Novel tNPWT+DL† Dressing Delivers Accelerated Healing in an *in vivo* Porcine Model

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Introduction

Whilst traditional Negative Pressure Wound Therapy (tNPWT) systems have demonstrated efficacy in managing hard-to-heal wounds[1], they are limited by their localized pressure delivery. In contrast, advanced single-use NPWT§ (sNPWT) systems[2] have shown accelerated healing outcomes, attributed to their ability to distribute negative pressure across a wider therapeutic zone. To bridge this gap, a novel cuttable and repositionable tNPWT dressing, enhanced with a distribution layer (tNPWT+DL†) has been developed (**Figure 1**).

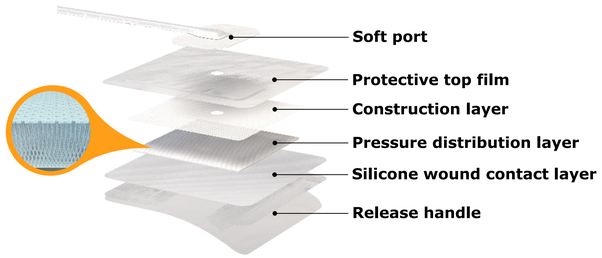

Figure 1. Novel tNPWT+DL* dressing and constituent layers.

Study Aim

To investigate and compare the effect on wound healing of traditional Negative Pressure Wound Therapy (tNPWT) with drape and foam filler‡ and a novel traditional Negative Pressure Wound Therapy dressing containing a distribution layer (tNPTW+DL†), that can be used with or without the use of foam filler (as facilitated by the design of the dressing), in a clinically relevant animal model.

Methodology

Full thickness 2.5 cm diameter excisional wounds were created in the flanks of 6 female pigs. Treatments were allocated to each wound with contralateral wounds treated with either tNPWT with drape and foam filler‡ or tNPWT+DL† with or without foam filler (according to manufacturer's guidelines). tNPWT+DL† dressings without foam filler were changed at 7 days while tNPWT‡ and tNPWT+DL† groups with foam filler were changed every 3 days were, in line with product instructions for use.

Observational measurements were taken after days 3, 6, 9 and 12 days for groups used with a foam filler and 7 and 12 days for tNPWT+DL† without foam filler (in line with scheduled dressing changes) to assess various wound healing and surrounding skin outcomes. Histological samples were taken for all groups after 12 days.

The following analyses were undertaken:

- Wounds were digitally photographed with Image Pro™ analysis software (version 4.1.0.0 Media Cybernetics, USA) used to measure closure outcomes.
- Wound depth was measured prior to device application, at each dressing change and at study conclusion to assess degree of filling by granulation tissue.

Methodology cont.

- Tissue samples were taken for histological analysis with haematoxylin and eosin (H&E) staining and assessed for degree of re-epithelization and depth of wound edge epithelium.
- Peri-wound region skin measurements were made using Courage & Khazaka Tewameter™ TM 300 for Trans Epidermal Water Loss (TEWL).
- Wounds were inspected for wound surface damage immediately after removal of dressings or filler (in wounds where the latter is used).
- Where appropriate, when data were found to be normally distributed parametric analysis (Anova – Multivariate Analysis followed by ad hoc two sample student t-test) was performed. For non-normally distributed data non-parametric analysis (Kruskal Wallace – Multivariate Analysis followed by ad hoc two sample Mann Whitney U-test) was used to test the significance of any inter-group differences. Differences were considered statistically significant at $p<0.05$.

Results

- The tNPWT+DL† dressing demonstrated significantly faster wound closure when used without a foam filler, as measured by the percentage of wound area remaining relative to the original wound size, compared to tNPWT‡. By day 12, only 28% of the wound area remained open with tNPWT+DL† versus 60% with tNPWT‡, representing a 1.8-fold (80%) greater area reduction ($P < 0.001$; **Figures 2** and **3**).
- When used with a filler (both groups undergoing 3-day dressing changes), a similar overall healing trajectory to tNPWT‡ was observed. However, significantly faster wound closure (1.1-fold improvement) was evident with tNPWT+DL† after 6 days of treatment ($P < 0.05$).
- The tNPWT+DL† dressing, when used without a foam filler, also enabled 1.7-fold (73%) faster re-epithelialization compared to tNPWT‡ by day 12 ($P < 0.03$; **Figure 4**).
- Furthermore, 90% of wound depth was filled with granulation tissue by day 7 in wounds treated with tNPWT+DL† without a foam filler, whereas this level of granulation was not observed with tNPWT‡ until day 12.

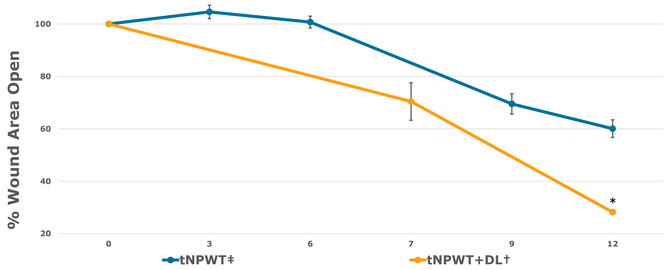

Figure 2. Wound closure (% wound area remaining) over time (n = 3; error bars represent ± SEM) across all groups. *P < 0.05.

- The tNPWT+DL† dressing, when used without a foam filler, resulted in no visible wound surface damage or disruption upon dressing removal at any time point, whereas wound surface disruption was observed in all cases treated with tNPWT‡.

Results cont.

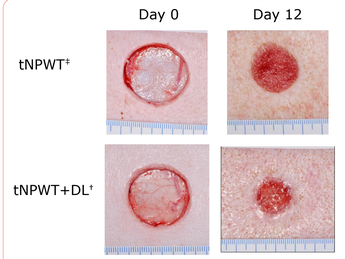

Figure 3. Wound progression over the 12-day study period for wounds treated with tNPWT‡ (with foam filler) and tNPWT+DL† dressing without a foam filler.

Figure 4. Percentage re-epithelialization of excisional wound surfaces by histology on post-wounding day 12 (n = 3; error bars = ± SEM) for tNPWT‡ (with foam filler) versus tNPWT+DL† dressing (without foam filler).*P < 0.05.

- The tNPWT+DL† dressing, when used without a foam filler, resulted in a >1.9-fold (>48%) reduction in peri-wound epithelial thickness depth compared to tNPWT‡ at day 12 ($P < 0.01$). Reduced peri-wound epithelial thickening may support progression of the advancing wound edge[3,4] (**Figure 5**).
- The peri-wound skin remained unstrained when treated with the tNPWT+DL† dressing (used with or without filler), compared to tNPWT‡, based on TEWL measurements obtained beneath the dressing. TEWL values for tNPWT+DL† remained ≤25 g/h/m² throughout the study (within normal skin conditions[5], 15-25 g/h/m²), whereas with tNPWT‡, values exceeded 25 g/h/m² at days 6, 9, and 12 (**Figure 6**).

Figure 5. Mean epithelial thickness at the wound edge (peri-wound) by histology (n = 3; error bars = ± SEM) for tNPWT‡ (with foam filler) versus tNPWT+DL† dressing (without foam filler). *P < 0.01

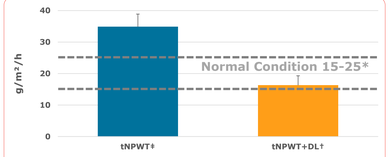

Figure 6. Peri-wound region TEWL on day 12 (n = 3; error bars = ± SEM) for tNPWT‡ (with foam filler) versus tNPWT+DL† dressing (without foam filler).*Threshold based on Matsui *et al*., 2024[3].

Conclusions

- Treatment with tNPWT+DL† dressing resulted significantly faster wound healing (when used with or without a foam filler) and re-epithelialization (when used without a foam filler) than tNPWT‡ with drape and foam filler.
- In addition, when the tNPWT+DL† dressing was used without a foam filler no wound surface disruption was observed upon dressing removal, hyperproliferation of wound edge epithelium was significantly reduced and surrounding skin remained similar to normal skin (TEWL measurements, dressing used with or without a foam filler).
- These findings support that the novel tNPWT+DL† dressing successfully delivered the benefits seen in sNPWT system§ treatment in the traditional NWPT system setting, through its design which delivers negative pressure to the wider zone and allows it to be used without a filler.

References: 1. Hurd T, *et al*. Adv Wound Care (New Rochelle). 2017 Jan 1;6(1):33-37. **2.** Kirsner R, *et al*. Wound Repair Regen. 2019 Sep;27(5):519-529. **. 3.** Fernandes MF, *et al*. Wound Practice and Research. 2025;33(4):186-195 **4.** Melnychuk I and Juriga J. Adv Skin Wound Care. 2023 Sep 1;36(9):495-501. **5.** Matsui, N. *et al*. Electronics 2024, 13, 4779.

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†RENASYS◊ WOUND+ Negative Pressure Wound Therapy dressing, Smith & Nephew. ‡RENASYS◊ Negative Pressure Wound Therapy with drape and foam filler, Smith & Nephew. § PICO◊ single-use Negative Pressure Wound Therapy, Smith & Nephew.

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