Novel Abrasive Wound Model to Investigate the Healing Properties of Different Dressings for Superficial Wounds

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Abstract

Aim: The objective of the study was the assessment of the suitability of a new abrasive wound model to evaluate wound healing and make comparisons between different types of wound dressings and further to compare wound healing rate and overall cosmetic outcome of wounds treated with different medical devices intended for moist or dry wound healing of superficial everyday wounds.

Methods: A total of ten healthy volunteers were enrolled in the open-label, randomized, intra-individual comparison study. On the forearms of each volunteer five standardized, superficial abrasive wounds were induced by scrubbing the skin repeatedly with a surgical brush until first signs of uniform plucking and punctuate bleeding was observed. Three dressings intended for moist wound healing (polyurethane, hydrocolloid, hydrogel) and two standard dressings were randomly allocated to the test area.

Results: Evaluation of wound healing at study days 2, 5, 8, and 14.1 performed by investigator showed best results for wound healing for the polyurethane product and the hydrocolloid product dressing. Visible re-epithelisation could already be recorded at study day 5 and day 8 more than 50% of the wound had been resealed. Video microscope images support these findings. Also cosmetic outcome assessed by investigator and panellists was evaluated best for polyurethane and hydrocolloid product with very high mean scores close to the maximum score of 10. Histological examination of biopsies taken from the abrasive wounds of two volunteers showed that the model is especially suitable for studies of these superficial wounds since the dermis remains intact.

Discussion/Conclusion: Uniform and identical standardized wounds created using an abrasive brush technique could be employed reliably to detect differences in the performance of wound dressings intended for the healing of superficial wounds. In general moist wound healing showed better results compared to dry wound healing with an earlier onset and a better outcome of healing. Superficial cutaneous wounds treated with a polyurethane or a hydrocolloid product demonstrated superior rates of repithelisation and overall cosmetic outcome.

Introduction

The occurrence and subsequent healing of small, superficial acute wounds such as cuts and abrasions is a familiar everyday process and in healthy skin, these wounds usually heal without consequences.

In the clinical setting, the investigation of any wound processes is dependent on the use of models. Small identical standardized wounds are required to perform wound healing studies in order to compare different wound healing and treatment methods on the basis. Obviously, current methods such as transepidermal water loss, seilkeiprian strips, suction blister or mini-incisions in healthy but intact skin can test two different models, accidental abrasion wounds such as abrasive wounds, and there is still need for realistic and standardized models. Abrasive models such as mechanical induc- tion using an emery wheel for dermabrasion were considered an option yet considered too invasive. A novel model was developed using a standardized brush technique to induce uniform abrasive wounds.

Benefits of effects of occlusive and semi-occlusive wound treatment e.g. hydrocolloid, polyurethane or hydrogel dressings are well-documented. They promote healing by providing a moist environment that increases not only the rate of re-epithelisation, but affects and improves all aspects of healing. Clinical studies have shown that moist wound therapy accelerates wound healing both in partial thickness and full thickness wounds in humans.

The purpose of this study was three-fold – firstly to produce standardised identical abrasive wounds, secondly to determine if identical wounds created by this new abrasion model could be used to evaluate wound healing and make comparisons between different wound dressings, and thirdly to compare the wound healing rate and overall cosmetic outcome of wounds treated with these dressings.

Patients and Methods

Volunteers: Ten healthy volunteers (1 male, 9 female, mean age 32.8 years) were enrolled onto the study. All inclusion and exclusion criteria were verified before inclusion of panellists. Informed consent was obtained from all subjects and the study was approved by an independent ethics committee.

Wound Induction: In total, 5 standardized, superficial, abrasive wounds were induced on the forearms of two volunteers showed that the model is especially suitable for studies of these superficial wounds since the dermis remains intact.

Wound Induction Evaluation:

1. Wound healing: Evaluation of wound healing at study days 2, 5, 8, and 14.1 performed by investigator showed best results for wound healing for the polyurethane product and the hydrocolloid product dressing. Visible re-epithelisation could already be recorded at study day 5 and at day 8 more than 50% of the wound had been resealed. Video microscope images support these findings (Fig. 5).

2. Test Products/Product Application: All test products were randomly allocated to the test area. The products intended for moist wound healing were a Polyurethane Dressing (Hansaplast Fast Healing) a Hydrocolloid Dressing (Hansaplast Blister Plaster) and a Hydrogel Dressing compared to a waterproof dressing and a hydrocolloid product with very high mean scores close to the maximum score of 10. Histological examination of biopsies taken from the abrasive wounds showed that only the epidermis already be recorded at study day 5 and at day 8 more than 50% of the wound had been resealed. Video microscope images support these findings (Fig. 5).

Results

Wound Induction Evaluation: Wounds induced with the abrasive brush method showed good uniformity (Figures 1a-c). Punctate bleeding was observed in all wounds indicating removal of the epidermis. Wound healing rate and quality was imaged over a period of 14 days.

Biopsy Histology Assessments: Histological examination of biopsies taken from the abrasive wounds of two volunteers showed the suitability of the model. PAS staining results of biopsies taken from the wound bed edge of fresh wounds showed that only the epidermis had been removed with no papillary dermal damage (Figure 2a) and that the glycos带给rich basal lamina remained intact (Figure 2b).

Assessment of Cosmetic Outcome/Acceptance: Cosmetic outcome was assessed using a visual analog scale by filling-in a questionnaire. At study day 31 a final examination of biopsies taken from the abrasive wounds showed that only the epidermis had been removed with no papillary dermal damage (Figure 2a) and that the glycos带给rich basal lamina remained intact (Figure 2b).

Determination of Product Traits: In a questionnaire the panellists determined product traits regarding: handling and adhesion; material properties/appearance; removal of products; and effectiveness. The hydrocolloid product received the highest mean scores of all products followed by the polyurethane product. The results of the “ef- ficacy” as judged by the panellists correlated well with the wound healing assessments of the investigator.

Safety: Neither infectious nor allergic or unusually strong irritant reactions were seen at any of the superficial abrasive wounds. However, in two panellists skin reactions surrounding the wound were observed. Considering the type, number and outcome of adverse events, no negative aspects regarding safety were seen in this study.

Discussion and Conclusion

In this open-label, randomized, intra-individual comparison it could be shown that uniform and identical standardized wounds created using an abrasive brush technique could be employed reliably to detect differences in the performance of wound dressings intended for the healing of superficial wounds. The primary purpose of this study was to produce standardized identical abrasive wounds, to reflect more closely the clinical situation in superficial wound healing. The accuracy and reproducibility of each wound induction was found to be identical, enabling standardized comparisons. In particular, the wounds can be created under identical conditions, and are of identical shape and size, as supported by histological examination. Each anesthetic was required prior to wound induction. The wound model itself can be considered the clinical equivalent of every day abrasions and grazes. Furthermore, these wounds are adjacent to each other within the same body area, making clinical comparison more comparable.

In general products intended for moist wound healing showed better results compared to dry wound healing with an earlier onset and a better outcome of healing. Superficial cutaneous wounds treated with a polyurethane or a hydrocolloid product demonstrated superior rates of repithelisation and overall cosmetic outcome.

References

Available on request.