CELLUTOME™ Epidermal Harvesting System

Skender Veliu[1*], Jasmina Kröpfl[2], Dominika Vrbnjak[3]

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Abstract

Introduction: Treatment of acute and chronic wounds are a major challenge. In modern medicine, numerous approaches to wound healing are known. One of them is the use of epidermal autologous grafts. The purpose of this article is to present the use of automated epidermal harvesting system (CELLUTOME™ Epidermal Harvesting System; KCI, an Acelity company, San Antonio, TX, USA) in General Hospital dr. Jože Potrč Ptuj, Slovenija.
Case presentation: Treatment of a patient with a chronic wound after ruptured varicose veins on the right shin, a patient with a chronic wound after crash injury and a patient with nonhealing postoperative wound using CELLUTOME™ Epidermal Harvesting System are described.
Conclusion: Our results showed the positive effects of epidermal autologous grafts on the healing process of various types of wounds and confirmed the advantages of this system for the production of epidermal autologous grafts.
Keywords: Wound healing, autologous epidermal grafting, chronic wound, acute wound

**Corresponding author*: *Skender Veliu*
Email. *skender.veliu@gmail.com*

[1] Surgeon, Surgical ward, General Hospital dr. Jože Potrč Ptuj, Slovenia
[2] Nurse for controlling hospital infection, General Hospital dr. Jože Potrč Ptuj, Slovenia
[3] PhD, Assistant, University of Maribor, Faculty of Health Sciences, Slovenia

Introduction

Acute and chronic wounds are a significant challenge for wound care specialists. While acute wounds proceed through the normal stages of healing, chronic wounds usually do not follow an orderly process of regeneration and repair (1, 2) The healing process can be lengthy, requiring frequent office visits and dressing changes (1). Today there are many known methods of treating acute and chronic wounds. Skin grafts have been used to achieve successful wound healing when primary wound closure is not a feasible repair option (3). Split-thickness skin grafts (STSGs) have long been the gold standard for the management of acute wounds but have not gained favor in the treatment of chronic wounds for several reasons: discomfort associated with the donor site, the creation of a second wound (donor site) in a patient with poor wound-healing potential, and a lack of documented efficacy for the procedure (1). Traditional types of autografts include full-thickness and split-thickness skin grafts. Some disadvantages of autografts include the need for a surgical procedure with anesthesia, creation of a second wound on donor site, difficulty in obtaining uniform graft thickness, pain, and challenges with graft take and graft rejection (3, 4). Problems with the donor site may include excessive pain, pruritus, infection, dyschromia, delayed healing, and hypertrophic scarring, particularly in patients with poor healing properties due to various comorbidities (5, 6). Another drawback to traditional skin grafting techniques is the cosmetic outcome, including hypopigmentation, hyperpigmentation, and hypertrophic scarring (7).
Dermatologists first used epidermal grafting in 1964 and later for the treatment of hypo pigmented lesions (8). Epidermal skin grafts differ from full-thickness and split-thickness skin grafts in that they only contain the epidermal layer of the skin, which is comprised of 5 layers and 4 cell types. Despite the challenges of harvesting epidermal grafts, successful use has been reported in the treatment of burns and chronic wounds (9, 10). Epidermal grafting does not have any of the limitations encountered with STSG, however, it has not gained wide acceptance, as previous harvesting techniques were cumbersome and time-consuming (1). Epidermal grafting or using autologous epidermis that has been minced to expand and cover wounds much larger than the donor site, are an alternative to traditional autografts using only a minimal amount of autologous tissue from the donor site (11, 12). Only the epidermal portion of the donor area is grafted. This means that the graft acquires the epidermal architecture and characteristics of the recipient site, not the donor site, what potentially leads to better color match and cosmetic outcome (12, 13).
In 2013 an automated epidermal harvesting system (CelluTome Epidermal Harvesting System; KCI, an Acelity company, San Antonio, TX, USA) that applies negative pressure to harvest epidermal microdomes was commercially introduced (1). This system is also used in General Hospital dr. Jože Potrč Ptuj, Slovenia, since 2016.

The CELLUTOME™ Epidermal Harvesting System is a minimally invasive tool for harvesting epidermal micrografts and is designed for use in the office or outpatient setting. This system combines suction and warmth and produces consistent thin sections of epidermal skin. The technology of the device involves splitting the dermal-epidermal junction to form microdomes (ie. blisters), which are harvested into epidermal micrografts. These micrografts consist of undamaged epithelium with keratinocytes (Kci). The system yields up to 128 epidermal micrografts (1).

Epidermal grafting provides an approach in the treatment of acute and chronic wounds. The epidermal grafts can be used on wounds that have a clean granulating base that is free of nonviable tissue. The inner thigh is the preferred donor site; any hair on the inner thigh should be clipped and the skin prepared with 70% isopropyl alcohol. The harvester should be positioned on the donor site with the blue handle orientated in the upwards position and secured with the provided Velcro strap (Figure 1, 2).

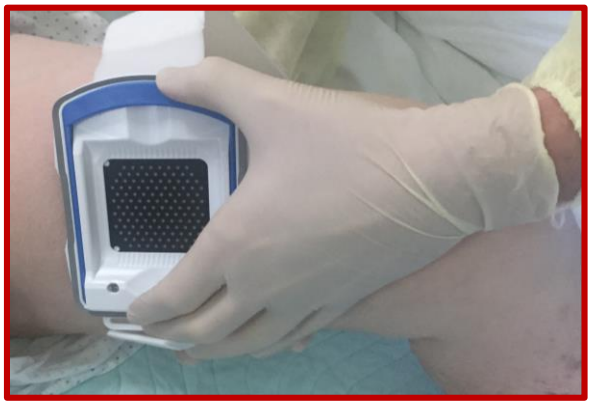

Figure 1: Positioning of harvester

Figure 2: Positioning of harvester

The physician should visually confirm complete contact with the skin and reposition if necessary. Alternate corners of the vacuum head-harvester complex should be pressed to ensure a good seal.

Next, the 'Start' button should be pressed on the control unit. The system heats the skin to between 37°C and 41°C and applies 400– 500mmHg of negative pressure. The vacuum head also provides illumination so that the site can be observed through the view window. The microdome preparation takes from 15 to 60 minutes; the preparation is complete when round epidermal microdomes form (Figure 3,4).

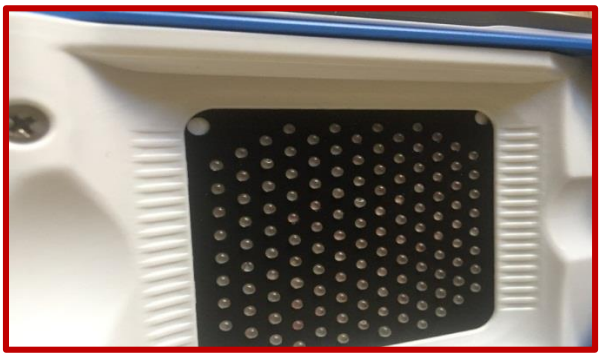

Figure 3: Formation of microdomes

Figure 4: Microdomes

To collect the microdomes, the control unit is turned off and the vacuum is removed from the vacuum head. The vacuum head is unlatched from the harvester by pressing the blue handle on either side. A dressing is then inserted into the harvester and pressed firmly against the microdomes. The choice of dressing can be left to the discretion of the physician—Tegaderm film dressing (3M Company, St. Paul, MN, USA) is recommended for

wounds with low levels of drainage. If using the film dressing, it is suggested that the dressing be rubbed gently against microdomes. Next, holding the harvester in place, the blue handle is retracted upwards until a click is heard, and then the handle is slowly returned to the start position. The dressing is carefully removed from the harvester and transferred to the recipient site (Figure 5).

The microdomes are secured in place by using compression wrapping, a bolster dressing, or with NPWT. The donor site (Figure 6) can be treated with a film dressing (1).

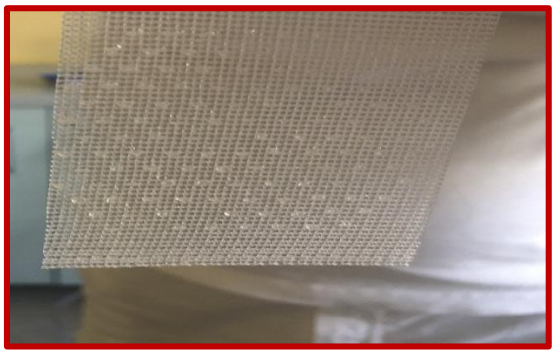

Figure 5: Microdomes for transmission

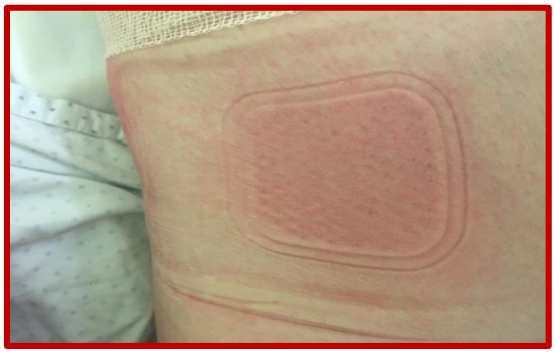

Figure 6: Donor site

Several advantages of epidermal grafting are noted over traditional split-thickness skin grafting. While split-thickness skin grafting necessitates the use of anaesthesia, with this automated system, epidermal grafts can be harvested easily by physicians in an out-patient setting. Patients experience little or no discomfort during the harvesting procedure. This novel automated epidermal harvesting system has simplified suction blister grafting, making epidermal grafting available to clinicians as an option for acute and chronic wounds. Early results from 17 cases have indicated decreased wound area of chronic wounds in a variety of patients, including those with comorbidities and in patients where an STSG was contraindicated (1). Epidermal grafting for dermatological use is well-documented in the literature, specifically in treating vitiligo (14, 15) and lesions of chronic discoid lupus erythematosus (16).

(17) reported their initial clinical experience using the CELLUTOME™ Epidermal Harvesting System for harvesting epidermal grafts when they treated 7 Haitian patients with chronic lower extremity wounds. Of the 7 wounds, 3 closed completely in 4 weeks and 3 showed marked improvements. All donor sites healed without any visible scarring. The harvesting of epidermal grafts using CELLUTOME™ Epidermal Harvesting System was accomplished in an outpatient setting and did not require anaesthesia or specialized surgical technique. Thus, epidermal grafting may provide a promising option for patients in resource-poor countries.

(18) provided a general overview of epidermal grafting and reported results of 4 patients treated with epidermal grafts harvested by the CELLUTOME™ Epidermal Harvesting System from the patient's thighs. Complete reepithelialisation was achieved in 3 wounds: a heat burns to the right radiated breast, right scalp melanoma excision site, and wound created after removal of a sacral tattoo. The fourth wound was a diabetic foot ulcer of 8 years' duration that maintained 50% reepithelialisation at the 2-month follow-up. All

donor sites healed without scarring within 1-2 weeks.

(19) treated 5 patients with chronic recalcitrant lower extremity ulcers (pyoderma gangrenosum) with epidermal grafts harvested by the CELLUTOME™ Epidermal Harvesting System. All patients continued to receive medical care for pyoderma gangrenosum. Three of the 5 wounds achieved full reepithelialisation at 5, 7, and 12 weeks, respectively. The remaining 2 wounds reduced in size by 64% and 99%, respectively, within 8 weeks. Minimal pain was associated with the procedure, and all donor sites healed within 1 week. There were no complications at the donor and recipient sites. In this series the authors noted that reepithelialisation moved in from the wound edges, and the epidermal grafts did not appear to "take" to the underlying tissue.

The purpose of this article is to present case examples of patients, treated in the wound care ambulatory setting in General Hospital dr. Jože Potrč Ptuj, Slovenia. Case examples of three patients where autologous epidermal graft, obtained by CELLUTOME™ Epidermal Harvesting System has been used to treat chronic wounds are described.

Case presentations

Case example 1

Patient ŠM (woman, born 1927) with heart failure, arterial hypertension, atrial fibrillation on anticoagulant therapy was previously treated because of spontaneous bleeding from right shin, because of ruptured varicose veins. Haemostasis was performed with regular wound treatments. The extent of necrosis was not determined. A month later, the patient was hospitalized with local necrosis of right shin sizing 15 x 10 cm (Figure 7).

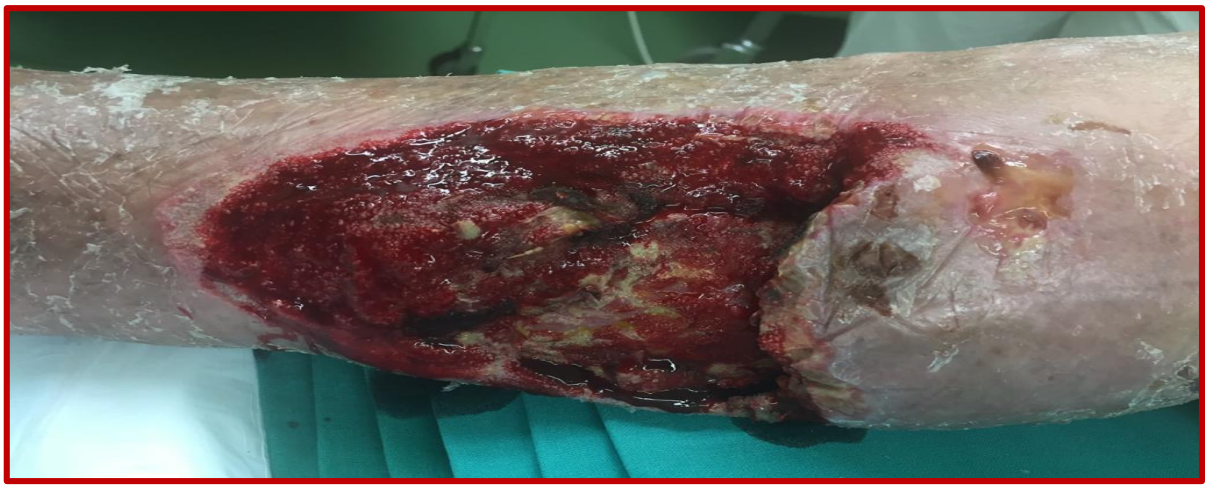

Figure 7: Wound after necrectomy (28. 9. 2016) (Case example 1)

Necrectomy was performed and negative pressure system was installed. During the hospitalization, patient received regular negative pressure wound treatment and the wound regularly healed. After discharge in home care, he continued with negative pressure wound treatment and ambulatory wound management. After three weeks, the patient returned to hospital due to the planned operative procedure (20). Because of comorbidities and

general health condition patient was not suited for a surgical procedure under general anaesthesia. Therefore, on the 26th of October 2016 we performed skin cell extraction with CELLUTOME™ Epidermal Harvesting System from medial left thigh and covered skin defect. Skin defect was covered with polyurethane foam. First wound dressing was performed after four days, while continuing treatment with Vaseline gauze. Vaseline gauze was later replaced by polymer membrane in a hydrophilic polyurethane matrix and used until healing (Figure 8).

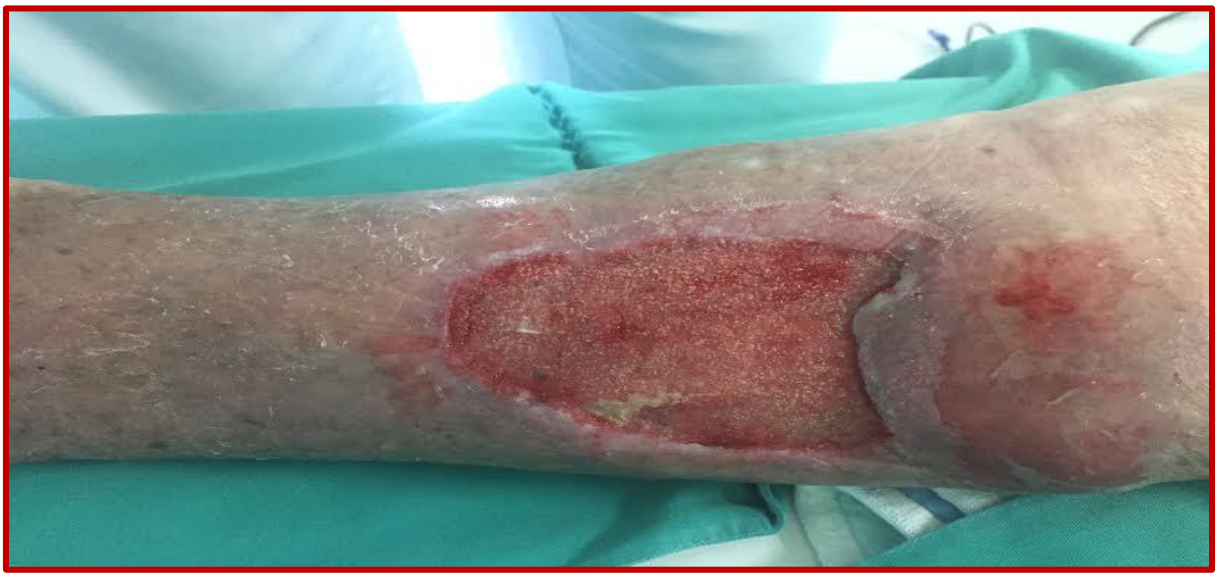

Figure 8: Wound after skin cell transplant, first wound dressing (Case example 1)

Cleaning of the wound was performed using saline solution. Wound care was performed three times weekly. A donor site for cell transplant was treated with film dressing and healed within 7 days. On 4th

Figure 9: Healed wound (4. 1. 2017) (Case example 1)

of January 2017 (70 days after skin cell transfer) wound healed (Figure 9).

Case example 2

Patient KM (male, born 1946) with arterial hypertension and rheumatic disease had a crush injury on the 29th of September 2017. First visit in our ambulatory setting was three weeks after the injury. There were two wounds on medial side of right thigh, dermacated necrosis with mild redness. Necrectomy and cleaning of the wound were performed. On 25th of October 2017 negative pressure wound system was installed (Figure 10). Patient regularly visited the ambulatory setting for wound care negative pressure wound system changes. On 1th of November 2017 skin defect was covered with clean granulation tissue. We performed skin cell extraction with CELLUTOME™ Epidermal Harvesting System from medial left thigh and covered skin defect measuring 6.0 cm x 5.0 cm. After cell transplant skin defect was covered with polyurethane foam. First dressing change was done after four days while continuing wound treatment with polymer membrane, followed by medical honey. Cleaning of the wound was performed using saline solution. Wound care was performed three times weekly.

A donor site for cell transplant was treated with film dressing and healed within 7 days. On 27th of December 2017 (57 days after skin cell transfer) wound healed (Figure 11).

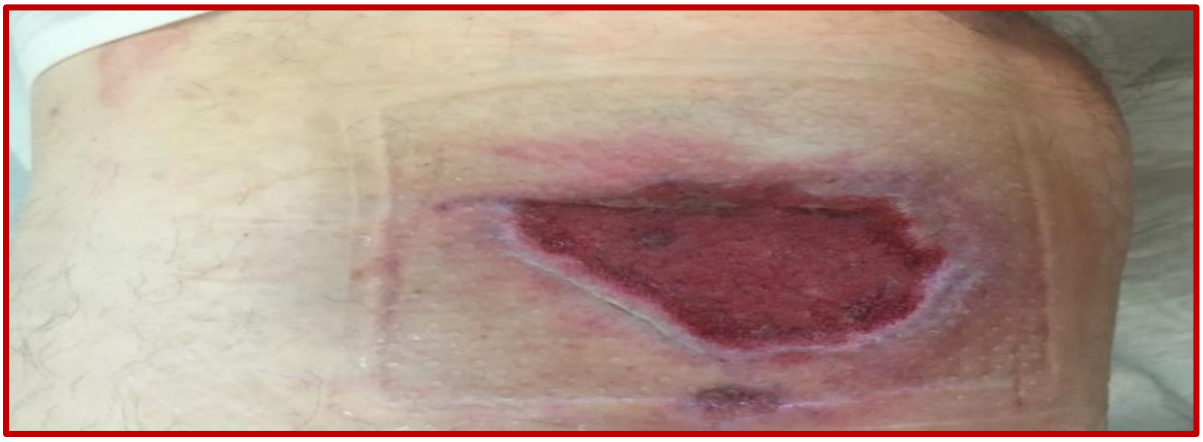

Figure 10: Wound after necrectomy (25. 10. 2017) (Case example 2)

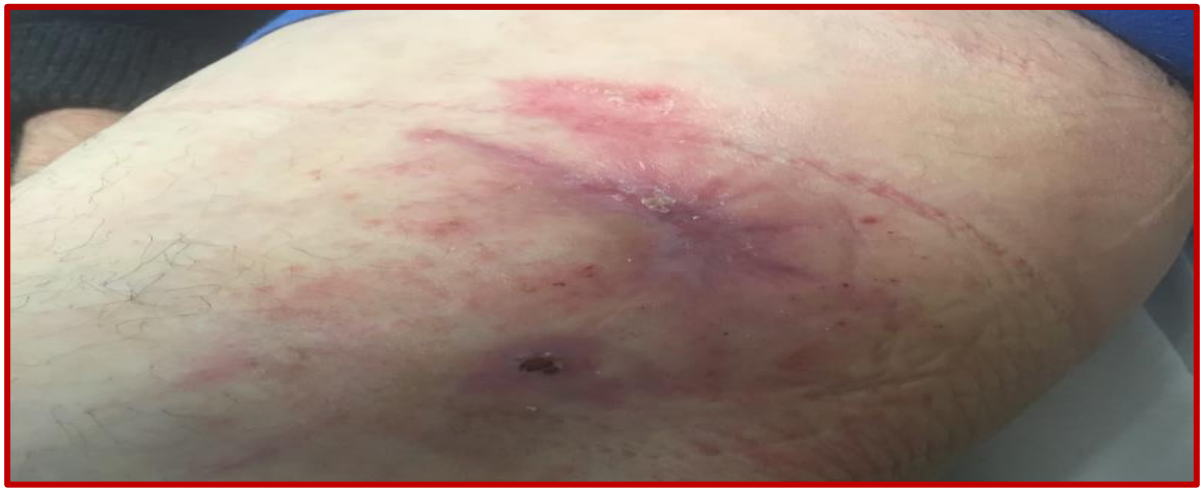

Figure 11: Healed wound (27. 12. 2017) (Case example 2)

Case example 3

Patient LN (woman, born 1961) with osteoporosis fell on the 15th of April 2017 and gained communitive fracture of right distal femur resulting in surgery. After surgical procedure, we treated skin defect using a negative pressure wound treatment which resulted in granulation of wound bottom. On 12th of May 2017 we performed skin cell extraction with CELLUTOME™ Epidermal Harvesting System from medial left thigh and covered skin defect (Figure 12).

Defect measured 10.0 cm x 5.0 cm. Again, polyurethane foam was used to cover skin defect. A first dressing change was made after four days while continuing wound treatment with a polymer membrane in the hydrophilic polyurethane matrix, which was used until the last treatment in our ambulatory settings (Figure 13).

Cleaning of the wound was performed using saline solution. Dressing change was three times weekly. A donor site for cell transplant was treated with film dressing and healed within 7 days. On 28th of June 2017 (47 days after skin cell transfer) wound measured 1.0 cm x 2.8 cm (Figure 14).

Unfortunately, the patient ended her visits in our ambulatory setting without knowing the reason. The end result is not known.

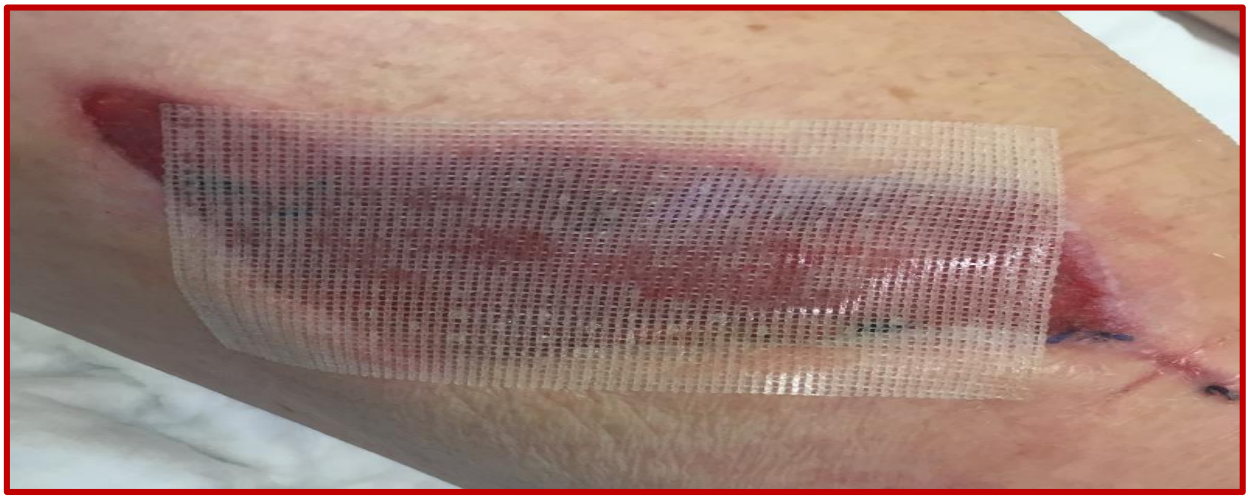

Figure 12: Application of microdomes to the wound (12. 5. 2017) (Case example 3)

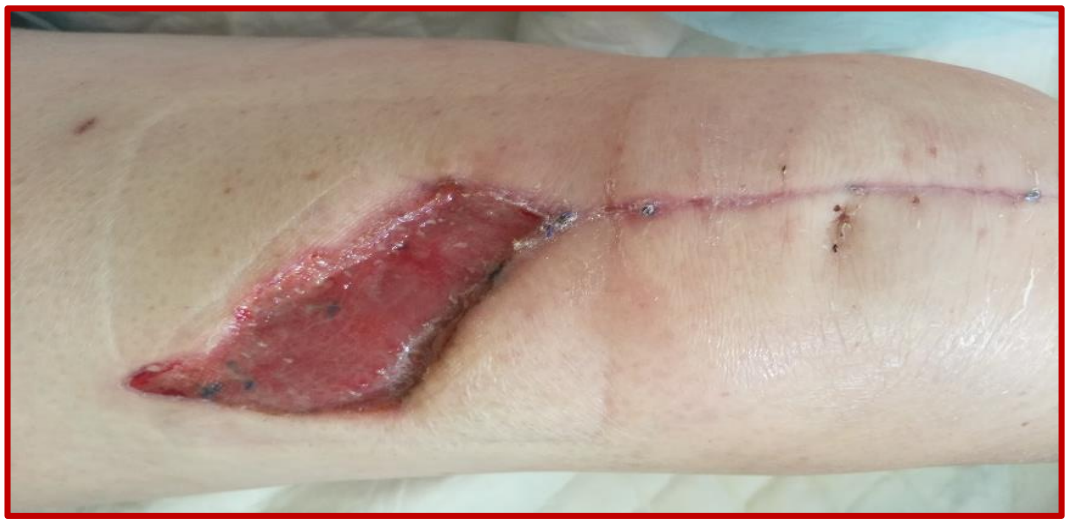

Figure 13: Wound after skin cell transplant, second wound dressing (19. 5. 2017) (Case example 3)

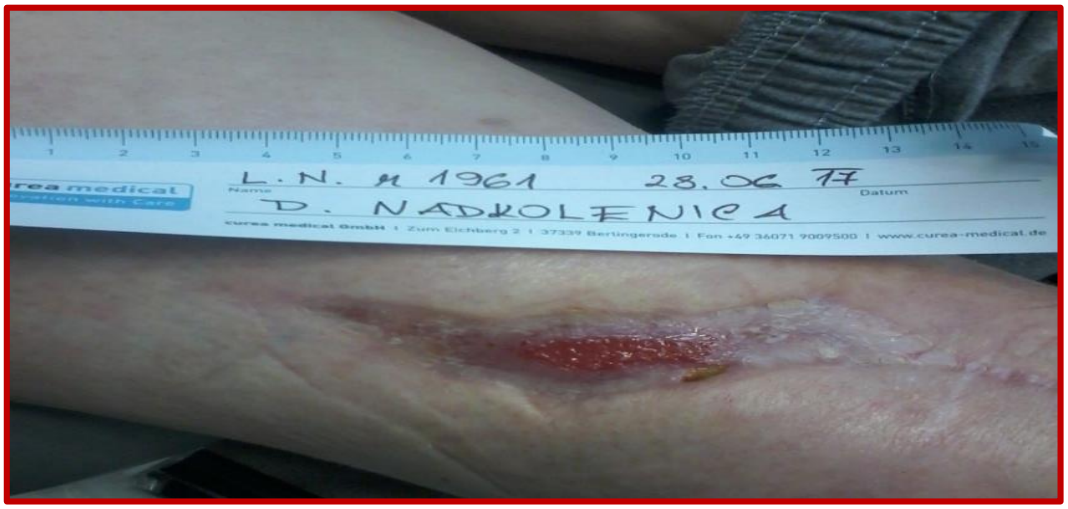

Figure 14: Wound 47 days after skin cell transplant (28. 6. 2017) (Case example 3)

Conclusion

We found that two out of three wounds completely healed. The average time from cell transfer to healing was 64 days. In the third case, the patient for unknown reasons did not come to the control in the ambulatory setting, but we find that during the period of 47 days after the transfer of cells in the area of the wound was reduced by 94%.
The procedure was carried out in the ambulatory setting by a physician and nurse. We found the procedure of cell transfer using the CELLUTOME ™ Epidermal Harvesting System short and simple. None of the patients needed hospitalization and the procedure was performed without anesthesia, what is a great advantage for polymorbid patients. The patients did not have any pain or unpleasant sensations in the take-off site during and after the procedure. The take-off sites completely healed in all patients within 7 days. The wound management after cell transfer was carried out with latest wound dressings, which reduced the number of shifts and visits in the ambulatory setting. We found lower economic burden for the patient and the health system and improved the quality of life of patients. CELLUTOME ™ Epidermal Harvesting System can be successfully used in the treatment of various types of wounds, as the results of the different studies shown positive effects on healing processes. However, randomized controlled trials are needed on a larger sample of patients in order to be able to finalize the safety and efficacy of this system. In addition, the effects of other factors that influence the wound healing process should be studied as part of the integrated treatment of patients.

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