A Prospective, Multicentre Study on the Use of Epidermal Graft to Optimise Outpatient Wound Management

Abstract

INTRODUCTION

Current wound management with the use of split thickness skin graft often requires hospital admission, a period of immobility, attentive donor site wound care and pain management. This study evaluates the feasibility of using a novel epidermal graft harvesting device (CelluTome) which allows pain-free epidermal skin grafting in the outpatient clinic setting. A prospective series of 35 patients was performed in 2 centres, involving 10 acute and 25 chronic wounds. All patients were subjected to epidermal grafting in the outpatient specialist clinic, without the use of anaesthesia, and allowed to return home after the procedure. Completely healed wounds were noted in 22 patients (62.9%). The overall mean time for 50% and 100% reduction in wound size was 3.31±2.33 weeks and 5.91±3.48 weeks respectively. There was no significant difference in healing times between the acute and chronic wounds (50% reduction in wound size; acute 2.20±0.91 weeks versus chronic 3.73±2.63 weeks, p=0.171. 100% reduction in wound size; acute 4.80±1.61 weeks versus chronic 6.83±4.47 weeks, p=0.183). The mean time for donor site healing was 5.49±1.48 days. The mean pain score during graft harvest was 1.42±0.95 and the donor site Vancouver Scar Scale was 0 for all cases at 6 weeks. This automated device offers autologous skin harvesting in the outpatient setting with minimal or no pain and a scar free donor site, equally benefiting both the acute and chronic wounds. It has the potential to save NHS resources by eliminating the need for theatre space and a hospital bed, while at the same time benefiting patient care.

Keywords

Epidermal graft, CelluTome, outpatient care, wound management, wound healing

Introduction

The cost of wound management to the NHS is considerable, estimated at about £2.3-3.1 billion per year[1]. Chronic wounds can present significant challenges to the practitioner with a long healing time and multiple dressing changes. Most of these wounds are managed in the outpatient setting with protocols that vary according to geography, institution and speciality. Wound coverage by dressings or the use of split thickness skin grafts aims to achieve complete healing in the shortest time period with minimal patient morbidity.

Current wound management with the use of split thickness skin grafts (SSGs) often requires hospital admission, even as a day case, anaesthesia, and a period of immobility for some patients. The donor site becomes a second, often painful wound, which may take more time to heal than the graft site[2, 3]. Newer alternatives to SSG such as tissue-engineered skin grafts carry their own challenges; namely the cost, lack of availability, and are often limited to specialised facilities.

Epidermal grafting (EG) was first described in 1964 by two Dermatologists, Kiistala and Mustakallio[4]. Their technique proposed the use of negative pressure (150 – 200mmHg), with minimal intra-procedure trauma. However, it was not until 1971, when Falabella[5] showed that EG was a valuable tool for providing coverage of granulating areas and repigmentation of achromic wounds. Although it has been described as cumbersome and time consuming there are reports of successful wound healing with the use of epidermal grafting, however, to-date it has been minimally explored. This study evaluates the feasibility of using a novel epidermal graft harvesting device, CelluTome, which allows epidermal skin grafting to be performed in the outpatient clinic setting, with minimal or no pain, as an alternative to the current wound management methodology.

Methods

A prospective case series was conducted, from July 2014 to March 2015, at two regional plastic surgery units in the United Kingdom: the Royal Free Hospital, London and the University Hospital of Wales, Cardiff. Epidermal Grafting was an established technique in the Trust so a Divisional protocol was developed with trust approval for a new device and all patients registered for a prospective audit.

Patient Selection

Adult patients who had been referred to the department of plastic surgery for consideration for SSG due to difficult or non-healing wounds were considered. The wounds were between 2cm x 2cm and 12cm x 12cm, and had clean and granulating wound beds. Prior to grafting, the wound bed was prepared as per standard clinical practice, either with negative pressure wound therapy or appropriate dressings, until healthy granulation tissue was present. Wound swabs were performed to exclude infection. Details on patient's demographics, co-morbidities, wound aetiology, wound type, wound location, wound size, healing time, pain scores during graft harvest, wound measurements at each visit, and donor site scar quality were recorded. The wound type was classified into acute (<3 months in duration) and chronic (≥3 months in duration). This study was conducted in the outpatient setting and patients were allowed to return home on the same day after the intervention.

Epidermal graft harvest and post grafting wound care

Epidermal grafts were harvested using an automated harvesting system, CelluTome (Acelity)[6]. This device harvests epidermal micrografts, without the use of anaesthesia, via the formation of suction blisters, carried out in the outpatient setting. By combining negative pressure (400 – 500 mmHg) and heat (40^{o}C), this device produces an array of epidermal blisters within 30 to 50 minutes, providing autologous keratinocytes for grafting (Figure 1). The microdomes are formed at the layer of the lamina lucida of the dermo-epidermal junction[6]. Following the harvest, the epidermal grafts are transferred onto a non-adherent silicone dressing (Adaptic Touch, Systagenix) and applied onto the wound (Figure 1). The graft is then secured with a secondary dressing, while the donor site is dressed with an occlusive dressing (Tegaderm Film, 3M) (Figure 2). Patients were allowed to return home on the same day after the procedure and were reviewed on day 7±3 post-grafting. The patients were reviewed weekly for a minimum of 6 weeks or until the wound had healed.

During the post-operative review the donor site dressing was removed at week 1 and no further dressing was required. The recipient wound was reviewed by the same clinician for every case to ensure continuity of care and practice as well as reliability in outcome measure assessment. Once the dressing was removed the bed was not tampered with, to allow for the fragile keratinocyte layers to set, and a new dressing was applied usually in the form of a non-adherent silicone dressing, Adaptic Touch (Systagenix), followed by a secondary dressing which usually included iNadine (Systagenix) or Aquacel (Figure 2) to deal with the exudate

levels. In cases where the exudate level was moderate or high the secondary dressing was changed twice weekly.

Outcome measures

The wounds were measured (length (cm) x width (cm)) and photographed before and after grafting, and at each wound review. The primary outcomes measured were the time taken for 50% and 100% reduction in wound size as well as the time taken for the donor site to heal. The secondary outcomes measured were pain score during graft harvest and donor site scar quality. The pain score was measured using a Numerical Rating Scale, with 0 being no pain and 10 being worst pain. The donor site scar quality was evaluated by using the Vancouver Scar Scale (VSS) at 6 weeks post grafting[7]. The VSS assesses 4 variables: vascularity, height/thickness, pliability, and pigmentation. Each variable include ranked subscales that are summed to obtain a total score ranging from 0 to 13, with 0 representing normal skin and 13 representing maximum alterations of the skin.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics 21 software. The p values of <0.05 were considered statistically significant. ata was presented as the mean ± standard deviation. The time for reduction in wound size between the acute and chronic wounds, and the size and type of wound were compared using the independent t-test. The Pearson correlation co-efficient was used to determine the association between the age and the time for the donor site to heal.

Results

A total of 35 patients were treated with the epidermal grafting with an average age of 66.1 years (range: 18-93 years). Of these patients, 16 were male (45.7%) and 19 were female (54.3%) (Table 1). The most common aetiology in this patient cohort was wound dehiscence (n=12). There were 10 acute wounds (mean duration: 1.50 ± 0.81 months) and 25 chronic wounds (mean duration: 26.3 ± 24.3 months) with the average wound duration of 19.4 months (range: 0.5-77 months) (Table 2). The majority of the wounds treated were on the leg (40.0%), followed by the ankle (17.1%) and abdomen (14.3%). The average wound size was 20.5 ± 22.4 cm^2. There was no difference between the wound size and type of wound (acute: 11.9 ± 6.65 cm^2 versus chronic: 23.9 ± 25.9 cm^2, p=0.079).

Complete wound healing (100% reduction in wound size) was achieved in 22 patients, 62.9%. Of these 22 patients, 17 patients (77.3%) healed within 6 weeks, 4 patients (18.2%) within 8 weeks, and the remaining person healed within 20 weeks.

The mean time for 50% and 100% reduction in wound size were 3.31± 2.33 weeks and 5.91 ± 3.48 weeks respectively. There was no significant difference in healing times between the acute wounds and the chronic wounds (50% reduction in wound size; acute 2.20 ± 0.91 weeks versus chronic 3.73 ± 2.63 weeks, p=0.171. Hundred percent reduction in wound size; acute 4.80 ± 1.61 weeks versus chronic 6.83 ± 4.47 weeks, p=0.183).

The mean time for the donor site to heal was 5.49 ± 1.48 days. There was no correlation between patient's age and donor site healing time (Pearson correlation, p=0.915). The mean pain score during graft harvest was 1.42 ± 0.95 and the donor site Vancouver Scar Scale was 0 for all cases at 6 weeks, whereby all donor sites looked similar to the surrounding skin.

There were seven graft failures due to infection. No improvement in wound size was seen in two other patients with chronic wounds, however the wound bed was noted to be more active with granulation tissue. No other complications were experienced by the patients.

Case examples

Case 1: Patient 2/HB.

A healthy young male sustained a traumatic wound over the left patellar region from a motorbike injury. The wound measured 4.5cm x 3.0cm with exposed infra-patellar tendon, requiring surgical debridement followed by four weeks of negative pressure wound therapy (NPWT). The wound granulated well with the NPWT and subsequently underwent epidermal grafting (Figure 3). Complete re-epithelialisation of the wound was noted at 5 weeks post-grafting while the donor site healed within the first week without any noticeable scar at week 6.

Case 2: Patient 7/JZ.

An 83 year old fit and independent gentleman with history of appendicectomy and right hemicolectomy complicated by an incisional hernia in 2011, referred with chronic non-healing wound over the central abdomen. The wound measured 4.5cm x 3.5cm and was dressed with honey dressings, Inadine (Systagenix) and Silflex (Advancis Medical) prior to epidermal grafting (Figure 4). 50% reduction in wound size was achieved at week 4, and complete wound healing was achieved at week 8.

Case 3: Patient 8/GM

A 60 year old female presented with a four week history of numerous Type 1 pre-tibial lacerations secondary to a ladder falling on her right leg (Figure 5). The wound had been initially managed with honey dressings, Inadine (Systagenix) and Silflex (Advancis Medical) prior to arrival in our clinic. At presentation the wound consisted of four small concave granulating wounds all measuring approximately 0.5 x 0.5 cm. There was no growth on microbiology swabs from any of the wounds. The patient had myasthenia gravis for which she was taking oral prednisolone. Epidermal grafts were taken from the right thigh using the CelluTome device and grafted onto the wounds. Adaptic touch (Systagenix) dressings were applied. At two weeks the wounds had reduced in size by 50% and at six weeks post-grafting all wounds had healed 100%. The donor site healed within five days of harvest.

Case 4: Patient 12/AL

A 26 year old female presented with a two week history of an acute thermal burn injury to her right leg. The wound measured 9.5 x 2 cm, was granulating and had no growth on microbiology swabs. The patient was a smoker but had no other comorbidities. Epidermal skin grafts were taken from the right thigh using the CelluTome device and grafted onto the wound. Adaptic touch (Systagenix) dressings were applied. Within one week the wound had reduced in size by 50% (Figure 6) and within three weeks the wound had healed 100%. The donor site healed within seven days of harvest.

Case 5: Patient 31/JS

An 88 year old male presented with a two week history of a right forearm laceration following trauma. The wound measured 2 x 3.5cm, was granulating and had no growth on microbiology swabs. The patient had a past medical history of ischaemic heart disease only and was a non-smoker. Epidermal grafts were taken from the right thigh and applied to the wound. Adaptic touch (Systagenix) dressings were applied. Within three weeks the wound had reduced in size by 50% and within five weeks the wound was 100% healed (Figure 7). The donor site healed within six days after harvest.

Case 6: Patient 9/RF

A 78 year old male presented with a three month history of wound dehiscence of the left lateral leg following basal cell carcinoma excision. The wound had broken down shortly after surgery and required debridement in theatre before presentation to our clinic. The wound measured 4.5 x 6 cm, was granulating and had no growth on microbiology swabs. The patient had numerous comorbidities including prostate cancer (not on active treatment), myelodysplasia, ischaemic heart disease and smoking. Epidermal grafts were taken from the left thigh using the CelluTome device and grafted onto the wound. Adaptic touch dressings were applied. At two weeks the wound was showing signs of over granulation and lack of graft-take (Figure 8). At four weeks the graft was judged to have failed and a wound swab confirmed *pseudomonas* growth. The donor site healed within five days of harvest.

Discussion

The use of epidermal grafts or blister grafts for the treatment of vitiligo and chronic wounds has already been widely reported but it's use limited due to the lack of reproducible and efficient harvesting techniques further limiting its potential to be used in the outpatient setting[8, 9]. This study demonstrates the feasibility of using a novel epidermal harvesting device to achieve definitive wound coverage in the outpatient setting.

The CelluTome device produces an array of epidermal microdomes, comprising of epidermis down to the basal layer, immediately available for transfer to the recipient site. Epidermal grafts are made of multi-layered keratinocytes, in which a variety of other cell types with specialised functions are embedded, such as the melanin pigment-producing melanocytes, the immune-competent Langerhans cells, and the neuroendocrine Merkel cell; while its basal layer contains epidermal stem cells[10]. During the early stages of wound healing, keratinocytes begin to migrate from wound edges within 24 hours to the wound bed where they proliferate and form new epithelium[11]. Migrating keratinocytes synthesise and deposit a variety of extracellular matrix components, such as laminin, fibronectin, and type IV collagen[12]. In addition, numerous growth factors are also produced, namely, epidermal growth factor (EGF), transforming growth factor alpha (TGF-a), and heparin-binding growth factor (HB-EGF) which acts on the epidermis to drive wound closure[13]. The epidermal grafts hence act more like a bioengineered skin, stimulating the endogenous process of wound healing.

Another key factor to the success of epidermal grafting is the ability for basal cell outgrowth from the graft edge and this occurs for up to a 2mm distance(REF). This is intrinsic to the design of the harvester, which consists of 128 micrograft pores set at a 2mm distance apart to allow for the grafts to be raised in this manner (Figure 1).

Wound healing was a key outcome measured and the results demonstrated that 62.9% of the wounds fully healed with the use of Cellutome. 50% wound healing was achieved within 3.31± 2.33 weeks and complete wound closure was achieved within 5.91 ± 3.48 weeks. Of the wounds that healed 54.5% were chronic wounds that were not responding to dressings and conservative management, which potentially implies that the epidermal grafts stimulates the healing process in quiescent wound. The donor site wound healed within 5.49 ± 1.48 days with excellent aesthetic outcome, requiring neither frequent nursing care nor scar management. This result is encouraging as a donor site from a split thickness skin graft can take up to 21 days to re-epithelialise with current donor site dressing methods[14].

Furthermore, donor site complications such as infection, pain, and hypertrophic scarring can be avoided. Interestingly there was no significant difference in wound healing time between the acute and chronic wounds making the CelluTome equally useful in both types of wounds. The aetiology of the wound and anatomical site also had no significant impact on the wound healing times. Donor site healing was excellent in all patients with all cases scoring 0 on the Vancouver Scar at 6 weeks. As for the pain scores, these were reported to be were very low for all patients with a mean pain score during graft harvest was 1.42 ± 0.95 making this a very tolerable technique.

As with all new technologies the costs of intervention needs to be assessed. We did not formally undertake a cost analysis. However the series included 8 acute wounds (1.38 ± 0.54 months) and 22 chronic wounds (29.6 ± 25.2 months)a total of 662 months of dressing care was performed before the intervention of CelluTome. If these wounds had been dressed 2-3 time per week, a total of 5296-7944 dressing changes would have been performed. In total 30 interventions were performed with 400-600 dressing changes in the 8 weeks of care with two thirds of patients achieving a dressing free (healed) outcome. The intervention and subsequent treatment therefore costing less than 10% of the previous management costs.

Our experience shows that this harvesting device can be introduced routinely in the outpatient setting for both acute and chronic wounds. Once a patient has been assessed they can be invited back to a routine 'cellutome' clinic and undergo the epidermal harvest followed by routine dressing changes by the delivering clinical team. Chronic wounds pose a significant burden on the NHS, representing at least 5.5% of NHS budget expenditure (15) therefore such technologies that can introduce lasting improvements to wound management should be welcomed.

Limitations of the study

This is an observational study and therefore prone to selection bias. The data reported includes all cases performed in a sequential manner and patients were identified from routine referrals. Both units experienced a learning curve and this was attributed to three main points; the quality of the wound bed preparation, ensuring absence of wound bed infection (responsible for 7 graft failures), the harvest and post-operative wound care.. Following some graft failures due to infection, assessing wounds with a pre-operative swab has become the standard approach. The fragility of the epidermal grafts and keratinocyte sheets that develop in the weeks post-operatively was acknowledged and as such our practice has

changed whereby the wound bed is not touched during the first 3-4 weeks of dressing changes. Furthermore, better management of exudate levels with various secondary dressings was achieved which also improved results.

The feasibility of treating acute wounds in the outpatient setting reduces the need for patients to be admitted for autologous skin grafting. In addition, the prospect of using this device in the emergency department for the management of acute wounds could potentially reduce the number of hospital visits. The CelluTome is easy to use and well tolerated by patients. Elderly patients with multiple co-morbidities would benefit from this technique as it does not require anaesthesia and avoids the complications of bed rest, maintaining patient's independence and quality of life.

Conclusion

This automated device offers a novel method in autologous skin harvesting resulting in minimal or no pain and a scar free donor site in the outpatient setting. Complete wound coverage is achieved, while maintaining patient independence. It has the potential to save healthcare resources by eliminating the need for theatre space and a hospital bed, while at the same time benefiting patient care.

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Figures

Figure 1: Illustration of the epidermal graft harvesting device

(A) The epidermal graft harvesting system: (i) the control unit, (ii) the vacuum head, (iii) the harvester. (B) Arrow pointing at the microdomes formed in the vacuum head after 50 minutes of suction. (C) Graft Harvest. (D) Microdomes transferred on to non-adhesive silicone

Figure 2: Dressings

(A) Secondary dressing with Aquacel (B) Secondray dressing with iNadine (C) Further occlusive dressing to be applied on top of either (A) or (B)

Figure 3: The wound and donor site of Patient 2/HB

(A) Healthy granulation tissue was seen on the wound bed after 4 weeks of NPWT. The wound measures 4.5cm x 3.0cm over the left patella region. (B) More than 50% of the wound was re-epithelialised at week 3 post grafting. (C) Complete wound healing was seen at week 5. (D) Minimal scabs were seen at the donor site (black arrow) at week 3. (E) No visible scar was seen at the donor site (black arrow) at week 6. The donor site looks aesthetically similar to the surrounding skin.

Figure 4: The wound of Patient 7/JZ

(A) 4.5cm x 3.5cm superficial, granulating wound over the central abdomen. (B) At week 4, 50% of the wound was re-epithelialised. (C) The wound was completely healed at week 6.

Figure 5: The wound of Patient 8/GM

(A) Multiple 4-week-old small Type 1 pre-tibial lacerations on right leg. (B) At 2 weeks post epidermal grafting, the wounds were 50% healed; (C) 100% healing was achieved at 6 weeks post grafting.

Figure 6: The wound of Patient 12/AL(A)Burn wound measuring 9.5x2cm over the right leg. (B) Complete healing was achieved at 3 weeks post grafting.

Figure 7: The wound of Patient 31/JS

(A) Right forearm 2x3.5cm laceration wound. (B) At 3 weeks post epidermal grafting the wound was 50% healed; (C) at 5 weeks the wound was 100% healed.

Figure 8: The wound of Patient 9/RF

(A) 3 month old left lateral leg wound following BCC excision, wound dehiscence and debridement measuring 4.5x6 cm. (B) At 2 weeks post grafting, over granulation seen on wound bed. (C) Wound bed was noted to be sloughy at 4 weeks, wound swab confirmed pseudomonas growth.

Tables

Table 1: Clinical data of patients treated with epidermal graft

No	Patient	Gender	Age	Comorbidities	Wound aetiology	Location of wound	Duration of wound (month)	Wound size (cm^2)	Time for 50% reduction of wound size (weeks)	Time for 100% reduction of wound size (weeks)	Time for donor site healing (days)	Pain score during graft harvest	VSS of donor site scar
1	SB	F	24	Nil	Pyogenic granuloma	Foot	4	6	Failed	failed	5	1	0
2	HB	M	18	Nil	Trauma	Knee	1	13.5	2	5	5	3	0
3	RK	F	85	IHD, CABG, HTN, asthma,	Venous ulcer	Leg	4	6	2	5	7	2	0
4	BL	F	93	Dementia, COPD, HTN, CCF	Trauma	Leg	1	14	1	3	5	1	0
5	JC	M	54	Nil	Amputation stump wound dehiscence	Foot	2	28	2	4	5	2	0
6	LH	F	50	SLE (oral steroids)	Venous ulcer	Ankle	5	8	2	5	7	2	0
7	JZ	M	84	R hemicolectomy, postop fistula and hernia	Abdominal wound dehiscence	Abdomen	60	15.8	4	8	5	1	0
8	GM	F	62	Bowen's disease, myasthenia gravis (on oral steroids), osteoporosis	Trauma	Leg	1.5	12	2	6	5	2	0
9	RF	M	78	Prostate cancer, myelodysplasia, IHD, PVD, multiple BCC/SCC	Wound dehiscence	Leg	3	27	Failed	failed	5	1	0
10	NS	F	91	Breast cancer, hypertension, smoker, CKD3,	Trauma	Leg	3.5	3	2	3	5	3	0
11	LR	F	64	RA, COPD	Trauma	Ankle	9	40	failed	failed	5	0	0
12	AL	F	26	Anaemia smoker	Burn	Leg	0.5	19	1	3	7	1	0

13	DM	F	50	Breast ca and chemo, prev DVT on warfarin	Dehiscence of LD donor site	Back	4	21	4	8	5	3	0
14	JB	F	52	Hypertension, gastric banding, abdominoplasty, thigh lift	Wound dehiscence	Thigh	1	28	4	8	7	2	0
15	JM	F	76	Cerebral palsy, hypothyroid, osteoporosis	SSG donor site	Thigh	24	18	2	4	5	2	0
16	OM	M	32	Deaf	Trauma	Foot	2	26	3	6	5	2	0
17	KI	M	82	IHD, CABG, HTN, T2DM, RA (on pred + methotrexate), Hypercholesterolaemia, CVA, AAA (4.5cm)	Wound dehiscence	Leg	2	16	3	6	5	1	0
18	BR	M	78	Prev sigmoid ca, colostomy, nec fas abdomen, CVA	SSG donor site	Thigh	36	39	2	5	7	2	0
19	HJ	F	85	RA	VLU	Ankle	24	11.25	12	20	7	1	0
20	AL	M	86		Arterial leg ulcer	Ankle	60	5.25	4	No change	9	2	0
21	IA	M	65	PVD Diabetes	Diabetic foot ulcer	Ankle	15	0.9	1	8	7	0	0
22	MW 4 applications	M	70	Bowel cancer	Wound dehiscence	Abdomen	42	123.5	8	Multiple small areas	3	1	0
23	EVD 2 applications	F	80	PVD	Mixed arterial leg ulcer	Leg	60	15.84	failed	failed	7	2	0
24	EO	F	72	RA	Trauma	Leg	24	4.94	Wound bed more active	Wound bed more active	7	2	0
25	MM	F	77	Diabetes type 1	Wound dehiscence	Abdomen	77	45	Failed	Failed	5	1	0
26	TS 3 applications	M	72	Bowel cancer	Wound dehiscence	Abdomen	72	22	Multiple small areas	Multiple small areas	3	0	0
27	BH	F	80	Nil	Wound dehiscence	Abdomen	14	21.6	Failed	failed	7	0	0

28	PN 2 applications	F	66	Systemic sclerosis	VLU	Leg	72	67.2	Failed	failed	3	0	0
29	BG	M	72	Nil	VLU	Leg	18	4.05	6	No change	3	0	0
30	JI	M	85	Diiabetes	Trauma	Leg	21	2.1	4	No change	3	0	0
31	JS	M	88	IHD, CABG, HTN	Trauma	Forearm	0.5	7	3	5	5	2	0
32	SM	M	93	IHD, CABG, HTN, AF	SSG donor site	Leg	3	9	2	3	5	2	0
33	PS	M	28	Nil	Wound dehiscence	Ankle	5	6	2	4	5	1	0
34	LM	F	39	GORD	Wound dehiscence	Arm	4	18	4	6	7	3	0
35	JK	F	58	PE/DVT, PCOS, asthma	Trauma	Pretibial	5	14	4	5	7	2	0

Table 2: Summary of patient demography and wound characteristics

Characteristics	Number of patients (%)
Mean age (years)	66.1 ± 21.1
Gender	
Male	16 (45.71%)
Female	19 (54.3%)
Wound aetiology	
Venous ulcer	5 (14.3%)
Arterial ulcer	2 (5.7%)
Burns	1 (2.9%)
Split thickness skin graft donor site	3 (8.6%)
Wound dehiscence	12 (34.3%)
Trauma	10 (28.6%)
Pyogenic Granuloma	1 (2.9%)
Diabetic foot ulcer	1 (2.9%)
Type of wound	
Acute	10 (28.6%)
Chronic	25 (71.4%)
Mean wound duration (months)	19.4 ± 24.0
Anatomical location	
Foot	3 (8.6%)
Ankle	6 (17.1%)
Leg	14 (40.0%)
Knee	1 (2.9%)
Thigh	3 (8.6%)
Abdomen	5 (14.3%)
Back	1 (2.9%)
Arm	1 (2.9%)
Forearm	1 (2.9%)