# Negative-pressure wound therapy followed by split-thickness skin grafting for reconstruction of a humeral amputation. A case report

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Case Report

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**Background:** Reconstruction of upper-extremity amputation stumps with wound dehiscence and bone exposure remains a challenging clinical problem, particularly in patients with significant comorbidities who are poor candidates for complex flap reconstruction. Negative-pressure wound therapy (NPWT) has emerged as an effective adjunct for wound-bed preparation before definitive soft-tissue coverage.

**Case Presentation:** A 65-year-old woman with poorly controlled type 2 diabetes mellitus and metastatic right breast cancer underwent right upper-extremity amputation at the humeral level following brachial artery thrombosis. During the postoperative course, she developed wound dehiscence with exposed humeral bone. Management consisted of serial surgical debridement, culture-directed antibiotic therapy, and NPWT. After tree dressing changes, a healthy granulating wound bed was achieved, allowing definitive reconstruction with a meshed split-thickness skin graft harvested from the ipsilateral thigh. The graft was secured with a tie-over dressing for five days. Minor areas of delayed epithelialization were treated conservatively with topical Centella asiatica powder (Madecassol®). At the two-week follow-up, complete graft integration and satisfactory wound healing were observed without evidence of infection, graft loss, or other complications.

**Conclusion:** This case demonstrates that a staged reconstructive approach combining aggressive debridement, infection control, NPWT, and delayed split-thickness skin grafting can provide successful soft-tissue coverage of a complex humeral amputation stump with previous bone exposure. In carefully selected high-risk patients who are unsuitable candidates for flap reconstruction, NPWT may facilitate the formation of an adequate vascularized wound bed, enabling successful skin grafting while minimizing surgical morbidity.

**Keywords:** Negative-Pressure Wound Therapym, Amputation Stumps, Skin Transplantation

Upper-extremity amputations are associated with substantial functional impairment and may be complicated by wound dehiscence, infection, and bone exposure, particularly in patients with significant comorbidities such as diabetes mellitus, peripheral vascular disease, malignancy, or immunosuppression. Achieving durable soft-tissue coverage of an amputation stump is essential to promote wound healing, prevent osteomyelitis, reduce pain, and facilitate rehabilitation and prosthetic fitting (1).

Management of complex amputation stump wounds requires meticulous debridement, adequate infection control, optimization of the wound bed, and selection of an appropriate reconstructive strategy. While local or free flap reconstruction remains the preferred option for coverage of exposed bone, these procedures may not be feasible in medically compromised patients because of prolonged operative time, limited donor sites, poor vascularity, or elevated perioperative risk (2). Consequently, less invasive reconstructive alternatives are often considered in carefully selected cases.

Negative-pressure wound therapy (NPWT) has become an important adjunct in the treatment of complex wounds. Its mechanisms include removal of wound exudate, reduction of bacterial burden, improvement of local perfusion, stimulation of granulation tissue formation, and promotion of wound contraction. Numerous studies have demonstrated that NPWT effectively prepares complex wounds for definitive closure while decreasing the incidence of wound complications (3,4).

Split-thickness skin grafting (STSG) remains a reliable and relatively simple reconstructive option once a healthy, well-vascularized recipient bed has

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Figure 1. Initial presentation of the right humeral amputation stump after wound breakdown. the image demonstrates extensive wound dehiscence with exposed distal humeral bone, partial necrosis of the surrounding soft tissues, fibrinous slough covering the wound bed, and mild erythema of the wound edges.

Figure 2. Dehiscent stump after the first surgical cleaning with soft tissue closure to cover bone exposure, removal of sutures and debridement of necrotic and fibrous tissue-

been established. Although skin grafts generally require a vascularized wound bed for successful integration, the use of NPWT before grafting may stimulate sufficient granulation tissue to cover previously exposed critical structures, thereby expanding the indications for skin graft reconstruction in selected patients who are not ideal candidates for flap surgery (3,5).

This report describes the successful staged reconstruction of a complex humeral amputation stump with wound dehiscence and bone exposure in a patient with poorly controlled diabetes mellitus and metastatic breast cancer. The combination of serial debridement, infection control, NPWT, and subsequent split-thickness skin grafting resulted in complete wound coverage and satisfactory healing, highlighting a practical reconstructive alternative for high-risk patients when more extensive procedures are contraindicated.

## Case report

We present the case of a 65-year-old female with a history of poorly controlled type 2 diabetes and metastatic right breast cancer complicated by brachial artery thrombosis; the latter was treated via amputation of the right upper extremity and creation of a humeral-level stump. She subsequently developed wound dehiscence with exposed bone. (Figure 1) Surgical debridement of non-viable tissue was performed, the exposed bone was covered, and a negative-pressure wound therapy system was applied. (figure 2,3) Cultures tested positive for Gram-positive cocci, and targeted antimicrobial therapy was administered. The patient progressed well, undergoing four negative-pressure system dressing changes; subsequently, a reconstruction method involving skin coverage—specifically a skin graft—was selected. (Figure 4) The recipient bed was prepared, and a meshed split-thickness skin graft (harvested from the right thigh using an electric dermatome) was applied and secured with a tie-over dressing for five days. Upon inspection, the graft showed adequate integration, though some areas remained slightly moist; Madecassol powder was applied, resulting in a favorable outcome. At the two-week follow-up, the wound showed satisfactory healing and complete coverage without complications.

## Discussion

Soft-tissue reconstruction of upper-extremity amputation stumps remains a reconstructive challenge, particularly in patients with multiple risk factors for impaired wound healing, including diabetes mellitus, malignancy, infection, and previous vascular compromise. Successful management depends on the principles of radical debridement, infection control, restoration of a well-vascularized wound bed, and selection of the least morbid reconstructive option capable of achieving durable coverage (6,7).

Bone exposure has traditionally been considered an indication for flap reconstruction because skin grafts require a vascularized recipient bed for successful take (7,8). Local, regional, or free flaps provide robust soft-tissue coverage, improve stump durability, and facilitate future prosthetic use. However, flap reconstruction is not always feasible in patients with severe systemic disease, poor vascular status, or limited reconstructive options, in whom prolonged operative procedures may carry unacceptable perioperative risks (7,9).

Negative-pressure wound therapy (NPWT) has substantially changed the management of complex wounds by promoting angiogenesis, stimulating granulation tissue formation, reducing tissue edema, improving local perfusion, and removing wound


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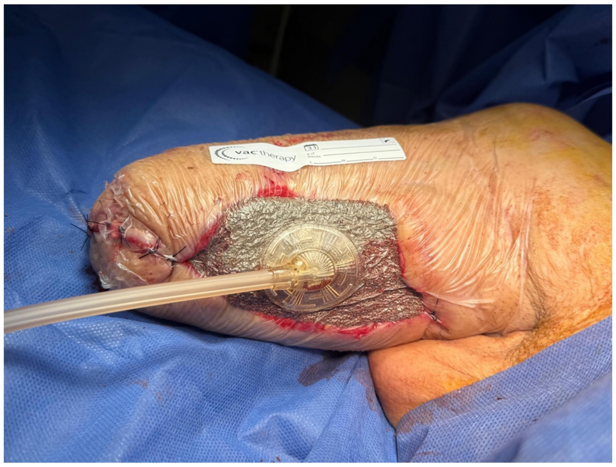

**Figure 3.** Placement of a negative pressure system in a previously cleaned wound area.

exudate (10). Experimental studies by Argenta and Morykwas demonstrated that controlled subatmospheric pressure enhances granulation tissue formation and accelerates wound healing (10). Subsequent clinical studies and international consensus recommendations have confirmed the role of NPWT as an effective bridge to delayed reconstruction, particularly in contaminated or infected wounds (11).

In the present case, serial surgical debridement combined with targeted antimicrobial therapy eliminated non-viable tissue and controlled the local infection before definitive reconstruction. This staged approach follows current reconstructive principles emphasizing wound-bed optimization before attempting closure (5,6). Four sequential NPWT dressing changes resulted in the development of a healthy granulating wound bed that adequately covered the previously exposed humeral bone, thereby creating favorable conditions for split-thickness skin grafting.

Although NPWT has been associated with reductions in bacterial burden, current evidence suggests that its principal benefit lies in improving wound physiology rather than serving as a substitute for adequate surgical debridement or antimicrobial treatment (11,12). Therefore, meticulous debridement and culture-directed antibiotic therapy remain fundamental components of treatment, particularly in infected amputation stumps.

Once sufficient granulation tissue was established, split-thickness skin grafting represented a reasonable reconstructive option. Compared with flap surgery, split-thickness skin grafts require shorter operative times, lower physiological stress, reduced donor-site morbidity, and simplified postoperative management (7). In medically fragile patients, these advantages may outweigh the theoretical benefits of more complex reconstructions when adequate

**Figure 4.** Granulation tissue after the third change of the negative pressure wound therapy system. adequate granulation, a reduction in the open wound area, and a recipient bed ready to receive a skin graft can be observed.

vascularized tissue has already developed over previously exposed structures.

The favorable graft integration observed in this patient was likely attributable to several complementary factors, including repeated debridement, infection control, optimization of the wound bed with NPWT, stable graft fixation using a tie-over dressing, and careful postoperative wound care. Although topical agents such as Centella asiatica (Madecassol®) have been proposed to enhance epithelialization, robust clinical evidence supporting their routine use remains limited, and their contribution to the successful outcome in this case cannot be established independently (13).

The principal limitation of this report is its inherent nature as a single-case experience, which precludes generalization of the findings. Furthermore, long-term outcomes regarding stump durability, prosthetic tolerance, and recurrence of wound complications were not evaluated. Nevertheless, this case illustrates that, in carefully selected high-risk patients, NPWT may generate sufficient granulation tissue to permit successful split-thickness skin grafting, thereby avoiding more extensive reconstructive procedures when these are contraindicated or carry excessive risk.

## Conclusion

Complex humeral amputation stump wounds with bone exposure can be successfully managed using a staged reconstructive approach consisting of

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**Figure 5**. skin graft 2 weeks after placement with adequate integration, suture and staple material removed

aggressive surgical debridement, culture-directed antimicrobial therapy, negative-pressure wound therapy, and delayed split-thickness skin grafting. In patients with significant comorbidities who are poor candidates for flap reconstruction, NPWT may facilitate the formation of a vascularized wound bed suitable for definitive skin graft coverage. This case supports the role of NPWT as an effective bridge to reconstruction and highlights that individualized treatment based on wound characteristics and patient condition can achieve satisfactory healing while minimizing surgical morbidity. Further prospective studies are required to better define the indications and long-term outcomes of this strategy in complex amputation stump reconstruction.

## Conflicts of interests

The authors declare no conflicts of interests.

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