In vitro model for the evaluation of the effect of dressings used for negative pressure wound therapy (NPWT) on the tissue

C. Wiegand[1], S. Springer[1], M. Abel[2], P. Ruth[2], U.-Ch. Hipler[1]

[1]Department of Dermatology, University Medical Center Jena, Jena, Germany

[2]Lohmann & Rauscher GmbH & Co. KG, Rengsdorf, Germany

Introduction

NPWT is clinically effective in the treatment of chronic-stagnating wounds. Studies suggest that the positive effects result from cell recruitments to the wound site, where they contribute to granulation tissue formation. We showed that dressings used for NPWT exhibit different effects, cells especially grow into large-pored foams (Figure 1). Here, we look at the effects of dressings under NPWT on the tissue itself. Therefore, we used a tissue substitute to test the punch marking characteristics of dressings during NPWT *in vitro* employing optical profilometry to evaluate the results.

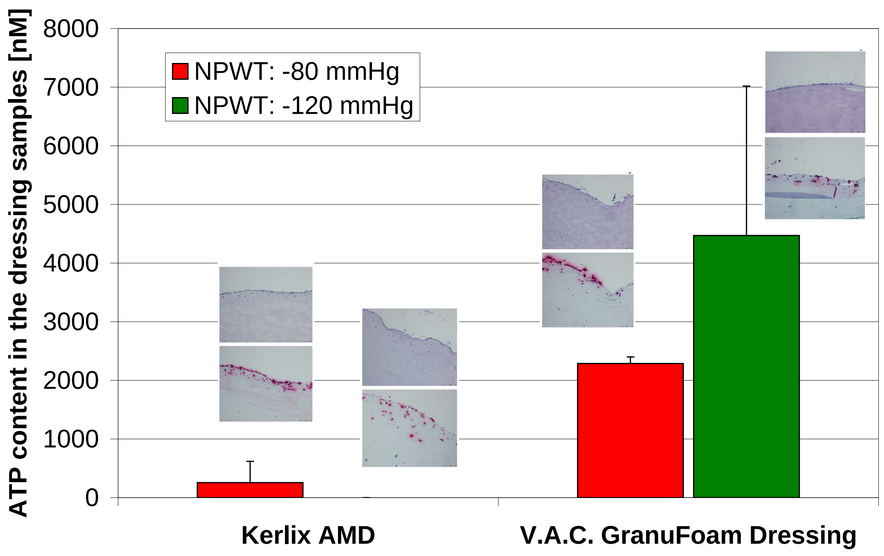

Figure 1: Measurement of the ingrowth of cells into a PHMB containing gauze (Kerlix AMD) and a large pored PU foam (V.A.C. GranuFoam dressing) after itreatment with NPWT for 24h in vitro (data presented as mean ± SE). Inserts show the corresponding cross sections of fibroblast-3D-cultures (upper panel: staining with haematoxylin/eosin, lower panel: staining with anti-vimentin antibody). [1]

Material & Methods

Different dressing samples* were placed on the tissue substitute (10% gelatine, 10% milk powder) and connected to a vacuum pump (Suprasorb® CNP-P1, Lohmann & Rauscher) by a vacuum seal. Experiments were carried out at -120mmHg for 24h under dry (no fluid-supply) and wet (additional fluid-supply) conditions. Embossing of the dressings into the tissue substitute was determined using optical profilometry (PRIMOS®, GFMesstechnik GmbH).

*white foam = Ligasano, Ligamed
⁺PU-foam = Suprasorb® CNP foam, Lohmann & Rauscher
#drainage foil = Suprasorb® CNP drainage foil, Lohmann & Rauscher,

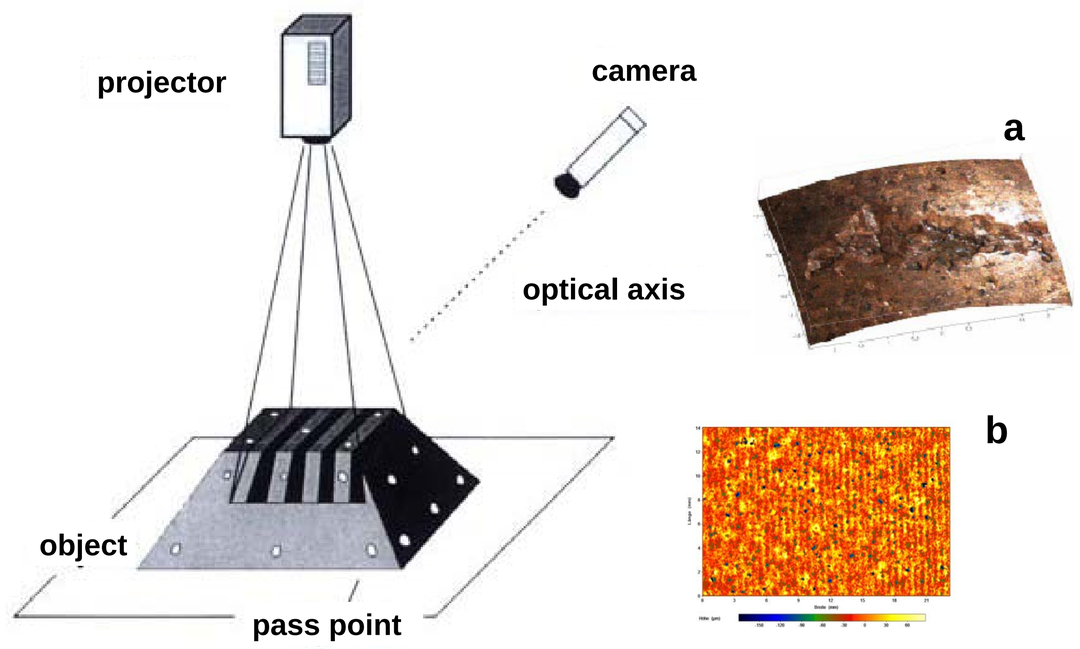

Figure 2: Schematic presentation of the principle of optical profilometry. Data points captured by a CCD camera can be used to generate a 3D image of the measured object (a) or are subjected to calculation surface roughness parameters (b). [2]

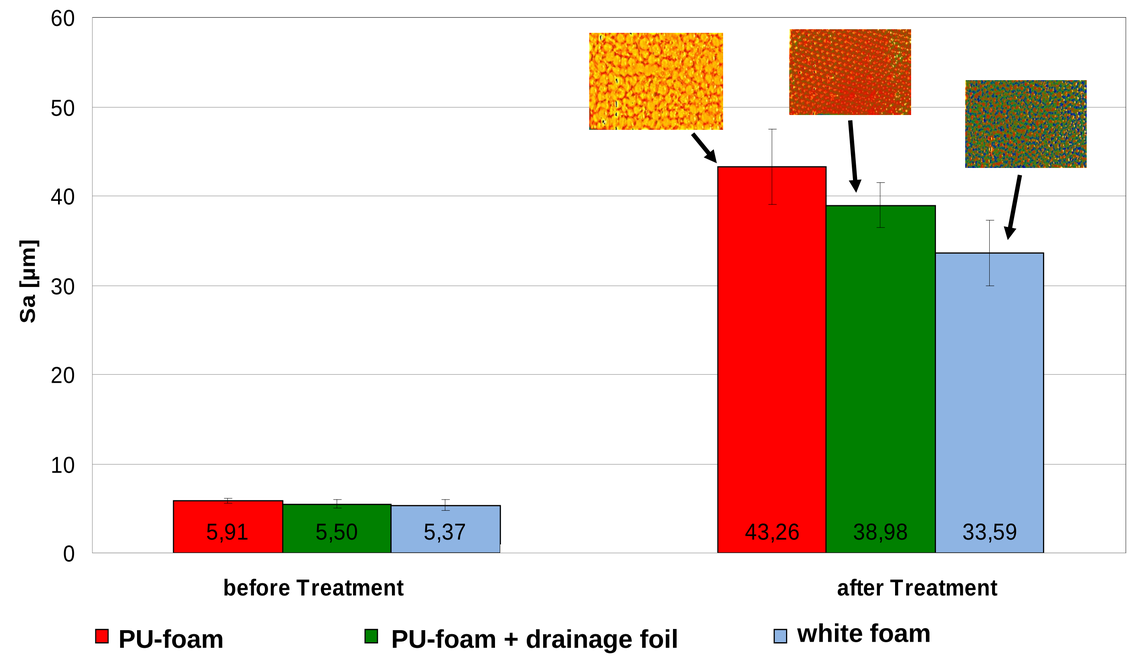

Figure 3: Under dry conditions (no additional fluid-supply), the white foam* exhibited the lowest effect on the surface roughness (data presented as mean). Inserts show selected PRIMOS images indicating color-coded height differences before and after treatment with the respective dressings.

Results

Measurement of the surface roughness was used for evaluating the dressings' effect on the tissue substitute. As expected, the large-pored PU-foam⁺ caused a higher irritation of the surface compared to the white foam* under dry conditions (Figure 3). However, no significant differences were found under wet conditions (Figure 4). The combination of PU-foam⁺ and drainage-foil# was found to reduce the effect of PU-foam+ on tissue substitute surface roughness in both cases (Figure 3 and Figure 4). Surface roughness values after vacuum treatment were decreased about 30% in both, dry and wet conditions.

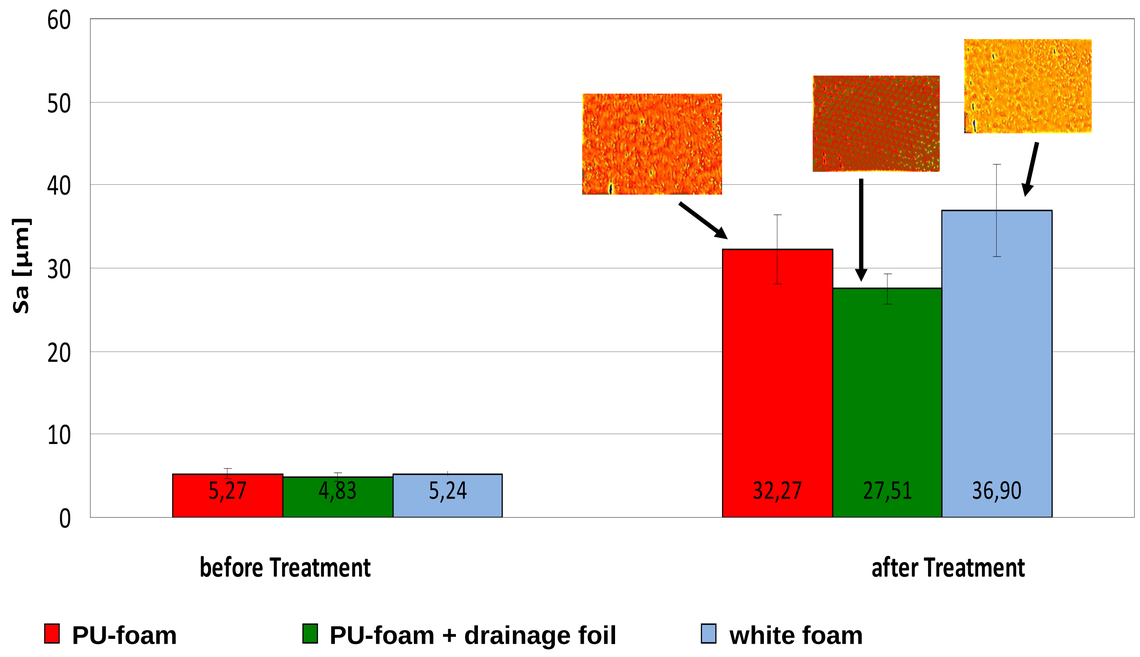

Figure 4: Under wet conditions (additional fluid-supply), the combination of PU-foam⁺ and drainage foil# achieved the lowest surface irritation (data presented as mean). Inserts show selected PRIMOS images indicating color-coded height differences before and after treatment with the respective dressings.

Discussion

Using an *in vitro* model for NPWT combined with a gelatine/milk powder-based tissue substitute it could be shown that different dressings exhibit a distinct effect on the wound area. In the test series, it could be shown that the combination of large-pored PU-foam⁺ and drainage-foil# irritated the surface less than the PU-foam⁺ alone, achieving results comparable to white foam*. Hence, their combined application seems advantageous for negative pressure wound therapy.

References

[1] Wiegand C, Abel M, Ruth P, Hipler UC. Influence of negative pressure wound therapy (NPWT) on fibroblasts in 3D-culture. Presented at the 20th Conference of the European Wound Management Association (EWMA) 2010, Geneva/Switzerland

[2] Przybilla H-J. Streifenprojektion - Grundlagen, Systeme und Anwendungen, 2008

XI. Congresso Nazionale AIUC, 26. - 27. Settembre 2012, Rimini