REVIEW ARTICLE

Use of Alternatives to Air-Fluidized Support Surfaces in the Care of Complex Wounds in Postflap and Postgraft Patients

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KEYWORDS:

Myocutaneous flap;
Fasciocutaneous flap;
Split-thickness skin graft;
Postsurgical care;
Support surface;
Air-fluidized therapy;
High air loss;
Alternative support
surfaces;
Alternating pressure;
Low air loss;

Abstract Air-fluidized support surface therapy has many drawbacks, such as dehydration, in an already difficult recovery for those wound patients who have undergone flap and graft surgery. In addition, patient care and handling are also problematic. Patients complain of discomfort, and the instability of the surface interferes with patient stability in side lying and semi-Fowler's positions. Alternative support surfaces can be considered for postflap or postgraft patients. Such technologies as alternating pressure, low-air-loss, and therapeutic nonpowered, advanced, and lateral rotation surfaces are widely used for pressure management in high-risk patients and those with existing pressure ulcers. These surfaces must be used within a total pressure ulcer management program that includes frequent turning and repositioning, skin and ulcer care according to evidence-based protocols, patient and caregiver instruction, nutrition, and offloading and positioning. The proposed recommendations require more research on the relative effectiveness of less expensive and more user-friendly support surfaces such as low-air-loss and nonpowered advanced support surfaces and is necessary in order to conclusively

Conflict of interest: The authors report no conflicts of interest.

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Therapeutic nonpowered
advanced and lateral
rotation;
Pressure ulcer
management

recommend one type of surface over another. However, at this time the available clinical studies and opinions remain positive.

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Introduction

Myocutaneous and fasciocutaneous flaps, along with split-thickness skin grafts, are surgical treatments of last resort that could be used in selected patient for nonhealing chronic wounds and other conditions. They are major, costly procedures that have high rates of failure if the patient's health is not optimized, both before and after the surgery, and if the patient is not prepared for both short-term and long-term follow-up care and potential lifestyle changes. Flaps are applied over full-thickness defects. Flaps are very fragile immediately postsurgery, with drains usually placed under the flap which is covering the defect. Flaps are only secured in place over the defect by only sutures placed at the edges. No pressure is allowed on the surgical site for several weeks postsurgery in order to avoid necrosis and allow the flap to heal by attaching to the underlying tissues. Skin grafts are applied on a prepared wound bed with healthy granulation tissue to maximize graft take. Occlusive dressings, bolster dressings, and negative pressure wound therapy dressing are being used to secure the grafts, apply vertical pressure, and avoid sheer forces from peeling the graft off the wound bed and maximize take.

Two important components of the postsurgical care of these patients are frequent repositioning and careful handling. Repositioning is required to minimize the risk of skin breakdown on the remaining surfaces of the body.^{1,2} Most individuals prefer recumbent positions such as lateral decubitus or supine and, less frequently, prone. With the body surface of the surgical site being eliminated as a weight-bearing surface, the number of lying surfaces is limited, which puts extra stress on the skin and soft tissues over bony prominences on the remaining surfaces and puts them at higher risk for future pressure ulcers. It is essential to reposition these patients often and to teach self-repositioning and proper weight shifting to reduce prolonged pressure on these bony prominences.

Along with frequently repositioning these patients, staff is required to handle them very carefully in order to avoid any pull or strain on the surgical site. Dehiscence of the flap can occur easily, and loosening the protective dressing and sheet forces may lead to graft failure. In both situations, the patients are left with open wounds that may require further surgery and a prolonged healing time. Unstable support surfaces complicate this delicate but necessary job of the nursing staff. In addition, it is difficult to guarantee that the surgical site will never have pressure during the entire time

that the postsurgical protocol demands. Recurrence of pressure ulcers is a common, serious problem after flap closure surgery, and flap choice becomes limited, which may lead to prolonged and expensive hospitalization. Recurrent breakdown may result from inadequate debridement of devitalized tissue or infected bone under the flap; failure to eliminate wound dead space and achieve a tension-free closure; poor hygiene and nutrition. Failure to eliminate the causative condition, such as the presence of spasm and contracture, pressure, shear force due to poor care or altered mentation and dementia may also lead to recurrence. The labor-intensive nursing care issues such as turning, local wound care, and avoidance of urine and fecal contamination of the wound may have not changed from the preoperative setting. In short, unless the predisposing factors have been modified, the recurrence rate is very high.³

The support surface becomes an integral part of patient care for these patients and their fragile tissues. Maximizing pressure redistribution away from the high-risk bony prominences, and away from the surgical sites when they inadvertently take pressure, is a major requirement. Less often discussed but nevertheless important goals to consider in tandem with pressure redistribution include the following⁴:

- ease of patient care for staff.
- ease of maintaining patient position on the surface.
- patient comfort while on the surface.
- cost.

A support surface widely used for these fragile patients is a technology called *air-fluidized therapy* (AFT), also known as *high air loss*. In 2007, the National Pressure Ulcer Advisory Panel defined "air-fluidized" as "a feature of a support surface that provides pressure redistribution via a fluid-like medium created by forcing air through beads as characterized by immersion and envelopment."⁵ See Figure.

The fluid-like nature of the air being forced through millions of sand-like silicone beads provides a unique medium that allows immersion of the patient into the surface, envelopment of the surface around the patient, equalization of pressure across the weight-bearing surfaces of the body, and a claim of reduced shearing. Extensive use of this technology over the years has led to its wide acceptance as a top-of-the-line support surface.

Drawbacks of AFT commonly referred to include difficulty with patient care because the envelopment of the

Figure Two Examples of Air-Fluidized Therapy.

surface interferes with patient handling. Patients complain of discomfort because the surface is made to envelop rather than support; back and shoulder pain are often cited anecdotally. The instability of the surface interferes with patient stability in side lying positions because wedges and other devices sink into the surface or move out from under the patient as the beads shift in the airstream. Other negative issues regarding the use of AFT include the following⁴:

- It can cause dehydration.
- The small beads may become airborne and cause accidents by making floor slippery.
- It increases heat in room and on patient.
- It requires use of occlusive dressing on wounds in order to avoid dryness.
- It is costly, and because AFT surfaces are usually rented, the cost of rental can become prohibitive to an overburdened health care system.

Proposal

Alternative support surfaces can be considered for postflap and postgraft patients. Such technologies as alternating pressure (AP), low air loss (LAL), therapeutic nonpowered advanced, and lateral rotation surfaces are widely used for pressure management in high-risk patients and those with existing pressure ulcers. These surfaces must be used within a total pressure ulcer management program that includes frequent turning and repositioning, skin and ulcer care according to evidence-based protocols, patient and caregiver instruction, nutrition, and offloading and positioning. If the flap or graft site is treated as an open wound would be treated, with offloading through patient

positioning, it would be expected that postflap and postgraft outcomes would be similar to wound outcomes.

One study whose purpose was to evaluate the effectiveness of a less expensive support surface used 12 patients involved in a clinical trial that lasted 14 days and compared the effectiveness of a nonpowered, air-filled surface to an AFT support surface. Findings indicated that postoperative patients were effectively treated on either support surface.⁶

These technologies often come without many of the disadvantages cited above. Patient care is often easier because these surfaces are more stable than air-fluidized surfaces. Patient positioning is more stable, and patients anecdotally report less back and shoulder pain, possibly because of the increased skeletal support that is afforded. Last but not least, these surfaces are less costly to rent and are often owned by a facility, reducing the financial burden of care.

Many U.S. medical care facilities where flaps and grafts are routinely performed are decreasing their use of AFT and increasing their use of other technologies (Table 1). This change has been observed slowly over the past decade. No comprehensive set of clinical trials has evaluated the relative effectiveness of specialty surfaces such as air-fluidized beds and low-air-loss beds in improving healing rates.⁷ Although an extensive literature search in the Medline database revealed only 1 article on this topic,⁸ such sites as the Shepherd Spinal Center (Atlanta, Georgia), the Swedish Medical Center (Englewood, Colorado), Christus Schumpert (Shreveport, Louisiana), and Corpus Christi Medical Center (Corpus Christi, Texas) have been using postflap and postgraft protocols that include AP, low air loss, or lateral rotation rather than AFT (Table 1).

A scientific poster presented at the 40th annual conference of the Wound, Ostomy, and Continence Nurses

Table 1 Medical Care Facilities and Their Use of Support Surfaces for Myocutaneous Flaps, Grafts, and Complex Wounds

Hospital	Surface Used for Flaps or Grafts	Comments
CHRISTUS Schumpert, Shreveport, LA	Low air loss	1. So many of our patients also have pulmonary problems that the air flotation bed is simply not feasible (the small particles of silicone can become airborne and create breathing difficulties for those with pulmonary problems). 2. The air-fluidized beds are difficult for staff to manage and turn patients on, and there is a risk of patients' ending up lying on a very hard, deflated surface for several hours when the staff does not know how to deal with an infrequently used bed.
Avera McKennan Hospital, Sioux Falls, SD	Low air loss	We use very few air-fluidized beds (475-bed hospital). We use low air loss for the first 3 weeks postflap, less (if at all) for grafts, and haven't seen a big difference in the "take."
Levindale Hebrew Geriatric Center and Hospital, Baltimore, MD	Continuous lateral rotation with low air loss	We found that many patients with stage IV on the buttocks healed better on low-air-loss rotation beds.
Skyline Medical Center, Nashville, TN	Low air loss	Colleagues in plastic surgery feel that this surface provides adequate pressure redistribution during the bedrest phase of healing as they believe the primary reason for flap failure is allowing the patient to sit too soon. We have not seen any decrease in flap take with use of the low-air-loss support surface.
CHRISTUS Spohn Hospital, Corpus Christi, TX	Alternating pressure	Therapeutic advanced nonpowered for prevention in high-risk, alternating pressure for flap or graft.
Rutland Regional Medical Center, and Rutland Area Visiting Nurses and Hospice, Rutland, VT	Low air loss	Rental of air-fluidized therapy equipment is very rare, but it does happen, for example a very compromised patient in a very compromised environment. It is apparent that the surface should be matched not only with the criteria of provision but also with the person's personality, medical history, and medication regime.
Shepherd Center, Atlanta, GA	Low air loss	We use air fluidized when there are other ulcers, reducing our turning surfaces, and to reduce moisture around the flap. We use alternating pressure mattress when there are 1 or 2 turning surfaces available.
Swedish Hospital, Craig Hospital, Denver, CO	Low air loss or combination of low air loss and alternating pressure	We found that the air-fluidized beds are so debilitating, they do not serve as good pulmonary beds, and most of our quads and paras ended up with hospital-acquired pneumonias or having to be vented. The flap does great on the fluidized bed, but the side effects for the patient, including depression, new breakdown on upper back from transition, and pneumonias, outweighed the bed. We switched to a low-air-loss mattress or a combination of a low-air-loss and an alternating-pressure mattress and have done very well.

Society⁸ compared clinical outcomes and patient and nursing satisfaction of 10 patients who were randomized to either AFT or AP for postreconstructive surgery care. The results found no differences between the two surfaces in terms of maintenance of intact surgical sites and incidence of facility-acquired pressure ulcers. However, patient and nursing satisfaction with the AP mattress were greater than with AFT.

The proposed recommendations require more research on the relative effectiveness of less expensive and more user-friendly support surfaces, such as low-air-loss and nonpowered advanced support surfaces. This research is necessary in order to conclusively recommend one type of surface over

another. However, the available studies, as well as clinical opinion and experience, suggest that further research is justified to help clinicians make their choice.

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