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The PAP Flap as a Propeller Flap in the Management of Ischial Pressure Ulcer with Distal De-epithelialization: A Case Report

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Abstract: **Case Report**

We report the case of a 25-year-old female patient presenting with a left ischial pressure ulcer refractory to conservative treatment. The defect was covered using a PAP flap (Profunda Artery Perforator) in a propeller flap configuration with distal de-epithelialization to fill the undermined cavity. This case illustrates the value of this minimally invasive, reliable technique, particularly suitable for young or cachectic patients.

Keywords: Ischial pressure ulcer, PAP flap, Propeller flap, De-epithelialization, Minimally invasive technique.

INTRODUCTION

Ischial pressure ulcers are chronic, deep, and often disabling wounds, commonly observed in paraplegic or wheelchair-bound patients. They are caused by prolonged pressure on soft tissues overlying bony prominences, leading to ischemia, necrosis, and tissue loss. Management relies on a multidisciplinary approach combining local wound care, optimization of general health, treatment of comorbidities (anemia, malnutrition), and surgical reconstruction when necessary.

Surgical intervention aims to remove necrotic tissue and restore durable cutaneous and volumetric coverage. Among the available options, perforator flaps such as the PAP flap, based on the profunda femoris artery perforators, have emerged as valuable solutions. The propeller flap design offers wide rotational freedom while reducing donor site morbidity. Distal de-epithelialization effectively addresses residual subcutaneous cavities.

Clinical Case

Ms. K.E., 25 years old, from Rabat, has a history of spina bifida operated on the 10th day of life, resulting in partial paraparesis of the lower limbs. Following a left ankle trauma in 2019, she discontinued the use of crutches and transitioned to full-time wheelchair use. This prolonged immobilization led to the development of bilateral ischial pressure ulcers in 2023, with the left ulcer remaining resistant to conservative measures.

Upon admission, the left ischial ulcer was classified as stage IV, measuring 5x4 cm, with no signs of superinfection or superficial necrosis. General examination revealed a cachectic patient with low serum albumin levels but overall stable condition.

Image 1: Ischial ulcer upon admission photograph

Preoperative Preparation

A complete laboratory workup was performed (CBC, CRP, electrolytes, PT/aPTT, albumin, viral serologies). Nutritional support was initiated with high-protein supplements, zinc, and vitamins. Local wound care included cleaning, debridement, and negative pressure wound therapy (NPWT) for 15 days before surgery. The patient was positioned on an anti-pressure mattress with repositioning every two hours.

Color Doppler ultrasound was used preoperatively to identify a perforator artery. Initial debridement of the ulcer was performed after injection of methylene blue to delineate the undermined cavity. Fibrinous and scar tissue was surgically removed from this cavity. Subsequent bone debridement was also performed, with samples sent for bacteriological and histopathological analysis.

A preoperative flap design, tailored to the dimensions of the cavity, was drawn as shown in the planning image.

Image 2: Detachment cavity after carcinological debridement of the eschar

Image 3: Pre-operative drawing

Surgical Technique

Intraoperatively, a cold-blade incision was made following the pre-established design. A meticulous sub-aponeurotic dissection was performed from distal to proximal, exposing the perforator artery. Careful dissection was carried out around the artery without skeletonizing it.

The flap was then elevated in a propeller configuration and rotated **140°** to reach the ischial region. A demarcation line was drawn to delineate the distal area to be de-epithelialized, which was then inserted into the cavity. The de-epithelialized segment was positioned within the defect, while the cutaneous portion remained external for coverage.

Two Redon drains were placed under suction in both the donor and recipient sites. The flap was stabilized with simple stitches, and the remaining operative site was closed using the Skoog technique.

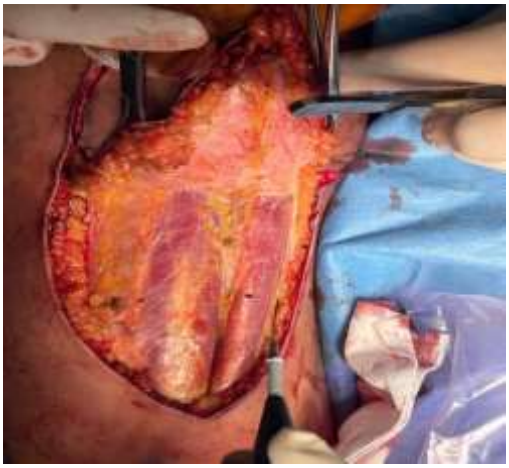

Image 4: Subaponeurotic dissection

Image 5: Lifted in propeller flap configuration

Image 6: Immediate post-operative photograph

RESULTS

Postoperative recovery was uneventful, with no hematoma or necrosis. The patient was mobilized on day 10 with pressure-relieving cushions. Complete healing was achieved by six weeks, with a satisfactory aesthetic outcome and good functional tolerance. At three months, there were no signs of recurrence.

DISCUSSION

The surgical management of ischial pressure ulcers aims to achieve stable and long-lasting coverage while preserving tissue resources. Traditional musculocutaneous flaps (e.g., biceps femoris, gluteus maximus) are effective but carry risks of muscular morbidity and limitations in case of recurrence.

The PAP flap, introduced by Allen *et al.*, in 2012 for breast reconstruction, has progressively been adopted for coverage of sacral and ischial areas. It provides a pliable, well-vascularized tissue with an advantageous rotation arc when used as a propeller flap. Distal de-epithelialization transforms the flap into a filling component, preventing dead space and associated complications (seroma, infection, dehiscence).

Compared to other perforator flaps such as the ALT (Anterolateral Thigh) flap or the SGAP (Superior Gluteal Artery Perforator) flap, the PAP flap shows unique advantages. The ALT flap, while versatile and voluminous, can be too thick in overweight patients and may require partial muscle sacrifice, increasing donor-site morbidity. The SGAP flap, although reliable, is technically demanding with less predictable vascular anatomy.

The PAP flap offers straightforward dissection based on constant anatomical landmarks and provides a pedicle of adequate length (>8 cm) with a favorable rotation arc. Its non-weight-bearing donor site minimizes the risk of secondary pressure-related necrosis and is easily concealed aesthetically.

A comparative study by Haddock *et al*., (2018) demonstrated that the PAP flap had similar or lower complication rates than musculocutaneous flaps in complex reconstructions, with equivalent operative time and faster functional recovery. In pressure sore reconstruction, this translates to improved healing quality, reduced secondary morbidity, and preservation of tissue options for future interventions.

In neurologically impaired patients, such as those with spina bifida, where gluteal flaps are often previously used or fibrosed, the PAP flap is particularly relevant and represents a key component in long-term reconstructive strategies.

Distal de-epithelialization, as applied in this case, improves adherence of the flap to the wound base and reduces the risk of fluid collection. It is especially useful in deep ulcers or those with persistent undermining. It also allows better contouring without excessive tension on the flap edges.

However, the PAP flap requires a learning curve and precise preoperative planning. Identifying perforators using Doppler or CT angiography is crucial. Avoiding pedicle torsion during rotation and ensuring careful dissection are critical for flap survival. In undernourished or slim patients, like ours, flap volume may be limited, necessitating meticulous flap design.

Ultimately, the success of this technique depends on integrating it within a comprehensive prevention strategy (anti-decubitus mattress, patient education, nutritional optimization, assisted mobility).

CONCLUSION

The PAP propeller flap with distal de-epithelialization represents an innovative and tissue-sparing option for managing ischial pressure ulcers, particularly in young patients with limited tissue reserves. It combines flexible cutaneous coverage, effective volume filling, and low donor-site morbidity. This case highlights its efficacy and supports broader use in specialized centers.

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