

# Rectus abdominis flap for the treatment of lumbosacral coverage defects

FRANCO L. DE CICCIO, MARIANO O. ABREGO, GERARDO L. GALLUCCI,  
PABLO DE CARLI, JORGE G. BORETTO

*Hand and Upper Limb Surgery Section, Instituto de Ortopedia y Traumatología "Prof. Dr. Carlos Ottolenghi",  
Hospital Italiano de Buenos Aires, Ciudad Autónoma de Buenos Aires*

Received on October 30<sup>th</sup>, 2017; accepted after evaluation on December 5<sup>th</sup>, 2017 • JORGE G. BORETTO, MD • [jorge.boretto@hospitalitaliano.org.ar](mailto:jorge.boretto@hospitalitaliano.org.ar) 

## ABSTRACT

**Introduction:** The principle of treatment in lumbosacral coverage defects is based on the management of the dead space and the coverage of the defect. The aim of this study is to present a surgical technique and results and complications in a patient-series treated with rectus abdominis musculocutaneous flap for lumbosacral defect.

**Materials and Methods:** We carried out a six-year retrospective revision. We analyzed preoperative demographic variables. We describe the surgical technique and intraoperative complications. We analyzed postoperative variables such as complications in donor site, complications in receptor site and flap survival.

**Results:** Five patients met the inclusion criteria (50 years old on average): four with sacral tumor and one patient with lumbosacral osteomyelitis. The average follow-up was of 20 months. The average size of the cutaneous graft was 8 x 13 cm. Among complications, we registered an intraoperative pedicle lesion (microsurgical repair) and the death of one patient. There was an infection with surgical wound dehiscence as postoperative complication. There were no postoperative vascular complications in the flaps, and all of them remained vital throughout follow-up.

**Conclusion:** The rectus abdominis musculocutaneous flap should be considered as a valid option for the treatment of large soft tissue defects at lumbosacral level. They provide the surgeon with sufficient skin and muscle tissue for such defects coverage. The surgical technique is relatively simple with no need for microsurgical procedures.

**Key words:** Rectus abdominis; flap, reconstructive surgery.

**Level of evidence:** IV

## COLGAJO DE RECTO ANTERIOR DEL ABDOMEN PARA EL TRATAMIENTO DE LOS DEFECTOS DE COBERTURA LUMBOSACROS

### ABSTRACT

### RESUMEN

**Introducción:** El principio de tratamiento de los defectos de cobertura lumbosacros se basa en el manejo del espacio muerto y la cobertura del defecto. El objetivo de este estudio es presentar la técnica quirúrgica, los resultados y las complicaciones de una serie de pacientes tratados con colgajo de recto anterior para defecto lumbosacro.

**Materiales y Métodos:** Se efectuó una revisión retrospectiva durante un período de seis años. Se analizaron variables demográficas preoperatorias. Se describen la técnica quirúrgica y las complicaciones intraoperatorias. Se analizaron las variables posoperatorias, como complicaciones del sitio donante, complicaciones del sitio receptor y duración del colgajo.

Conflict of interests: The authors have reported none.

**Resultados:** Cinco pacientes cumplieron con los criterios de inclusión (edad promedio 50 años): cuatro con tumor sacro y una paciente con osteomielitis lumbosacra. El seguimiento promedio fue de 20 meses. El tamaño promedio de la pastilla cutánea fue de 8 x 13 cm. Entre las complicaciones, se registró una lesión del pedículo intraoperatoria (reparación microquirúrgica) y el óbito de un paciente. Se evidenció una infección con dehiscencia de la herida como complicación posoperatoria. No hubo complicaciones vasculares posoperatorias en los colgajos y todos permanecieron vitales durante el seguimiento.

**Conclusión:** El colgajo de recto anterior ha de ser considerado una opción válida en el tratamiento de heridas con grandes defectos de partes blandas a nivel lumbosacro. Provee de suficiente volumen de piel y tejido muscular para la cobertura de dichos defectos. La técnica es relativamente sencilla sin necesidad de procedimiento microquirúrgico.

**Palabras clave:** Recto anterior; colgajo, cirugía reconstructiva.

**Nivel de Evidencia:** IV

## Introduction

Deficit of soft tissues as a consequence of ample resection at lumbosacral level comes as a challenge at the time of planning reconstructive surgery. Such coverage defects, generally associated with a third space, usually originate in tumour resection, complications resulting from infection in spinal surgery, or severe trauma with loss of soft tissues. In these lesions, the aim of treatment is to manage dead spaces, to cover defects and to close wounds appropriately.

The local flap of choice in small defects is the unilateral or bilateral V-Y advancement gluteal musculocutaneous flap and, secondly, free flaps.<sup>1,2</sup> As a third alternative, we can mention pedicle flaps, especially the rectus abdominis musculocutaneous flap, which is preferably used in the cases of larger defects.<sup>2</sup>

The rectus abdominis musculocutaneous flap was described by Holmström for the first time and stems from the need for getting enough tissue coming from an appropriate donor site.<sup>3</sup>

The aim of this continuous case-series is to describe a surgical technique, and results and complications associated with the rectus abdominis musculocutaneous flap to reconstruct lumbosacral defects.

## Materials and Methods

We carried out a six-year retrospective revision (2011-2017) in patients treated with rectus abdominis musculocutaneous flap operated on at our Center by the same surgeon (JB). The patients' data were collected from our institution's electronic medical histories.

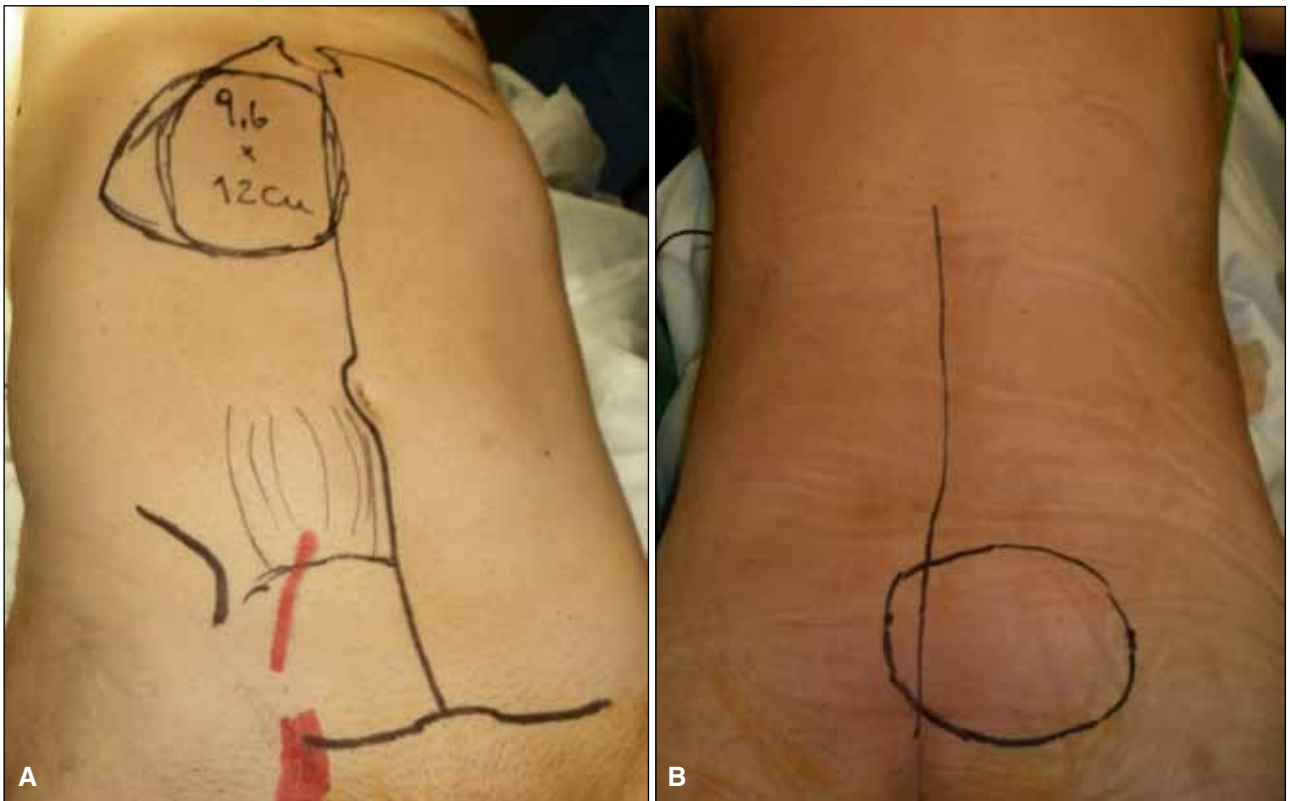
We included patients with lumbosacral coverage defects in whom surgical reconstruction was carried out with rectus abdominis musculocutaneous flap because, at the time of preoperative planning, they showed the need for an intraabdominal or pelvic surgical time. We excluded those patients who received a rectus abdominis musculocutaneous flap to manage coverage defects in other anatomic regions.

We analyzed preoperative, intraoperative and postoperative variables. Preoperative variables were: BMI, comorbidities, number of previous surgeries and the cause of the lumbosacral defect. The intraoperative variables were: size of cutaneous graft, intraoperative complications, closure of the abdominal wall and whether surgery was performed at consecutive or deferred times. Postoperative variables were: Complications in donor site, complications in receptor site, and flap survival. Moreover, we report tumor resection techniques and consecutive lumbosacral stabilization.

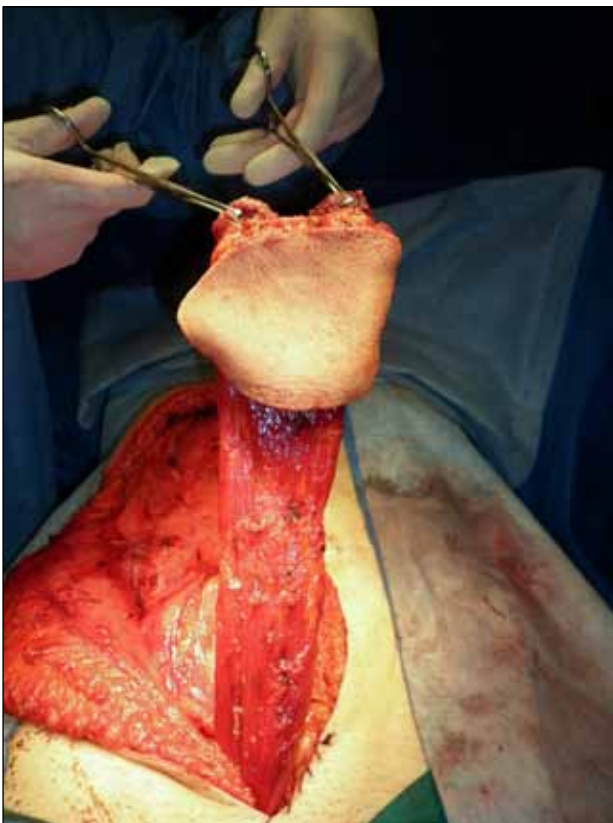
### Surgical technique

Surgery should be performed in two times, which can be continuous or deferred on the basis of the patient's characteristics and the type of surgery.

*First time:* It starts with the patient in prone position under the effects of general anesthesia. The cutaneous flap should be designed in the abdomen on the basis of the planned cutaneous resection or the previous lumbosacral defect (Figure 1). The skin incision is started on the paramedian line covering the pubic bone towards the sternum xiphoid process to then dissect the anterior abdominal wall until identifying the fascia of the rectus abdominis muscle. In general, it is preferable to mobilize the right rectus abdominis muscle because, if colostomy were necessary, there is virgin territory in the left hemi-abdomen.<sup>4</sup> Abdominal perforating arteries should then be ligated to the muscle, with thorough hemostasis in cutaneous perforating arteries. For ulterior reconstruction of the abdominal wall it is important to preserve fascia 2 cm towards the lateral edge and 1 cm from the linea alba thus keep the linea semilunaris with its fibrous portion.<sup>5</sup> Afterwards, the muscle is subject to proximal de-attachment lifting the musculocutaneous flap around its distal pedicle (Figure 2). Extreme care should be taken so as to preserve the whole insertion of the rectus abdominis muscle to the pelvic bone and thus avoid pedicle compression and torsion and protect it from traction and manipulation of the flap. Afterwards the flap should be introduced in a sterile bag within the intraperitoneal or retroperitoneal cavity as the origin of the defect is in (Figure 3). The flap can be kept in



▲ **Figure 1.** A. Preoperative planning and flap dissection. B. Planning of preoperative defect.



▲ **Figure 2.** Musculocutaneous flap based on lower pedicle.



▲ **Figure 3.** Flap introduced in sterile bag.

the abdomen safely during 24-48 hours. What comes next is the closure of the abdominal cavity with a Prolene™ or Vicryl net on the basis of the degree of contact that the omentum makes with the peritoneum. This way, the risk of enterocutaneous fistula decreases.<sup>2,7</sup> The net should be then positioned at peritoneum level in front of the omentum and anchored to the linea semilunaris (Figure 4). Aspiration drainage should be finally left in parafascial position (Figure 5).

*Second time:* With the patient in supine position. After tumor resection (Figure 6) or through lumbosacral defect, the flap is recovered posteriorly and, with special care so as not to rotate it more than 180° around its axis, it should be positioned so as to fill in the third space and give cutaneous coverage (Figure 7). It should be stitched with separate stitches.<sup>5</sup>

*Appendix to the first surgical time:* Part of the first surgical time should be performed together with the general surgery team, because the first surgical time varies according to the characteristics of the patient's tumor or condition. Exploratory laparotomy is carried out by means of the dieresis of the posterior fascia of the rectus abdominis

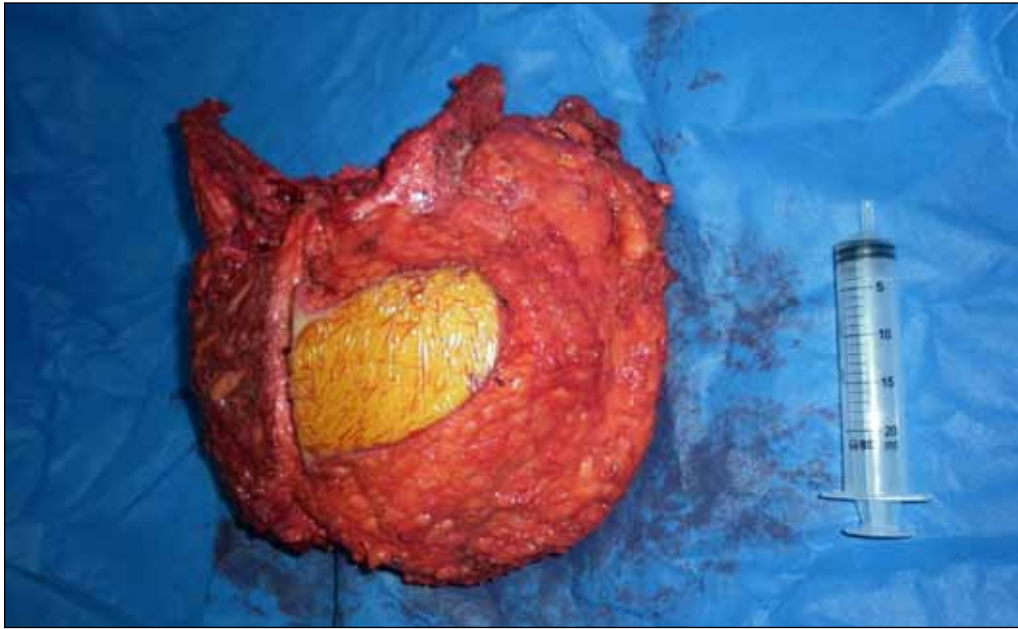
muscles and the peritoneum. Then a wound retractor ring (AlexisR) should be inserted so as to get to the abdominal cavity. Firstly, identification and dissection of both ureters should be performed up to near their bladder insertion to then go on to left coloparietal approach. The tumor should now be identified only to continue with circumferential rectum dissection taking care of the mesorectum fascia, first posteriorly and then on both sides up to the plane of the elevators and, finally, towards the front until uncovering the seminal vesicles. Hypogastric arteries and veins are dissected, ligated and severed on the right and, then, same procedures on the left should be used, following this order. Afterwards and depending on the location of the tumor, it is the presacral vessels which should be dissected, ligated and severed giving place this way to the de-vascularization of the tumor. Finally, what should be dissected and uncovered are the first sacral roots bilaterally up to their entrance through the greater sciatic notch, this way leaving sacro-iliac joints released bilaterally. With these maneuvers pelvic approach is done up with for ulterior tumor resection through posterior approach. In the case of surgery being performed due to spinal infection, this



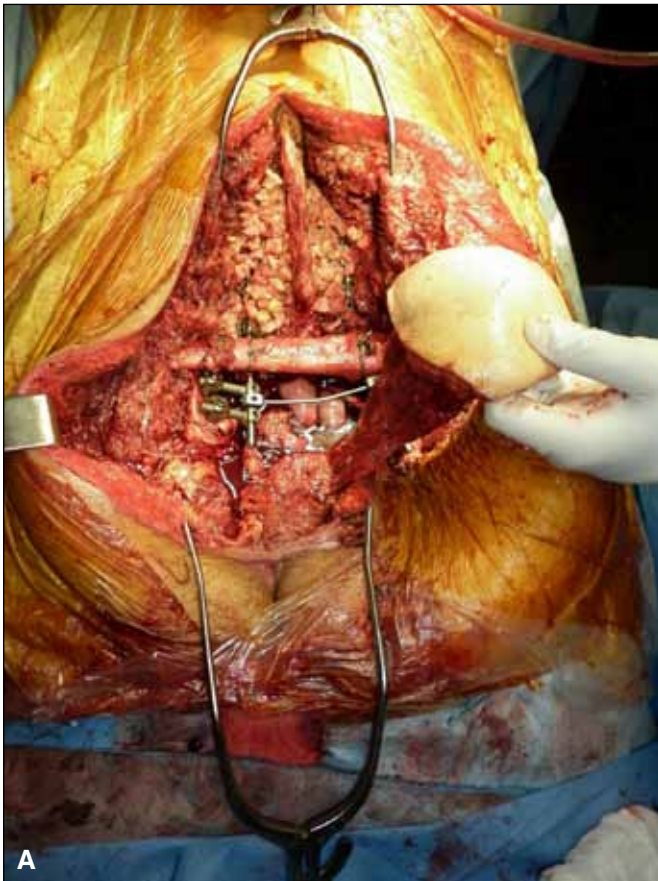
▲ **Figure 4.** Reconstruction of abdominal wall with net.



▲ **Figure 5.** Closure of abdominal wall with aspiration drainages.



▲ **Figure 6.** Resected tumour piece.



**Figure 7. A.** Recovery of flap at posterior level.  
**B.** Final closure of the cutaneous graft in the defect area.

surgical time has the aim of carrying out anterior debridement and stabilization on demand.

## Results

We identified six patients undergoing treatment with flap from rectus abdominis muscle in the assessed time. Five of them met the inclusion criteria (3 females and 2 males), whereas the remaining patient was excluded because in this case the flap was used to cover an anterior defect.

The patients' average age at the time of the surgery was 50 years old (ranging from 27 to 65), and their BMI at the time of the surgery was 25.14.

Three patients had had diagnosis of sacral chordoma, one had been diagnosed sacral chondrosarcoma and another one, lumbosacral osteomyelitis (Table 1). The latter patient had a 5-year history of defect previous to the surgery, whereas the remaining four cases underwent tumor resection with a third space or coverage defect as a consequence. As patients' relevant preoperative histories we detected a smoker patient, who showed an infection associ-

ated with osteosynthesis in her lumbar vertebral column. Such osteosynthesis was carried out at another Center due to vertebral collapse fracture. The patient did poorly with multiple surgical toilets, removal of the osteosynthesis material and active fistula plus chronic coverage defect as sequela in such area. Moreover, we detected a patient with stabilized HBP and asthma history, and another one with history of recurrent urinary infection. The two remaining patients did not have history of co-morbidities.

In three cases, surgery was performed in two continuous times and, in two cases, in a deferred way (Table 2).

One male patient passed away during the surgery after tumor resection. The remaining four patients had maximal follow-up of 26 months with 7 months as minimal follow-up (average 20 months). The average size of the cutaneous graft was 8 x 13 cm (ranging from 7 x 14). In one patient the flap was used to fill in a third space with no need for cutaneous graft, since the tumor did not involve dermic coverage.

The second surgical time varied as the characteristics of the patients' conditions did. The four patients with tumor lesions were subject to tumor resection with previ-

**Table 1.** Demographic data

Case	Age	Comorbidities	BMI	Condition	Defect
1	61	Asthma, HBP	25	Sacral chordoma	Lumbosacral
2	65	Recurrent urinary infection	24.5	Sacral chordoma	Lumbosacral
3	40	-	22.6	Sacral chordoma	Lumbosacral
4	27	-	27.1	Sacral Chondrosarcoma	Lumbosacral
5	57	Smoking	26.8	History of spinal osteomyelitis	Lumbosacral

**Table 2.** Intraoperative variables and results

Case	Size	Surgical times	Complications of flap	Reconstruction of abdominal flap	Second time	Follow-up
1	9.6 x 12 cm	One	-	Sandwiched Vicryl and Prolene™ net	Tumour resection + Lumbopelvic arthrodesis	-
2	7 x 14 cm	Two	Infection + Surgical wound dehiscence	Vicryl net	S1-S2 multiplanar osteotomy + Tumour resection	26 months
3	8 x 13 cm	One	-	Prolene™ net	S1-S2 multiplanar osteotomy + Tumour resection	22 months
4	Without cutaneous graft	Two	-	Vicryl net	Tumor resection + Structural bone graft from bank + Lumbopelvic arthrodesis	26 months
5	8 x 13 cm	One	Pedicle lesion	Vicryl net	Surgical toilet + Implant removal	7 months

ous planning to carry out navigation-guided-osteotomy. In two cases, the patients were subject to lumbopelvic arthrodesis behind tumor resection using structural bone graft from bone graft bank in one of them. In the two remaining tumor resections, we did not carry out spinal stabilization. The patient with lumbosacral osteomyelitis was subject to surgical toilet and anterior debridement in the lumbosacral spine.

As complications we registered an injury of the pedicle during the surgery (microsurgical repair) and one infection with surgical wound dehiscence (closure at postoperative month 4). None of the flaps suffered postoperative vascular complications, and all of them remained vital throughout follow-up (Figure 8).

## Discussion

The rectus abdominis musculocutaneous flap has a type III vascular pattern according to the Mathes and Nahi's classification,<sup>8</sup> with two dominating pedicles (lower epigastric arteries, which provide blood supply to the lower portion of the muscle, and upper epigastric arteries, branches from the internal thoracic artery, which provide blood supply to the upper portion of the muscle). Nowadays, this is considered to be one of the main therapeutic

options in the management of sacral chordoma post-resection wounds.

They come from an anatomic region which is away from the lesion; therefore, they are affected by neither previous procedures scars nor the radiotherapy used as adjuvant treatment in some tumors.<sup>10</sup> Esthetic results are usually satisfactory as long as appropriate skin closure is carried out in the donor zone.<sup>9</sup> Since this is a non-radiated and vascularized flap, blood supply to the receptor area increases providing tissues with oxygen, thus decreasing the risk of infection and surgical wound dehiscence.<sup>11</sup>

With respect to morbidity in the donor site, it is worth highlight the weakness of abdominal walls for trunk flexion and the likely abdominal hernias.<sup>8,12,13</sup> It has been determined that, on average, trunk flexion strength is recovered within the first postoperative year.<sup>14</sup> Hernias and bulges, if any, are usually asymptomatic and they are associated with exercise.

Predisposing factors for wound complications in the donor zone include history of diabetes mellitus, smoking, >23 BMI, HBP, hyperlipidemia, >3.5 mg/dl serous albumin, preoperative or postoperative chemotherapy and previous colostomy.<sup>15</sup> The rates of surgical wound dehiscence in the donor site vary among series between 0% and 11%.<sup>16,17</sup> In our series, all the patients had <30 BMI, something that we consider to be acceptable.



**Figure 8.** A. Coverage defect in a patient with history of osteomyelitis due to previous spinal surgery. B. Results three months after the surgery.

Obesity, Chemotherapy and radiotherapy are considered to be risk factors for intraabdominal complications.<sup>2</sup>

Among contraindications for the use of rectus abdominis musculocutaneous flap, we can mention history of abdominal surgery, previous ligation of lower epigastric vessels and abdominal wall tear.<sup>18</sup> Some authors affirm that those patients who have undergone laparotomy or osteotomy have active contraindication for the use of rectus abdominis musculocutaneous flap.<sup>1</sup> However, the Glatt et al. series<sup>6</sup> reports five cases of previous laparotomy (with or without associated osteotomy) without complications. In our series, no patient had undergone abdominal surgery, nor did they have wall defects.

The limitations of this work are all about the number of patients and its retrospective character; however, but for

that of Mayo Clinic (39 cases),<sup>2</sup> our experience includes a significant number of patients to contribute with evidence to the specialized literature.

## Conclusions

The rectus abdominis musculocutaneous flap should be considered as a valid option for the treatment of lumbosacral tumor post-resection wounds when preoperative planning includes an intraabdominal or pelvic time. It provides the surgeon with sufficient skin and muscle tissue for ample coverage defects. The surgical technique is relatively simple with no need for microsurgical procedures, low morbidity rates and low complication rates.

## Bibliography

1. Miles WK, Chang DW, Kroll SS, Miller MJ, Langstein HN, Reece GP, et al. Reconstruction of large sacral defects following total sacrectomy. *Plast Reconstr Surg* 2000;105(7):2387-94.
2. Maricevich M, Maricevich R, Chim H, Moran SL, Rose PS, Mardini S. Reconstruction following partial and total sacrectomy defects: an analysis of outcomes and complications. *J Plast Reconstr Aesthet Surg* 2014;67(9):1257-66.
3. Holmström H. The free abdominoplasty flap and its use in breast reconstruction. An experimental study and clinical case report. *Scand J Plast Reconstr Surg* 1979;13(3):423-7.
4. Vaccarezza H. Reconstrucción perineal con colgajo de recto anterior por cáncer de ano localmente avanzado. Una opción para el cirujano colorrectal. *Rev Argent Cirug* 2016;108(4):208-12.
5. Chirappapha P, Trikunagonvong N, Praprutam D, Rongthong S, Lertsithichai P, Sukarayothin T, et al. Donor-site complications and remnant of rectus abdominis muscle status after transverse rectus abdominis myocutaneous flap reconstruction. *Plast Reconstr Surg Glob Open* 2017;5(6):e1387.
6. Glatt BS, Disa JJ, Mehrara BJ, Pusic AL, Boland P, Cordeiro PG. Reconstruction of extensive partial or total sacrectomy defects with a transabdominal vertical rectus abdominis myocutaneous flap. *Ann Plast Surg* 2006;56:526-30; discussion 530-1.
7. Brandi CD, Roche S, Bertone S, Fratantoni ME. No enterocutaneous fistula development in a cohort of 695 patients after incisional hernia repair using intraperitoneal uncoated polypropylene mesh. *Hernia* 2017;21(1):101-6.
8. Mathes SJ, Nahai F. Classification of the vascular anatomy of muscles: experimental and clinical correlation. *Plast Reconstr Surg* 1981;67(2):177-87.
9. Schwab JH, Healey JH, Rose P, Casas-Ganem J, Boland JP. The surgical management of sacral chordomas. *Spine (Phila Pa 1976)* 2009;34(24):2700-4.
10. Cheong YW, Sulaiman WA, Halim AS. Reconstruction of large sacral defects following tumour resection: a report of two cases. *J Orthop Surg* 2008;16(3):351-4.
11. Petrie N, Branagan G, McGuinness C, McGee S, Fuller C, Chave H. Reconstruction of the perineum following anorectal cancer excision. *Int J Colorectal Dis* 2009;24:97-104.
12. Nahabedian MY, Dooley W, Singh N, Manson PN. Contour abnormalities of the abdomen after breast reconstruction with abdominal flaps: the role of muscle preservation. *Plast Reconstr Surg* 2002;109:91-101.
13. Kuntscher MV, Mansouri S, Noack N, Hartmann B. Versatility of vertical rectus abdominis musculocutaneous flaps. *Microsurgery* 2006;26:363-9.
14. Edsander-Nord A, Jurell G, Wickman M. Donor-site morbidity after pedicled or free TRAM flap surgery: a prospective and objective study. *Plast Reconstr Surg* 1998;102:1508-16.
15. Kim JE, Pang J, Christensen JM, Coon D, Zadnik PL, Wolinsky JP, et al. Soft-tissue reconstruction after total en bloc sacrectomy. *J Neurosurg Spine* 2015;22(6):571-81.



16. Pocard M, Tiret E, Nugent K, Dehni N, Parc R. Results of salvage abdominoperineal resection for anal cancer after radiotherapy. *Dis Colon Rectum* 1998;41:1488-1493.
17. Weiwei L, Zhifei L, Ang Z, Lin Z, Dan L, Qun Q. Vaginal reconstruction with the muscle-sparing vertical rectus abdominus myocutaneous flap. *J Plast Reconstr Aesthet Surg* 2009;62:335-40.
18. Petit JY, Rietjens M, Ferreira MA, Montrucoli D, Lifrange E, Martinelli P. Abdominal sequelae after pedicled TRAM flap breast reconstruction. *Plast Reconstr Surg* 1997;99:723-9.