# Determination of the reduction of biofilm *in vitro* during wound cleansing using a monofilament debrider*, a cleansing system with poloxamer**, and conventional cotton gauze

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## Introduction

Biofilms (figure 1) are complex structures consisting of bacteria cells embedded in an extracellular matrix consisting of hydrated extrapolymeric substances (EPS) [1]. They are usually associated with chronic infections such as the pathogenesis of dental caries, urinary tract infections, chronic bronchitis in cystic fibrosis patients, and endocarditis [1]. It is also thought that a major impediment to wound healing and the formation of chronic wounds is the development of bacterial biofilms on the wound [2]. Hence, a combined treatment approach involving debridement and the addition of antibacterial agents may provide the highest success rates. Surgical debridement requires trained personal, an operation theatre and is often associated with pain but conventional methods relaying on cotton gauze may not be enough. This could be amended by using a wound debrider* made from monofilament polyester fibres, which has been designed to provide fast, effective mechanical debridement that is pain- and trauma free. In contrast, the cleansing system containing poloxamer** is a pre-moistened single use cloth containing a mild cleansing solution for effective wound debridement and cleaning of the surrounding leg area. The cleansing efficacies and capacities of these products have been evaluated *in vitro* and were compared to the effects of conventional cotton gauze.

## Material & Methods

For the wound debridement model (figure 2), a *S. aureus* biofilm is cultivated on glass plates. Monofilament debrider*, cleansing system with poloxamer**, and cotton gauze were used to debride/clean the glass plates under standardized conditions (p=0.067N/cm$^2$, v=1.6cm/s). Afterwards, the glass plates were stained with crystal violet to visualize the bacteria residuals. Plate images were obtained and all images were processed using ImageJ 1.45m (NIH, Bethesda, Maryland, U.S.).

*Debrisoft®, Lohmann & Rauscher;
**UCS™ Debridement, Medi

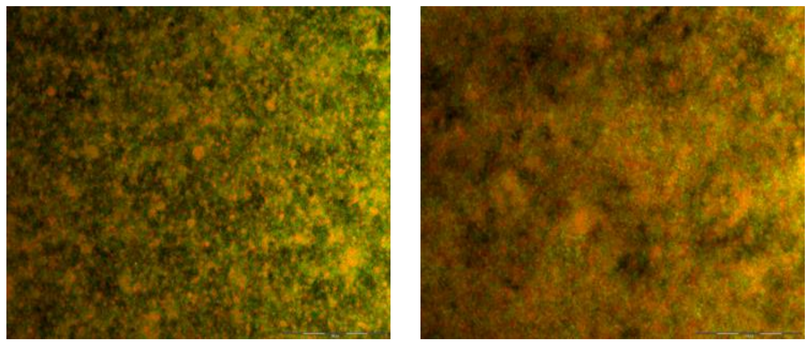

**Figure 1:** Mature *S. aureus* biofilm on glass plates after 48 hours of incubation and stained for life and dead cells with SYTO-9/PI.

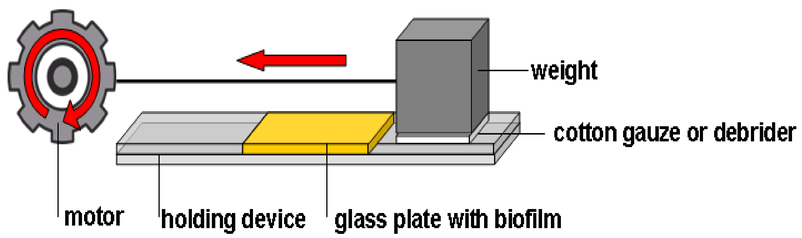


**Figure 2:** The wound debridment model: Glass plate with biofilm was put into the holding device and cotton gauze or debrider were attached to a weight. The weight was pulled over the glass plate at a constant speed of 1.6 cm/s.

## Results

It could be shown that monofilament debrider* and cleansing system with poloxamer** as well as cotton gauze pads were able to eradicate the biofilm present on the glass plates (figure 3). However, further testing of the cleansing capacity of monofilament debrider*, cleansing system with poloxamer**, and cotton gauze displayed a significant efficacy of the monofilament debrider* compared to the cleansing system with poloxamer** and cotton gauze (figure 4). Eight glass plates with biofilm were consecutively wiped with one sample of monofilament debrider*, cleansing system with poloxamer** or cotton gauze. The monofilament debrider* exhibited a retained removal of biofilm over the total of eight glass plates, while the cleansing system with poloxamer** and cotton gauze quickly lost their effect (figure 4).

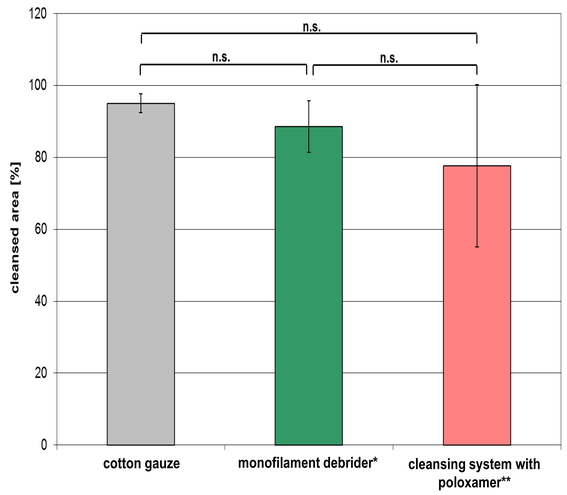


**Figure 3:** Cleansing efficacy of monofilament debrider* and cleansing system with poloxamer** for biofilm on glass plates compared to cotton gauze. Experiments were performed five times. No significant (n.s.) deviations were observed.

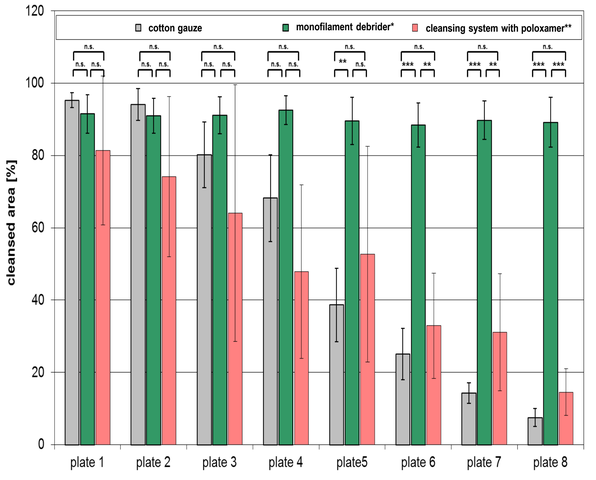


**Figure 4:** Cleansing capacity of monofilament debrider* and cleansing system with poloxamer** for biofilm on glass plates compared to cotton gauze. Experiments were performed in triplicate. Asterisks indicate significant deviations: ** $p < 0.001$, *** $p < 0.001$; n.s. – not significant.

## Conclusion

Monofilament debrider* and cleansing system with poloxamer** as well as cotton gauze pads were able to eradicate the biofilm present on the glass plates. However, the monofilament debrider* demonstrated a retained removal of biofilm, while the cleansing system with poloxamer** and cotton gauze quickly lost their effect. Hence, it can be concluded that the cleansing of the infected or critically colonized wound using the monofilament debrider* is a successful antibiofilm strategy and potentially superior to usage of the cleansing system** or cotton gauze pads.

## References

[1] Davis SC, Ricotti C, Cazzaniga A, Welsh E, Eaglstein WH, MertzPM. Wound Rep Reg 2008; 16:23-9

[2] Scali C, Kunimoto B. J Cutan Med Surg. 2013; 17:1-6

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