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STAGED RECONSTRUCTION OF AN ADVANCED SACRAL PRESSURE ULCER FOLLOWING FAILED ADIPOSE-BASED THERAPY USING GLUTEAL ROTATIONAL FLAP COVERAGE

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ABSTRACT

Background: *advanced sacral pressure ulcers represent a significant reconstructive challenge, particularly in patients with extensive soft tissue loss and exposure of underlying bone. Staged management strategies, including debridement, negative pressure wound therapy (NPWT), adipose-based techniques, and flap reconstruction, are commonly used to achieve definitive wound closure.*
Objective: *to present the management of an advanced sacral pressure ulcer treated with staged surgical reconstruction and to review current literature regarding adipose-based techniques and flap reconstruction in complex sacral defects.*
Methods: *a literature review was performed using PubMed, Cochrane Library, and Google Scholar databases, selecting relevant articles related to pressure ulcer reconstruction, adipose-based therapies, and flap techniques. In addition, a clinical case of an adult male with an advanced sacral pressure ulcer and bone exposure managed through staged debridement, NPWT, adipose tissue grafting, and subsequent gluteus maximus rotational flap reconstruction is described.*
Results: *the literature supports the use of NPWT as an effective method for wound bed preparation and highlights the regenerative potential of adipose-based therapies in selected cases. However, in large defects with bone exposure, flap-based reconstruction remains the most reliable method for definitive closure. In the present case, adipose tissue grafting alone did not achieve satisfactory healing, and definitive coverage was successfully achieved using a unilateral gluteus maximus rotational flap, resulting in favorable wound healing and functional recovery.*
Conclusion: *advanced sacral pressure ulcers require staged and individualized management. Although adipose-based techniques may provide regenerative benefits, flap reconstruction remains the gold standard for large and deep defects. Early recognition of inadequate wound progression and timely flap reconstruction are essential to optimize clinical outcomes.*

KEYWORDS: *Sacral pressure ulcer; Gluteus maximus flap; Negative pressure wound therapy; Fat grafting; Pressure injury; Surgical reconstruction.*

INTRODUCTION

Pressure ulcers remain a significant health problem worldwide, particularly among hospitalized and critically ill patients who require prolonged immobilization. These lesions result from sustained pressure, shear forces, and tissue ischemia over bony prominences, most commonly affecting the sacral region. Advanced pressure ulcers represent a major reconstructive challenge due to the presence of extensive tissue loss, infection, dead space formation, and, in many cases, exposure of underlying bone structures.

Despite advances in preventive strategies, the incidence of pressure ulcers continues to be considerable, especially in intensive care unit settings, where prolonged immobility, hemodynamic instability, and comorbidities contribute to tissue breakdown. Sacral pressure ulcers are particularly problematic because of their anatomical location, difficulty in maintaining

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wound hygiene, and high risk of contamination and recurrence. In severe cases, conservative management alone is insufficient, requiring surgical intervention to achieve adequate wound closure and functional recovery.

The surgical management of advanced pressure ulcers involves a multidisciplinary approach that includes aggressive debridement, infection control, and soft tissue reconstruction. Negative pressure wound therapy (NPWT) has become a widely accepted method for preparing the wound bed by promoting granulation tissue formation and reducing bacterial burden. Additionally, adipose-based techniques, including autologous fat grafting, have been proposed as adjunctive methods to improve tissue quality, enhance vascularization, and promote wound healing in selected cases.

However, in large and deep sacral defects, especially those associated with exposed bone or extensive tissue loss, flap-based reconstruction remains the gold standard for definitive coverage. Muscle and myocutaneous flaps, particularly the gluteus maximus flap, provide well-vascularized tissue capable of obliterating dead space, improving local blood supply, and reducing the risk of infection. The selection of the appropriate reconstructive method depends on wound characteristics, patient comorbidities, and previous surgical interventions.

This report presents the case of an advanced sacral pressure ulcer initially managed with staged debridement, negative pressure wound therapy, and adipose-based reconstruction, which failed to achieve satisfactory healing and ultimately required definitive coverage using a gluteus maximus rotational flap. In addition to the case description, a review of the current literature is provided to discuss the role of adipose-based techniques and flap reconstruction in the management of advanced sacral pressure ulcers(1,2).

METHODOLOGY

A literature review was conducted to support the clinical findings described in this case report. A total of 18 articles were initially identified, including original articles, review articles, case reports, and clinical studies. After applying relevance and quality criteria, 11 articles were selected for inclusion in this study.

The literature search was performed using the databases PubMed, Cochrane Library, and Google Scholar. Articles published in English, Spanish, and Portuguese were considered. The following keywords were used individually and in combination:

- *Pressure Ulcer*
- *Sacral Pressure Ulcer*
- *Negative Pressure Wound Therapy*
- *Adipose Tissue Grafting*
- *Fat Grafting*
- *Gluteus Maximus Flap*
- *Sacral Reconstruction*
- *Muscle Flap*
- *Perforator Flap*

Articles were selected based on their relevance to the etiology, evaluation, diagnosis, and management of advanced sacral pressure ulcers, with particular emphasis on reconstructive surgical techniques, adipose-based therapies, and flap reconstruction strategies.
Duplicate articles and publications lacking sufficient clinical or methodological relevance were excluded.

DEVELOPMENT

Case Presentation

A male patient in his fifth to sixth decade of life, with a history of obesity, underwent abdominal surgery at another institution due to a complicated intra-abdominal condition reportedly associated with peritonitis. The postoperative course was complicated by hemodynamic instability, requiring admission to the intensive care unit (ICU), where he remained hospitalized for a prolonged period.

During his ICU stay, the patient developed a pressure ulcer in the sacral region. After clinical stabilization and improvement of his systemic condition, he was discharged from the ICU; however, the sacral lesion progressively worsened, evolving into a large sacral pressure ulcer. The patient was subsequently referred to our service for further evaluation and management.

On admission to our department, clinical examination revealed a large sacral pressure ulcer with extensive soft tissue involvement. Due to the size and depth of the lesion, surgical management was indicated. The sacral defect measured approximately 6 cm in its greatest diameter based on clinical estimation, with deep tissue involvement extending to the sacral bone. Intraoperative findings confirmed exposure of the sacrum, consistent with an advanced Stage IV pressure ulcer.

The initial surgical procedure consisted of extensive debridement of necrotic and devitalized tissue, allowing clear delineation of the extent of tissue involvement. Intraoperatively, exposure of the sacral bone was observed, suggesting significant compromise. Surgical curettage of the exposed sacral bone was performed to remove nonviable tissue. This was followed by placement of negative pressure wound therapy (NPWT) using a vacuum-assisted closure (VAC) system, which was maintained for approximately 7–10 days to promote granulation tissue formation and optimize the wound bed.

Over the following days, the wound was closely monitored, and staged reconstruction was planned. As part of the reconstructive strategy, autologous adipose tissue grafting was performed in a subsequent procedure, aiming to enhance soft tissue coverage and promote adjacent tissue regeneration.

However, during the postoperative recovery period, the expected clinical improvement was not observed. The wound evolution remained suboptimal, prompting reassessment of the treatment plan. Due to the lack of satisfactory progress, surgical reintervention was indicated.

During this second reconstructive procedure, a gluteal-based rotational flap reconstruction was performed to achieve definitive coverage of the defect. The flap provided adequate

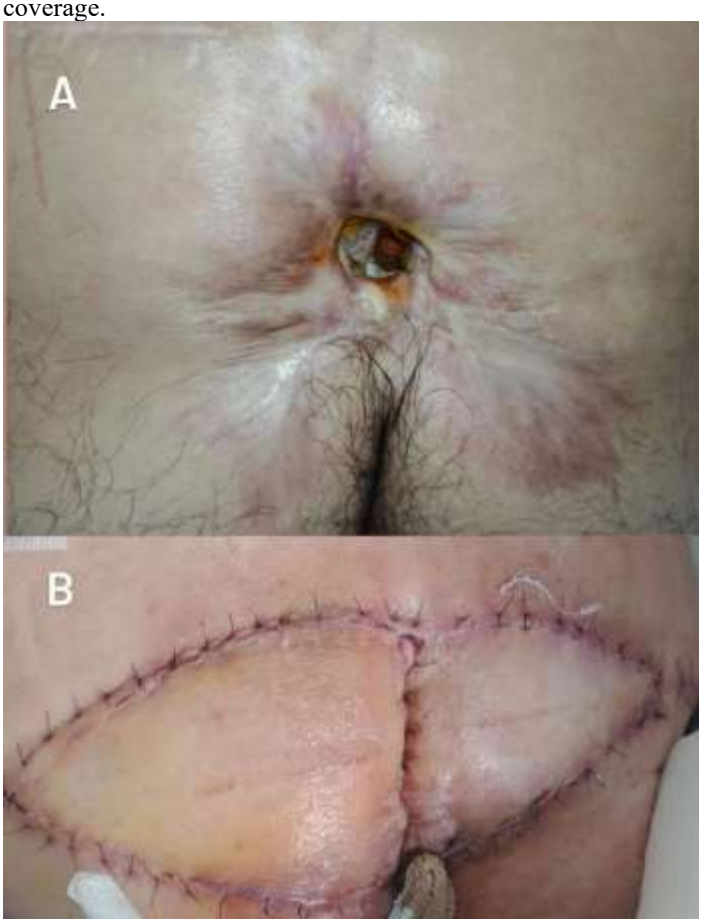
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obliteration of dead space and stable coverage of the exposed sacral region.

Postoperatively, the patient demonstrated favorable clinical evolution, with progressive wound healing and no major complications such as flap necrosis, infection, or wound dehiscence. At follow-up, the surgical site showed good integration of the flap and satisfactory healing progression.

Figure 1. Clinical evolution of advanced sacral pressure ulcer reconstruction.

A: Preoperative view showing an advanced sacral pressure ulcer with necrotic tissue and deep tissue involvement.
B: Immediate postoperative view following reconstruction using a gluteus rotational flap, showing adequate defect coverage.



Source: The Authors.

DISCUSSION

Advanced sacral pressure ulcers remain a major reconstructive challenge due to their multifactorial origin, high recurrence rates, and frequent association with systemic comorbidities such as immobility, malnutrition, and infection. These lesions commonly affect bedridden patients and are associated with prolonged hospital stay, increased healthcare costs, and significant morbidity. The sacral region is particularly vulnerable due to its constant exposure to pressure and its anatomical relationship with bony prominences(3).

The management of advanced pressure ulcers requires a staged and multidisciplinary approach. Initial treatment focuses on the correction of systemic factors, infection control, and repeated surgical debridement to remove necrotic tissue and promote the formation of healthy granulation tissue. Once infection is controlled and the wound bed is optimized, definitive reconstruction can be considered. Sequential treatment strategies involving debridement, local wound care, and delayed reconstruction have been widely described as essential steps for achieving successful outcomes(1,4).

Negative pressure wound therapy (NPWT) has gained widespread acceptance as an effective method for wound bed preparation prior to definitive reconstruction. This technique promotes granulation tissue formation, reduces bacterial contamination, and decreases wound size, thereby facilitating subsequent reconstructive procedures. In many complex sacral wounds, NPWT serves as a bridge between debridement and definitive closure, improving surgical outcomes and reducing postoperative complications.

Negative pressure wound therapy (NPWT) plays a critical role in the staged management of complex sacral pressure ulcers. In addition to promoting granulation tissue formation and reducing wound contamination, NPWT has been described as an effective bridge toward definitive reconstruction, including flap coverage. Arowojolu and Wirth reported that advanced NPWT techniques facilitate wound bed preparation, reduce fibrinous debris, and decrease the number of required surgical debridements, ultimately improving readiness for reconstructive procedures(5).

Adipose-based therapies, including autologous fat grafting, have been increasingly investigated as adjunctive strategies in wound healing. Adipose tissue contains mesenchymal stem cells capable of promoting angiogenesis and tissue regeneration. These biological properties have generated interest in the use of adipose-derived products to improve tissue quality and reduce chronic inflammation. However, their role in large and deep pressure ulcers remains limited, particularly in cases involving extensive tissue loss or exposed bone structures. In such situations, adipose-based interventions alone are frequently insufficient to achieve definitive closure, and additional reconstructive techniques are required.

Flap reconstruction remains the gold standard for the treatment of large stage IV sacral pressure ulcers. Muscle and myocutaneous flaps provide well-vascularized tissue capable of obliterating dead space, improving perfusion, and enhancing resistance to infection. Among available reconstructive options, the gluteus maximus flap has historically been considered the workhorse for sacral reconstruction due to its reliable vascular supply, large tissue volume, and proximity to the defect site(6). Surgical flap reconstruction remains a cornerstone in the management of advanced sacral pressure ulcers. Bielecki et al. reported successful treatment of deep sacral sores using pedicled musculocutaneous gluteus maximus flaps, achieving complete healing in most cases. Their findings support the concept that even extensive sacral defects can be effectively managed with unilateral pedicled flaps, provided that adequate preoperative preparation and wound bed optimization are performed(7,8).

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Several modifications of the gluteus maximus flap have been described, including V-Y advancement flaps, rotational flaps, and perforator-based flaps. These techniques allow adequate coverage of large sacral defects while preserving donor site function. Recent studies have demonstrated favorable outcomes using gluteal flaps, with reduced rates of wound dehiscence and recurrence when proper patient optimization and surgical technique are applied(9).

Several reconstructive techniques have been described for sacral pressure ulcer coverage, particularly fasciocutaneous rotational and V–Y advancement flaps. A comparative study by Djedovic et al. demonstrated that both gluteal rotational and V–Y fasciocutaneous flaps are safe and reliable options for the management of Stage III–IV sacral pressure ulcers, with comparable complication rates. However, rotational flaps may be more suitable for larger defects, while V–Y flaps are often used for smaller lesions, highlighting the importance of tailoring flap selection to defect size and tissue availability(10). In addition, recent evidence continues to support the effectiveness of gluteus muscle flaps in advanced sacral ulcers. A contemporary study evaluating bilateral gluteus muscle flaps for stage IV sacral pressure ulcers reported successful wound closure and acceptable complication rates, reinforcing the continued relevance of muscle-based reconstruction in complex defects(11).

The present case highlights the limitations of adipose-based therapy when used as a primary reconstructive method in large sacral defects. Although adipose grafting may enhance tissue regeneration in selected cases, its isolated use may not provide sufficient structural support or vascularized tissue for deep defects. In our case, staged management with debridement and NPWT was followed by adipose-based intervention; however, definitive healing was achieved only after reconstruction with a gluteus maximus rotational flap. This sequence reinforces the concept that flap-based reconstruction remains essential in advanced stage IV pressure ulcers.

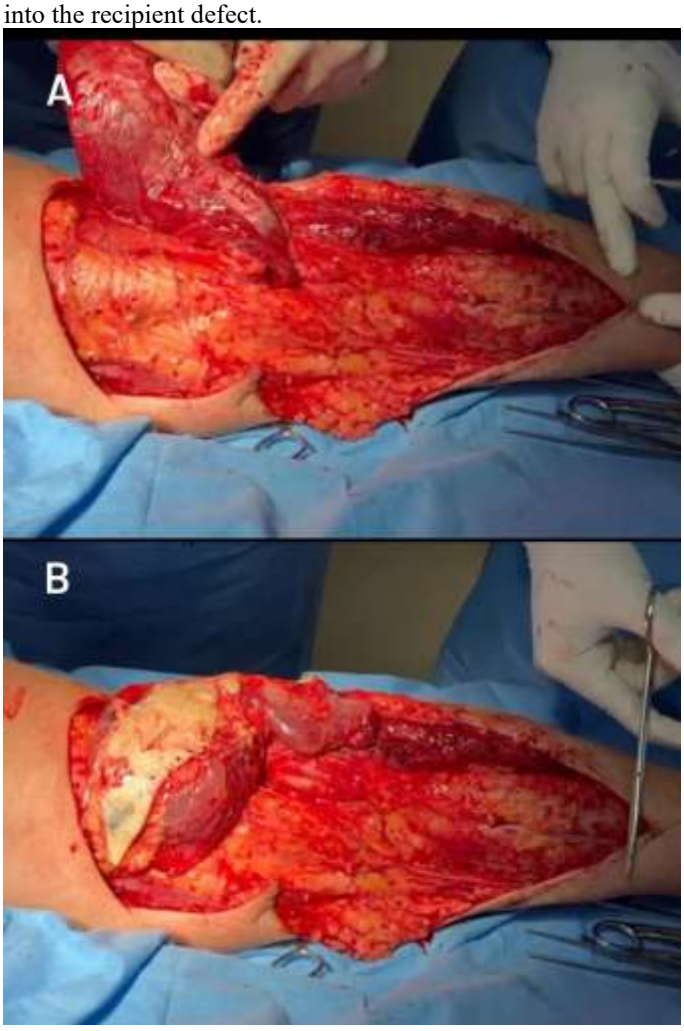
Furthermore, this case illustrates the importance of individualized treatment strategies based on wound characteristics and patient condition. The use of muscle flaps not only provides mechanical coverage but also contributes to infection control through improved vascularization. The successful outcome observed in this patient supports the continued role of gluteus maximus flaps as a reliable and effective reconstructive option for complex sacral pressure ulcers.

Recent advances in reconstructive surgery have introduced perforator-based flaps as an alternative to traditional muscle and rotational flaps in sacral pressure ulcer reconstruction. Perforator flaps offer the advantage of preserving muscle function while providing adequate soft tissue coverage. However, their use requires meticulous surgical technique and precise identification of vascular anatomy. In contrast, rotational muscle flaps remain technically reliable and are widely used in large defects where significant dead space obliteration is required.

Other authors compared gluteal perforator flaps with rotational flaps in the reconstruction of sacral pressure sores and found that both techniques achieved satisfactory wound closure rates. However, rotational flaps demonstrated greater reliability in extensive defects and in cases requiring substantial tissue volume to fill dead space. These findings support the continued use of rotational gluteus maximus flaps as a dependable reconstructive option in large and complex sacral ulcers, particularly when rapid and durable coverage is required(9).

Overall, the literature consistently supports the use of muscle-based rotational flaps as a reliable solution for large sacral pressure ulcers, particularly when deep tissue involvement and bone exposure are present. In such scenarios, adequate obliteration of dead space and restoration of vascularized coverage remain critical factors for long-term success. The findings observed in the present case further reinforce the role of staged management and timely flap reconstruction as key determinants of favorable outcomes.

Figure 2. Schematic representation of muscle flap elevation and transposition principles.
A: Elevation of the medial gastrocnemius muscle flap following detachment from its distal insertion.
B: Rotation and placement of the gastrocnemius muscle flap into the recipient defect.



Source: The Authors.

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Limitations

This report has several limitations inherent to single-case studies. The findings presented may not be generalizable to all patients with advanced sacral pressure ulcers, as outcomes depend on patient-specific factors such as nutritional status, comorbidities, and wound characteristics. Additionally, the role of adipose-based therapy in this case could not be fully evaluated due to the progression toward definitive flap reconstruction. Further prospective studies are required to determine the optimal timing and indications for adipose-based techniques in complex pressure ulcer management.

CONCLUSIONS

Advanced sacral pressure ulcers require a structured and staged surgical approach to achieve optimal outcomes. Although adipose-based therapies may offer regenerative benefits in selected cases, their isolated use appears insufficient for large and deep defects involving bone exposure.

The present case demonstrates that negative pressure wound therapy serves as an effective preparatory step for wound bed optimization, while definitive closure with a gluteus maximus rotational flap remains a reliable and effective reconstructive solution.

Early recognition of inadequate wound progression and timely transition to flap-based reconstruction are essential to prevent prolonged treatment and reduce complication risk. Further studies are required to better define the role of adipose-based techniques within staged reconstructive strategies for advanced pressure ulcers.

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Declaration of Conflict of Interest

The authors report no conflicts of interest.

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