In-Vitro Modulation of MMP-1, MMP-2, MMP-9 and Elastase by a Range of Wound Dressings

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Introduction

Matrix metalloproteinases (MMPs) play an essential and beneficial role in normal wound healing. When present in excess in a wound bed, MMPs can impair wound healing. There is substantial evidence to suggest that they are highly elevated in wounds with delayed healing compared to healing wounds. It is thought that reducing excess protease activity in a non-healing wound may convert the wound to a healing state. Consequently, MMP modulating wound dressings could have useful clinical implications.

Methodology

- Recombinant human MMP-1, MMP-2 and MMP-9 were prepared at a concentration of 2 ngml^{-1}.
- Human polymorphonuclear granulocyte (PMN) elastase was prepared at a concentration of 0.7 ngml^{-1}.
- Test dressings:
  1. Knitted Viscose Primary Dressing
  2. Activated Carbon Cloth Dressing (ACCD)*
  3. Silver-containing hydrofiber wound dressing
  4. Dermal template containing collagen and extracellular matrix components
  5. Oxidized regenerated cellulose and collagen wound dressing
- Dressing samples (1 cm^2) were placed into 24-well plates and 1 ml of protease was added to each sample.
- Plates were sealed and incubated at 37^{o}C ± 2^{o}C and 50 rpm ± 5 rpm for the required time period.
- Following incubation the supernatants were collected. The concentration of the remaining protease in each supernatant was determined using specific ELISA kits. ELISA kits were processed according to manufacturer's instructions.

Results

MMP-1

No MMP-1 was detected in the supernatant following incubation with ACCD following 24 hours incubation (Figure 1).

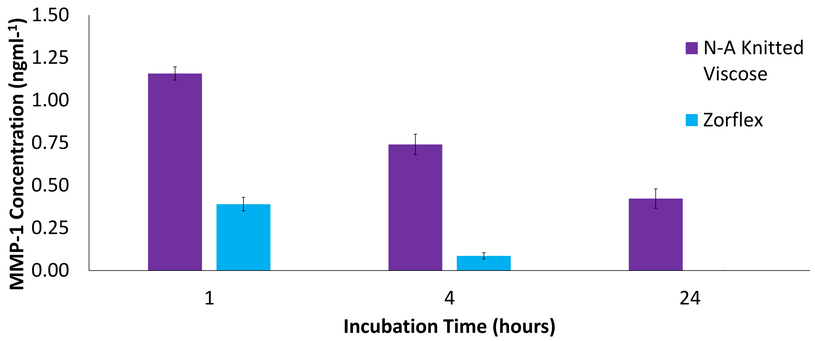

Figure 1. Concentration of MMP-1 remaining in supernatant following 1, 4 and 24 hours incubation with test dressings.

MMP-2 and MMP-9

The concentration of MMP-2 and MMP-9 detected in the ACCD supernatant decreased following 1 and 4 hours incubation compared to the control. No MMP-2 or MMP-9 was detected in the supernatant following incubation with ACCD following 24 hours incubation (Figure 2).

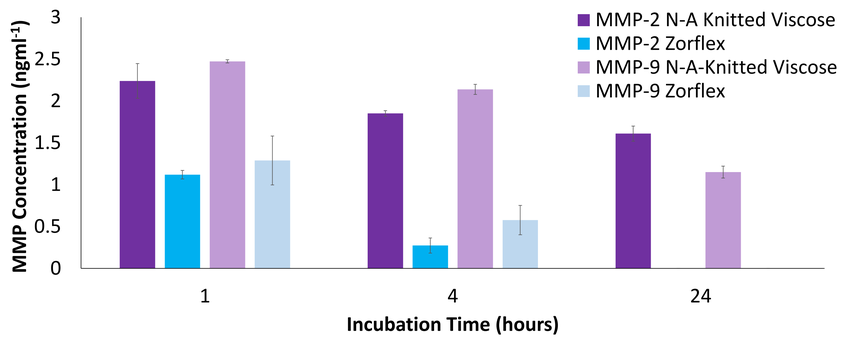

Figure 2. Concentration of MMP-2 and MMP-9 remaining in supernatant following 1, 4 and 24 hours incubation with test dressings.

No MMP-2 and MMP-9 were detected in the ACCD supernatant following 24 hours incubation. There was no significant difference between the amount of MMP detected in Competitor 1 supernatant and the control sample. Competitor 2 and Competitor 3 significantly reduced the amount of MMP-9 in the supernatant (Figure 3).

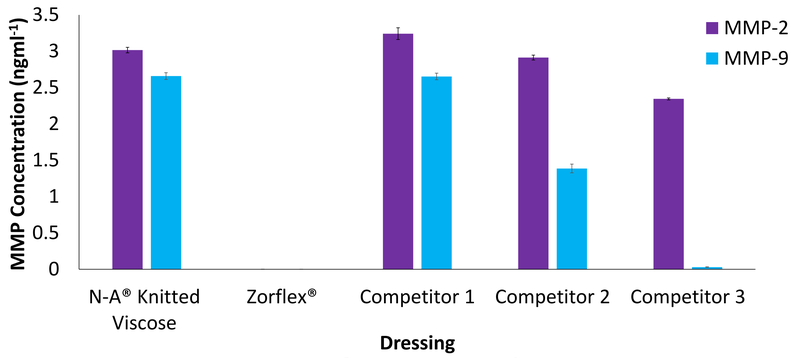

Figure 3. Concentration of MMP-2 and MMP-9 remaining in supernatant following 24 hours incubation with test dressings.

Human PMN Elastase

The concentration of elastase remaining in the supernatant after 24, 48 and 72 hours incubation with ACCD was significantly lower than the control (Figure 4).

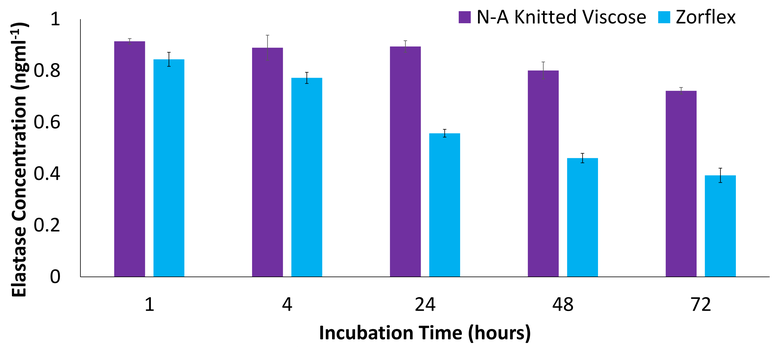

Figure 4. Concentration of Human Elastase remaining in supernatant following 1, 4, 24, 48 and 72 hours incubation with test dressings.

Discussion and Conclusions

This study demonstrates that ACCD is able to sequester and retain MMP-1, MMP-2 and MMP-9 *in-vitro* within 24 hours. Sequestration of elastase was slower but a significant reduction was observed by 24 hours. Wound dressings typically stay *in-situ* for 24-72 hours; this data suggests that application of ACCD could help to reduce protease levels within a wound. Further studies are required in order to confirm this observation in a clinical scenario.

***ACCD – Zorflex® Activated Carbon Cloth Dressing.**

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