

# Effect of a new non-adherent absorbent silver antimicrobial dressing on biofilm formation

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## Abstract

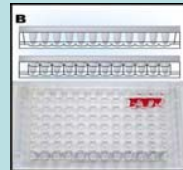
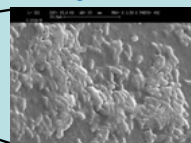
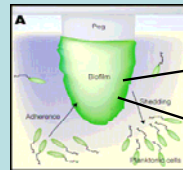
Biofilms are commonly defined as microorganisms encased in a matrix of both host and microbial origins that form large three-dimensional communities with coordinated multicellular behaviour. While most chronic wounds are contaminated by a diverse bacterial population, it is thought to be the presence of bacteria in biofilms, which allows them to resist host defenses and protects them from antimicrobial treatments.

Silver dressings have been widely used in the treatment of infected chronic wounds, due to their potent antimicrobial efficacy. However, there is a lack of evidence regarding the effect of silver dressings on biofilm disruption. In this study we have evaluated a new non-adherent absorbent silver dressing, Silvercel® Non-Adherent, in a high through put, *in vitro* biofilm model. This model allows us to assess the ability of the dressing to prevent biofilm formation or disrupt preformed biofilms of common wound pathogens; *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Enterococcus faecalis*.

Our results demonstrate the potent antimicrobial action of a new non-adherent absorbent silver antimicrobial dressing when tested against common wound pathogens and resistant strains in standard *in vitro* assays such as log reduction and zone of inhibition. Interestingly, microorganisms present in this biofilm model were less responsive to therapy than when tested in current standard *in vitro* assay systems. However, we have demonstrated that this new non-adherent silver dressing can effectively prevent biofilm formation, as well as significantly reducing the bacterial load in preformed biofilms. These results demonstrate efficacy, *in vitro*, of a new non-adherent absorbent silver dressing. Further studies confirming effectiveness in clinical practice are ongoing.

\*SILVERCEL is a trade mark of Systagenix Wound Management Ltd

## High Throughput *in vitro* pre-formed biofilm killing model

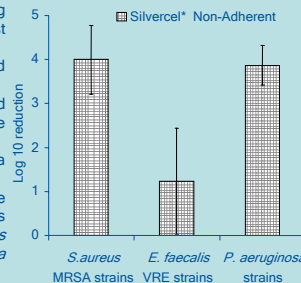


Images courtesy of Innovotech

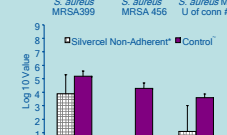
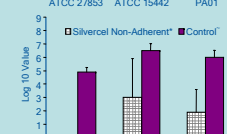
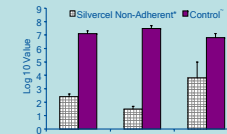
- 96 well format giving reproducible biofilms.
- Biofilms grown for 24 hours pre-antimicrobial challenge in human serum.
- Human serum used as challenge medium to reflect physiological conditions.
- Planktonic cells removed by washing leaving adherent cells attached to pegs to be challenged by antimicrobial.
- Dressings are placed firmly in the bottom of each well, with human serum media, and preformed biofilms are incubated for desired time.
- Endpoint measured by removing adherent cells via sonification and plating to give colony forming units (CFU)/peg.

## Biofilm prevention *in vitro* Model

- 12 well quantitative method to measure adherence killing and biofilm formation of viable organisms attached to test materials.
- Samples were attached to a pegged lid and incubated with inoculum ( $10^5$  cells) with overnight shaking.
- After 24hr contact time, samples were rinsed 3x, adhered bacteria were removed by sonification and plated to give CFU recovered/sample.
- Result's are presented as log<sub>10</sub> reduction compared to a non-silver containing absorbent dressing control.
- This assay demonstrated the ability of silver to reduce microbial adherence to the dressing. Silver was particularly effective on inhibition of *Staphylococcus aureus* (MRSA) strains and *Pseudomonas aeruginosa* strains, given  $\geq 3$  log reduction criteria for efficacy.



## Results of pre-formed biofilm killing

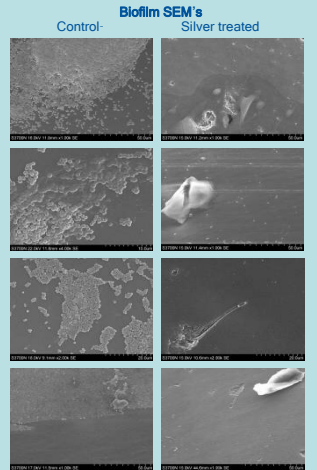


*P. aeruginosa* ATCC 15442

*S. aureus* MRSA 399

*S. aureus* MRSA 456

*E. faecalis* VRE M4682



- Control refers to biofilm formed peg that was untreated after 24hrs

## Conclusion

The data presented shows SILVERCEL® Non-Adherent is effective at reducing the bioburden of *S. aureus* (MRSA), *P. aeruginosa* and *E. faecalis* (VRE) in pre-formed biofilms within 24 hours. Notably, no viable bacteria were recovered from the biofilms of MRSA 399 and VRE 06-0147 strains when treated with Silver.

The representative SEM demonstrate the removal of bacteria from the pegs when treated with silver dressing compared to the untreated control showing large amounts of bacteria adhered to the surface with an exopolysaccharide matrix apparent in the micrographs. Silvercel® Non-Adherent was able to inhibit the formation of biofilms over 24hrs in *S. aureus* (MRSA) and *P. aeruginosa* strains giving  $> 3$  log reduction. Future work will concentrate on using a multi-species biofilm model to evaluate antimicrobial efficacy.

The study gives insight into the differences in bacterial killing efficiency from the standard log<sub>10</sub> and zone of inhibition assays (See complementary SILVERCEL® Non-Adherent poster for data) compared to performance in biofilm models, this suggests the need to evaluate the efficacy of microbial agents in more relevant *in vitro* assay for wounds.