



# Synergistic Effect of Silver Carboxylate and Chlorhexidine Gluconate Coated Sutures decreases Surgical Site Infections and Wounds of the Hand and Wrist by Methicillin-resistant *Staphylococcus aureus* and *Cutibacterium acnes*

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## Introduction

Surgical site infection (SSI) following hand and wrist surgery is a significant complication with a reported incidence of 0.33%-10%. [1] Despite current preoperative antiseptic practices, methicillin-resistant *Staphylococcus aureus* (MRSA) and *Cutibacterium acnes* (*C. acnes*) are known to colonize wound sites in the hand and wrist, promoting infection and wound dehiscence. [2] Bacterial resistance has been demonstrated against current antibiotic suture coatings like triclosan. [3] While chlorhexidine (CHG) has broad spectrum activity, it fails to penetrate the pilosebaceous glands where *C. acnes* resides. [4] Previous studies have indicated that a silver carboxylate titanium-dioxide polydimethylsiloxane antimicrobial matrix can penetrate into these glands. [5] We hypothesize that when the penetrative nature of silver carboxylate is combined with the high bactericidal broad-spectrum activity of CHG, it will be efficacious against both nosocomial pathogens.

## Materials and Methods

Dose response curves (DRC) and drop assays were generated to determine (1) therapeutic concentrations for *C. acnes* and MRSA and (2) optimal therapeutic ratio of silver carboxylate to CHG. Coatings were then applied to two sutures commonly used in surgery of the hand: Arthrex FiberWire® sutures and Ethicon Coated VICRYL®. Kirby Bauer assays were conducted to visualize and quantify the antimicrobial efficacy of the chemistry. Triclosan Coated VICRYL antimicrobial sutures served as antimicrobial controls. Graphite furnace atomic absorption spectroscopy (GFAAS) was used to measure silver elution from sutures over time.

## Results

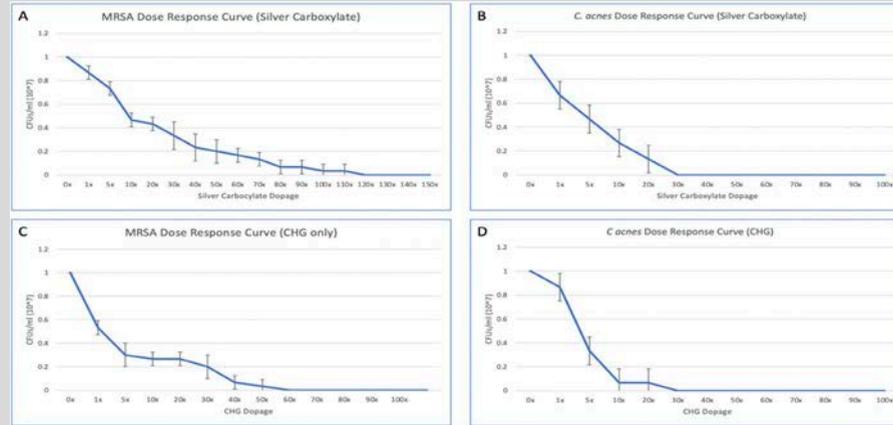


Figure 1. Dose Response Curves for Isolated Silver carboxylate and CHG

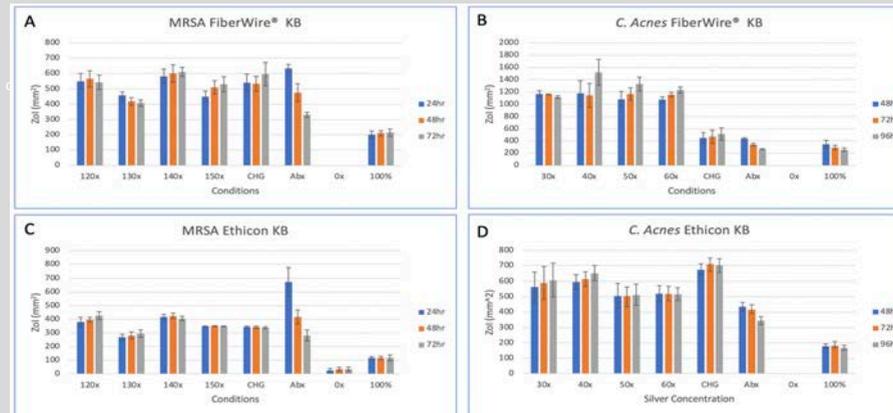


Figure 2. Zones of Inhibition for FiberWire® and Ethicon® Sutures Coated in Concentrations of Silver carboxylate:CHG Deemed Therapeutic against MRSA and C. acnes by DRC

- Therapeutic concentration of silver carboxylate was 120x-150x dopage for MRSA, 30x-60x dopage for *C. acnes* (Fig 1)
- Therapeutic ratio of silver carboxylate to CHG was 1:1
- 60x silver-carboxylate:CHG coated FiberWire® and Ethicon® showed sustained bactericidal activity against *C. acnes* ( $p = 0.147$ ,  $p = 0.998$ , respectively) (Fig 2)

## Results

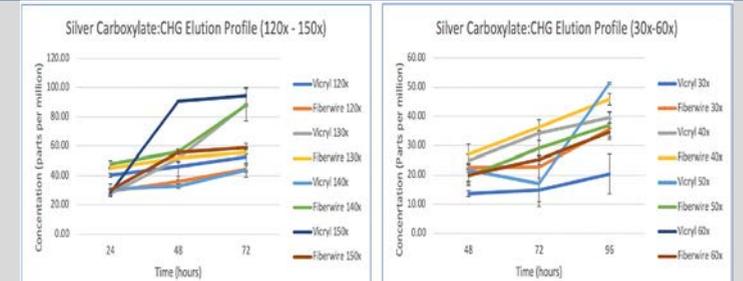


Figure 3. GFAAS data of silver release from sutures coated with various concentrations of silver carboxylate:CHG

- 150x silver carboxylate:CHG coated FiberWire® and Ethicon® sutures demonstrated sustained bactericidal activity against MRSA ( $p = 0.53$ ,  $p = 0.803$ , respectively) (Fig 2)
- The coating maintained its efficacy significantly better than Triclosan Coated VICRYL antimicrobial sutures over the 3-4 day period ( $p < 0.01$ ) (Fig 2)
- GFAAS testing demonstrated that silver-carboxylate:CHG maintained elution over 96 hours in the majority of conditions. (Fig 3)

## Discussion

Overall, silver carboxylate:CHG chemistry demonstrated safe dosing, extended elution, and efficacy against MRSA and *C. acnes*. It maintains efficacy as a coating on sutures. This antibiotic-independent synergistic combination could be a novel technology in preventing hand and wrist SSI by problematic pathogens

## Acknowledgements

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## References

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