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INTRODUCTION

Microbial contamination of contact lenses during wear is closely associated with ocular inflammation such as contact lens-induced acute red eye (CLARE),^{1,2} contact lens peripheral ulcer (CLPU)³ and infiltrative keratitis (IK).⁴ Although rare, microbial keratitis (MK) is a sight-threatening contact lens-related infection.^{5,6} A contact lens with high antimicrobial activity may inhibit microbial adhesion and consequently reduce these contact lens related adverse events.

Melimine, prepared by combining active regions of protamine and melittin, is a broad spectrum antimicrobial peptide (AMP).⁷ Covalently bound melimine on contact lenses has demonstrated high activity against a range of microorganisms including fungi, *Acanthamoeba* and various strains of multi-drug resistant bacteria.⁸ When worn by rabbits, these lenses did not produce any signs or symptoms that may indicate ocular toxicity.

PURPOSE

The aim of this study was to investigate the performance of melimine-coated contact lenses in a human clinical trial.

METHODS

- Melimine (T-L-I-S-W-I-K-N-K-R-K-Q-R-P-R-V-S-R-R-R-R-R-G-G-R-R-R-R) was covalently attached on contact lens surface that has been detailed by Dutta et al.⁸
- The study was approved by Human Research Ethics Committee (HREC) of the University of New South Wales, Sydney and followed the tenets of the Declarations of Helsinki. It was registered in the Australian and New Zealand Clinical Trial Registry (ATRN12613000369729).
- Seventeen participants were enrolled in the prospective, randomised, double masked, one day clinical trial that was conducted as contralateral wear of melimine-coated (test) and uncoated (control) lenses.
- The participants' comfort, dryness and lens awareness with lenses and corneal health were evaluated.
- Following lens wear, follow-up visits were conducted after 1 and 4 weeks to evaluate any delayed ocular reactions to these lenses as this was first-in-man use these lenses.
- Ex-vivo retention of antimicrobial activity of worn lenses was assessed by reduction in numbers of viable *Pseudomonas aeruginosa* 6294 and *Staphylococcus aureus* 31.

RESULTS

- There were 10 females and 7 males in this study and mean (±SD) age of the participants was 30.9 ± 9.4 years.

Clinical Signs and Symptoms:

- There were no significant differences seen in wettability or surface deposition between melimine-coated and control contact lenses during both lens dispensing and collection visits ($p > 0.05$).
- Melimine-coated lenses showed clinically acceptable centration, movement, tightness and overall fitting at all times. Refitting of melimine-coated lenses was not required.
- No significant differences in different areas of redness, or palpebral roughness was found compared to controls ($p > 0.05$).
- Melimine-coated contact lens wear was associated with significantly higher levels of fluorescein corneal staining (Figure 1) in all areas compared to the control lenses ($p < 0.05$; extent, depth and type).
- Figure 2 shows the extent, depth and type (median; mean ± SD) of fluorescein staining associated with melimine and control lenses in all the corneal areas.
- Overall, 65% participants preferred the control contact lenses.
- Distribution of comfort scores during melimine-coated and control contact lens wear is presented at Figure 3 using box plots.

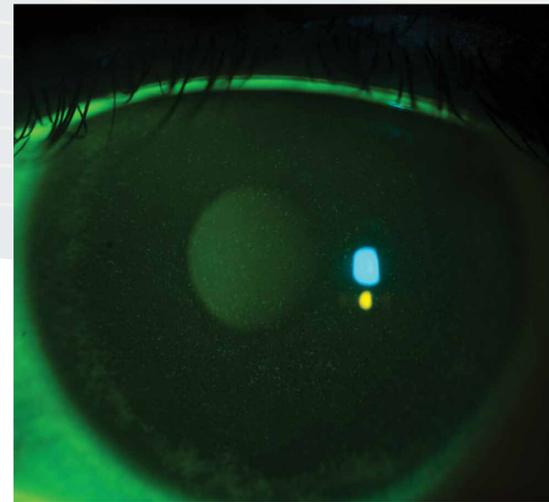


Figure 1. Diffuse corneal staining after melimine-coated contact lens wear.

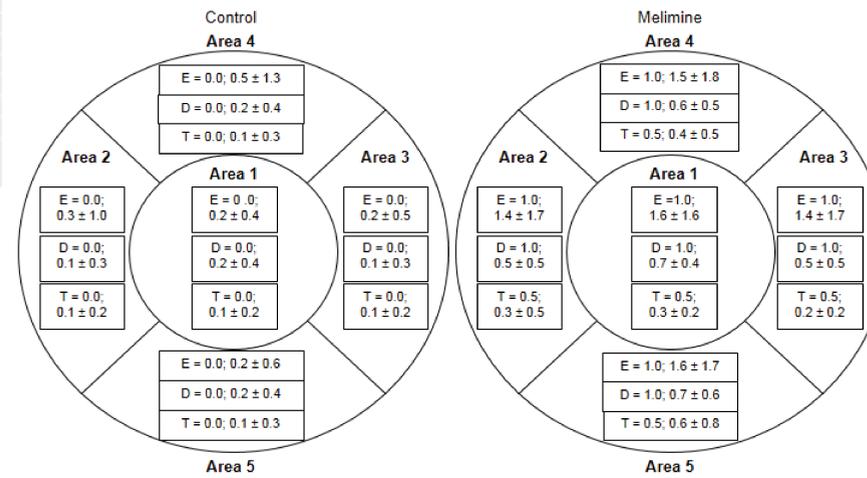


Figure 2. Fluorescein staining scores (median; mean ± SD) in melimine-coated and control contact lens corneal areas.

Retention of Antimicrobial Activity:

- When incubated with *Paeruginosa* 6294 and *S. aureus* 31, worn melimine-coated contact lenses showed significantly lower adhesion ($p < 0.05$) when compared to worn control lenses, resulting in 1.5 ± 0.5 log and 1.5 ± 0.4 log inhibition in adhesion respectively.
- Worn melimine lenses showed 0.5 ± 0.3 log ($p = 0.05$) and 0.8 ± 0.5 ($p > 0.05$) log higher *P. aeruginosa* 6294 and *S. aureus* 31 adhesion than unworn melimine lenses (Figure 4).
- P. aeruginosa* 6294 and *S. aureus* 31 adhesion to contact lenses collected from each of the 17 participants is presented in Figure 5.

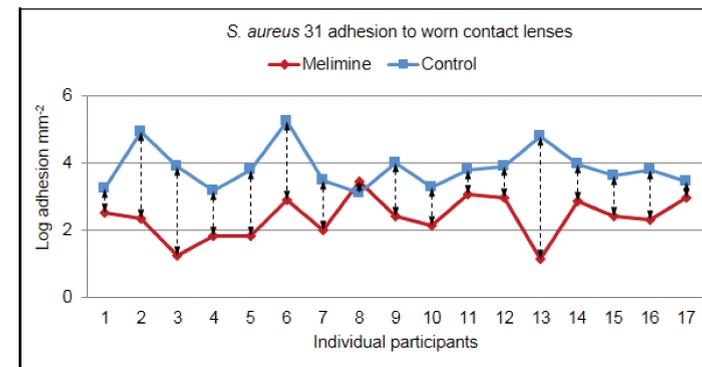
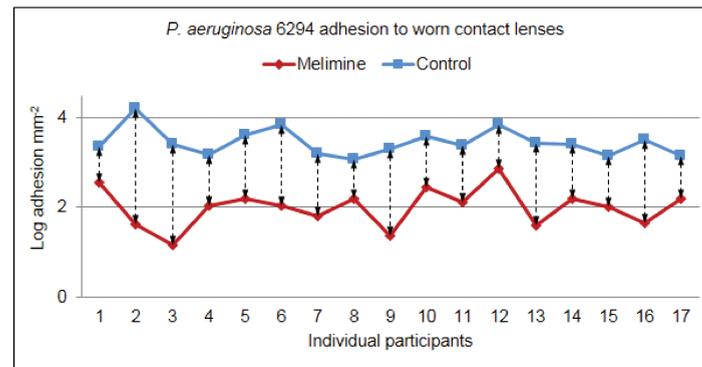


Figure 5. Bacterial adhesion to melimine-coated and control contact lenses collected from each participant. The dotted vertical lines show inhibition in bacterial adhesion to melimine lenses when compared to controls after lens wear for each individuals.

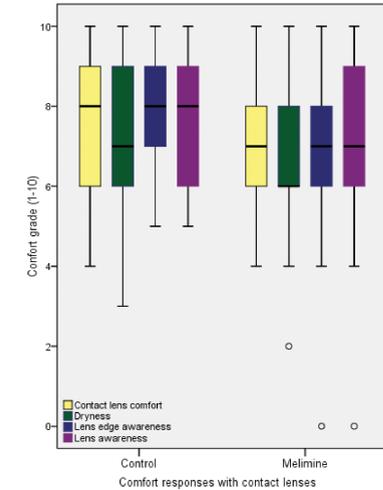


Figure 3. Distribution of comfort scores during melimine-coated and control contact lens wear. Data are presented as box plots showing median, 25th and 75th percentile ranges.

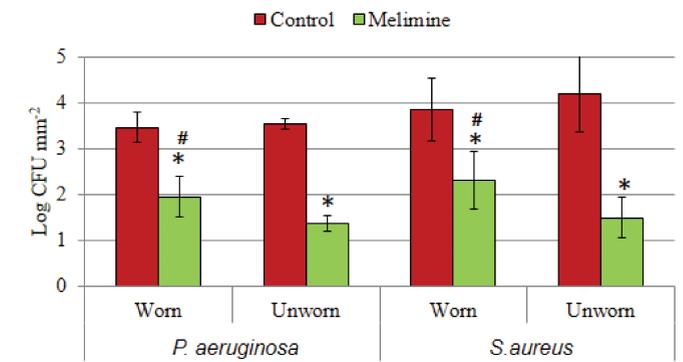


Figure 4. Bacterial adhesion to worn melimine-coated and control contact lenses. The asterisk "*" represents significantly reduced adhesion to worn or unworn melimine-coated lenses compared to worn or unworn uncoated lenses, whereas "#" represents significantly higher adhesion to worn melimine lenses compared to unworn melimine lenses.

CONCLUSION

This study for the first time showed that antimicrobial peptide-coated contact lenses can be safely worn by humans. Melimine-coated lens wear was uneventful except that it was associated with higher corneal staining, similar in presentation to solution-induced corneal staining. The melimine-coated lenses retained high antibacterial activity after wear.

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