polypropylene, and an unknown mesh brand for structural support, with it being used in two patients for repair of late sacral herniation at 4 and 72 months (Atkin, Junge). Another late sacral herniation was treated with acellular dermal matrix one-year post resection (Brizidene). Acellular dermal matrices combined with gluteal-based reconstruction were used in 29 cases. Complications included infection, deep vein thrombosis, flap necrosis, wound dehiscence, seroma, and rectal perforation secondary to mesh. Complications are listed in Table 1 and include undifferentiated complications of total and partial sacrectomies as well as secondary malignancy reconstruction that could not be delineated for some articles.

Discussion

Compared to total sacrectomies, partial sacrectomy defects can often be managed without instrumentation to reconstruct the structural support of the spinopelvic junction, provided the sacroiliac (SI) joint is spared. However, lack of skeletal support and often large soft tissue defects lead to challenges in decision-making for posterior pelvic reconstruction. Without adequate reconstruction following partial sacrectomy, post-operative complications including infection, herniation, and fistula formation may ensue [7]. Resection volume has previously been determined to be a factor in choice of flap reconstruction [4]. Other factors that may determine flap reconstruction include previous radiation to the site or sacrifice of the gluteal vessels secondary to resection. Prior laparotomy or previous ostomy site once precluded the vertical rectus flap as an option, but this is no longer supported [8,9].

The most common flap reconstructions following partial sacrectomies were gluteal-based flaps. Reconstruction included unilateral or bilateral and sliding/advancement and turn-over methods. Advantages of this flap include adequate bulk, robust blood supply, and proximity to the defect [9,10]. Additionally, it allows for a posterior-only approach [11]. Disadvantages include possible disruption of gluteal perforators during tumor resection and risk of gluteal weakness affecting gait [7,9]. Vertical rectus flow-through flaps offer the advantage of having a robust blood supply as well as providing sufficient soft tissue bulk and long pedicle length [12]. Donor site complications including abdominal herniation and weakness should be factored into decision-making.

Marichevi et al. [13] present evidence that acellular dermal matrix (ADM) reconstruction decreased the number of intra-abdominal complications when compared to a control group. The use of ADM restores the continuity of the posterior abdominal wall as well as provides an additional barrier between intraperitoneal space and instrumentation if present. Addition of flap reconstruction helps to obliterate the dead space and minimizes seroma and infection. Sciubba et al. [3] present a decrease trend in surgical site infection with presence of soft-tissue flap reconstruction, further supporting other's recommendations of utilizing flaps for sacrectomy defects. There are few published studies presenting partial sacrectomy reconstruction and their possible complications. The current published level of evidence available to guide the reconstructive surgeon in tackling partial sacrectomy defects is limited. A summary of options are presented in this manuscript.

Conclusion

A review of the literature on soft tissue reconstruction of the posterior pelvis following partial sacrectomy reveals that VRAM and gluteal perforator flaps are appropriate choices for obliterating dead space and closure of skin deficiencies, and ADM provides structural support and fewer intraabdominal complications.

Table 1: Summarized articles highlighting soft tissue reconstruction for partial sacrectomy defects.

Article	Year of publication	Number of patients	Age	Sex	Flap	Other support	Complications	Pathology	Follow-up (months) – range or average
Gillis [14]	2014	1	30	M (1)	Latissimus dorsi flap	-	Hardware removed 84 months post-op secondary to chronic infection	Chondrosarcoma (1)	96
Maricevich [13]*&	2014	Partial: 38 Total: 16	54a	ND M (36) F (18)	Gluteal advancement (14), vertical rectus abdominis myocutaneous (23), combined (1)	ADM (12)	ND – Early death due to bleeding and coagulopathy (2), parasacral hernia (1), pelvic abscess (9), pelvic hematoma (1), bowel obstruction (1), bowel perforation/fistula (2), CSF leak (2) donor site complications (10), flap complications (21)	ND – Chordoma (23), rectal cancer (18), sarcoma (9), MPNST (1), ependymoma (2), recurrent endometrial cancer(1)	27a
Weitao [9]*n&	2013	27	57a	M (19) F (8)	Bilateral gluteus maximus adipomuscular sliding (23), unilateral (4)	-	ND – Wound infection (4), wound dehiscence (3), wound necrosis (3)	ND – Chordoma (14), MM (3), metastatic (5), GCT (3), other (1)	48
Asavamongkolkul [15]*	2012	Partial: 9 Total: 12	Range 29-75	ND M (14) F (7)	-	Dacron® mesh to reconstruct urogenital diaphragm	ND – Infection & wound disruption (3), seroma (2), tumor recurrence (3)	Chordoma (9)	84
Clarke [11]*	2012	34	51a	ND M (18) F (18)	Verticle rectus abdominis myocutaneous (8)	-	ND – Wound complication (9) DVT (2), hyponatremia (1), ileus (1) tumor recurrence/ metastasis (6)	ND – Chordoma (30), osteoblastoma (2) sarcoma (1), hemangioma (1), MPNST (1), epidermoid (1),	47a
Dasenbrock [18]	2011	29	50a	M (15) F (14)	Bilateral gluteus maximus myocutaneous advancement (29)	ADM	Infection (5), reoperation (4) parasacral hernia and local tumor reccurence (1)	Chordoma (26), sarcoma (1), MPNST (1) osteoblastoma (1)	46a
Garvey [4]&	2010	50 (40 patients with primary sacral neoplasm)	NR	ND M (29) F (21)	Gluteus-based (25), gluteal thigh (4), vertical rectus abdominis musculocutaneous (13), paraspinous (4), other (4)	Mesh (7)	ND – Abscess (6), mesh infections (2), partial flap necrosis (4), dehiscence (10), delayed healing (14), seroma (4), unplanned operation (7)	Chordoma (24), sarcoma (8), MPNST (5), giant cell (2), ependymoma (1), metastatic (10)	26a
Varga [26]	2010	1	57	M (1)	-	Dacron® mesh	-	Chordoma (1)	60
Abhinav [1]	2009	2	63, 61	M (1) F(1)	-	Permacol™	-	Chordoma (2)	12
Korn [6]	2009	1	63	M (1)	Bilateral gluteus maximus transposition flap (1)	ADM	-	Chordoma (1)	12
Ramamurthy [23]	2009	6	23	M (2) F (4)	Omental transposition(1)	-	Wound dehisence (1), tumor recurrence (3)	GCT (3) myxopapillary ependymoma (1), chondroblastoma (1), PNET (1)	ND – 24
Sahakitrungruang [10]	2009	5	58a	M (5)	Bilateral gluteus maximus (5)	-	DVT (2), seroma (1)	Chordoma (5)	38a
Schwab [24]*n	2009	42	NR	M (30), F (12)	Rectus abdominis myocutaneous flap (10)	-	ND – 19 wound complications requiring debridement (10), persistent drainage needing reoperation (1), pulmonary embolism (2), enterocutaneous fistula (1) bowel perforation (1), 2 deaths within 6 weeks post-op, perirectal abscess (1), septicemia (1), recurrence (17)	Chordoma (42)	46a
Solini [25]&	2009	11	61	M (6) F (5)	Gluteal fascia advancement (11)	Mesh (1) (later removed after post-operative rectal perforation)	Rectal perforation (1), wound dehiscence (3)	Chordoma (9), ependymoma (1), bladder metastasis (1)	54-72

Cheong [12]	2008	1	33	F (1)	Vertical rectus abdominis myocutaneous (1)	-	Delayed reconstruction due to hemodynamic instability	GCT (1)	12
Brizendine [17]	2006	1	71	F (1)	1st stage: left-sided gluteus maximus myocutaneous flap closure, 2nd stage hernia repair: right -sided gluteus maximus turnover	ADM	Developed sacral hernia 12 months after resection, no secondary complications	Chordoma (1)	20
Glatt [8]*&	2006	12	59a	M (8) F(4)	Vertical rectus abdominis myocutaneous (11), Vertical rectus abdominis myocutaneous with bilateral gluteal advancement flap (1)	-	ND Minor flap necrosis (3)	ND Chordoma (9), osteogenic sarcoma (1), MFH (1), rectal ca (1)	20a
Koh [21]	2004	4	53a	F (4)	Right gluteus maximus turnover (2), gluteus maximus bilateral advancement (1) vertical rectus abdominis myocutaneous followed by unilateral gluteus maximus transposition (1)	-	Verticle rectus abdominis myocutaneous partial flap necrosis (1) and gluteus maximus transposition flap done 2 weeks later	Chordoma (4)	8
Atkin [5]	2003	1	68	M (1)	-	Polypropylene mesh to repair hernia 2 yrs after initial sacrectomy	Post-operative infection and prolonged ileus. Developed sacral hernia 4 months after resection, no secondary complications	Chordoma (1)	48
Junge [20]	2003	1	29	F (1)	-	Knitted polypropylene mesh (Atrium®) to repair defect after cystic tumor removal)	Late cystic tumor formation (6 years)	Spindle-cell rhabdo-myosarcoma (1)	NR
Althausen [16]	2002	1	29	F (1)	Bilateral lumbar fascial flap interposed between the rectum and instrumentation	-	Broken instrumentation requiring removal	GCT (1)	20
Di Benedetto [19]	2002	3	61a	ND	Free latissimus dorsi myocutaneous flap (3)	-	ND	Chordoma (3)	6-36
Furukawa [7]	2000	2	53, 48	M (1) F (1)	Gluteus maximus adipomuscular turnover flap (1) gluteus maximus adipomuscular sliding flap (1)	-	-	Chordoma (2)	5

* – Data for total and partial sacrectomies not differentiated by patient
n – Data for flap reconstruction not differentiated by patient
& – Includes data for secondary neoplasms of sacrum
a – Average of all patients reported in article
ND – Not differentiated, results listed may include total sacrectomy patients
ADM – Acellular dermal matrix
MM – Multiple myeloma
GCT – Giant cell tumor
MPNST – Malignant peripheral nerve sheath tumor
DVT – Deep vein thrombosis
Ca – Carcinoma
MFH – Malignant fibrous histiocytoma
PNET- Primitive neuroectodermal tumor

Appendix

Search terms applied to Medline Ovid database.

General scheme

[("tumor terminology" AND "sacral area terminology") OR ("sacral resection terminology")] AND [("reconstruction terminology")].

Search terms

Tumor terminology

"primary tumor" OR "neoplasm" OR "bone neoplasms" OR "chondrosarcoma" OR "chondrosarcoma" OR "giant cell tumor" OR "lymphoma" OR "multiple myeloma" OR "myeloma" OR "plasmacytoma" OR "Ewing sarcoma" OR "chordoma" OR "osteosarcoma" OR "osteogenic sarcoma" OR "spinal neoplasms" OR "bone cysts" OR "aneurysmal bone cysts".

Sacral area terminology

"sacrum" OR "sacral" OR "Sacrum" OR "lumbosacral"

OR “lumbo-sacral” OR “spinal pelvic” OR “spinal-pelvic” OR “spinopelvic” OR “sacroiliac” OR “sacro-iliac” OR “iliosacral” OR “ilio-sacral” OR “lumbo-pelvic” OR “lumbopelvic” OR “lumbo-iliac” OR “lumbosacropelvic” OR "posterior pelvis" OR "posterior pelvic wall".

Sacral resection terminology

("partial sacrectomy" OR "en bloc resection" OR "enbloc resection" OR (("sacral" OR"sacrum") and resection)).

Reconstruction terminology

"reconstruction" OR "flap" OR "mesh" OR "acellular dermal matrix" OR "Strattice" OR "Alloderm" OR "musculocutaneous flap" OR "cutaneous flap" OR "fasciocutaneous flap" OR "gluteal flap" OR "soft tissue reconstruction" OR "soft tissue coverage" OR "soft-tissue reconstruction" OR "reconstructive procedures" OR "reconstructive surgical procedures" OR "free flap" OR "myocutaneous flap" OR "rectus flap" OR "vertical rectus flap" OR "flap" OR "woundclosure".

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