The Perforator-Sparing Buttock Rotation Flap for Coverage of Pressure Sores

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Background: The rotation fasciocutaneous flap for buttock pressure sore coverage has the distinct advantage of allowing rerotation in the event of ulcer recurrence. The authors describe their approach of preserving and incorporating musculocutaneous perforators into the conventional rotation design.
Methods: The skin incision is the same as that for the conventional gluteal rotation flap. The flap is elevated subfascially until one or two large musculocutaneous perforators of the superior or inferior gluteal arteries are encountered. Intramuscular dissection by splitting fibers of the gluteus maximus muscle is then performed to free the perforator down to its emergent point at the level of the piriformis muscle to enable the perforator to pivot freely with the rotation of the skin flap. Further elevation of the flap beyond the location of the perforator is then performed as necessary to enable tension-free rotation of the skin flap into the defect. Muscle to fill dead space when needed is raised as a separate flap. Seven patients underwent closure of buttock pressure sores in the sacral, ischial, and trochanteric areas using this technique.
Results: All wounds healed, with no recurrence, at a mean follow-up of 30 months. This technique can be used to cover pressure sores over the sacral, trochanteric, and ischial regions.
Conclusions: This modification of the conventional rotation flap affords the flexibility of rerotation in the event of ulcer recurrence while providing the flap with enhanced blood supply. This is an ideal flap for patients in whom the risk of ulcer recurrence is high. (*Plast. Reconstr. Surg.* 119: 1259, 2007.)

Pressure sore, bedsore, and decubitus ulcer are terms used to describe ischemic tissue loss resulting from prolonged pressure over bony prominences. Davis pioneered the concept of using flaps as a means of providing well-vascularized bulky tissue to cover ulcers over bony prominences.[1] Since Koshima et al. reported the feasibility of using perforator flaps for coverage of sacral pressure sores, many types of such flaps have been described.[2–8] Perforator flaps are particularly indicated for ambulatory patients with pressure sores because they minimize donor-site morbidity by preservation of the underlying muscle. However, all designs described to date involve islanding the skin flap.[2–8] Central to the flap considerations for paraplegic or nonambulatory patients is the tendency for recurrence despite the best nursing care.[9–11] The island-type design limits the prospect of reusing the buttock flap in repeated surgery for ulcer recurrence.[4] In contrast, a rotation type design is ideal for these patients, as further rotation is possible through the same incision (with or without further extension of the original incision). We describe a novel modification of the gluteal skin fasciocutaneous rotation flap by including the dominant musculocutaneous perforators from the superior or inferior gluteal vessels. This perforator-preserving rotation flap maintains the advantages of the rotational design and provides better vascularity, making the flap more resistant to pressure-induced ischemia.

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METHODS

The patient is placed in prone position. Preoperatively, hand-held Doppler assessment, guided by anatomical landmarks, is performed to mark the location of the gluteal perforators and the planned rotation flap is marked out. The surface marking of the piriformis muscle is made by drawing a line between the posterior superior iliac spine and the greater trochanter of the femur. A

second line is drawn between the top of the greater trochanter to a point midway between the posterior superior iliac spine and the coccyx. The superior gluteal artery and inferior gluteal artery and their perforators are located above and below this triangle, respectively.[2–7]

The ulcerated area and the underlying bursa are excised down to healthy tissue. Ostectomy of any underlying bony prominences is performed to even out any irregular bony surfaces and the wound washed with pressure irrigation. The skin rotation flap is designed as large as possible to achieve tension-free closure of the ulcer. Depending on the location of the ulcer (e.g., sacral, trochanteric, or ischial), the perforator incorporated into the rotation flap can be from the superior or inferior gluteal vessels. Undermining from cranially to raise an inferiorly based flap (for sacral or trochanteric ulcers), the superior gluteal perforators would be encountered and incorporated into the rotation flap. Conversely, elevating the flap from caudally to raise a superiorly based flap (for ischial sores), the inferior gluteal perforators would be encountered and then preserved (Fig. 1). The dissection commences from laterally toward the location of the selected gluteal vessels and the marked perforators, below the gluteus maximus muscle fascia (i.e., subfascial dissection). Guided by the preoperative Doppler markings, large musculocutaneous perforators are preserved when encountered (Fig. 2, *above*). Under 2.5× loupe magnification, the largest perforator is selected and dissected through the gluteus maximus muscle to its origin at the superior or inferior gluteal arteries. These arteries are in turn further mobilized to the emergent point above and below the piriformis muscle, respectively (Fig. 2, *second row*, *left*). The muscle is split in the direction of the

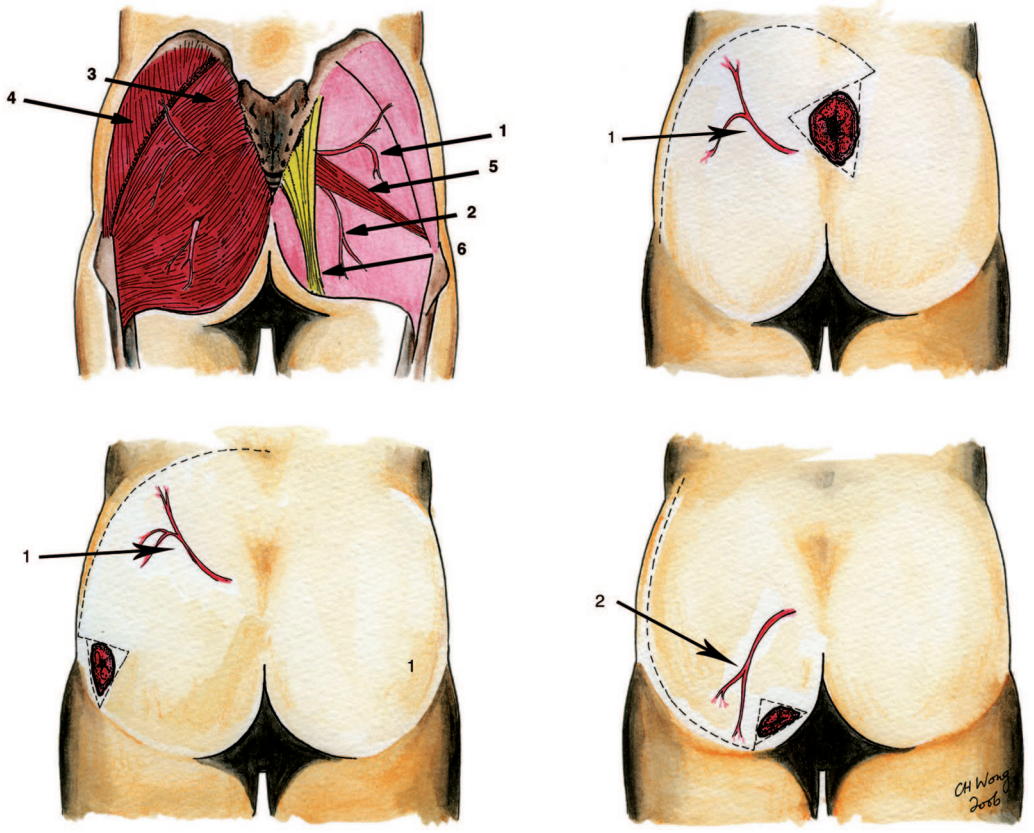

Fig. 1. The perforator-sparing buttock rotation flap can be used for coverage of pressure ulcers in any area of the buttock. Depending of the location of the ulcer, perforators from the superior or inferior gluteal arteries can be incorporated into the flap. (*Above*, *left*) Relevant anatomy of the gluteal region. (*Above*, *right*) The perforator-sparing buttock rotation flap incorporating the superior gluteal artery perforator for coverage of a sacral sore. (*Below*, *left*) The perforator-sparing buttock rotation flap incorporating the superior gluteal artery perforator for coverage of a trochanteric sore. (*Below*, *right*) Ischial ulcer is covered with a perforator-sparing buttock rotation flap based on the inferior gluteal artery perforator. *1*, Superior gluteal artery; *2*, inferior gluteal artery; *3*, gluteus maximus; *4*, gluteus minimus; *5*, piriformis; *6*, sacrotuberous ligament.

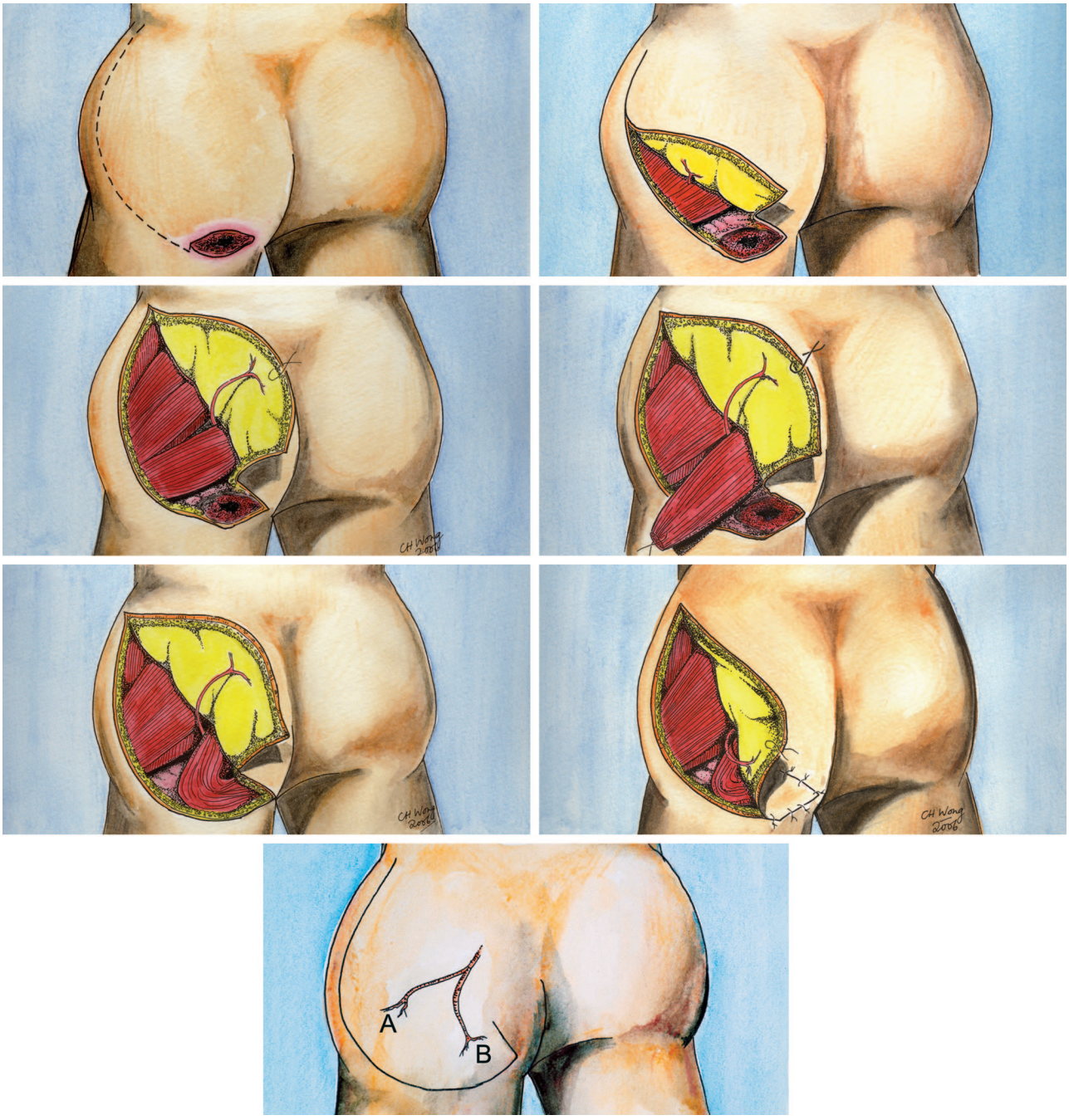

Fig. 2. Schematic illustration of the operative technique of the perforator-sparing buttock rotation flap for coverage of an ischial pressure ulcer. (*Above*, *left*) Ischial pressure sore. (*Above*, *right*) The flap is elevated subfascially until the inferior gluteal perforator is encountered. (*Second row*, *left*) The inferior gluteal perforator is dissected intramuscularly through the gluteus maximus muscle to its emergent point below the piriformis muscle. This enabled the perforator to pivot freely with the skin flap rotation without tension or kinking. (*Second row*, *right*, and *third row*, *left*) The inferior half of the gluteus maximus muscle (below the inferior gluteal pedicle) is detached from its attachment at the gluteal tuberosity of the femur and transposed medially to fill the dead space at the exposed ischial bone. Independent movement of the skin and muscle flaps gives more flexibility during flap inset. (*Third row*, *right*) Tension-free rotation of the skin flap into the defect. The inferior gluteal perforator pivots freely with the rotation of the skin flap without tension or kinking. (*Below*) Closure of ischial pressure sore achieved with the perforator-sparing buttock rotation flap. Note the rotation of the inferior gluteal perforator from position *A* to *B* at completion of the operation. The perforator can rotate freely up 180 degrees with adequate mobilization of the inferior gluteal pedicle.

muscle fibers and muscle branches encountered are clipped. Obliteration of potential dead space when necessary can be done by transposing or advancing a portion of the gluteus maximus muscle separately into the defect (Fig. 2, *second row, right*, and *third row, left*). The skin is then rotated into the defect carrying the perforator and closed in a tension-free manner (Fig. 2, *third row, right*, and *below*). The independent and separate movement of both the fasciocutaneous skin flap and the muscle affords more free play in flap inset for both components. Closed suction drains are placed and the wounds closed in layers. The drains are left in place for 10 to 14 days and the patient nursed prone for 3 weeks before gradual mobilization. A low-residual diet is given for 1 week and meticulous perineal hygiene is maintained.

RESULTS

Seven patients underwent reconstruction with this perforator-sparing rotation flap technique (Table 1). The mean age of the patients was 52 years (range, 33 to 62 years). The mean follow-up period was 30 months (range, 9 to 51 months). The early breakdown rate was 0 percent and there was no ulcer recurrence over the follow-up period. Inferiorly based flaps were used to cover three sacral sores and one trochanteric sore. Superiorly based flaps were used to cover three ischial sores. In five patients, a single musculocutaneous perforator was included, and in two patients, two muculocutaneous perforators were included. Depending on the course and number of perforators dissected, the time needed for the intramuscular dissection of perforators ranged from 35 to 115 minutes in our clinical cases (mean, 48 minutes). In three patients, a skin rotation flap alone was used. In four patients, muscle was also needed to fill dead space at the base of the ulcer. In these instances, rotation of the skin flap was performed independent of the muscle flap.

CASE REPORTS

Case 1

A 58-year-old paraplegic patient presented with a grade 4 sacral sore. He was assessed by our standard protocol and deemed a suitable candidate for flap closure of his sacral sore. Preoperative hand-held Doppler (8-MHz) assessment to localize perforators of the superior gluteal vessels was performed (Fig. 3, *above, left*). The flap was raised until the perforator was encountered. This measured 2.5 mm in diameter and was dissected intramuscularly through the gluteus maximus muscle to its origin at the superior gluteal vessels (Fig. 3, *above, right*). Further elevation of the skin flap beyond the location of the perforator was then performed to mobilize more skin (Fig. 3, *center, left*). The superior half of the gluteus maximus muscle was detached from its attachment at the iliotibial tract and advanced medially to cover the exposed sacrum (Fig. 3, *center, right*). The skin was closed in layers over the muscle flap (Fig. 3, *below, left*). He was discharged 3 weeks later and was ulcer-free at 14-month follow-up (Fig. 3, *below, right*).

Case 2

A 53-year-old man suffered a fall that left him paralyzed below the T10 level. He was motivated and was independent in his activities of daily living. He presented with a right stage 4 ischial ulcer (Fig. 4, *above, left*). Preoperatively, Doppler assessment was performed in the inferior lateral gluteal region to identify the location of the dominant inferior gluteal perforators. The skin flap was raised at the subfascial level until the dominant perforator was encountered (Fig. 4, *above, right*). Intramuscular dissection of the perforator was performed down to the emergent point of the inferior gluteal vessels below the piriformis muscle. This allowed the perforator the freedom to move with the rotation of the skin flap. Further undermining

Table 1. Patient Summary*

Case	Age (yr)	Location of Ulcer	Perforator Used and No. of Musculocutaneous Perforator Preserved	Type of Flap	Outcome
1	58	Sacral sore	Superior gluteal artery perforator, single perforator	Fasciocutaneous and muscle	14-mo follow-up, no breakdown
2	53	Ischial sore	Inferior gluteal artery perforator, single perforator	Fasciocutaneous and muscle	No recurrence at 3-yr follow-up
3	33	Sacral sore	Superior gluteal artery perforator, two perforators	Fasciocutaneous only	No recurrence at 9-mo follow-up
4	54	Sacral sore	Superior gluteal artery perforator, two perforators	Fasciocutaneous and muscle	No recurrence at 13-mo follow-up
5	45	Trochanteric ulcer	Inferior gluteal artery perforator, single perforator	Fasciocutaneous only	No recurrence at 45-mo follow-up
6	58	Ischial sore	Inferior gluteal artery perforator, single perforator	Fasciocutaneous only	No recurrence at 51-mo follow-up
7	62	Ischial sore	Inferior gluteal artery perforator, single perforator	Fasciocutaneous and muscle	No recurrence at 2-yr follow-up

* The predisposing condition in all cases was traumatic paraplegia.

Fig. 3. (*Above*, *left*) Grade 4 sacral sore. Preoperative hand-held Doppler assessment to locate the perforator was performed (marked *X*). This served as a useful intraoperative guide for localization of the dominant musculocutaneous perforator of the superior gluteal vessels. (*Above*, *right*) A large musculocutaneous perforator was dissected intramuscularly through the gluteus maximus muscle to the emergent point of the superior gluteal artery above the piriformis muscle. (*Center*, *left*) Wide undermining beyond the location of the perforator (after intramuscular dissection to free the perforator) allowed rotation of the skin flap into the sacral defect in a tension-free manner. (*Center*, *right*) The superior half of the gluteus maximus muscle (above the superior gluteal vessels) is detached from its attachment at the iliotibial tract and transposed medially to fill the dead space at the exposed sacrum. (*Below*, *left*) Closure of the sacral pressure sore achieved with the perforator-sparing buttock rotation flap. (*Below*, *right*) Photograph of the patient at 14-month follow-up.

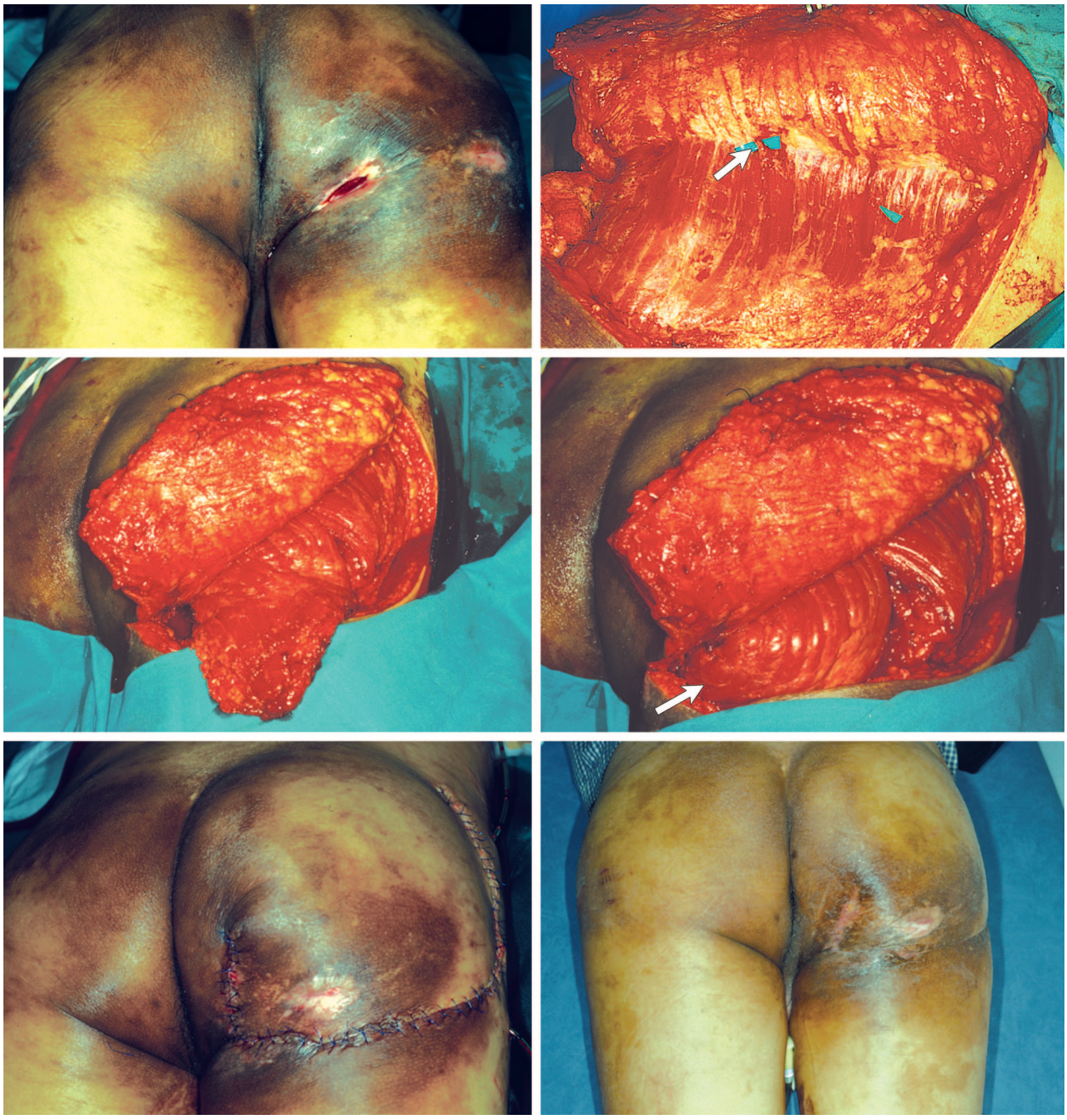

Fig. 4. (*Above*, *left*) Ischial pressure sore. (*Above*, *right*) Musculocutaneous perforator of the inferior gluteal vessels (*arrow*). Once identified, the dominant perforator was dissected intramuscularly. (*Center*, *left*) The inferior half of the gluteus maximus is detached from the its attachment at the gluteal tuberosity of the femur. (*Center*, *right*) The muscle was transposed medially to fill the dead space at the exposed ischial bone (*arrow*). (*Below*, *left*) The ischial pressure sore was closed with the perforator-sparing buttock rotation flap technique. (*Below*, *right*) Photograph of the patient at 3-year follow-up.

of the skin flap of approximately 10 cm beyond the location of the perforator was performed to allow better mobility of the skin flap. The inferior half of the gluteus maximus muscle was detached from its attachment at the greater tuberosity of the femur and transposed medially to fill the dead space at the exposed ischial bone (Fig. 4, *center*). Tension-free closure of the skin rotation flap followed the inset of the muscle flap (Fig. 4, *below*, *left*). He was discharged 3 weeks later and was ulcer-free at 3-year follow-up (Fig. 4, *below*, *right*).

DISCUSSION

Central to the considerations for the management of pressure sores in the nonambulatory pa-

tient is the high incidence of recurrent and new ulcers. Recurrence rates of up to 77 percent have been reported.[1] Disa et al. reported a 61 percent recurrence in 66 pressure sores after an average follow-up of just 9.3 months.[10] More recently, Kierney et al. reported on 268 pressure sores managed jointly by plastic surgery and rehabilitation medicine with a standardized protocol. They reported an overall recurrence rate of 19 percent at an average follow-up of 3.7 years.[11] Therefore, to maximally preserve buttock skin available for coverage of ulcers that may develop in other areas of the buttock, one of the cornerstone principles in the design of flaps for pressure sores in nonambulatory patients is that the flaps must be reusable in the event of ulcer recurrence.[12]

With the advent of the perforator flap era, there has been a profusion of island-type flap designs for coverage of sacral, ischial, and trochanteric pressure ulcers.[2–8] The skin paddle could be elliptical in shape, and the donor site closed primarily, or it could be triangular, in which case the donor site is closed in a V-to-Y pattern. The major advantage of perforator flaps when used for pressure sore coverage is preservation of the gluteus maximus muscle. This is particularly important and beneficial for ambulatory patients. However, such designs generally do not allow reuse of the flap, unless they are very large to begin with. Meltem et al. recently reported their experience of using gluteal perforator island flaps for coverage of pressure sores in 27 patients.[4] They noted an early, partial flap necrosis rate of 7.4 percent that consequently required coverage with a second rotation flap. This risk of early flap breakdown, factored in with the risk of ulcer recurrence in the long run, translates to a high incidence of a second flap in these nonambulatory patients. Flaps commonly used in such redo situations include rotation flaps for the contralateral buttock or perforator flaps from the contralateral "virgin" site.[4] This expends valuable skin and limits options available for coverage of pressure ulcers that may later develop in other areas of the buttock. The rotation type design, in contrast, can be reelevated by means of the same incision and advanced in the event of tip necrosis or ulcer recurrence. It is to enhance the vascularity of this ideal design for paraplegic pressure sore coverage that we developed this modification of the conventional design.

The conventional rotation flap can be elevated with varying extents of undermining. When sufficient rotation is achievable with limited undermining, the central portion should be spared, preserving the skin perforators from the superior and inferior gluteal vessels. This maximally preserves skin flap vascularity but limits the arc of rotation and thus is suitable only for smaller ulcers. For large, deep ulcers, full undermining is necessary to achieve tension-free closure because more rotation is needed. In these instances, some gluteal perforators would have to be ligated. The perforator-sparing rotation flap uses perforator flap techniques to preserve these musculocutaneous perforators from the superior or inferior gluteal vessels while allowing the same amount of under-

Table 2. Comparative Characteristics of Rotation Fasciocutaneous, Rotational Myocutaneous, Island-Type Perforator, and Perforator-Sparing Rotation Flaps

	Fully Undermined Rotation Fasciocutaneous Flap	Myocutaneous Rotation Flap	Island-Type Perforator Flap	Perforator-Sparing Rotation Flap
Components	Skin only	Skin and muscle	Skin only	Skin only *or* skin and muscle
Blood supply	+ Random pattern from its broad base	+ + + Musculocutaneous perforators from the superior and inferior gluteal coming through the gluteus maximus muscle	+ + Perforator vessels	+ + + Random pattern from its broad base *and* from the preserved perforator
Ability to reuse flap in ulcer recurrence	Yes	Yes	No	Yes
Recommended for	Shallow ulcers when muscle is not needed to fill dead space	Deep ulcers when muscle is needed to fill dead space	Ambulatory patients, where the risk of recurrence is not high	Suitable for deep or shallow ulcers, ambulant or nonambulatory patients

Plus signs indicate the relative vascularity of the flaps.

mining, thereby providing the gluteal skin with an enhanced blood supply compared with the conventional "fully undermined" rotation flap.

Table 2 compares and provides indications for some common flaps used for coverage of buttock pressure sores. The rotation flap with preserved perforators has a better blood supply compared with both the fully undermined conventional rotation flap and other island-type perforator flap designs, as it has a dual blood supply from the preserved perforator and a random component from its broad base. Theoretically, this improved perfusion should make this flap more resistant to pressure-induced ischemia. This may have contributed to the 0 percent rate of ulcer recurrence in our series, although we acknowledge that this series was too small to conclusively demonstrate this and that patient motivation and selection are probably the most important factors in determining recurrence rates. Compared with the sliding gluteus maximus musculocutaneous flap as described by Ramirez et al.,[12] two advantages are noted. First, when muscle is not needed, the perforator-sparing rotation flap preserves muscle for future use in nonambulatory patients and reduces donor-site morbidity in ambulatory patients. Second, when the muscle is required for filling of potential dead space, the independent movement of both the skin and muscle components allows more free play and therefore better inset of both components.

CONCLUSIONS

The partially undermined gluteal rotation fasciocutaneous and myocutaneous rotation flaps remain standard flaps for buttock pressure sores. The perforator-sparing buttock rotation flap has a role in selected cases where full mobilization or undermining is needed to achieve tension-free closure of the ulcer. A modification of the conventional gluteal rotation flap, it has three major advantages. First, the preservation and inclusion of the dominant perforator augments the blood supply of the fasciocutaneous flap and allows the same amount of mobilization as the classic design. Second, the improved vascularity renders the flap more robust and better able to withstand pressure-induced ischemia. Finally, in the event of an ulcer recurrence, rerotation is possible.

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DISCLOSURE

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this article.

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