Benefits of collagen/ORC dressings
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Introduction
Research has shown that collagen has many benefits in wound healing such as helping to promote increased cell growth and wound contraction. However, it has been utilised in a range of wound healing products. Oxidised regenerated cellulose (ORC) is a known haemostat that has been used clinically for over 50 years. It is the only modified derivative of cellulose that is biocompatible and which readily degrades under physiological conditions through fluid absorption and subsequent gelling. The combination of collagen and ORC is already recognized for its protease modulating properties, particularly human neutrophil elastase and MMP-9 proteases, which have been associated with chronic, non-healing wounds. Whilst not specifically designed to be antimicrobial, previous in vitro data has suggested that Collagen/ORC may help to control bacterial levels, thus providing additional benefits for patients with chronic, non-healing wounds.

The aim of the in vitro study was to compare a dressing comprised of a combination of Collagen/ORC to three different collagen-only dressings. The dressings were evaluated for their ability to reduce protease activity levels and their antimicrobial potential.

Protease reduction assay
Protease Activity Reduction: Samples of human neutrophil elastase (273 mU/mL) and MMP-9 (1 µg/mL) were incubated (37 °C) for 30 min in the presence of each dressing were tested to determine the residual protease activity. Fluorometric protease activity assays were used to determine the activity and results are presented as a percentage of the control, which was the enzyme incubated with no dressing sample.

Bacterial log10 reduction assay
Antimicrobial Efficacy: The antimicrobial efficacy of each dressing was evaluated in triplicate by log10 reduction assay against clinically significant organisms S. aureus (SA) and P. aeruginosa (PA), which involves challenging a small dressing sample with a bacterial culture containing 10^6 bacteria. Samples of culture were removed at various time points over 3 hours and total viable counts (TVC) determined. A silver containing antimicrobial Collagen/ORC dressing was included as a positive control.

Results
Significant differences were observed between the dressings tested in both the protease and anti-microbial assay systems.

Protease reduction
Collagen/ORC performed significantly better than the collagen-only dressings at reducing both MMP-9 and Elastase activity. Both enzymes had less than 10% residual activity remaining, which was not achieved by any of the collagen-only dressings.

Collagen/ORC reduced MMP-9 and Elastase Activity significantly more than collagen only dressings (*p<0.05)

Antimicrobial efficacy
The Collagen/ORC dressing significantly outperformed the collagen-only dressings when tested against SA, achieving a 4.8 log10 unit reduction in TVC within 3 hours compared to reductions of 0.0-2.1 log10 units for collagen-only dressings (p<0.05). When tested against PA, log10 reductions of 1.9-2.1 log10 units were achieved by the test dressings, with the largest reduction in TVC occurring after exposure to the Collagen/ORC dressing. This reduction was significant compared to 0.2 of the 3 collagen-only dressings tested (p<0.05). The Collagen/ORC/Silver positive control dressing gave a log10 reduction of 5.2 and 5.6, for SA and PA respectively which was higher than any other dressing tested.

Discussion
The results show that in vitro, the combination of Collagen/ORC is more effective than collagen-only dressings in reducing inflammatory protease activity. The Collagen/ORC dressing demonstrated bactericidal activity against SA and bacteriostatic activity against PA in the log10 assay. This may be attributed to the low pH generated as ORC degrades and releases glutaric acid. This study shows that in these in vitro models, Collagen/ORC is more effective than collagen-only dressings both in protease reduction and ability to control PA and SA. Hart et al. showed that Collagen/ORC promotes human dermal fibroblast proliferation and cell migration in vitro. Therefore, results from this study when combined with Hart’s previous publication suggest that in these in vitro assays Collagen/ORC is bactericidal against SA and bacteriostatic against PA without having a negative effect on human dermal fibroblast cells.

While we have demonstrated that Collagen/ORC is effective against some bacteria which are sensitive to low pH, Collagen/ORC/Silver dressing retains the benefits Collagen/ORC with the additional bactericidal benefits of silver, effective against a broad range of bacteria (both PA and SA). In this experiment, Collagen/ORC/Silver was significantly more effective against PA compared to Collagen/ORC.

Conclusion
Collagen has known benefits for wound healing, however, the results presented here suggest that the combination of Collagen/ORC is more effective in vitro than collagen alone at reducing protease activity and controlling bacterial biofilm. This suggests that ORC provides a significant contribution to the effectiveness of the dressing.

References

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