Bacterial retention within a multi-layered absorbent AIRLOCK◇ Technology Single Use Negative Pressure Wound Therapy (sNPWT) dressing

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Introduction

- The dressing with AIRLOCK Technology* helps promote wound healing in low to moderate exuding wounds; it is a four-layer dressing that ensures negative pressure is delivered to the wound bed and exudate is removed through absorption and evaporation,[1] which:
  - May help to reduce oedema[2–5]
  - May help to improve perfusion,[1,5] stimulating blood flow[1]
  - Stimulates granulation tissue formation[1,6-8]
  - Supports macro-deformation facilitating wound contraction[1,8]
- High bacterial bioburden in all types of wounds can delay and impair the time taken for wounds to heal[9]
- The ability of dressings to retain bacteria and hold them away from the wound bed is therefore a key feature
- *In vitro* experiments were undertaken to evaluate bacterial retention capabilities of an sNPWT dressing with AIRLOCK Technology* in a wound model incorporating a flow rate to simulate a moderately exuding wound

*PICO◇ (Smith & Nephew)

References

1. Malmsjö M et al. *Eplasty*. 2014;14:e15; **2.** Selvaggi F et al. *Surg Technol Int*. 2014;24:83-89; **3.** Young SR et al. *Int Wound J*. 2013;10:383-388; **4.** Hyldig N et al. *Br J Surg*. 2016; 103:477-486; **5.** Dowsett C et al. *JCN Supplement*. 2015;29(5):3; **6.** Wilkes R et al. *J Biomech Eng*. 2009;131(3):031012; **7.** Saxena V et al. *Plast Reconstr Surg*. 2004;114(5):1086-1096; **8.** Borgquist O et al. *Ann Plast Surg*. 2010;64(4):789-93; **9.** Edwards R & Harding KG. *Curr Opin Infect Dis*. 2004;17:91-96

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Materials and methods

- Test organisms used were ***Pseudomonas aeruginosa*** **NCIMB 8626** and ***Staphylococcus aureus*** **NCTC 10788**
- Inocula were prepared from overnight slope cultures (approximately $1x10^9$ colony forming units [CFU]/mL) and adjusted in maximum recovery diluent (MRD) to contain approximately $1x10^6$ CFU/mL

sNPWT preparation

- Dressings (10cm x 30cm) were tested as whole dressings, and were inoculated with 15mL of prepared inoculum using a 1.2 x 40mm needle and 20mL syringe. Dressings were inoculated away from the port so as not to block the filter before the rest of the dressing was saturated, simulating clinical use of the dressing.
- Dressings were then immediately placed wound contact layer (WCL) down onto a wound model plate, and adhesive strips applied to the 72h samples. These dressings where then attached to the sNPWT pump, and ~80mmHg negative pressure was applied.
- MRD was pumped into the wound model plate via a peristaltic pump at 15.5µl/min and samples were incubated at 32°C for 72h (Figure 1). Dressings were tested in triplicate at 0 and 72h.

Control preparation

- For the control, 15ml of prepared inoculum was placed in a 250mL sterile pot and incubated alongside the wound models. This was also attached to a bottle of MRD via sterile tubing, which was pumped into the 250mL pot using a peristaltic pump. This was pumped at a rate of 15.5µL/min.
- The control was incubated at 32°C for 72h and was tested in triplicate at 0 and 72h.

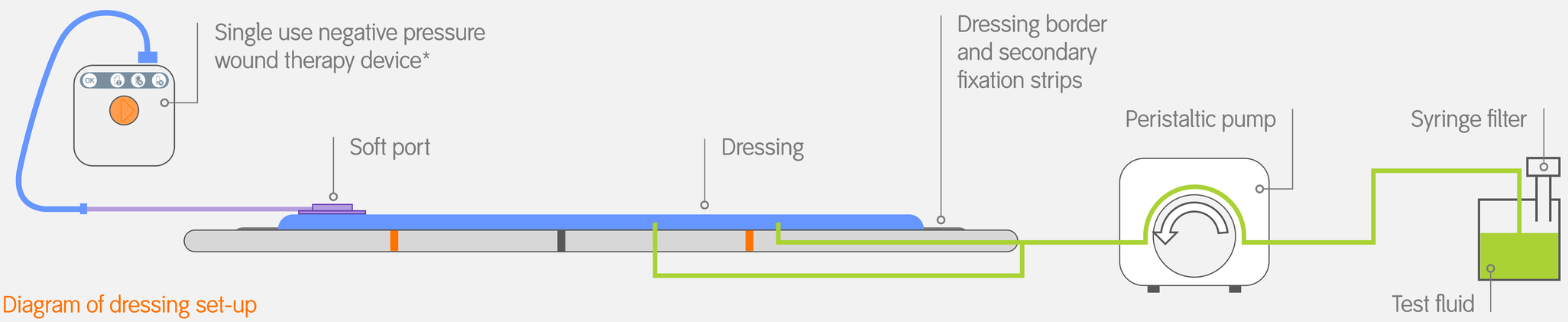

Figure 1. Diagram of dressing set-up

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Materials and methods (cont)

Sample processing

- 0h dressings were given 2 minutes dwell time before processing to reflect the time between inoculation and application of NPWT for the 72h samples.
- After the required incubation times, sNPWT was stopped and the tubes supplying pressure to the dressings were cut away so as not to interfere with sample processing. The dressing was cut around the pad with a sterile scalpel, leaving the adhesive border attached to the plate. The remaining dressings were separated, with the AIRLOCK layer and super-absorber layer being placed into a sterile bag containing 150mL of MRD.
- All dressings were then stomached (paddled/blended) for 5 minutes at 300rpm using a Stomacher™ 400 circulator (Seward) to recover the organisms from the dressing.
- The base of the wound was swabbed using a sterile swab. The swab (containing approximately 0.5mL fluid) was recovered in 9mL of MRD and was thoroughly mixed by vortex.
- For the inoculum control, 150mL of MRD was added to the 250mL pot containing the 15ml of inoculum and thoroughly mixed by vortex.
- The number of viable organisms (CFU) remaining in each processed solution were determined by the pour plate technique.

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Results

- Over the duration of incubation (72h), with both test organisms, an increase in bacterial counts was observed in both the inoculum control and layers of the dressing (~3 $\log_{10}$ CFU/sample) demonstrating the viability of the test organisms throughout the test period
- Bacterial counts from the wound model swab, AIRLOCK layer and super-absorber layer were added together to give the total bacterial recovery from the dressing. Counts from each section of the dressing were then divided by the total bacterial recovery and this value was then converted into a percentage
- At 72h, 99.99971% of *P. aeruginosa* were retained in the dressing (9.45719% in the AIRLOCK layer, 90.54252% in the super-absorber) and 0.00029% were recovered from the swab of the wound model (Figure 2)
- At 72h, 99.99951% of *S. aureus* were retained in the dressing (11.78199% in the AIRLOCK layer, 88.21752% in the super-absorber) and 0.00049% were recovered from the swab of the wound model (Figure 3)

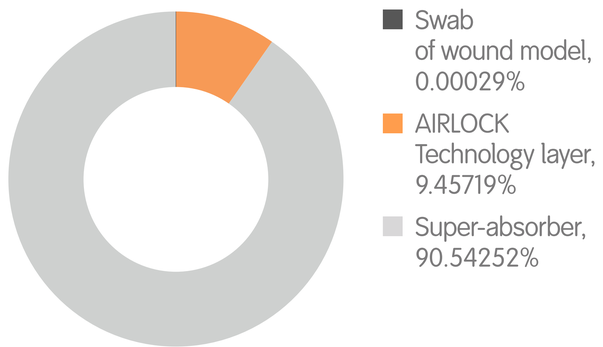

Figure 2. Percentage retention of *P. aeruginosa* bacteria throughout total dressing after 72h under NPWT in a dynamic model (mean values, n=3)

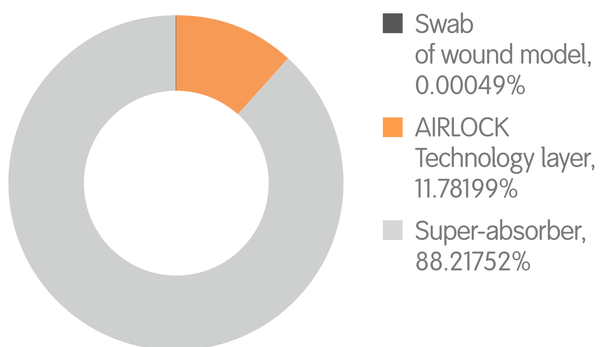

Figure 3. Percentage retention of *S. aureus* bacteria throughout total dressing after 72h under NPWT in a dynamic model (mean values, n=3)

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Conclusions

- This *in vitro* study demonstrates that >99.999% of bacteria are held within the sNPWT dressing*
- This *in vitro* study demonstrates that the bacteria tested do not move through the dressing AIRLOCK layer back to the wound model surface
- Management of bioburden and retention away from a wound is important to minimise delayed wound healing[1,2]

Acknowledgements

The authors would like to thank Ashley Laverick (Smith & Nephew) and Kiersten Vaughan (Smith & Nephew) for their technical assistance and helpful discussions.

For detailed product information, including indications for use, contraindications, precautions and warnings, please consult the product's applicable Instructions for Use (IFU) prior to use.

*PICO◇ (Smith & Nephew)

References

1. Edwards R & Harding KG. *Curr Opin Infect Dis*. 2004;17:91-96; **2.** Schultz GS, et al. *Wound Repair Regen*. 2003;11: (Suppl 1):S1-28

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