Post-operative Dressing to Minimize Complications after Skin-Grafting Procedures in Reconstructive Surgery

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**Background**
Every year, millions of victims suffer physically and emotionally as a consequence of trauma, burns, or cancer. Skin-grafting is the most commonly performed procedure in plastic surgeons’ armamentarium in order to reconstruct body parts and restore functionality after these disfiguring events. This technique plays an important role by providing coverage with healthy skin to the affected area after an accident, or after a large cancer resection. Moreover, skin-grafting has associated complications such as post-operative pain, risk of infection, and requirement of additional grafting sessions. These complications involve not only the graft, but also the donor site where the skin is taken from.

Most of the research on improvement of skin grafting techniques has been aimed towards the graft itself, and not towards the donor site. Healthy skin is harvested from the “donor site” by using a fine blade that transects the skin with precision to a specified depth, including parts of the two outermost layers of skin—the epidermis and dermis-. Then the donor site is left to heal by itself by means of re-epithelialization. Clinical evidence has shown that the donor site constitutes the main source of discomfort after the procedure for several reasons: it is very sensitive and can be irritated easily with dressings; it is highly exudative, requiring multiple dressing changes to keep the minimal necessary moisture; it is prone to dangerous pathogen infections such as pseudomonas, staphylococcus aureus, and fungi if moisture accumulates excessively.

The associated complications result in higher narcotic requirement, lower mobility, prolonged rehabilitation process, uncomfortable dressing changes which must be done in sterile conditions, and even antibiotics and re-hospitalizations if the donor site becomes infected. Although skin grafts were first described in the 1800’s, the strategies used in modern medicine for the management of donor sites have remained unchanged for decades. Yet, the multiple inconveniences occasioned by skin graft donor sites continue to persist.

**Purpose and Preliminary Information:**
The purpose of this project is to develop an enhanced dressing design for skin graft donor sites. We will develop a technique based upon plastic surgery and wound healing principles, and upon our cumulative clinical experience after many years of patient care.

**Principle 1:** Wounds heal faster in a moist environment through promoting cell migration and re-epithelialization.
**Principle 2:** Wounds produce exudate fluid through the entire process of healing. This exudate contains growth factors known to stimulate wound healing. Keeping them in contact with the wound in a sterile environment induces faster wound healing.
**Principle 3:** Excessive moisture in a wound creates an infection-prone environment.
**Principle 4:** Non-absorbent dressings accumulate a high amount of exudate. This exudate will continuously leak through the dressing site, causing high levels of patient discomfort and requiring constant nursing interventions.
**Principle 5:** Highly absorbent dressings become saturated quickly and require multiple changes. The dressing changes are very painful and require sterile technique.
**Principle 6:** Leaving the wound open to air dries out the wound, hampering re-epithelialization. It also lacks protection against infection and shearing.
Hypothesis:
The ideal dressing can reduce pain, frequency of dressing changes and eliminate leakage of excess fluid though the following features:
- Preservation of a moist environment that promotes wound healing.
- Elimination of excess exudate to avoid leakage, discomfort and the risk of infection.
- Minimal dressing changes in order to avoid pain and unnecessary clinic visits.

Design:
Our experimental dressing consists of a semipermeable plastic film with adhesive surrounded edges. This material allows gas and oxygen exchange, but impedes flow of liquids, concentrating the wound exudate under the dressing.
The dressing contains a fenestrated tubing system in the film. The tubing system runs longitudinally along one side, and serves as a drainage system. This system emerges from the dressing at one end, and is linked to a Luer-lock connection. This can be connected to an automated drainage mechanism or manual mechanism using regular syringes (as illustrated). With this feature, accumulating excess exudate can be aspirated as needed to prevent leakage; however, moisture and the growth factor benefit will not be eliminated.
This dressing requires minimal to no changes until the donor site has completely healed, as it preserves the interior environment sterile and moist. This dressing will be low maintenance, highly durable, and meets all the principles enlisted above. This tubing system could also be adapted for instillation of local anesthetic (lidocaine or marcaine), and “bathe” the wound in order to reduce pain, especially within the first 2-3 days post graft procedure.

Additional expertise required: Pilot studies with improvised material have proven the concept to be successful. Partnership with an engineering group from UMass Lowell will be critical in order to develop the proposed dressing and the drainage mechanism. Testing of the device will be carried over by both co-investigators. Pre-clinical testing of the dressing will take part in our Plastic Surgery Research Lab. Clinical testing will be performed both in our Plastic Surgery Wound Clinic and in the hospital wards under appropriate regulatory approval.