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ORIGINAL ARTICLE

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Plastic solutions for orthopaedic problems

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Abstract *Introduction:* Infection and exposure of the implant may occur in 1–12% of patients operated on for arthroplasty or osteosynthesis. Variables such as tissue viability, presence of infection, exposure of osteosynthesis material and patient-related factors contribute to the lack of general consensus regarding the management of these defects. *Materials and methods:* Between January 1999 and January 2001, six patients were treated for complex soft-tissue defects following various orthopaedic procedures at the Department of Plastic Surgery in the Slotervaartziekenhuis in Amsterdam, a rheuma-orthopaedic orientated hospital. All patients were initially treated by radical debridement and vacuum-assisted closure (VAC) system of the wound. After 1 week, this was followed by transplantation of a pedicled or free flap to cover the defect. We studied the medical history, initial orthopaedic procedure, wound treatment, transplanted flap and outcome of plastic surgery in this group. *Results:* Plastic surgical intervention led to wound closure in all cases. In only one case was the osteosynthesis material removed because of osteomyelitis. *Conclusions:* We conclude that the earlier coverage with vital tissue is obtained, the lower the incidence of infection. Early consultation by a plastic surgeon will increase a positive outcome of treatment of complex tissue defects.

Keywords Postoperative wounds · Plastic surgery · Flaps · Osteosynthesis · Arthroplasty

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Introduction

Most patients operated on for arthroplasty or osteosynthesis have an uncomplicated postoperative wound healing course, but dehiscence of the overlying soft tissue may occur. In 1–12% of cases, the resulting defects can be complicated by infection of the soft tissue, the bone and/or the implant. Such infections may be accompanied by superficial skin loss or severe soft-tissue loss [6, 7, 10, 15]. The complexity of the problem, then, is often compounded by the presence of exposed metal or bone. Even though wound exposure puts both the bone and the implant at risk, no general consensus exists regarding the management of these defects. This is mainly due to the large number of variables that influence the management options. These include wound factors (depth, diameter), amount of viable tissue, presence of infection and exposure of implant components [8]. Patient-related factors that have a negative effect on wound healing are advanced age, diabetes mellitus, nutritional status, corticosteroid medication, peripheral vascular disease and tobacco use [13].

Most of the soft-tissue problems following osteosynthetic/arthroplastic operations can be treated successfully by means of thorough debridement and coverage of the wound by a well vascularised, pedicled or free, musculocutaneous or fasciocutaneous flap.

Some authors suggest removing the implant [2], whereas others only perform a thorough debridement and cover the exposed endoprotheses by a well vascularised flap [1, 4, 5, 8, 9, 11, 12]. By means of this treatment, open fractures can be changed into closed ones.

In this article we present our experiences with the treatment of six patients with complex soft-tissue defects following operation treated with radical debridement, vacuum-assisted closure (VAC) and pedicled or free flap coverage.

Patients and methods

Between January 1999 and January 2001, three men and three women with the mean age of 60.2 years (range 33–76 years) were

Table 1 Results after plastic surgery intervention on complex wounds (*RA* rheumatoid arthritis, *Elastogel* glycerine hydrogel dressing, Mediprof Medical Products, Moerkapelle, the Netherlands, *TAP* total ankle prosthesis, *SSG* split skin graft, *VAC* vacuum-assisted closure)

Patient no.	Age (years) M/F	Medical history	Primary surgery/ diagnosis	Wound treatment	Flap used	Closing of the wound
1	76 F	RAUse of prednisone 5 mg/day	02/06/1999:TAP right	20/07/1999: Debridement reveals exposed ankle implant 29/07/1999: Evacuation haematoma	28/07/1999: m. peroneus longus flap	22/11/1999
2	33 M	–	21/07/1999: Fracture crus dexter 23/07/1999: External fixation 05/08/1999: Plate-osteosynthesis	Elastogel local wound treatment 25/08/1999: Debridement	31/08/1999: Free m. gracilis flap, SSG, VAC	25/11/1999
3	58 M	Medial compartment gonarthrosis	06/09/1999: Valganising tibia head osteotomy	15/09/1999: Debridement, gentabeads/pearls 22/09/1999: Debridement, Gentasponge	30/09/1999: m. gastrocnemius flap, SSG, VAC	08/11/1999
4	64 F	Mammaca with meta distal femur, radiation arthrosis	10/02/2000: Left knee prosthesis	20/04/2000: Spooling of the knee	04/05/2000: m. gastrocnemius flap, SSG, VAC	29/06/2000
5	75 M	–	27/04/2000: Osteosynthesis after bimalleolar Weber B fracture	12/05/2000: Debridement, VAC, Exposure osteosynthesis 31/05/2000: Debridement (due to partial flap necrosis) 05/06/2000: Debridement, VAC 14/06/2000: Removal osteosynthesis 11/07/2000: SSG, VAC 18/07/2000: Start conservative treatment	18/05/2000: Distally based sural artery flap, SSG	12/03/2001 (11/12/2000 Remaining defect with a diameter of 0.8 cm)
6	53 F	RAUse of prednisone 5 mg/day	27/09/2000: TAP	14/10/2000: Drainage 08/11/2000: Partial debridement flap 21/11/2000: SSG 30/11/2000: Start conservative treatment	27/10/2000: Fasciocutaneous transposition flap a. peronea	21/05/2001

treated jointly by the Departments of Plastic and Orthopaedic Surgery because of complex soft-tissue defects following orthopaedic surgery (Table 1).

All six patients were treated with antibiotics and local wound management without a positive result before they were presented to a plastic surgeon (Fig. 1).

Once consulted, the plastic surgeon started treatment with a radical surgical debridement (Fig. 2). The mean time between the orthopaedic intervention and debridement was 35 days (range 9–70 days). Subsequently, open-cell foam dressings were fitted to the open wound and connected to a controlled subatmospheric pressure (125 mmHg below ambient pressure; vacuum-assisted closure, KCI Medical BV, De Houten, The Netherlands). The VAC system technique reduces chronic oedema and increases blood flow, and the applied underpressure results in the enhanced formation of granulation tissue and, subsequently, coverage of the wound [4]. After an average of 8.2 days (range 6–13 days) of VAC system treatment, definitive coverage of the defect was obtained by transplantation of a vascularised muscle flap and a split skin graft (SSG; n=five cases) or by a fasciocutaneous flap (n=1) (Figs. 3, 4). In the four patients who had had ankle operations, we used a peroneus longus flap, distally based sural artery flap, distally based fasciocutaneous a. peronea transposition flap, and microsurgically revascularised, m. gracilis free flap. In both patients who had had knee operations, m. gastrocnemius flap was used. The VAC system was used for another 7 days to prevent non-adherence due to fluid collection between the SSG and the underlying wound bed [14] (Fig. 5). All patients were confined in their bed for the time of treatment with the VAC system. After this period three patients (patients 2, 3, 5) were kept immobilised for an extra period of 10–21 days.

Results

We had to remove the osteosynthesis material in one case (patient 5) because of a developing osteomyelitis. The

Fig. 1 Soft-tissue defect 4 weeks after osteosynthesis of a crus dexter fracture. The osteosynthetic material is visible

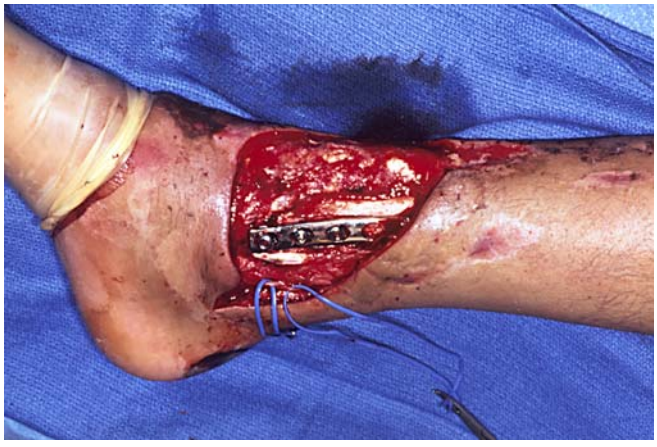

Fig. 2 Status of the same wound after debridement and before transplantation of the flap

Fig. 3 Defect covered by a free m. gracilis flap

wound of this patient consequently took a long time to heal, and this influenced our average time of wound closure. In the other five patients the implant was left in situ (Table 2). Plastic surgery resulted in total wound closure

Fig. 4 Same flap covered by a split skin graft (SSG)

Fig. 5 VAC system placed over the flap and SSG

Table 2 Comparison of outcomes of similar studies

Study	*n*	% intervention success	% implant salvage
Nahebedian 1999 [13]	29	97	83
Adam 1994 [1]	25	–	76
Markovich 1995 [11]	12	100	83
Gerwin 1993 [3]	12	92	82
Current study	6	100	83

after an average of 131.7 days (range 39–294 days) in all six cases. At a mean postoperative follow-up of 514.8 days (range 246–693 days), all wounds had remained closed (Fig. 6).

Discussion

The optimal management of complex soft-tissue defects following orthopaedic implant surgery remains controversial. The management of threatening conditions such as deep infection, osteomyelitis and exposure of implant components continues to be a focus of discussion.

Fig. 6 Result at follow-up consultation, 129 days after plastic surgical intervention

Controversy exists regarding the removal of prosthetic components in these cases. Authors who used a strict two-stage procedure, similar to ours for covering soft-tissue defects, reported total salvage of wounds in 95% of cases [16]. Authors who used different techniques (a single-stage procedure consisting of debridement and soft-tissue coverage) mentioned percentages varying from 92 to 100%, often with additional treatment (re-operation) [1, 3, 11, 13] (Table 2). This means that strictly one-stage procedure outcomes are lower than described: 68–75% [11, 13]. By looking closer at the results in the literature, we discovered also that the outcome is not always clearly described. Therefore, we cannot really compare the percentages of 'salvaged', 'revascularised' or 'successfully covered' wouds with our 'closed wounds' definition [1, 11, 13]. The comparison of implant salvage results is much easier – our outcomes did not really differ from those in the literature. However, everyone agrees with the fact that the earlier definitive coverage is obtained after an adequate debridement has been performed, the lower the incidence of infection is. With the VAC system, however, the risk of infection is minimal [14, 16].

We advise early consultation with the plastic surgeon in treating complex soft-tissue defects following osteosynthesis or arthroplasty. Aggressive debridement, use of a VAC system and early secondary coverage of the defect may salvage the orthopaedic procedure.

By introducing muscular, musculocutaneous or fasciocutaneous flaps, complex wounds can be successfully treated with preservation of the osteosynthesis material. For this, muscular and musculocutaneous flaps are most effective.

However, in case of only a soft-tissue problem with healthy bone, a strictly two-step concept with debridement, VAC system and adequate soft-tissue coverage will solve the problem in a high percentage of cases, but on the other hand the presence of infection of the bone requires additional debridement of the bone or removal of plates.

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