

Case report

# A collagen based dermal substitute and the modified Meek technique in extensive burns

## Report of three cases

Anthony Papp\*, Markku Härmä

*Burn Unit, Kuopio University Hospital, PL 1777, 70211 Kuopio, Finland*

Accepted 5 September 2002

### 1. Introduction

Treating extensive burns is challenging. The lack of unburned skin is a limiting factor to achieve early total wound closure. Artificial skin helps this problem. With Integra® artificial skin one can excise and close even very big burns rapidly. This is essential to lower the inflammatory response, minimise fluid losses and reduce the undesirable effects of toxins. In our unit, Integra® is used on extensive burn patients, where donor sites are limited. Using Integra®, however, always requires a second stage operation, where the silicone layer is removed and the newly formed neodermis is covered with autografts. Normally a widely meshed thin skin graft is used [1].

### 2. Micrograft (modified Meek) technique

Meek described a new technique in 1963 to expand skin grafts [2]. Later the technique was modernised using a dermatome running on compressed air [3]. Harvested thin skin grafts (6/1000 in.) are cut to fit a piece of cork which is put on a carrier with the skin graft and then run through a Meek-Wall dermatome, which cuts the skin graft horizontally in narrow slices. The cork is then turned 90° and run through the dermatome again to achieve small square shaped pieces of skin (postage stamp autografts). After this glue is sprayed over the autograft and a double-folded silk paper-folio gauze is glued on the autograft. After the glue has dried, the foldings are pulled open both ways to achieve expansion of the skin graft. Expansion rates vary from 1:2 up to 1:9. The advantage of this technique is that even the smallest pieces of skin can be effectively used, even the most

widely spread autografts can be easily handled and the expansion rate is true [4]. The thickness of the autograft in this technique is usually 4/1000 to 6/1000 in., which is good also considering Integra® [1]. No Vaseline nor paraffin is used in harvesting the graft for it prohibits the glue to stick on the graft.

### 3. Purpose of study

The purpose of this study was (1) to describe a method for covering the neodermis formed by Integra® artificial skin in the second stage operation in extensive burns and (2) to review our results using this technique.

### 4. Operating technique

In this material all burned tissue was removed in multiple operations within 7 days postinjury and wounds were primarily partly covered with Integra® artificial skin and partly with autografts. Integra® was applied to fascially excised wounds and fixed with staples. A tubular net dressing (Surgifix®) was cut open, expanded and wrapped around the Integra® and fixed with staples. Dry dressings and cotton were applied over the net and fixed with a circular compressive dressing. At the second stage operation, as much of the silicone layer was removed as could be covered with unburned skin. The formed neodermis was brushed, seams cleaned with a curette and a tissue sample taken for microbiological analysis. Thin (4/1000 to 6/1000 in.) autografts were harvested from unburned areas with a dermatome and expanded using the Meek-Wall machine using ratios from 1:3 to 1:6. Skin grafts together with the silk paper were stapled on the wound bed and covered with saline dressings, which were changed two–three times daily to keep the tiny

\* Corresponding author. Tel.: +358-44-3455000(R); fax: +358-17-173846.

E-mail address: anthony.papp@kuh.fi (A. Papp).

pieces of skin moist. Staples and silk paper were removed on postoperative days 4–7. Prior to this, silversulfadiazine cream was used for 24 h on the silk paper to make it softer and easier to remove. Largely expanded (1:6) skin grafts were covered with meshed allografts after removing the silk paper.

## 5. Cases

*Patient 1:* A 13-year-old boy with a 77% flame burn, all full thickness, after an explosion. During the first hours of postburn inotropic medication was needed for low cardiac output. On postburn day 2 (PBD 2) Integra® was used to cover his chest and abdomen in the first operation after a fascial excision. At 3-week postburn the silicone layer was peeled off the Integra® and neodermis covered with 1:4

Micrograft-sheets. The second stage operation was complicated by a *Pseudomonas aeruginosa* infection and hence required a re-operation, where the Micrograft technique was used again. Seven days after the re-operation, silk paper was removed and the skin islands were covered with 1:1.5 meshed allografts. With this a 75% epitheliasation was obtained in 4 weeks and the residual open areas healed conservatively. Other burned areas were treated with regular meshgrafts. At PBD 55 the patient was discharged from our unit for rehabilitation.

*Patient 2:* A 19-year-old boy with a 76% full thickness burn and inhalation injury after a suicide attempt by setting himself on fire. Right antebrachial amputation was performed due to burn injury down to nerves, tendons and bone on PBD 4. Septic episodes requiring inotropic medication occurred. Continuous venovenous hemodiafiltration was temporarily needed for acute renal failure between



Fig. 1. Application of Integra® artificial skin at postburn day 2.



Fig. 2. Three weeks after applying Integra®.

PBD 14–33. Both lower extremities, chest and abdominal areas were covered with Integra® on PBD 2 and 3 and a total of three second stage operations using 1:3 and 1:4 expansion ratios were performed on PBD 28, 43 and 60, respectively. The first second stage operation was complicated by a wound colonisation of *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Acinetobacter* and *Enterococcus faecium*. No allograft was used after removing the silk paper. All three areas needed another re-operation due to graft loss caused by infection, where open areas were covered with meshed autografts. A microvascular latissimus dorsi muscle flap was needed to cover his open mandible on PBD 108. Patient was transferred to local central hospital at PBD 129 with no open wounds.

*Patient 3:* A 17-year-old boy with a 92% full thickness burn after setting himself on fire. Fascial excision was per-

formed to his anterior trunk and anterior thighs and shins (PBD 2), back and posterior thighs and shins (PBD 3), both upper extremities (PBD 4) and hands and neck (PBD 5). Integra® was applied to his both upper extremities, shoulders, chest, abdomen and the other thigh and shin. At 5 weeks postinjury he was already transferred from the ICU to the traumatology ward. A total of seven second stage operations were performed using the modified Meek technique to cover the neodermis of Integra® on PBD 28, 38, 45, 54, 65, 79 and 92. Both arms and the thigh were covered with allografts 4–7 days after applying the autografts. No major surgical complications occurred in the early stage. Several months later some already healed skin grafts were lost due to a multiresistant *P. aeruginosa* infection and this also complicated later operations. Also several sheets of already completely healed Integra® was lost due to late



Fig. 3. Removal of silicone layer, good vascularisation of neodermis.



Fig. 4. Micrograft skin grafts in place.

haematogenous infection. After a total of 22 operation, patient died at PBD 177 due to uncontrollable multiresistant *P. aeruginosa* infection.

## 6. Conclusion

The modified Meek technique has been used in our burn unit since January 1996. During 1997–2001 we have treated 19 burn patients with TBSA >40%. Integra® has been used in a total of 15 acute burn patients during that time. On three patients the neodermis of Integra® was covered using the modified Meek technique. No major complications occurred in these patients concerning the application of Integra®. Partial skin graft losses occurred due to infection after applying the autograft on the neodermis. In those cases another operation was performed to cover open areas which did not heal conservatively. All three patients had extensive burn injuries Figs. 1–6.

With Integra® the second stage operation is possible only after at least 2 weeks after applying it. During this time small vessels grow from the wound bed into the matrix of Integra® allowing the formation of the neodermis. In extensive burns the immunological system is impaired and the wounds are often colonised, leading to an enhanced risk of wound infection. Hence, the risk for graft losses might be greater in the second stage operation compared to the first stage operation. Also the fact that the tiny pieces of skin are glued on silk paper is a risk factor. Because silk paper is a foreign material bacterial colonisation is more likely to occur on silk paper than on a plain skin graft, which is covered with proper dressings. This is why some losses of skin grafts can be predicted to happen. As infections occurred after the second stage operation, some changes have been addressed to our wound care protocol. In extensive burns where the



Fig. 6. Result at 12 months.

Micrograft technique is used to cover Integra®, antiseptic dressings are used to avoid primary postoperative infection. Also, new silver impregnated dressings could be used. Ideally, an allograft could be used as a carrier for the Micrograft skin grafts. However, allograft can not be double-folded as silk paper making the expansion of these grafts impossible. Larger (1:6 to 1:9) expansion rates need secondary coverage with allograft [3]. This, however, doesn't seem to be a problem with Integra®.



Fig. 5. Three months postburn. No Integra® was used on the back of the patient. Note the clear margin on the side of the torso between sites treated with (front) and without (back) Integra®.

Using Integra® in extensive burns have several benefits. One is that the wounds can be sealed rapidly. Secondly, it is possible to wait and let the patient get in a more stable condition before the second stage operation, where large donor sites are unavoidable. Thirdly, after applying Integra®, the later skin grafting operations are performed as elective, carefully planned procedures. These all can be achieved also with allografts. However, Integra® has a benefit of creating a neodermis over the excised wound which in our clinical experience leads to a softer scar compared to standard split thickness autografts, particularly when using large expansion rates. Allografts lack this property. Also, peeling off the silicone layer of Integra® in the second stage operation causes actually no bleeding, which again can be a problem with allografts. There is no skin bank in our unit, fresh cadaver skin is used when needed.

In conclusion, the modified Meek technique is a suitable tool for covering the neodermis formed by Integra® artificial skin. Large expansion rates can easily be used to achieve full

usage of limited donor sites in extensive burns. However, special care must be addressed to infection control of the postage stamp grafts glued on silk paper. Early removal of the silk paper, antiseptic compresses and even antimicrobial therapy is recommended in both prevention of and treatment of graft infection.

## References

- [1] Burke JF, Yannas IV, Quinby WC, Bondoc CC, Jung WK. Successful use of a physiologically acceptable artificial skin in the treatment of extensive burn injury. *Ann Surg* 1981;194(4):413–28.
- [2] Meek CP. Successful microdermagrafting using the Meek-Wall microdermatomes. *Ann J Surg* 1958;96:557–8.
- [3] Kreis RW, Mackie DP, Vloemans AWF, Hemrans RP, Hoekstra: widely expanded postage stamp skin grafts using a modified Meek technique in combination with an allograft overlay. *Burns* 1993;19(2):142–5.
- [4] Raff R, Hartman B, Wagner H, German G. Experience with modified Meek technique. *Acta Chir Plast* 1996;38(4):142–6.