

# Epidermal harvesting in plastic surgery outpatients – an interdisciplinary team approach

Epidermal harvesting (EH) is the practice of taking micro-grafts for autologous skin grafting. EH involves applying a device (Cellutome™ Epidermal Harvesting System, Acelity) with a sterile disposable harvester that heats the donor site skin (typically the medial thigh) to produce epidermal blisters for transplantation as micro-grafts directly onto a recipient site. As an adjunctive therapy, EH is indicated for the treatment of acute and chronic wounds healing by secondary intention. Wound assessment by the interdisciplinary team is key to effective EH practice in plastic surgery outpatients.

## KEY WORDS

- » Epidermal harvesting
- » Interdisciplinary team
- » Outpatients
- » Wound preparation

**C**ellutome™ Epidermal Harvesting System was launched by Kinetic Concepts Inc (KCI), an Acelity Company as a method of micro-grafting wounds. Epidermal harvesting (EH) takes intact cells at the dermal – epidermal junction for transplantation onto a recipient site, allowing the migration of basal keratinocytes and melanocytes and secretion of growth factors to bring about re-epithelialization (KCI, 2013a; Osborne et al, 2015).

EH differs from conventional skin grafting because only the epidermal layer is harvested and not the dermis. Although micro-graft techniques go back 150 years to when Jacques-Louis Reverdin described epidermic grafting in 1869 as a method of raising the epidermis with a needle before detaching it with a scalpel to transplant it onto a wound (Biswas et al, 2010), EH is still in its infancy (Serena, 2015).

EH is a simple but effective method of bringing about wound closure by re-epithelialisation. As an adjunctive therapy, EH complements advanced treatment interventions such as negative pressure wound therapy in the management of hard-to-heal acute and chronic wounds (Wounds UK, 2014a). An interdisciplinary team approach ensures that EH is safely undertaken in the outpatient setting, without the need for a general or local anaesthetic, thus avoiding the need for costly hospital stays and theatre time (Hachach-Haram et al, 2015; Hachach-Haram et al, 2016).

## PATIENTS SUITABLE FOR EH

Patients who may benefit from EH include those with trauma injuries, vascular wounds, post skin cancer excision, surgical wound complications and burns. EH offers an alternative method of wound closure for patients, particularly those with hard-to-heal wounds when there has been a poor response to other therapeutic interventions or when surgical wound closure with conventional skin grafts is not indicated. Patient selection takes into consideration age, type, size and location of wound as well as comorbidities and underlying aetiology.

For the interdisciplinary team, EH offers an advanced wound management option to promote healing in the least invasive way. There is no adult age restriction to EH, but in all cases the health status and skin integrity of each individual must be considered. Cellutome™ EH is not designed for use in paediatric wound care. It would not be used on a baby. EH should be used with caution in patients with bleeding disorders and EH is contraindicated during end-of-life care.

The Royal Free London NHS Foundation Trust (plastic surgery and vascular specialties) began an EH pilot in 2014 to establish a clinical pathway for a larger study. Patients referred to the plastic surgery department for complex wound management were assessed and recruited into the EH pilot if they met the following criteria:

- » Adult (over 18 years of age) with an acute or chronic wound

LUCY TWYMAN  
*Clinical Nurse Specialist in  
 Plastic Surgery Outreach, Royal  
 Free London NHS Foundation  
 Trust, London*



Figure 1. Mr JZ's abdominal wound 3 days (a) and 7 weeks (b) after epidermal harvesting. There was complete wound healing after 4 months (c)

- ▶ There was wound breakdown following surgical complications or the wound was hard to heal with other surgical interventions
- ▶ The underlying aetiology and comorbidities could be managed
- ▶ The wound size was proportional to the size of the Harvester (5cm<sup>2</sup> or double if two EH applications were to be undertaken)
- ▶ The wound bed was suitable (it had to be granulating and not infected).

An interdisciplinary team of doctors and nurses managed the patients' wounds from the time of referral, during the EH procedure and during follow-up. EH was largely undertaken by specialist registrars and a nurse specialist was trained in the technique. Any decisions made on dressings during the re-epithelialisation stage were based on wound assessment by the interdisciplinary team. Number of patients was 35 at two centres as reported in the recently published case series (Hachach-Haram et al, 2016), which included data from Royal Free and Cardiff: 25 patients were seen at the Royal Free while the other 10 patients were seen in Cardiff. As per the Royal Free London NHS Foundation Trust policy, informed consent was obtained from each patient, as was the permission to publish photographs and quotes for the case study evaluations.

**CASE STUDY 1**

**Background**

Mr JZ, aged 84 years, presented with a 6-year history of a non-healing wound to the abdomen following surgical complications. During this protracted period of living with a chronic wound, Mr JZ had been prescribed various dressing products including antimicrobials and foams.

**Epidermal harvesting**

On 4 August 2014, Mr JZ underwent EH as an outpatient in the plastic surgery department. The micro-grafts were transplanted using a soft silicone non-adherent dressing. During outpatient follow-ups (Figures 1a and 1b), as the wound gradually re-epithelialised, the team noted the formation of encrusting over the wound bed. A topical antimicrobial non-adherent povidone-iodine dressing was applied prophylactically twice weekly, which not only prevented wound breakdown but effectively promoted moisture balance, while the encrusting was left intact.

**Outcome**

The wound's dimensions were measured using photography and complete wound closure was reported 4 months after EH (Figure 1c), bringing an end to the burden of living with a chronic wound.

*"I was so pleased you introduced me to the new (EH) system."* Mr JZ

**CASE STUDY 2**

**Background**

Mrs NS, aged 91 years, sustained a traumatic injury to left lower leg in July 2014, after accidentally knocking it against a wheelchair while on a cruise. Although independent, Mrs NS had comorbidities including arthritis and hypertension. For 3 months her wound was treated in the plastic surgery outpatient department with dressings including antimicrobial honey, protease modulators and foams.

**Epidermal harvesting**

On 21 October 2014, EH was undertaken to treat the clean granulating wound (Figure 2a). The micro-



Figure 2: Mrs NS's lower left leg wound before epidermal harvesting (a). Complete wound healing of the donor site (medial thigh) (b) and recipient site (lower left leg) 14 days post epidermal harvesting (c)



Figure 3. Mrs EB's amputation site 3 weeks post epidermal harvesting (a). Encrusting was visible and left undisturbed during re-epithelialisation (b) and (c). There was complete wound healing 16 weeks post epidermal harvesting (d)

grafts were transplanted using a soft silicone non-adherent dressing. After 7 days a 50% reduction in wound size was noted. A topical antimicrobial non-adherent povidone-iodine dressing was applied twice a week to prevent infection and promote moisture balance, together with a secondary basic gauze dressing and retention bandage.

**Outcome**

Complete wound closure of both the donor and recipient sites was reported 14 days post EH (Figures 2b and 2c), much to the delight of Mrs NS.

*“Everything went swimmingly.” Mrs NS*

**CASE STUDY 3**

**Background**

Mrs EB, aged 64 years, had an acute wound following her right, below-knee amputation. Due to her comorbidities, including diabetes, a conventional skin graft was not the best option for closing the wound.

**Epidermal harvesting**

EH was undertaken in April 2015 prior to Mrs EB's transfer to a rehabilitation unit. During outpatient follow-up 3 weeks later (Figure 3a) an increase in exudate was noted. To achieve moisture balance, a protease modulator was applied as the primary dressing. Over time, moisture levels decreased and encrusting of the wound bed was clearly visible (Figures 3b and 3c). The encrusting was left undisturbed and the dressing was changed to a topical

antimicrobial non-adherent povidone-iodine dressing to promote moisture balance during re-epithelialisation.

**Outcome**

Complete wound closure was reported on 19 August 2015 (Figure 3d). Mrs EB attributed her experience of wound healing to EH.

*“I think if they didn't do it [EH] I wouldn't be better.” Mrs EB*

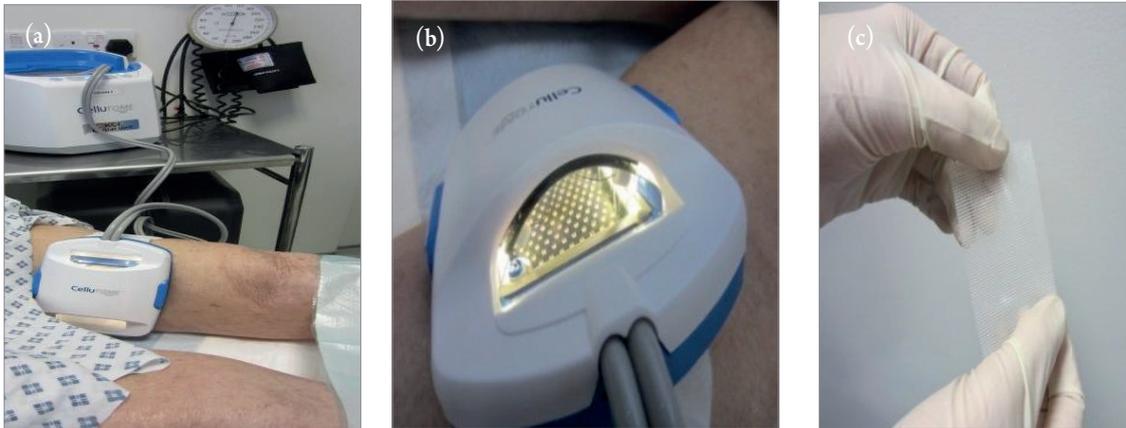
**WOUND PREPARATION**

The patient should have a clear understanding of the EH procedure (Figures 4a–c) before informed consent is obtained and a follow-up plan of care established to bring about wound closure. The timing of EH is dependent on wound assessment and wound bed preparation (Leaper et al, 2012).

Optimising a wound before a patient undergoes EH to reduce the bioburden and correct any moisture imbalance often requires various treatment modalities, such as debridement methods, negative pressure wound therapy to control exudate (Wounds UK, 2013a), and topical antimicrobials to manage the bacterial load (Wounds UK, 2013b). The recipient site for the EH must be free of necrotic tissue, slough, biofilm, heavy exudate, malodour and infection. It must also have healthy granulation tissue, as with conventional skin graft procedures (Holden, 2015). Key factors in EH preparation are the choice of dressing and frequency of dressing changes.

**INTERDISCIPLINARY TEAM APPROACH**

Interdisciplinary team-working underpins EH



The Harvester is strapped to the medial thigh and the control unit set to 30-45 minutes (a). Micro-graft formation is visible as the Vacuum Head heats to 37-41°C at a negative pressure -400 to -500 mmHg (b). A non-adhering silicone dressing effectively transplants micro-grafts onto the recipient site (c)

practice, holistic patient assessment, wound bed preparation and follow-up. Utilising the skills and expertise of interdisciplinary team members in wound management is known to positively impact on clinical outcomes (Moore et al, 2014). As with any wound therapy device or advanced practice, wound care specialists must be trained and competent to undertake EH practice safely in accordance with local protocols while upholding professional standards of practice.

During patient assessment, the following factors are taken into account:

- » The type of wound
- » Underlying aetiology
- » Size and location of the wound
- » Existing comorbidities.

A wound assessment tool that involves the patient serves as a useful framework to guide this process (Dowsett et al, 2015). Wound bed preparation, particularly moisture balance, is essential for successful cell outgrowth from micro-grafts.

Combining other treatment modalities before and after EH should feature in the interdisciplinary treatment plan. Such modalities may include negative pressure wound therapy to control fluid levels and compression therapy to support the vascular system following assessment in patients with lower extremity wounds (Richmond et al, 2014; Wounds UK, 2014b; Harding et al, 2015; Serena et al, 2015).

#### EPIDERMAL HARVESTING IN PRACTICE

EH is usually completed within an hour in the outpatient setting. With the patient positioned comfortably on the treatment couch, an aseptic technique is employed to prepare both the donor and recipient sites. The Harvester is strapped onto the thigh, but not too tightly (Figure 4a). The Vacuum Head is clipped into position and the control unit set to between 30 and 45 minutes (Figure 4b), the duration of time it usually takes to form micro-grafts. As the Vacuum Head heats to 37–41°C, at a negative pressure of -400 to -500mmHg, the patient may experience the sensation of heat but there should be little or no pain. Singh et al (2015) suggest that this may be because micro-blisters are cleaved through the lamina lucida of the dermal–epidermal junction, leading to very little inflammation. The only discomfort that may be experienced by the patient is when the Vacuum Head is released from the Harvester following micro-graft formation.

A non-adhering silicone dressing (Adaptic Touch™, Acelity Company) is applied to the Harvester to retrieve the newly-formed micro-grafts, with the aid of a gloved finger (Figure 4c). The interdisciplinary team has found this method to be an effective way of picking up and transplanting the micro-grafts. In addition, the non-adherent silicone dressing can be cut to the shape of the wound without harming the micro-grafts. Adaptic Touch™ allows exudate to pass

**Box 1. Top tips for epidermal harvesting (EH)**

- ▶ Before EH, the wound should be assessed and the wound bed prepared
- ▶ Care should be taken to ensure the Harvester is not strapped too tightly to the inner thigh
- ▶ Regularly check on micro-graft formation
- ▶ Ensure patient comfort throughout the procedure
- ▶ Transplant the micro-grafts to the recipient site with a non-adhering silicone dressing
- ▶ After EH consider using a supportive dressing, negative pressure wound therapy or compression
- ▶ Observe for micro-graft outgrowth during follow-up
- ▶ Appropriate dressing selection is the key to moisture balance
- ▶ Do not debride during the micro-graft outgrowth phase; leave encrusting of the wound edge undisturbed
- ▶ Ensure interdisciplinary team follow-up, use medical photography, take regular wound measurements and complete documentation

through the silicone mesh (Wounds International, 2014; Wounds International, 2015a) and conforms easily to the bed of the recipient site for maximum micro-graft coverage. With the micro-grafts *in situ*, the Adaptic Touch™ is secured with a simple gauze dressing or secondary foam product for the first week post EH.

**DONOR SITE CARE**

On completion of EH, the donor site is protected with Tegaderm™ (3M) transparent film dressing. Left undisturbed, complete wound healing is usually achieved within 2 weeks, as observed in case study 2 (Figure 2b).

**MANAGEMENT OF MICRO-GRAFTS**

Aftercare post EH is perhaps most challenging for the interdisciplinary team once micro-grafts have been transplanted. Micro-graft ‘take’ differs from conventional skin graft ‘take’ and may not be clearly visible at the initial dressing change (KCI, 2013a). This could be mistaken for micro-graft failure.

The micro-grafts are only 1.8mm in size and the 5cm × 5cm Harvester produces 128 microdomes. Through close observation of the wound bed it should be possible to detect micro-graft outgrowth and distinguish this from the gelatinous material that may form on the bed of a medium- to highly-

exuding wound. Assessment of the wound bed, and particularly the level of exudate, will influence dressing product selection.

**WOUND ASSESSMENT AND DRESSING SELECTION**

During EH follow up, micro-graft outgrowth from within the wound was detected and not just from the outer margins. Similar findings were reported by Serena et al (2015). To manage micro-graft outgrowth, a non-adherent povidone-iodine dressing (Inadine®, Systagenix, an Acelity Company) was applied directly onto the wound bed in case studies 1 and 2 when the exudate levels were low. As a primary layer, Inadine® effectively created a moisture balance that may have protected the micro-grafts during re-epithelialisation, while the broad-spectrum topical antimicrobial property prevented infection (Campbell and Campbell, 2013; Wounds International, 2015b).

In case study 3 (Figure 3a), medium to high exudate levels were documented in the first few weeks after EH. This was controlled with a protease modulator dressing (Aquacel® Extra™, ConvaTec), which did not appear to inhibit micro-graft outgrowth. As wound exudate decreased, the formation of an encrusted layer was observed and left intact (Figures 3b and 3c). At this point Inadine® was applied in keeping with case studies 1 and 2.

The team of doctors and nurses observed an unusual build-up of gelatinous slough and exudate in some cases of micro-graft outgrowth, making wound assessment challenging. The decision was made not to remove slough and exudate from the wound bed as it was not clear whether this would harm the micro-grafts. Although a non-adhering silicone dressing was initially applied post EH, it was thought that other categories of dressing products may be more effective in managing wound bed conditions. A topical antimicrobial was applied for prophylaxis. Dressing product selection post EH is still a work in progress for the team.

Consistency throughout the process of EH should promote best practice (Box 1). Arguably, the choice of dressings and frequency with which they are changed after EH impacts on the time to

complete re-epithelialisation. Successful micrograft outgrowth requires moisture balance, which may need to be regulated through the use of a combination of therapies, such as negative pressure wound therapy and compression therapy. Regular wound assessment and follow-up will guide interdisciplinary team decision making.

**PATIENT EXPERIENCE**

In case studies 1 to 3, dressing changes were performed twice a week by members of the interdisciplinary team. Mr JZ and Mrs NS were happy to participate in dressing changes after showering at home. Mrs EB was receiving rehabilitation at another trust during the EH follow-up phase therefore her local nursing team was instructed on how to manage the wound between appointments to the plastic surgery outpatient department.

EH impacted positively on patient experience. An overall rating of between 8 and 10 (where 10 is excellent) was given by Mr JZ, Mrs NS and Mrs EB when questioned on the outpatient environment, wound assessment, wound bed preparation, EH procedure, wound dressings post EH and follow-up care. Complete wound healing in these cases was achieved within 16 weeks (Figures 1c, 2c and 3d).

**CONCLUSION**

An interdisciplinary team approach is key to EH practice in the outpatient setting. This approach advocates the patient as being central to decision-making during holistic assessment, wound bed preparation and follow-up. The case studies presented have illustrated that consistency in dressing product selection is fundamental to EH and wound healing outcomes.



**REFERENCES**

Biswas A, Bharara M, Hurst C et al (2010) The micrograft concept for wound healing: strategies and applications. *J Diabetes Sci Technol* 4(4):808–19

Campbell N, Campbell D (2013) Evaluation of a non-adherent, povidone-iodine dressing in a case series of chronic wounds. *J Wound Care* 22(8):401–6

Dowsett C, Protz K, Drouard M, Harding KG (2015) *Triangle of Wound Assessment Made Easy*. Available at: [http://www.woundsinternational.com/media/other-resources/\\_/1189/files/twa-made-easy\\_web.pdf](http://www.woundsinternational.com/media/other-resources/_/1189/files/twa-made-easy_web.pdf) (accessed 22.08.16)

Harding K, Dowsett C, Fias L et al (2015) *Simplifying Venous Leg Ulcer Management: Consensus Recommendations*. Available at: <http://www.woundsinternational.com/consensus-documents/view/simplifying-venous-leg-ulcer-management> (accessed 22.08.16)

Hachach-Haram N, Bystrzonowski N, Kanapathy M et al (2015) The use of epidermal grafting for the management of acute wounds in the outpatient setting. *J Plast Reconstr Aesthet Surg* 68(9):1317–8

Hachach-Haram N, Bystrzonowski N, Kanapathy M et al (2016) A prospective, multicentre study on the use of epidermal grafts to optimise outpatient wound management. *Int Wound J* doi: 10.1111/iwj.12595 [epub ahead of print]

Holden J (2015) Top tips for skin graft and donor site management. *Wound Essentials* 10(2):7–13

KCI, an Acelity Company (2013a) *CelluTome™ Epidermal Harvesting System: Mechanism of Action*. Available at: [http://www.kci-medical.de/cs/Satellite?c=KCI\\_Product\\_C&childpagename=DE-GER%2FKCILayout&cid=1229640564932&p=1229634984971&packedargs=locale%3Dde\\_DE&pagename=DE-GERWrapper](http://www.kci-medical.de/cs/Satellite?c=KCI_Product_C&childpagename=DE-GER%2FKCILayout&cid=1229640564932&p=1229634984971&packedargs=locale%3Dde_DE&pagename=DE-GERWrapper)

KCI, an Acelity Company (2013b) KCI Launches Novel Tool to Simplify Epidermal Harvesting. Available at: <http://bit.ly/2b9fuBF> (accessed 22.08.2016)

Leaper DJ, Schultz G, Carville K et al (2012) Extending the TIME concept: what have we learned in the past 10 years? *Int Wound J* 9 (Suppl):1–19

Moore Z, Butcher G, Corbett LQ et al (2014) AAWC, AWMA, EWMA. Position Paper: Managing Wounds as a Team. *J Wound Care* 23(5 Suppl):S1–S38.

Osborne SN, Schmidt MA, Derrick K, Harper JR (2015) Epidermal micrografts produced via an automated and minimally invasive tool form at the dermal/epidermal junction and contain proliferative cells that secrete wound healing growth factors. *Adv Skin Wound Care* 28(9):397–405

Richmond NA, Lamel SA, Braun LR et al (2014) Epidermal grafting using a novel suction blister-harvesting system for the treatment of pyoderma gangrenosum. *JAMA Dermatol* 150(9):999–1000

Serena TE (2015) Use of epidermal grafts in wounds: a review of an automated epidermal harvesting system. *J Wound Care* 24(4):30–4

Serena T, Francius A, Taylor C, MacDonald J (2015) Use of a novel epidermal harvesting system in resource-poor countries. *Adv Skin Wound Care* 28(3):107–12

Singh M, Nuutila K, Kruse C et al (2015) Challenging the conventional therapy: emerging skin graft techniques for wound healing. *Plast Reconstr Surg* 136(4):524e–30e

Wounds International (2014) *International Case Studies: Adaptive Touch™ in Partial-Thickness Skin Graft Donor-Site Wounds*. Available at: <http://www.woundsinternational.com/case-studies/view/case-series-evaluation-adaptive-touch-in-partial-thickness-skin-graft-donor-site-wounds> (accessed 22.08.16)

Wounds International (2015a) *International Case Studies: Adaptive Touch™ in Conjunction with Negative Pressure Wound Therapy*. Available at: <http://www.woundsinternational.com/case-studies/view/case-series-adaptive-touch-in-conjunction-with-negative-pressure-wound-therapy> (accessed 22.08.16)

Wounds International (2015b) *International Case Studies: Using INADINE™ for Minor Traumatic Wounds: Case Studies*. Available at: <http://www.woundsinternational.com/case-studies/view/using-inadine-for-minor-traumatic-wounds-case-studies> (accessed 22.08.16)

Wounds UK (2013a) *Best Practice Statement. Effective Exudate Management*. Available at: <http://www.wounds-uk.com/best-practice-statements/best-practice-statement-effective-exudate-management> (accessed 22.08.16)

Wounds UK (2013b) *Best Practice Statement. The Use of Topical Antimicrobial Agents in Wound Management*. Available at: <http://www.wounds-uk.com/best-practice-statements/best-practice-statement-the-use-of-topical-antisepticantimicrobial-agents-in-wound-management> (accessed 22.08.16)

Wounds UK (2014a) Using Nanova™ Therapy System in Practice: a round table discussion. *Wounds UK* 11(4 Suppl):1–17

Wounds UK (2014b) *Two-Component Compression: Concordance, Evidence and Clinical Use*. Available at: [http://www.wounds-uk.com/pdf/content\\_11383.pdf](http://www.wounds-uk.com/pdf/content_11383.pdf) (accessed 22.08.16)

**Acknowledgement**

The author would like to acknowledge the members of the epidermal harvesting interdisciplinary team at the Royal Free London NHS Foundation Trust and University College London