

## The use of axially vascularised flaps in reconstructing dehiscent surgical wounds

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**ABSTRACT:** *Purpose:* The purpose of the study is to present the indications and evaluate the effectiveness of axial regional flaps in treating dehiscent surgical traumas.

*Materials - Methods:* During the last three years, 11 patients (7 male, 4 female) underwent a reconstructive operation for a dehiscent surgical wound, which resulted after an orthopaedic, vascular, cardiovascular or urological surgery. Trauma dehiscence was related to ischemia due to prior radiotherapy, haematoma formation, infection or previous scarring. Prosthetic implants were exposed in five cases. All patients had one to three attempts for primary closure before they were seen by the plastic surgeon. In all cases, a pedicle axial flap was used: a muscle or musculocutaneous flap for managing traumas located over the torso (n = 7), and fasciocutaneous (n = 3) or muscle (n = 1) flaps for those located on the extremities.

*Results:* Follow-up ranged from 2 to 7 months. In all cases, flaps provided safe closure and sufficient coverage of the wound; exposed implants were not removed. No recurrences were recorded. We had a partial necrosis of the skin island in a musculocutaneous pectoralis major flap used for covering a sternal defect; revision consisted in debridement and secondary coverage with a skin graft.

*Conclusion:* Axial flaps offer reliable solutions when we face dehiscent surgical traumas. The appropriate flap is chosen according to the location, size and other characteristics of the defect. Muscle flaps are mostly indicated for reconstructing complicated wounds over the torso, especially in previously irradiated areas, while fasciocutaneous flaps are used for complicated traumas of the extremities.

*Key Words:* Dehiscent traumas, Reconstruction of surgical wounds, Axial flaps.

### INTRODUCTION

Dehiscence and delayed healing of surgical wounds is a challenging problem that involves many surgical specialties. It may frequently be associated with significant risk of further complications and prolonged patient's hospitalization. In most cases, wide surgical debridement followed by secondary or delayed primary closure is performed<sup>1</sup>. Recurrence of the wound breakdown is not rare especially when other comorbidities are present, i.e. tissue ischemia, previous irradiation, diabetes etc. Moreover, exposition of prosthetic materials may require surgical removal and secondary reconstruction.

The aim of this retrospective clinical study is to present our experience and evaluate the reliability of pedicle axial flaps in the management of recurrent dehiscent surgical wounds.

### MATERIAL AND METHODS

During the last three years, eleven patients (seven male and four female), aged from 25 to 82 years, were referred to our department presenting a dehiscent surgical trauma after a previous orthopaedic (n = 7), vascular (n = 2), cardiovascular (n = 1) or urologic (n = 1) surgery. All patients had undergone elective surgical operations. In three cases, wound break-

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**Table 1.** Data concerning patients' profile, treatment applied and results.

Sex	Age (yrs)	Location	Previous surgery	Exposed implant	Aetiology of dehiscence	Treatment applied - Type of flap	FU (mo)	Result
M	82	knee R	orthopaedic	yes	hematoma	VAC, gastrocnemius MF + STSG	5	success
M	68	groin R	vascular	yes	infection	VAC, sartorius MF + STSG	7	success
F	79	presternal area	cardio-vascular	no	infection, diabetes	VAC, pectoralis major MCF	3	partial loss of skin island
M	42	lumbar area R	orthopaedic	no	hematoma	superior gluteal MCF	2	success
M	59	lumbar spine	orthopaedic	no	irradiation, seroma	VAC, latissimus dorsi MF + STSG	5	success
M	31	elbow R	orthopaedic	yes	hematoma, previous scars	perforator FCF	5	success
M	34	achilles zone R	orthopaedic	no	infection	lat supramalleolar FCF	3	success
F	25	achilles zone R	orthopaedic	no	hematoma	lat supramalleolar FCF	4	success
F	60	lumbar spine	orthopaedic	yes	irradiation, CSF leakage, scarred tissue	latissimus dorsi MF	6	success
M	74	suprapubic area	urological	no	irradiation, previous scars	tensor fascia latae MCF	2	success
F	65	groin R	vascular	yes	infection	sartorius MF + STSG	4	success

*FU: follow-up, MF: muscle flap, MCF: myocutaneous flap, FCF: fasciocutaneous flap, STSG: split thickness skin graft, VAC: vacuum assisted closure.*

down was related to prior radiotherapy, in six cases to postoperative haematoma or other fluid collection, in four to infection, and in three patients dehiscence was associated to previous scarring. Traumas were located to the lumbosacral and inguinal area, the Achilles tendon zone, the presternal area, the knee and the elbow.

All patients had had one to three attempts for primary closure after debridement, before they were seen

by a plastic surgeon. Infection was present in all cases and confirmed by positive cultures; antibiotics were systemically administered until negative results were obtained. In five patients, exposition of prosthetic materials was recorded (prosthetic vascular grafts in two cases, orthopaedical metalwork in three cases). In four patients, vacuum assisted closure (V.A.C.) was applied locally prior to the planned reconstructive procedure.



**Figure 1.** [a] 34-year-old man suffering from wound dehiscence after Achilles tendon repair on the right leg; two previous attempts to close the surgical wound were performed. [b] Wide surgical debridement of the area. [c] Transposition of a fasciocutaneous lateral supramalleolar island flap to cover the defect. [d] Final result in three months.

We used pedicle axial regional flaps for reconstructing these multiple operated wounds. Muscle or musculocutaneous flaps were used for covering traumas located over the torso and the knee ( $n = 8$ ), while fasciocutaneous axial flaps ( $n = 3$ ) were transposed for reconstructing complex wounds over the elbow and ankle (Table 1).

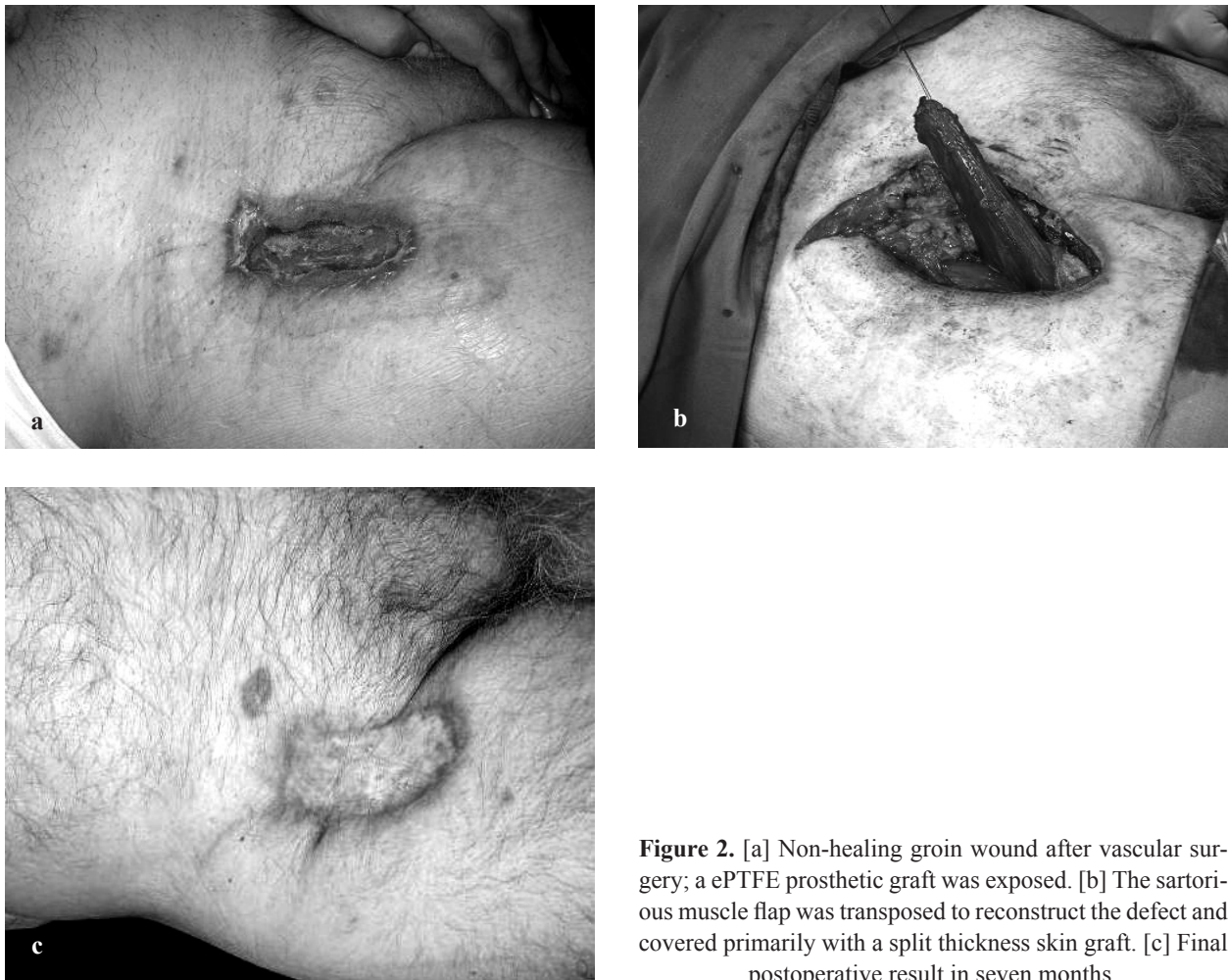
### RESULTS

Patients' follow-up ranged from 2 to 7 months. In ten out of eleven cases, the transferred flap offered stable coverage of the dehiscent wound. No signs of recur-

rence of the reconstructed defect were recorded (Figure 1). Morbidity of the donor area was minimal and donor site scars were well accepted by the patients.

We had a partial necrosis of the skin island of a myocutaneous pectoralis major flap used for covering a median sternotomy wound; surgical revision was required, and a split thickness skin graft was used and covered successfully the secondary defect.

Exposed prosthetic materials were not removed. In two patients with dehiscent groin wounds over patent infrainguinal bypass grafts, the transposition of a



**Figure 2.** [a] Non-healing groin wound after vascular surgery; a ePTFE prosthetic graft was exposed. [b] The sartorius muscle flap was transposed to reconstruct the defect and covered primarily with a split thickness skin graft. [c] Final postoperative result in seven months.

sartorius muscle flap provided successful reconstruction (Figure 2). Exposed metalwork used for knee and elbow prosthetic joint was covered successfully with a gastrocnemius muscle flap and a perforator fasciocutaneous flap, respectively. Finally, a latissimus dorsi muscle flap was turned over and covered the exposed metal framework that was used to stabilize the lumbar spine in one patient (Figure 3).

#### DISCUSSION

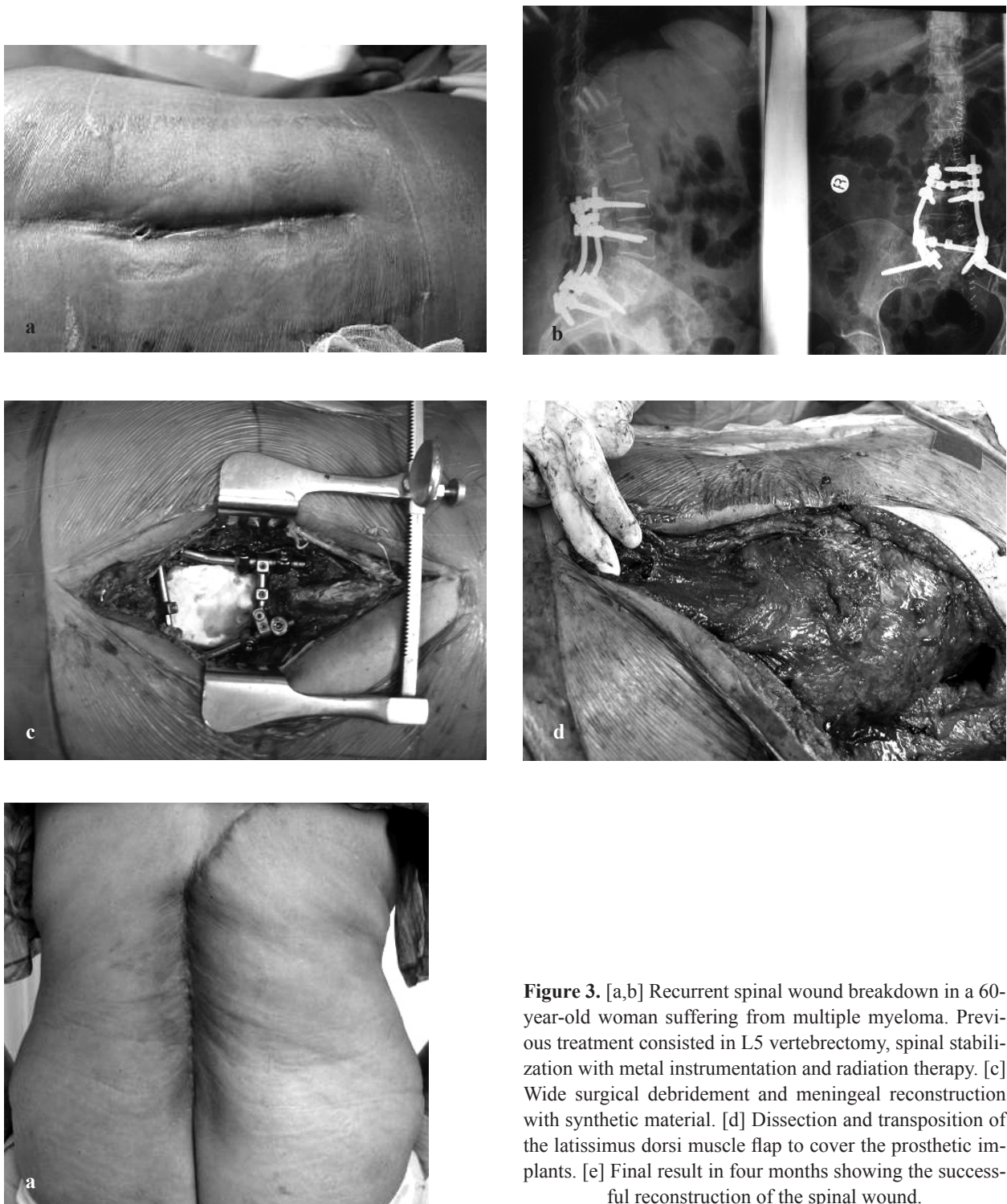
Compromised vascularization and tissue ischemia are the main causes of wound dehiscence. The most common treatments include surgical debridement, control of local infection and secondary closure. Attempts to close the wound with tension or using small random flaps have most frequently met with failure and recurrence of the wound breakdown<sup>2</sup>.

The situation is even more difficult when prosthet-

ic implants are involved. When a prosthetic material becomes exposed, most authors -traditionally- advocate its removal followed by some type of secondary reconstruction, depending on the nature of the original surgery<sup>3,4</sup>; however, this surgical explanation may not always be the best alternative, because of either the configuration of the reconstruction, or the significant associated morbidity<sup>5</sup>.

Yet it is now appreciated that in certain instances, exposed and contaminated implants can be salvaged; a requirement for such an approach is that the exposed implant be covered by well-vascularized tissue. Muscle flap reconstruction has traditionally been considered as the best option for treating such complex infected wounds. Muscle flaps can improve the local healing environment and assist in salvaging prosthetic material in many cases. The transferred muscle not





**Figure 3.** [a,b] Recurrent spinal wound breakdown in a 60-year-old woman suffering from multiple myeloma. Previous treatment consisted in L5 vertebrectomy, spinal stabilization with metal instrumentation and radiation therapy. [c] Wide surgical debridement and meningeal reconstruction with synthetic material. [d] Dissection and transposition of the latissimus dorsi muscle flap to cover the prosthetic implants. [e] Final result in four months showing the successful reconstruction of the spinal wound.

only provides covering tissue, but also a well-vascularized organ that increases local blood flow and oxygen tension to combat infection<sup>1,5</sup>. Current results have demonstrated that fasciocutaneous axial flaps

may also provide stable coverage of exposed prosthetic materials; the key consideration is the sufficient blood flow of the transferred flap and the obliteration of dead space in the wound<sup>2</sup>.

Our study brings together a number of patients who underwent flap coverage for surgical trauma dehiscence. Although patients vary a lot regarding the aetiology, localization of the wound and type of flap used, the concept of wound reconstruction is similar. A variety of flaps was employed to achieve closure in our series. Musculocutaneous or muscle axial flaps with split thickness skin grafts were our first choice and used in all wounds of the torso. Fasciocutaneous axial flaps were used to cover postoperative dehiscences on the extremities. These two groups of flaps seem to be equally effective in covering exposed metalwork of the extremities<sup>6</sup>. Evidence of infection is almost always present in such complex cases; surgical debridement of nonviable tissues and control of infection is of paramount importance. In a large reported series, Gault and Quaba pointed out the strong correlation between pre-operative cultures and the outcome of covering exposed metalwork; early flap coverage may reduce the risk of failure of the reconstruction<sup>6</sup>.

Data on the management of infected media sternotomy advocates the use of omentum or muscle flaps. Pectoralis major muscle flap is recommended as the flap of choice by several centers<sup>7-9</sup>. The partial skin island pectoralis flap necrosis recorded in our patient, was due to infection, and was treated with debridement and skin grafting without alteration of the final outcome.

As far as exposed peripheral vascular prostheses are concerned, muscle flap coverage has been suggested in appropriately selected patients by a number of authors<sup>1,10-12</sup>. Both, sartorius and gracilis muscle transposition may provide durable clinical success and control groin infections. However, prosthetic graft infections are not truly eradicated in many patients. Although lifelong suppressive doses of antibiotics may be considered in those cases, late infectious complications may still arise<sup>5</sup>. In our practice, sartorius muscle transposition provided very satisfactory results.

In a retrospective study on 22 patients with postoperative infections after spine surgery, Dumanian et al reported good results after a wide debridement and use of muscle flaps; all patients with spinal implants retained their instrumentation<sup>13</sup>. According to the authors, spinal instrumentation should only be removed if it is no longer providing any stability. In our two

similar cases, where wound dehiscence was also associated to post-irradiation fibrosis, we successfully used the latissimus dorsi muscle flap based on the lumbar vascular pedicles; the procedure provided very satisfactory results, while prosthetic implants that were exposed in one patient were not removed.

### CONCLUSION

When facing postoperative complicated wounds, wide debridement, control of local infection and early coverage with well-vascularized tissues is the mainstay of the treatment. Muscle, musculocutaneous or fasciocutaneous axial flaps are very useful therapeutical means to provide stable reconstruction and avoid additional complications; in selective cases, they allow salvage of exposed prosthetic implants, and achieve significant reduction in morbidity and decrease in hospital stay.

## Αντιμετώπιση διασπασθέντων χειρουργικών τραυμάτων με αξονικούς κρημνούς

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**ΠΕΡΙΛΗΨΗ:** Σκοπός της εργασίας είναι η εκτίμηση της αποτελεσματικότητας των αξονικών κρημνών στην αντιμετώπιση διασπασθέντων χειρουργικών τραυμάτων, σε έδαφος πτωχής αιμάτωσης ή έκθεσης αλλοπλαστικών υλικών.

**Υλικό - Μέθοδος:** Κατά την τελευταία 3ετία, 11 ασθενείς (7 άνδρες, 4 γυναίκες) υποβλήθηκαν σε επέμβαση σύγκλεισης διασπασμένου τραύματος με χρήση αξονικού κρημνού, μετά από ορθοπαιδική, αγγειοχειρουργική, καρδιοχειρουργική ή ουρολογική επέμβαση. Η ιστοική ισαχμία που οδήγησε στη διάσπαση σχετίστηκε με παρουσία παλαιών ουλών, προηγηθείσα ακτινοβολία, επιμόλυνση του τραύματος και μετεγχειρητική εμφάνιση συλλογής ή αιματώματος. Σε όλους τους ασθενείς είχαν προηγηθεί μία ως τρεις προσπάθειες επανασυρραφής του τραύματος από τους θεράποντες γιατρούς. Για την τελική σύγκλειση των τραυμάτων στον κορμό (n = 7) χρησιμοποιήθηκαν μυικοί και μυοδερματικοί κρημνοί, και στα άκρα περιτονο-δερματικοί αξονικοί κρημνοί (n = 3) και ένας γαστροκνήμιος μυικός κρημνός.

**Αποτελέσματα:** Η μετεγχειρητική παρακολούθηση των ασθενών ήταν από 2 ως 7 μήνες. Σε όλες τις περιπτώσεις, οι κρημνοί παρέιχαν ασφαλή σύγκλειση και κάλυψη της περιοχής χωρίς υποτροπή της διάσπασης. Σε μία ασθενή με διάσπαση τραύματος στέρνου είχαμε μερική νέκρωση της δερματικής νησίδας μυοδερματικού κρημνού του μείζονος θωρακικού, που αντιμετωπίστηκε με καθαρισμό και εφαρμογή δερματικού μοσχεύματος. Σε καμία περίπτωση δεν απαιτήθηκε αφαίρεση των εκτεθειμένων αλλοπλαστικών υλικών.

**Συμπέρασμα:** Η χρήση αξονικών κρημνών αποτελεί αξιόπιστη μέθοδο για την αντιμετώπιση επιπλεγμένων χειρουργικών τραυμάτων. Απαιτείται σωστή επιλογή του κατάλληλου κρημνού ανάλογα με τη θέση και τη φύση του τραύματος. Οι μυικοί κρημνοί είναι οι πλέον ενδεδειγμένοι σε ελλείμματα κορμού, ιδίως σε ακτινοβολημένες περιοχές, ενώ στα άκρα οι περιτονοδερματικοί κρημνοί αποδεικνύονται εξίσου αποτελεσματικοί.

**Λέξεις Κλειδιά:** Διασπασθέντα τραύματα, Επανόρθωση χειρουργικών τραυμάτων, Αξονικοί κρημνοί.

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