Pelvic pressure sores reconstruction by the v–y advancement flaps: a 2-year experience

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Background
Pressure ulcers have complex etiopathogenesis. They are localized mainly in the pelvic region over the bony prominences of sacral, ischial, and trochanteric areas. The fundamental surgical treatments are debridement with excision of the underlying bursa and the involved bone tissue, followed by tissue coverage.

Aim
This study reports our experience in repairing pelvic pressure sores with the V–Y advancement flaps and analyzes our results in terms of morbidity and recurrence.

Methods
A prospective study was conducted between Jan 2013 and Dec 2015 of 15 patients (11 males, 4 females), with mean age of 43.5 years, with grade IV pelvic pressur sores (9 sacral, 6 ischial). 2 ulcers were recurrent and 13 were primary. The mean ulcer size was 11.8 × 7.1 cm. The sacral bed sores were covered by the gluteus maximus (GM) fasciocutaneous V–Y advancement flaps (2 unilateral and 7 bilateral flaps) while the ischial bed sores were covered by the biceps femoris (BF) fasciocutaneous V–Y advancement flaps in 4 cases, BF myocutaneous V–Y advancement flap in 1 case and vertical GM fasciocutaneous V–Y advancement flap in 1 case.

Results
All flaps survived completely with no complications in 11 patients. Complications occurred in 4 cases (26.7%); (1 hematoma, 1 wound infection, 1 small wound dehiscence (1.5 cm) and 1 distal superficial flap necrosis), all treated conservatively without necessitating 2nd operation. During the follow up period from 8 to 20 months (mean- 13.2 months) only one case of ulcer recurrence (6.7%) that was treated by re-advancement of the same flap.

Conclusion
We can conclude that the success of pressure ulcer surgery depends not only on the appropriate flap choice but also on patient education and compliance. However, the V–Y advancement flaps offer a reliable and robust coverage of sacral and ischial pressure sores even recurrent ones with minimal donor site morbidity, accepted rate of complications, low recurrence rate and preservation of future reconstructive options.

Keywords:
pelvic pressure sores, reconstruction, VY advancement flaps

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Introduction

Pressure ulcers (PUs) can be defined as superficial or deep lesions in the skin or soft tissue of ischemic etiology [1]. Substantive data support tissue ischemia resulting from external pressure over the bony prominences exceeding the closing pressure of nutrient capillaries (32 mmHg) for a long time enough to result in lethal injury to the tissues, as the cause of pressure sores [2]. The other factors contributing to the formation of pressure sores are friction (breach the epidermis), shearing (causes tearing of blood vessels), moisture (causing maceration of the skin), local infection, edema, neurological conditions, and poor nutrition [3].

In immobile patients, the pelvic region is the most predisposed topographic area to PUs in the human body [4]. A study performed with 649 patients and 1604 PUs demonstrated that the most affected region was the ischiatic, an area with a high pressure among wheel-chair bound patients. The sacral and trochanteric ulcers are more common in bedridden ones [5].

Various classification systems have been published to assist in diagnosis and facilitate the choice of the proper reconstructive method. We consider the classification system proposed by the European Pressure Ulcer Advisory Panel in 2009 as the most relevant one [6].

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Table 1 European Pressure Ulcer Advisory Panel classification (2009) [6]

Stage I	Intact skin with non-blanchable redness of a localized area usually over a bony prominence
Stage II	Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed
Stage III	Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed
Stage IV	Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present on some parts of the wound bed

It classifies PUs according to the level of tissue destruction into four stages (Table 1). Pressure sores are classified as stages I and II, which can be treated conservatively by using the optimal nonsurgical ulcer treatment and by eliminating the local and general conditions that adversely affect healing. However, if stages III or IV PUs are present, the surgical management is normally required [7].

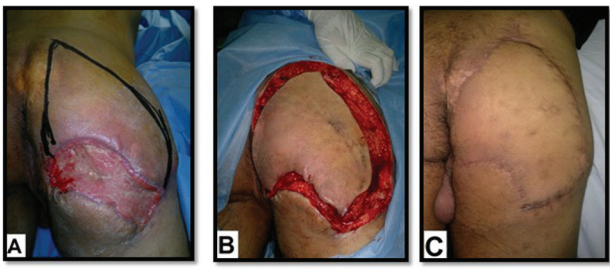
The fundamentals of PU treatment have remained unchanged since the study by Conway and Griffith [8], who described ulcer debridement with excision of the underlying bursa and, when required, of any involved bony tissue, followed by tissue coverage. Various methods can be used for reconstruction including primary closure, skin grafting, fasciocutaneous flaps, musculocutaneous flaps, muscle flaps, and the recently developed perforator flaps [9]. Free flaps are for exceptional indications and are reserved for panpelvic pressure sores for which local and regional flaps are inadequate to obtain adequate tissue coverage [10].

Reconstruction with flaps remains the reconstructive strategy of choice for most of the patients. The flap provides a well vascularized tissue for healing, obliterates dead space, and provides excellent padding over the bony prominence to allow a reasonable distribution of pressure [11]. Various flap techniques have proven effective for defect coverage; however, they continue to have high complication and recurrence rates [12]. In this study, we aimed to report our experience in repairing pelvic pressure sores with the V–Y advancement flaps and analyze our results in terms of morbidity and recurrence.

Patients and methods

The study was performed prospectively in the Department of Plastic, Reconstructive Surgery and Burns, Tanta University Hospitals, during the period from January 2013 to December 2015, on 15 patients (11 men and four women), aged from 19 to 70 years (mean: 43.5 years), admitted for grade IV pelvic PUs (according to the NPUAP system). The ulcers were localized in the ischial region in six cases (four right and two left) and in the sacral region in nine cases.

Figure 1



A 28-year-old man paraplegic due to traumatic spinal cord injury 6 years ago, had recurrent ischial sore after bursectomy and primary closure, underwent vertical gluteus maximus fasciocutaneous V–Y advancement flap. (a) Preoperative flap design. (b) Intraoperative view shows the flap after being completely islanded. (c) Six-month postoperative view showing sound healing.

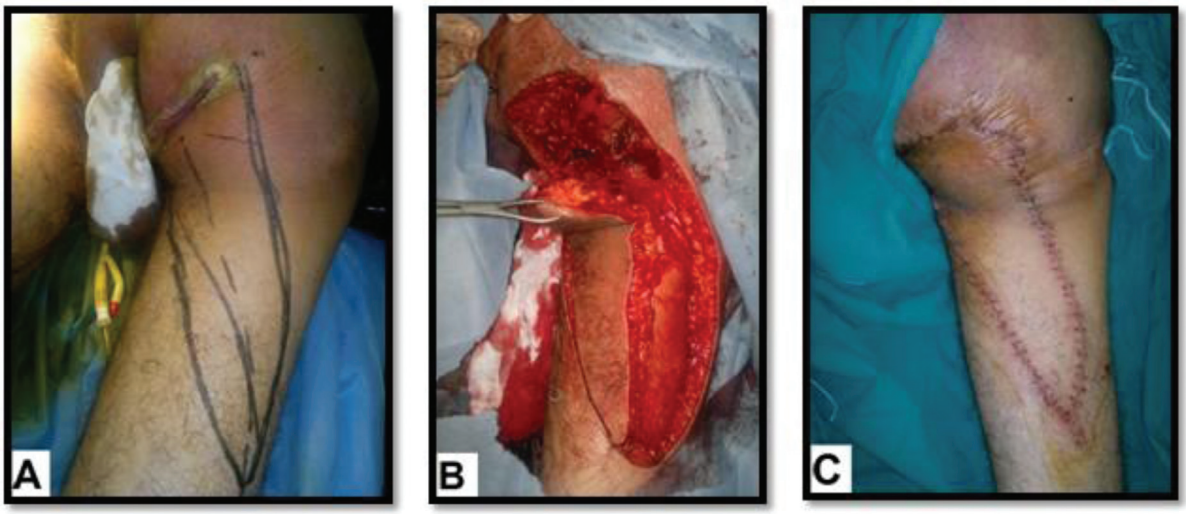
Two patients were ambulating, one had quadriplegia (traumatic spinal cord injury) and 12 had paraplegia (10 traumatic spinal cord injuries, one spinal stenosis, and one spina bifida). Two ulcers (ischial) were recurrent after bursectomy and primary closure, and 13 were primary. The sores ranged in size from 7×3 to 19×13 cm (mean: 11.8×7.1 cm). The sacral bed sores were covered by the gluteus maximus (GM) fasciocutaneous V–Y advancement flaps (two unilateral and seven bilateral flaps), whereas the ischial bed sores were covered by the biceps femoris (BF) fasciocutaneous V–Y advancement flaps in four patients, BF myocutaneous V–Y advancement flap in one patient, and vertical GM fasciocutaneous V–Y advancement flap in one patient (Fig. 1).

After approval of the Ethics Committee at Tanta Faculty of Medicine, all patients were evaluated for surgical treatment preoperatively and concurrent diseases were dealt with. The patients and their relatives were thoroughly educated for adjusting the patients' daily living activities with postoperative pressure relief and general care. Preoperatively, a standard bowel preparation was done for all patients.

Operative technique

The operative procedures were performed under general anesthesia. The design of the flap was marked, with the patients hip flexed in the prone position. The ulcerated

Figure 2



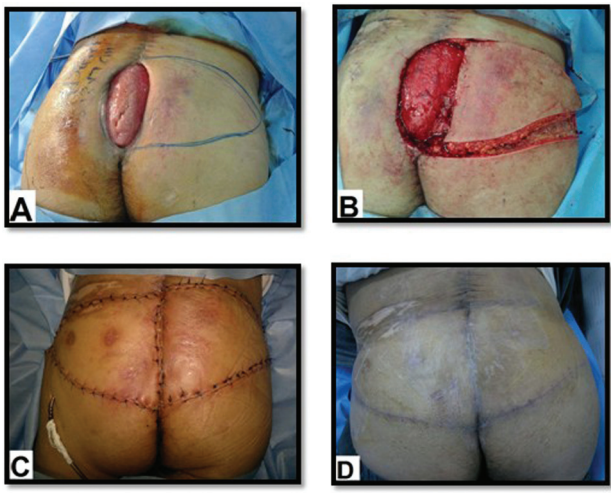
A 36-year old male paraplegic due to traumatic spinal cord injury 3 years ago, had right ischial sore, underwent biceps femoris fasciocutaneous V–Y advancement flap. (A). Pre-operative flap design. (B). Intra-operative view shows the flap after being completely islanded. (C). One month postoperative view shows sound healing.

area and the underlying bursa were excised down to healthy tissue as a whole (en-bloc excision). Ostectomy of any underlying bony prominences was performed to even out any irregular bony surfaces, and the wound was washed with 10% betadine and 0.9% saline solution.

With regard to the BF V–Y advancement flap, the flap was outlined on the posterior thigh centralized on the long head of the BF muscle and was designed as large as possible to allow tension-free closure. The base of the V was incised during the ulcer excision. The rest of the incisions were made medially and laterally to the apex and continued through the skin, subcutaneous tissue, and deep fascia for the fasciocutaneous flaps (Fig. 2). In case of myocutaneous flaps, the incisions were extended to the underlying muscles, where the BF muscle was dissected medially from the semimembranosus and semitendinosus muscles and laterally from the vastus lateralis. The origin and insertion of the long head were divided. If more advancement of the flap was needed, dissection of the deep surface was done and vascular pedicles were identified and mobilized without division.

With regard to the GM fasciocutaneous V–Y advancement flap, the V fashioned wide and long enough to close as a Y without tension. The flap was completely islanded, the incisions were continued through the skin, subcutaneous tissue, and deep fascia taking care not to injure the Gluteal maximus (GM) perforators. An attempt was then made to transpose the flap. If no tension was encountered, unilateral flap was used and closure of the donor defect was commenced and completed first. The flap was then found to fit snugly into the recipient defect. If tension was encountered, bilateral flaps were used (Figs 3 and 4).

Figure 3



A 70-year-old man developed sacral bed sore after being bedridden for 1 year due to fracture pelvis, underwent bilateral gluteus maximus fasciocutaneous V–Y advancement flaps. (a) Preoperative picture. (b) Intraoperative picture shows an attempt to close the defect with unilateral flap, but tension was encountered, so bilateral flap was used. (c) Early postoperative picture. (d) Nine-month postoperative picture showing sound healing.

Closed suction drains were placed and the wounds were closed in layers. The drains were left in place for 7–10 days.

Postoperative care

The patients were nursed prone for 3 weeks before gradual mobilization. A low-residue diet was given for

Figure 4

A 19-year-old man paraplegic due to traumatic spinal cord injury 3 years ago, had sacral bed sore, underwent bilateral gluteus maximus fasciocutaneous V–Y advancement flaps. (a) Preoperative picture. (b) Early postoperative picture. (c) Seven-month postoperative picture showing sound healing.

2 weeks and meticulous hygiene of the perineum was maintained. The patients were maintained entirely nonweight bearing on the flap sites for 1 month on air-flotation beds, with frequent change of the position and total body care. After this period, a sitting protocol including gradual increase in pressure on the operation site was introduced. In cases with wound complications, a sitting protocol was delayed until wound healing.

Postoperative monitoring

Presence or absence of the complications was assessed during the postoperative period and the following were described: hematoma, postoperative infection at the surgical site, wound dehiscence (small, length<3 cm and large, length>3 cm), and partial (<30%) or total (>30%) flap necrosis. The success rate was determined by including cases that healed within 1 month after surgery. The recurrence rate was determined by including cases in which the lesion reappeared more than 1 month after healing.

Results

In 2 years, 15 patients with grade IV pelvic pressure sores were treated surgically by the V–Y advancement flaps. The summarized data of the study including the age, sex, ulcer site and size, predisposing factor, patient's status, type of flaps, follow-up period as well as the events of complications and recurrence are shown in Table 2.

All flaps survived completely without major complications. Minor complications occurred in four (26.7%) patients; postoperative hematoma was diagnosed in one patient; drainage of the hematoma was followed by uneventful recovery, another patient had superficial necrosis, which occurred in the distal end of the flap; the wound healed without necessitating a secondary operation, wound infection was diagnosed in one patient and was treated by culture-specific intravenous antibiotics with the local wound care, and one patient suffered from a small wound dehiscence (1.5 cm) that was healed by conservative measures for less than 1 month.

After an average follow-up period of 13.2 months (range: 8–20 months), all flaps were viable and intact. One (6.7%) ulcer (ischial) had local recurrence after 6 months. Adequate history taking revealed prolonged weight bearing on the ischial areas, with lack of proper medical and nursing care for early signs of recurrence. It was managed by readvancement of the same flap after dividing the origin and insertion of long head of BF muscle.

Discussion

Surgical management of patients with PUs has always been a challenge. Performing a correct surgical procedure does not assure that the patient is not going through recurrences or complications [13]. So, we must select a treatment option offering the best results, while preserving the maximum skin capital and therefore, the possibility of a second flap in case of recurrence. Moreover, this must be followed by a more comprehensive management, in terms of rehabilitation of the patient [14]. However, till now there has been no evidence in the literature showing the superiority of one technique of flap coverage compared with another [15]. We aimed in this study to report our experience in repairing pelvic pressure sores with the V–Y advancement flaps and analyze our results in terms of morbidity and recurrence.

In total, 15 patients with grade IV pelvic pressure sores were enrolled in this study. The highest incidence of PUs was in the sacral region (60%), which is consistent with the other studies [1,5] and could be explained by the greater frequency of supine position among our population with lack of knowledge of PUs preventive measures. Unlike our study, Yankov *et al.* [4] noticed that the pressure sores were localized in the ischial

Table 2 Summary of patients' data

Patient nos	Age (years)/ sex	Site	Defect size (cm)	Predisposing factor	Status	Type of flap	Complications	Follow-up (months)
1	19/male	Sacral	12×10	Traumatic SCI	Paraplegia	Bilat. V–Y (GM) Fascio. F.	–	12
2	30/male	Sacral	19×13	Traumatic SCI	Paraplegia	Bilat. V–Y (GM) Fascio. F.	Infection	15
3	36/male	Rt ischial	8×3	Traumatic SCI	Paraplegia	V–Y (BF) Fascio. F.	–	8
4	68/female	Sacral	12×8	Spinal stenosis	Paraplegia	Bilat. V–Y (GM) Fascio. F.	–	13
5	58/male	Sacral	11×7	Traumatic SCI	Paraplegia	Unilat. V–Y (GM) Fascio. F.	Distal superficial flap necrosis	18
6	70/male	Sacral	13×8	Fracture pelvis	Ambulation	Bilat. V–Y (GM) Fascio. F.	–	10
7	55/male	Lt ischial	7×3	Traumatic SCI	Paraplegia	V–Y (BF) Fascio. F.	–	16
8	45/male	Rt ischial (Rec.)	10×5	Traumatic SCI	Paraplegia	V–Y (BF) Myo. F.	Hematoma	11
9	60/female	Sacral	10×7	Traumatic SCI	Paraplegia	Unilat. V–Y (GM) Fascio. F.	–	18
10	28/male	Rt ischial (Rec.)	15×7	Traumatic SCI	Paraplegia	Vertical V–Y (GM) Fascio. F.	–	16
11	37/female	Lt ischial	11×5	Traumatic SCI	Paraplegia	V–Y (BF) Fascio. F.	Recurrence	20
12	45/female	Rt ischial	9×4	Traumatic SCI	Paraplegia	V–Y (BF) Fascio. F.	Small wound dehiscence	12
13	33/male	Sacral	12×8	Spina bifida	Paraplegia	Bilat. V–Y (GM) Fascio. F.	–	9
14	25/male	Sacral	15×9	Traumatic SCI	Quadriplegia	Bilat. V–Y (GM) Fascio. F.	–	10
15	69/male	Sacral	13×10	Cerebral stroke	Ambulation	Bilat. V–Y (GM) Fascio. F.	–	9

BF, biceps femoris; Bilat, bilateral; F., flap; Fascio., fasciocutaneous; GM, gluteus maximus; Lt, left; Myo., myocutaneous; Rec., recurrent; Rt, right; SCI, spinal cord injury; Unilat. unilateral.

(63.3% of cases) and the sacral region (36.4% of cases), and this could be attributed to that most of their patients were wheel-chair bound ones.

In the literature, pressure sores are common problem among long-term hospitalized patients, geriatric population, and those with spinal cord injury. Traumatic spinal cord injury is the most prevalent in our series (73.3%), which is related to the rapid increase in the incidence of road traffic accidents. Byrne and Salzberg [16] observed that 70% of patients with spinal cord injury suffer from multiple PUs and 85% of the patients have at least one PU during their lifetime.

In our study, the fasciocutaneous flaps were the most frequently used, accounting for 93.3% of cases. The fasciocutaneous flaps have a reliable blood supply, provide enough tissue to cover dead space, improve functional and esthetic results, and allow adequate closure with minimal donor site morbidity. Furthermore, the use of muscle flaps is controversial as sparing the muscles is of functional value in ambulant patients, the muscle undergoes atrophic changes shortly after surgery, muscle tissue is less resistant to ischemia, the pressure points in the body are covered by skin and subcutaneous tissue, and muscle coverage provides no additional benefit.

Recent studies [17,18] found that fasciocutaneous flaps provide comparable, if not superior, long-term results in surgical reconstruction of pressure sores than myocutaneous flaps. In other studies, Bertheuil *et al.* [10] used myocutaneous BF flap to cover 23 stage IV ischial PUs and Rajacic *et al.* [19] used inferior GM myocutaneous flap to treat 31 ischial pressure sores. They demonstrated that myocutaneous flaps are of choice for filling dead space in large, deep wounds, whereas fasciocutaneous flaps may have insufficient volume to do so. Additionally, because of their rich blood flow, myocutaneous flaps are a good choice for the treatment of infected wounds.

We used the GM fasciocutaneous V–Y advancement flaps to cover all sacral ulcers. This flap is easy to

harvest, shows good resistance to pressure, and ensures long PU-free survival rate. In 77.8% of the sacral ulcers, we used bilateral flaps to cover defects as large as 13 cm in diameter, whereas unilateral flaps were used in two sacral ulcers to cover defects as large as 7 cm in diameter. In the study of Ohjimi *et al.* [20], the largest defects that were closed with bilateral and unilateral gluteal fasciocutaneous V–Y advancement flaps were 15–21 and 10–11 cm, respectively. In another study, Wong *et al.* [21] recommended the perforator-sparing buttock rotation flap for gluteal pressure sores as it affords the flexibility of rerotation in the event of ulcer recurrence; moreover, it provides the flap with enhanced blood supply.

In our series, one ischial bed sore was covered by vertical GM fasciocutaneous V–Y advancement flap and another one was covered by BF myocutaneous V–Y advancement flap. Both ulcers were recurrent after bursectomy and primary closure. The remaining four ulcers were primary and were covered by BF fasciocutaneous V–Y advancement flaps. The BF V–Y advancement flap is highly reliable, covers large ischial defects, can be used fasciocutaneous or myocutaneous with deepithelialization for a suitable segment of the proximal part of the flap, and can be readvanced easily in case of recurrence.

Albarah [22] used deepithelialized BF myocutaneous V–Y advancement flaps for reconstruction of 11 ischial bed ulcers and concluded that this flap can be used efficiently to reconstruct recurrent and difficult ischial pressure sores and the deepithelialization provides the flap with more advantages and improves the results. Other studies [19,23] advocated the inferior GM myocutaneous flap for ischial ulcers reconstruction, as it does not interfere with the patient's ability to walk in ambulant patient and flaps based on the immobile trunk or pelvis showing better outcome than those based on the more mobile lower extremity. In the large series of ischial pressure sores reconstruction by Foster *et al.* [24], who compared the efficacy of one flap to another and reported that inferior GM flap and inferior gluteal thigh flap, had the highest success rates, 94 and 93%, respectively, followed by the V–Y hamstring flap 58%, and the tensor fascia lata flap 50%.

The series witnessed a complication rate of 26.7%; one hematoma, one wound infection, one small wound dehiscence (1.5 cm), and one distal superficial flap necrosis, all treated conservatively without necessitating second operation. We observed that 22.2 and 33.3% of the sacral and ischial ulcers, respectively, had complications. This could be attributed to the close proximity of the ischia to the perineum, which promotes local maceration, and mechanical stresses, such as shear in the sitting position. During the follow-up period from 8 to 20 months (mean: 13.2 months), only one (6.7%) patient had ischial ulcer recurrence and was treated by readvancement of the same flap. The low rate of ulcer recurrence is probably related to the fewer cases of ischial ulcers, as these have the greater recurrence rates and also the short follow-up time, since other studies report rates above 26% [25].

In the study of Figueiras [1], 33 PUs were surgically treated, complications related to 13 (39%) ulcers, and the ulcer recurrence occurred in three (18%) patients after an average of 6 months of follow-up. Our data confirmed the study of El Hawary [26], who treated 13 sacral pressure sores by using V–Y advancement gluteal fasciocutaneous flap and noticed that only two (15.4%) patients had superficial necrosis in the distal end of the flap that was treated conservatively, all flaps survived without major problems and after a mean follow-up of 10 months, no ulcer recurrence was detected. In another study, Hurbungs and Ramkalawan [9] used the pedicled superior gluteal artery perforator flap to cover 10 sacral PUs and found that only one (10%) patient had postoperative hematoma, all flaps survived and after a mean follow-up of 14 months, no ulcer recurrence was detected.

Tavakoli *et al.* [27] performed a study on 37 ischial PUs operated by V–Y advancement hamstring myocutaneous island flap. They found that after a mean follow-up of 20 months, 33% of patients had recurrent ulcers and 14.8% of them underwent readvancements and recommended the use of the hamstring V–Y myocutaneous flap as a reliable and safe reconstructive modality in the treatment of ischial pressure sores. In the study of Albarah [22], two (18.2%) patients had mild wound dehiscence (<1 cm in width) that were healed by conservative measures, and after a mean follow-up of 9 months, 27.3% of patients had recurrent ulcers that were managed by readvancement of the same flap.

Mostafa [28] used inferior GM myocutaneous flap to treat 20 ischial pressure sores and observed that two (10%) patients had partial dehiscence of the wound; one of them healed spontaneously, whereas secondary revision of the wound was done in the second patient. Recurrence occurred within 6 months in two (10%) patients and were operated again using the rerotated and advanced inferior GM myocutaneous flap. In the study of Kim *et al.* [29] on 23 patients with ischial PUs using the inferior gluteal artery perforator flap, six

(23%) patients developed early partial wound dehiscence; debridement and primary repair was done for four patients, while two of them healed conservatively. After 6 months postoperatively, the sore recurred in five (21%) patients and were treated with muscle transposition flap to fill the dead space. A larger clinical trial with a longer follow-up period would be necessary for better evaluation of the outcomes in terms of morbidity and recurrence.

Conclusion

We can conclude that the success of PU surgery depends not only on the appropriate flap choice, but also on the patient's education and compliance. However, the V–Y advancement flaps offer a reliable and robust coverage of sacral and ischial pressure sores, even recurrent ones, with minimal donor site morbidity, an accepted rate of complications, a low recurrence rate, and preservation of future reconstructive options.

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Nil

Conflicts of interest

There are no conflicts of interest.

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