

## Superior Gluteal Artery Perforator Flap for Closure of Large Sacral Defects

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### ABSTRACT

During the period from September 2001 and December 2003, eleven patients with sacral defects were treated with unilateral superior gluteal artery perforator flap (SGAP flap). The use of a handy Doppler probe was of paramount importance in flap design and operative detection of perforators. The total operative time averaged 3 hours with no major blood loss necessitated blood transfusion. There was no major loss of the flaps and only minor complications were encountered in five patients. Re-rotation of the flap was needed in two patients, one for early wound disruption and the other for recurrent ulceration. The advantages of the flap were appreciated in this series when compared to the conventional gluteus maximus musculocutaneous flap favoring the use of SGAP flap for reconstruction of sacral pressure ulcers.

### INTRODUCTION

Closure of sacral pressure ulcers remains one of the common problems facing the reconstructive surgeon. For the last 3 decades, gluteus maximus musculocutaneous flap is considered the workhorse for reconstruction of such defects [1,2]. Depriving an ambulant patient from one of the important pelvic girdle muscles will adversely affect the walking mechanism [3]. On the other hand, unilateral or bilateral utilization of gluteus maximus musculocutaneous flap in a bed confined patient will abandon the prospects for future reconstruction in case recurrent ulceration occurs [4]. Practically, the inclusion of muscle in this flap is not a prerequisite for reconstruction of this area as it is naturally devoid of muscles, besides, it limits the flap mobility and contributes to much blood loss. The only reason for inclusion of muscle is to ensure adequate blood supply to the overlying skin which could be achieved by applying the principle of perforator based flaps [5]. In this study, I present my experience in gluteal perforator flap for closure of large sacral defects concerning preoperative design, operative technique and postoperative evaluation during the follow up period.

### MATERIAL AND METHODS

Eleven patients with sacral defects were included in this study during the period from Sep-

tember 2001 and December 2003. One of them was a female and the remainders were males with their ages ranged between 22 to 53 years. The ulceration was developed in traumatic paraplegic or quadriplegic patients in 9 cases and as a result of transient confinement to bed with lack of proper mobilization following orthopaedic surgery in 2 patients. Associated ischial and/or trochanteric ulcers were encountered by the time of the initial presentation in 3 patients. A unilateral superior gluteal artery perforator flap (SGAP flap) was used for all patients in a V-Y fashion. Simultaneous closure of an ischial ulcer using a posterior thigh fasciocutaneous flap was performed in one patient with continuity between both flaps at the area of debrided ischial ulcer (Fig. 3). Follow up for early wound complications, stability of coverage and recurrent ulceration for an average period of 18 months postoperatively.

#### *Operative technique:*

Preoperative design and markings followed the same guidelines as described by Verpaele et al. [6] (Fig. 1,a). The superior gluteal artery perforators were identified and mapped with the aid of a handy Doppler probe within the territory of the superior gluteal artery in the middle zone of a triangle (ABC) drawn between the posterior superior iliac spine (A), the tip of the coccyx (B) and the centre of the greater trochanter (C). There is a general correlation between the audible volume of the Doppler signal and the diameter of the perforator which could define the most sizeable one. A triangular design was drawn on the gluteal area that included most of the identified perforators within its centre. The triangle was based on the defect with its apex directed away from the critical area of potential ulceration over the greater trochanter (Fig. 1,b). The initial step, as in any surgical reconstruction of pressure ulcers, is adequate debridement with thorough excision of the bursa. Debridement was performed as a separate preliminary operation before the definitive stage of reconstruc-

tion in 7 patients. The superior limit of the flap was incised first, then flap dissection was effected from above downwards and from lateral to medial, incising through skin, subcutaneous fat and deep fascia down to the gluteal muscle, then dissection started in a subfascial plane searching for a sizeable lateral perforator. Lateral perforators are more preferable than medial ones because they run in a medial direction towards their origin from the superior gluteal artery which is the same direction of the desired advancement towards the median sacral defect. Using loupe magnification, the selected largest lateral perforator was followed through the gluteal muscle fibres separating them with careful ligation and division of the tiny muscular branches till reaching its origin from the superior gluteal artery (Fig. 1,c). If the selected perforator was injured during dissection, switch to the next lateral perforator. Operative identification of perforators was facilitated by the aid of a sterile Doppler probe. Following completion of perforator dissection, attention was paid to flap mobilization to reach the point of comfortable closure of the defect with no sacrifice of further perforators. Care should be taken during flap trans-

port not to cause any kink or stretch of the dissected perforator. If the edge of the defect on the contra lateral side is undermined, a larger flap was harvested with the medial strip of the flap being de-epithelialized to be tucked underneath the undermined edge of the defect obliterating the dead space.

## RESULTS

### Case presentation (Figs. 1-3):

All flaps, except one with marginal necrosis, survived completely. Marginal flap necrosis was treated with excision and secondary sutures. Haematoma occurred in one case underneath the lateral limit of the flap causing disruption of the vertical limb of Y that necessitated secondary sutures. Infection occurred in three patients that caused medial disruption of the flap in two cases, one was minimal necessitated only secondary sutures and the other more major disruption necessitated re-rotation of the flap. Recurrent sacral ulcer occurred in one paraplegic patient 14 months following the primary surgery that required re-rotation of the flap.



Fig. (1-A): Preoperative markings and landmarks. The points ABC form a triangle which includes the superior gluteal artery perforators within its center. The identified perforators by Doppler signal are D, E, F, G, with D being the largest.



Fig. (1-B): Preoperative design of the flap in a triangular fashion based on the defect with its apex directed away from the greater trochanter. The triangle includes the identified perforators within its center.

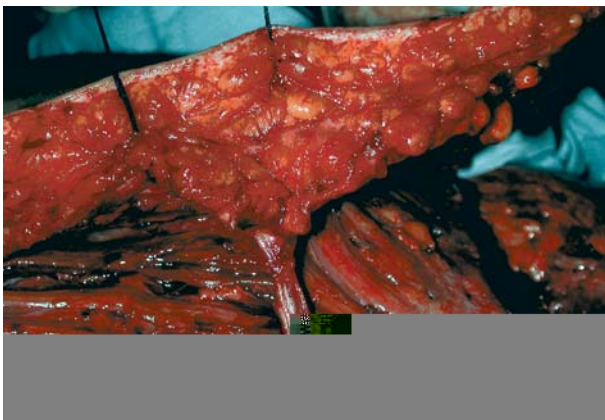


Fig. (1-C): The dissected lateral perforator down to its origin from superior gluteal artery.



Fig. (1-D): Late postoperative view of the same patient with stable wound coverage.



Fig. (2-A): Preoperative view of a patient with sacral pressure ulcer.



Fig. (2-B): Intraoperative view of the ulcer after debridement and excision of the bursa. The flap is harvested and ready to be inset.



Fig. (2-C): Late postoperative view of the same patient with stable wound coverage.



Fig. (3-A): Preoperative view of a patient with sacral and bilateral ischial ulcers. Preoperative markings with Doppler identification of the superior gluteal artery perforators (A & B) and the profunda femoris perforators (C & D).



Fig. (3-B): Postoperative view of the same patient with simultaneous reconstruction of the sacral ulcer with left SGAP flap and the left ischial ulcer with posterior thigh fasciocutaneous flap.

## DISCUSSION

In the continuing quest for improved results in reconstructive surgery, surgeons have used a variety of flap techniques to achieve excellence in form and function [7].

Pressure sore management has been improved through the development of musculocutaneous flaps with significant reduction in the incidence of wound complications in pressure sore patients. The use of gluteus maximus muscle or musculocutaneous flap to close sacral pressure ulcers should



be considered a revolutionary method because of the reliability of blood flow. However, the mobilization of deep gluteus maximus muscle is a little bit complicated and contributes to much blood loss. In addition, future reconstruction for recurrent ulceration is especially limited in paraplegic patients in whom much of the muscle may have been already sacrificed for unilateral or bilateral gluteus maximus musculocutaneous flap. Because of the possibility of gait disturbance, using this flap in ambulatory patients should be avoided [2,3,4].

In their interesting work for reconstruction of lumbosacral defects, Ramirez and his colleagues tried to overcome the difficulties and complications associated with the use of gluteal flap for reconstruction of such defects. They described the sliding gluteus maximus flap that allowed reconstruction to be performed with preservation of structural and functional integrity of the muscle unit. Their results were satisfactory, however, the restricted mobility of the flap limited the reconstruction of larger defects even with the use of bilateral gluteal flaps [3,8,9,10].

In the 1980s, studies have shown that a passive muscle carrier is not necessary for flap survival if careful dissection of the musculocutaneous perforator vessels is accomplished. By selective harvesting the skin above the underlying muscle, a reduction of donor site morbidity has been demonstrated. When only skin is needed for a specific reconstruction, it makes logical sense to transfer only skin to the recipient site while preserving the integrity of the muscle at the donor site [5,11].

The science of perforator flaps based on the initial pioneering work by a number of authors represents an improvement over the popular musculocutaneous and fasciocutaneous flaps. They introduced a new type of surgical flap based on musculocutaneous perforator arteries that was composed exclusively of skin and subcutaneous fat. They all agreed that perforator flaps combine the reliable blood supply of musculocutaneous flaps with the reduced donor site morbidity of skin flaps [11,12,13,14].

Advantages of perforator flaps over traditional musculocutaneous flaps include muscle sparing, less donor site morbidity, versatility in design to include as little or as much tissue as required, as well as improved postoperative recovery of the patient. However, each different perforator flap donor site has its own unique features, making patient-specific selection essential [7].

Preservation of muscle function is not the only concern with muscle harvest. Higgins et al. [15] suggest that muscle sparing should be considered not only in ambulatory and sensate patients, but in paraplegic patients as well. In their experience, preserving muscle in ischial pressure sore reconstruction also conserves future reconstructive options in situations of postoperative wound breakdown or recurrence.

An important consideration on selecting SGAP flap for sacral pressure sore management is the size and consistency of perforators, making preoperative flap planning, with perforator mapping, of extreme importance.

Reliable flap planning as adopted by a handy Doppler probe based on anatomical knowledge of the site of the superior gluteal artery perforators, besides the possible need for their operative identification using a sterile Doppler probe made this device extremely helpful and indispensable in planning and execution of this type of surgery [16].

The surgical plan is to design the skin island in a V-Y fashion based on the defect with the apex directed away from the greater trochanter. This versatile design allowed for simple and comfortable translation of the flap with preservation of the integrity of the gluteal donor area to be available for possible future use in case of recurrent ulceration. Directing the apex of the triangle away from the greater trochanter avoids potential ulceration in this critical area.

Incising only the superior limit of the flap as an initial step was of great value in that it allowed for changing the plan of reconstruction at any phase of flap dissection. If a lateral perforator was successfully dissected, flap mobilization was completed as originally designed in a V-Y fashion. If no sizeable lateral perforator was found, the plan was switched to dissect a medial perforator and flap dissection was continued in a rotational way. If no suitable perforator was found, then a conventional gluteus maximus musculocutaneous flap was harvested. I faced the last situation in two cases whom I excluded from this series and a V-Y flap based on a lateral perforator was executed in all patients included in this series.

Although dissection of the perforator was tedious, yet it was facilitated by the use of loupe magnification and the aid of bipolar diathermy and vessel micro-clips to control the tiny muscular branches of the perforator. The total operative time was reduced by growing experience in perforator dissection with an average of 3 hours. Dissection

in avascular plane with minimal blood loss, dispensing the need for blood transfusion, outweigh the deep and bloody dissection of the conventional gluteus maximus musculocutaneous flap.

A goal that should be achieved is a comfortable reach of the flap to cover the defect without undue tension on suture lines. Therefore, the end point of dissection should be the flap reach and not the full skeletonization of the perforator vessel which carry the risk of stretch, kink or twist that can lead to complications such as vasospasm or even blockage of blood flow with total loss of the flap. The same concept of flap safety was approved by Koshima et al. [6], although it was opposed by Verpaele et al. [12], who stressed upon full vessel skeletonization with the flap being solely attached to a single perforator vessel. Full skeletonization of the perforator vessel was not required in any patient of this series with safe dissection and translation of the flap that was appreciated in the form of flap survival in all cases.

De-epithelialization of the medial strip of the flap when the contralateral edge of the defect is undermined effectively obliterated the dead space and consequently prevented haematoma or seroma formation.

Although the flap is thinner than its myocutaneous variant, which is considered by some authors a drawback of the perforator flap, yet it meets the reconstructive requirement of the defect as the presacral area is naturally devoid of muscles [7].

No major complications were encountered in this series. Though expected in any bed confined patient, the only serious sequel was the recurrent ulceration that occurred in one paraplegic patient 14 months following the primary surgery. The V-Y fashion of the flap allowed for its re-rotation. An advantage, which also needed to manage an early wound disruption in another patient.

Stable wound coverage could be achieved in all cases with adequately vascularized flap as denoted by flap survival with no evident fat necrosis. Versatile design of the flap with no additional need for skin grafting the donor site, minimal blood loss, impressive mobility of the flap that could achieve coverage of large defects with a unilateral flap, besides the preservation of the gluteus maximus muscle structure for possible future use for recurrent ulceration in bed confined patients and muscle function in ambulatory patients, are all factors that favor the use of S-GAP flap for reconstruction of sacral defects.

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