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ABSTRACT: Case studies are presented of donor and autograft sites covered with a recently developed non-adherent dressing. The product is made of a polymer blend which provides a semi-occlusive transparent membrane. The membrane conforms and clings to the wound site, yet does not aggressively attach to the wound bed. Staples or an appropriate secondary dressing are required to secure the dressing in place. The non-adherent film was compared to impregnated gauze and non-adherent fabric. Adjacent to impregnated gauze on a donor site, the new dressing was shown to reduce pain and promote moist wound healing. Sheet autografts on a recipient's right hand were covered with the non-adherent film, producing qualitatively better healing than the left hand covered with non-adherent fabric. On a meshed autograft site the non-adherent film was placed adjacent to non-adherent fabric. Epithelialization of the interstices occurred more rapidly under the film dressing.

The material remained transparent and non-adherent when left on the wounds for up to 9 days. The healing process was visually monitored through the film, and the dressing did not disrupt the fresh epithelium when removed from the wounds. Using non-adherent film dressings holds significant potential for improving wound management techniques in the field.

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Historically, wound care products were based on readily available materials such as cloths and rags. Little or no regard was paid to aseptic technique, and the materials were often merely tied in place. These methods were primarily used to control wound bleeding. Once clinicians began to realize the need to keep wounds clean, more sophisticated methods of wound care were developed. Cotton gauze was refined and used to meet the bulk of wound care needs for many years.

Someone eventually placed gauze pads on adhesive strips, and the wound care market was launched. Slowly the focus turned from wound control to wound repair, and eventually modern semi-occlusive materials were developed to promote moist, high quality healing.

Today, cotton gauze and gauze impregnated with petrolatum jelly are still widely used for wound care. The impregnated gauze products are inexpensive and initially provide a moist, non-adherent environment. Eventually, however, these products integrate into the wound surface as exudate wicks through the dressing and dries. This results in a ridged and desiccated wound surface that can restrict patient mobility, slow healing and increase pain.^{1,2} Gauze products are opaque and therefore do not allow visual monitoring of the wound without removal.

Semi-occlusive film dressings offer advantages of transparency, moist healing, breathability and impermeability to bacteria. Conventional films are made of polyurethane, and use acrylic based pressure sensitive adhesives to aggressively adhere to the wound area. This tends to be painful and disruptive, particularly when the dressing is removed or changed.

Furthermore, due to their limited moisture vapor permeability, polyurethane films manage excessive amounts of exudate poorly. Malodorous fluid can accumulate under the dressing and promote the growth of bacteria, thereby leading to infection.³

Interfacial fabrics made from synthetic textiles provide a non-adherent wound contacting surface and are relatively translucent. These fabrics allow some visual monitoring of the wound, as well as minimal wound disruption upon removal.⁴ Unfortunately, however, non-adherent fabrics are not conducive to moist healing because they are highly permeable to wound fluid. As a result, non-adherent fabrics are usually covered with gauze secondary dressings to absorb wound exudate.

Silon® (Bio Med Sciences, Inc.) transparent film dressings were developed to provide both a non-adherent wound contacting surface and a moist, semi-occlusive environment. The material was also designed to reduce pain and allow visual inspection of the wound as it heals. Silon is a semi-occlusive film dressing made from a blend of polytetrafluoroethylene (PTFE Teflon®, E.I. DuPont) and polydimethylsiloxane (PDMS - Silastic®, Dow Corning). The blend is formed into a

system of interwoven matrices known as an interpenetrating polymer network (IPN).^{5,6} The material has several characteristics which differentiate it from conventional semi-occlusive dressings. Most importantly, the Teflon/silicone blend possesses a self-cling ability which eliminates the need for pressure sensitive adhesives. This characteristic provides close contact to the wound surface, but avoids aggressive attachment to the wound bed. The nature of the IPN structure provides moisture vapor permeability of about 900 g/m²/day, which is approximately twice the permeability of polyurethane films.⁷ The membrane also maintains a barrier to fluid and bacteria, thereby reducing the risk of infection.

Silon non-adherent film dressings were applied to three types of wounds (donor site, sheet autograft, and meshed autograft), and compared to impregnated gauze (Xeroform® Sherwood Medical) and non-adherent fabric (N-Terface®, Winthrop Laboratories). The sheet autografts were mirror image studies (same patient, separate identical wounds), and the meshed autograft and donor sites were self-controlled studies (side-by-side on the same wound).

Materials

The Silon non-adherent dressings were supplied by Bio Med Sciences, Inc. of Bethlehem, PA. Xeroform impregnated gauze and N-Terface non-adherent fabric were obtained from commercial sources.

Case 1: Donor Site.

Methods. A split-thickness autograft of 0.01 inches (250 microns) was harvested from a healthy male patient's quadracep region. The wound measured approximately 9 x 6 inches (23 x 15 cm) as shown in Figure 1. The lower region was covered with impregnated gauze, and the upper portion was covered with a 5 x 10 inch (13 x 26 cm) non-adherent film dressing. The entire wound site was wrapped in compression with a gauze secondary dressing for 24 hours. The gauze secondary dressing was removed and the primary dressings remained uncovered for the duration of the study. Eight surgical staples were used to secure the film dressing to the wound site. Daily observations of drainage, fluid collection, pain and adherence were made until the primary dressings were removed on post-op day 9.

Observations: Impregnated gauze. Strike-through of blood from the wound resulted in significant pain when the secondary dressing was removed from the impregnated gauze area. On a scale from 0 to 4, with 4 indicating the most pain experienced, the patient gave the impregnated gauze a score of 4. The area was initially moist (see Figure 1a) until it dried over a period of several days (see Figure 2a). Irritation is evident at the wound perimeter on post-op day 3. By post-op day 6, the impregnated gauze area hardened (see Figure 3a), and the patient was still scoring wound pain as a 4 on the pain scale. On post-op day 9 the impregnated gauze was removed and the underlying wound surface was covered by thick scabs. (See Figure 4a.) Even with the aid of hydrotherapy, the removal process was considerably painful and time consuming.

Non-adherent Film. Removal of the secondary dressing on post-op day 1 was painless (score of 0), because there was no strike-through of blood. (See Figure 1b.) The wound remained moist and the patient continued to score the area a 0 on the pain scale. A slight amount of wound fluid pooled under the non-adherent film area, and no signs of irritation were present at the perimeter of the site. (See Figure 2b.) Re-epithelization was visually evident by post-op day 6. (See Figure 3b.) On post-op day 9 the staples were extracted (causing momentary discomfort), and the non-adherent film dressing was removed from the site without disruption of the wound surface. (See Figure 4b.) The wound was slightly crusty and less irritated in comparison to the impregnated gauze area.

Case 2: Sheet Autograft Sites

Methods. The patient suffered full-thickness thermal injury to both hands. After matching excision on each site, sheet autografts of 0.01 inches (250 microns) were stapled on the wounds. The left hand was covered with non-adherent fabric, (see Figure 5a) and the right with non-adherent film. (See Figure 5b.) Both sites were covered with gauze and immobilized with molded splints. The dressings remained on the wounds until post-op day 9.

Observations. Vascularization occurred on both autograft sites. The seams of the grafts are clearly visible and hematomas are present on the left hand, which was covered with non-adherent fab-

ric. (See Figure 6a.) The seams of the grafts on the right hand are less conspicuous and hematomas are not present. (See Figure 6b.) The patient had a greater range of motion and experienced less pain with the hand covered with the non-adherent film. On post-op day 13, the graft seams are still noticeable on the left hand and hematomas are slightly present. (See Figure 7a.)

The hand covered with non-adherent film is relatively well healed. (See Figure 7b.)

Case 3: Meshed Autograft Site

Methods. The patient received a full-thickness scald injury to her left quadracep region. A split thickness autograft was harvested from her right leg and meshed 1.5:1. The wound site was excised and the meshed autograft stapled in place. The lower region was dressed with non-adherent fabric (see Figure 8a), and the upper region with non-adherent film. (See Figure 8b.) The entire site was covered with gauze for 2 days.

Observations. On post-op day 2 the non-adherent fabric is somewhat opaque and the area is relatively dry (see Figure 9a). The non-adherent film dressing is transparent and is moist. (See Figure 9b.) On post-op day 7 both dressings were removed. The interstices of the graft are larger and more distinctive on the area covered by the non-adherent fabric (see Figure 10a) in comparison to the area covered by the non-adherent film. (See Figure 10b.)

Discussion

In each of the three cases, the non-adherent film dressing provided a moist healing environment and did not aggressively attach to the wound. It was determined that the film's non-adherent nature requires the use of surgical staples or a snug fitting secondary dressing to prevent inadvertent removal or roll-up from the edges. It is believed that a self-adherent elastic wrap would provide adequate stabilization for sites where staples are not already indicated. Where staples are typically used, such as graft sites, the non-adherent film can be secured with the use of several additional staples. Alternatively, the grafts may be placed on the wounds and stapled through the film dressing to provide the same effect without excess staples.

The non-adherent film was shown to significantly reduce pain compared to impregnated

gauze, and seems to have increased the rate of re-epithelialization on the donor site. Wound exudate flowed under the non-adherent film to the edges of the dressing where it was released in manageable amounts. The non-adherent film did not irritate the wound, and the patient stated that he preferred the product over impregnated gauze. The reduction in pain is believed to be due to several factors. As with any semi-occlusive dressing, the new film reduced pain by preventing exposure of the wound bed to air.⁸ In addition, the non-adherent film is very soft (Young's modulus <1,000 psi)⁹ in comparison to impregnated gauze, particularly once the gauze begins to dry. The non-adherent film also possesses a smooth surface morphology. It is believed that these attributes reduce agitation of open nerve endings at the wound surface. Furthermore, it is likely that the thermal properties of the film are closer to those of natural skin when compared to gauze, thereby reducing any temperature gradient across the wound surface.

Donor sites are typically more painful than graft sites because the nerves are severed at a uniform depth and the surrounding tissue has not suffered thermal injury. As a result, the need for pain relief in donor site dressings is more acute than it is for other types of wound sites and dressings.

The healing of the sheet autograft covered with the non-adherent film dressing was qualitatively better than that of the fabric dressing. This may be due to the presence of exudate on the wound surface under the film, which is known to contain numerous growth factors.¹⁰ Whereas the fabric dressing tended to wick fluid to the secondary dressing and therefore kept the area drier. As with the donor site, the patient preferred the non-adherent film to the non-adherent fabric.

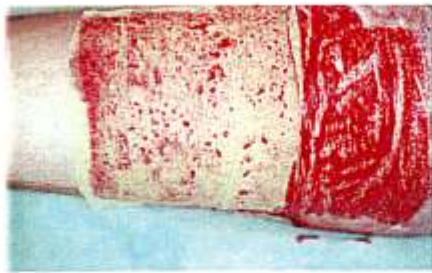
The meshed autograft site provided an excellent basis for analytical comparison. As indicated in the photographs, the interstices of the graft closed more rapidly under the film dressing than under the fabric. It is believed that the non-adherent film allowed increased moisture vapor transmission, but also retained a layer of proteinaceous fluid on the wound surface. Additionally, the fresh epithelium was not disrupted when the dressing was removed. As in the other cases, the patient preferred the non-adherent film to the non-adherent fabric.

Conclusion

Silon non-adherent film dressings hold significant potential for improving wound management techniques in the field. Detailed studies of donor and autograft sites should be conducted to scientifically validate the performance of the dressing. Precise quantification using image analysis techniques should be performed on additional meshed autograft cases, since the geometric nature of the healing pattern readily lends itself to numerical analysis. Finally, it is anticipated that other types of wounds will be candidates for treatment with the non-adherent film dressing. Venous stasis and decubitus ulcers could be dressed with non-adherent film using elastic wrap as a fixation mechanism.

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a. Figure 1. b.



a. Figure 2. b.



a. Figure 3. b.



a. Figure 4. b.



Figure 5a.



Figure 5b.



Figure 6a.



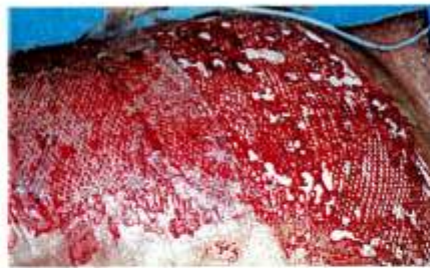
Figure 6b.



Figure 7a.



Figure 7b.



a. Figure 8. b.



a. Figure 9. b.



a. Figure 10. b.