

Hypochlorous Acid-Mediated Oxidative Debridement in Human Chronic Wound Tissue

Lannika Johnson^{1,2}, Lauren Fernandez¹, Sandra Predic¹, Jelena Marjanovic¹, Hadar Lev-Tov¹, Jose Jaller¹, Irena Pastar^{1, 2}

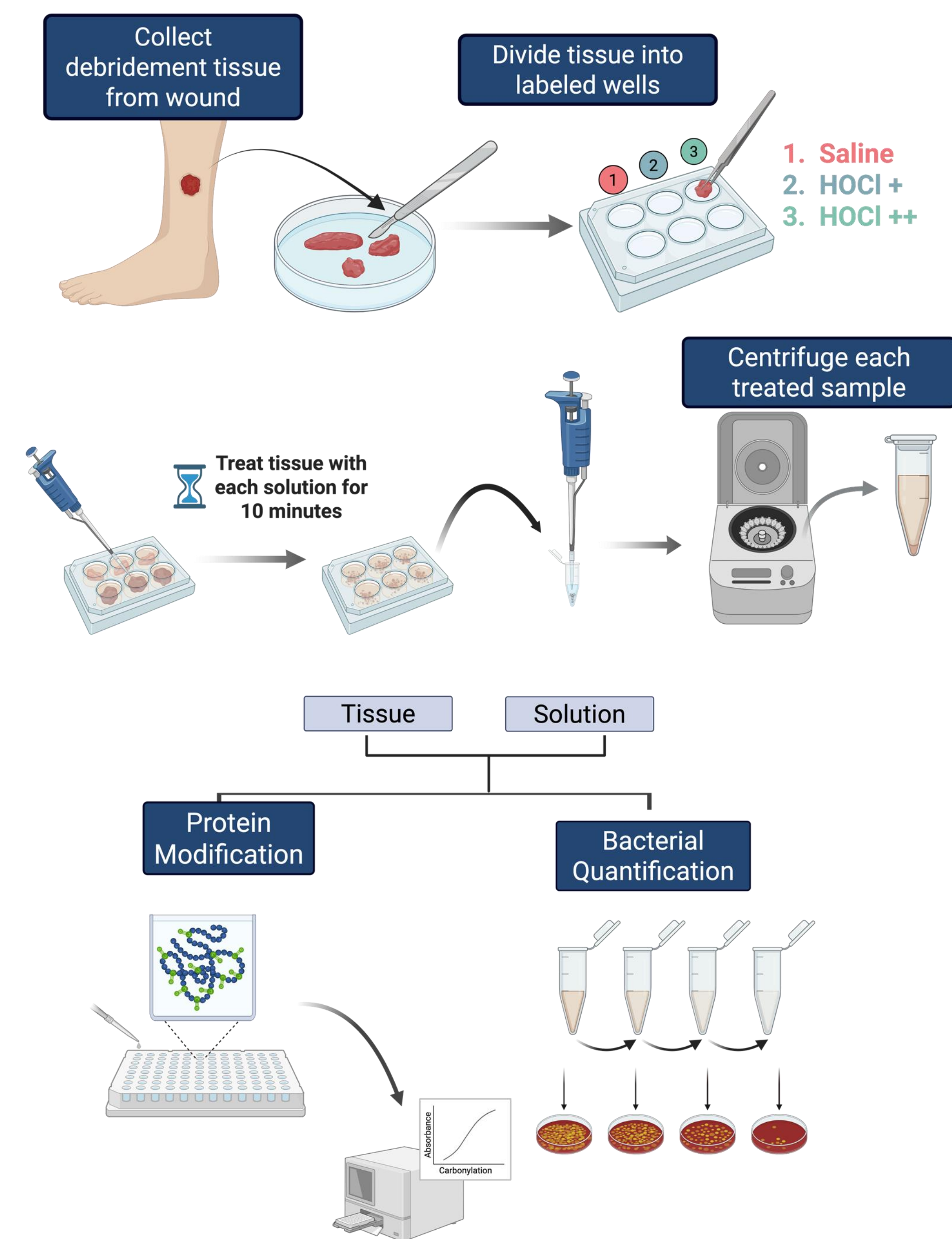
¹Dr. Phillip Frost Department of Dermatology and Cutaneous Surgery, ²Department of Biochemistry and Molecular Biology University of Miami Miller School of Medicine, Miami, FL



Introduction

Chronic wounds remain a major clinical challenge due to necrotic and bacterially loaded tissue that delays healing and complicates debridement. Conventional techniques often cause patient discomfort and lack procedural consistency. This pilot study evaluated hypochlorous acid (HOCl) formulations as non-invasive alternatives for wound cleansing and oxidative debridement using *ex vivo* chronic wound tissue (n=13). Samples were treated for 10 minutes with standard HOCl solution (HOCl+), high-concentration HOCl solution (HOCl++), or saline control. HOCl treatments reduced bacterial counts and eliminated bacteria in samples with lower baseline bioburden (≤ 5 logs), accompanied by visible tissue dissociation. Protein carbonyl assays showed greater oxidative modification in HOCl-exposed samples than in controls. These findings highlight HOCl's dual antimicrobial and oxidative activity and support further optimization of exposure parameters to establish standardized, non-invasive protocols for chronic wound management.

Methods



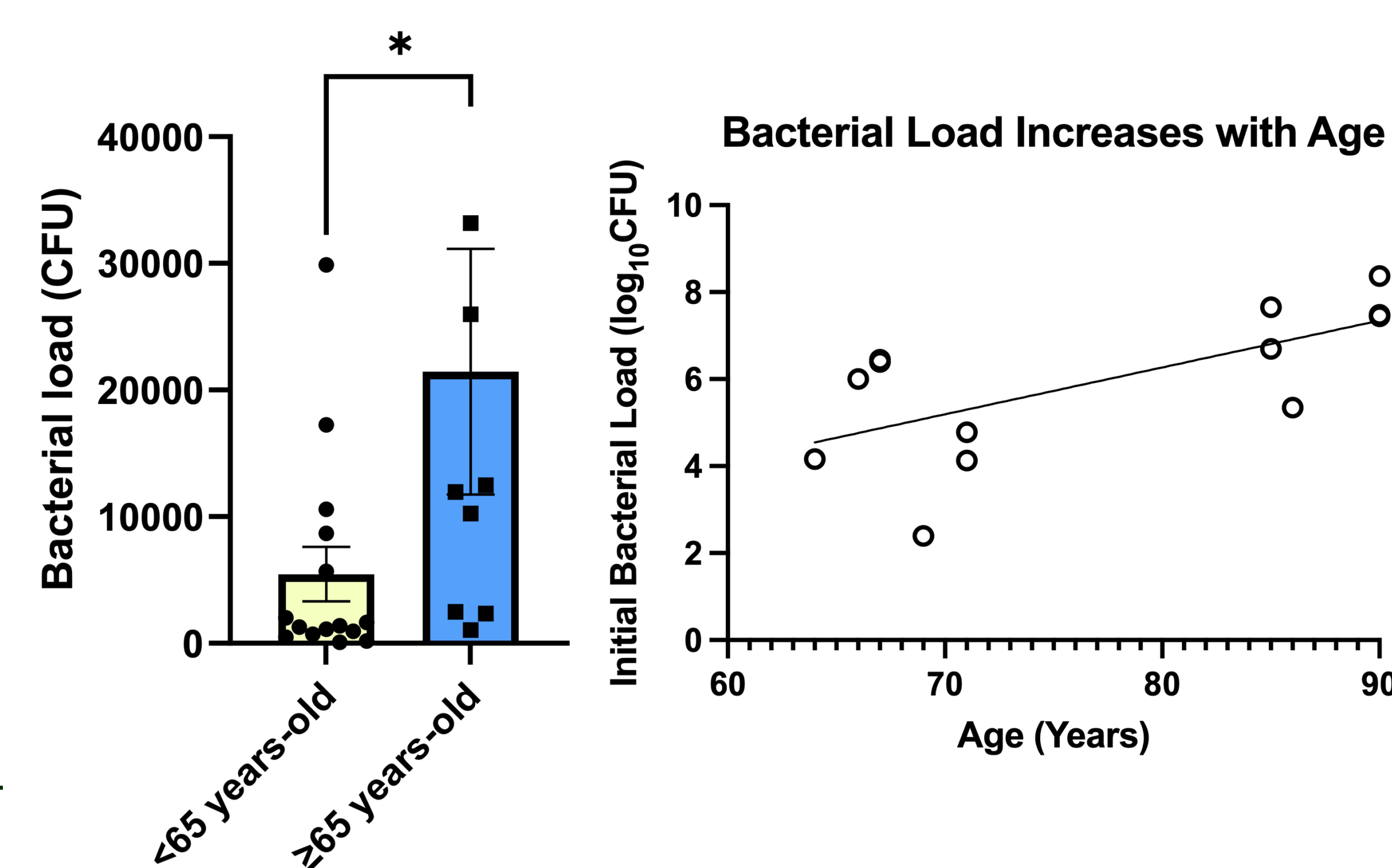
Results

Patient Demographics

	Age (Years)	Sex	Wound Type	Treated with HOCl previously?
PT01	67	Female	Venous Leg Ulcer	Unknown
PT02	90	Unknown	Venous Leg Ulcer	Unknown
PT03	86	Unknown	Venous Leg Ulcer	Yes
PT04	90	Unknown	Venous Leg Ulcer	No
PT05	90	Male	Venous Leg Ulcer	No
PT06	67	Male	Venous Leg Ulcer	No
PT07	85	Male	Unknown Etiology	No
PT08	85	Male	Unknown Etiology	No
PT09	66	Male	Diabetic Foot Ulcer	No
PT10	69	Unknown	Venous Leg Ulcer	No
PT11	71	Unknown	Venous Leg Ulcer	No
PT12	64	Female	Venous Leg Ulcer	No
PT13	71	Female	Venous Leg Ulcer	No

Baseline characteristics of chronic wound patients (n = 13). The majority presented with venous leg ulcers (77%), were ≥ 64 years of age, and had no prior exposure to HOCl wound irrigation.

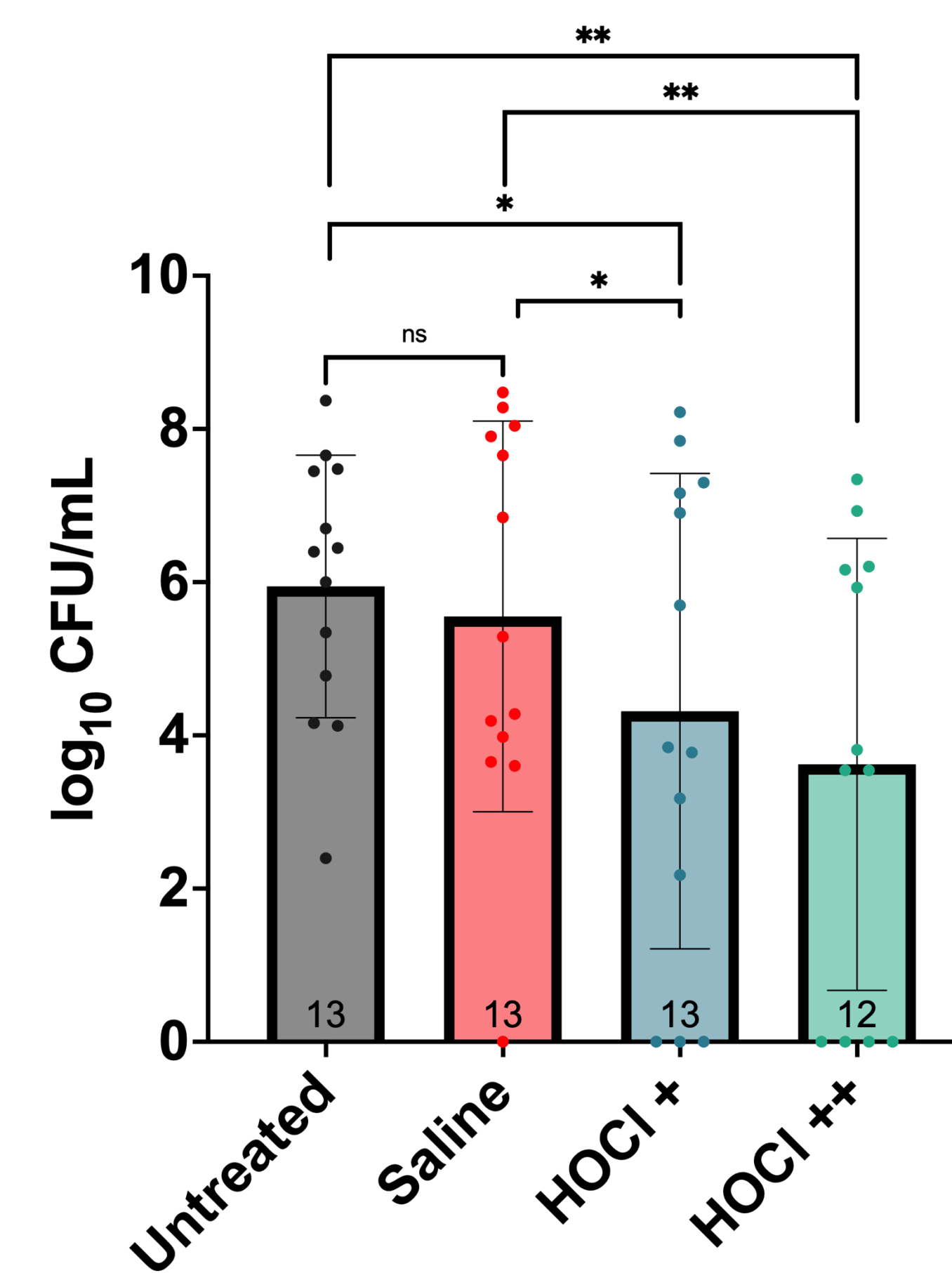
Older Age is Associated With Higher Bacterial Load



Consistent age-bacterial load association across studies. Prior data (left) shows elevated bacterial load in older patients, correlating with linear progression in current data (right).

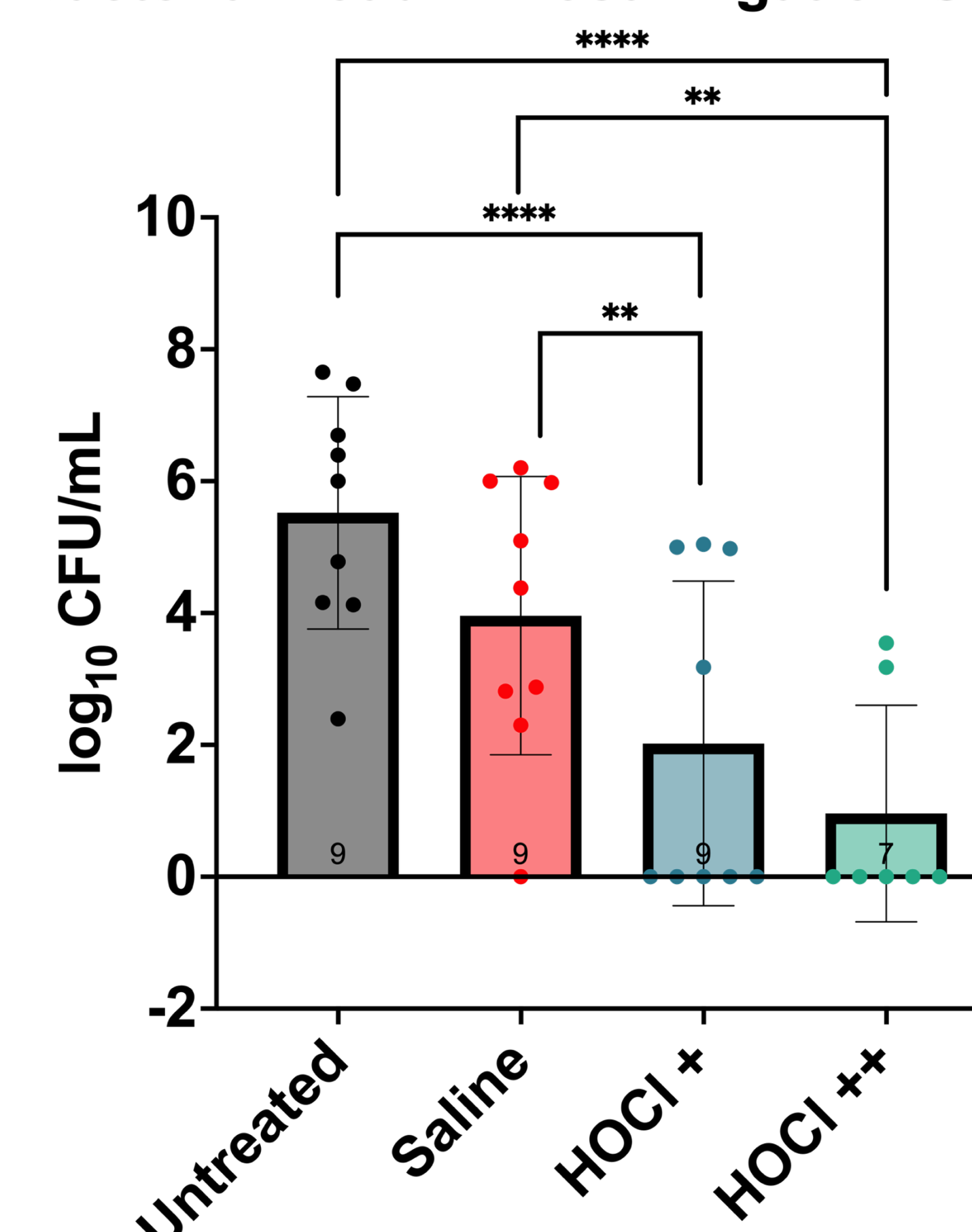
HOCl Reduces Bacterial Load in Chronic Wound Tissue

Bacterial Load in Tissue



Data are shown as mean \pm SEM. ns = not significant; * = p < 0.05; ** = p < 0.01; *** = p < 0.001; **** = p < 0.0001

Bacterial Load in Post-Irrigation Solution



Data are shown as mean \pm SEM. ns = not significant; * = p < 0.05; ** = p < 0.01; *** = p < 0.001; **** = p < 0.0001

Pre- and post-irrigation tissue analysis. Both standard HOCl (HOCl+) and high-concentration HOCl (HOCl++) significantly reduced bacterial load (\log_{10} CFU/mL) compared to untreated control and saline. Saline treatment *ex vivo* did not result in significant reduction of bacterial load.



Untreated tissue
CFU = 6.0 logs

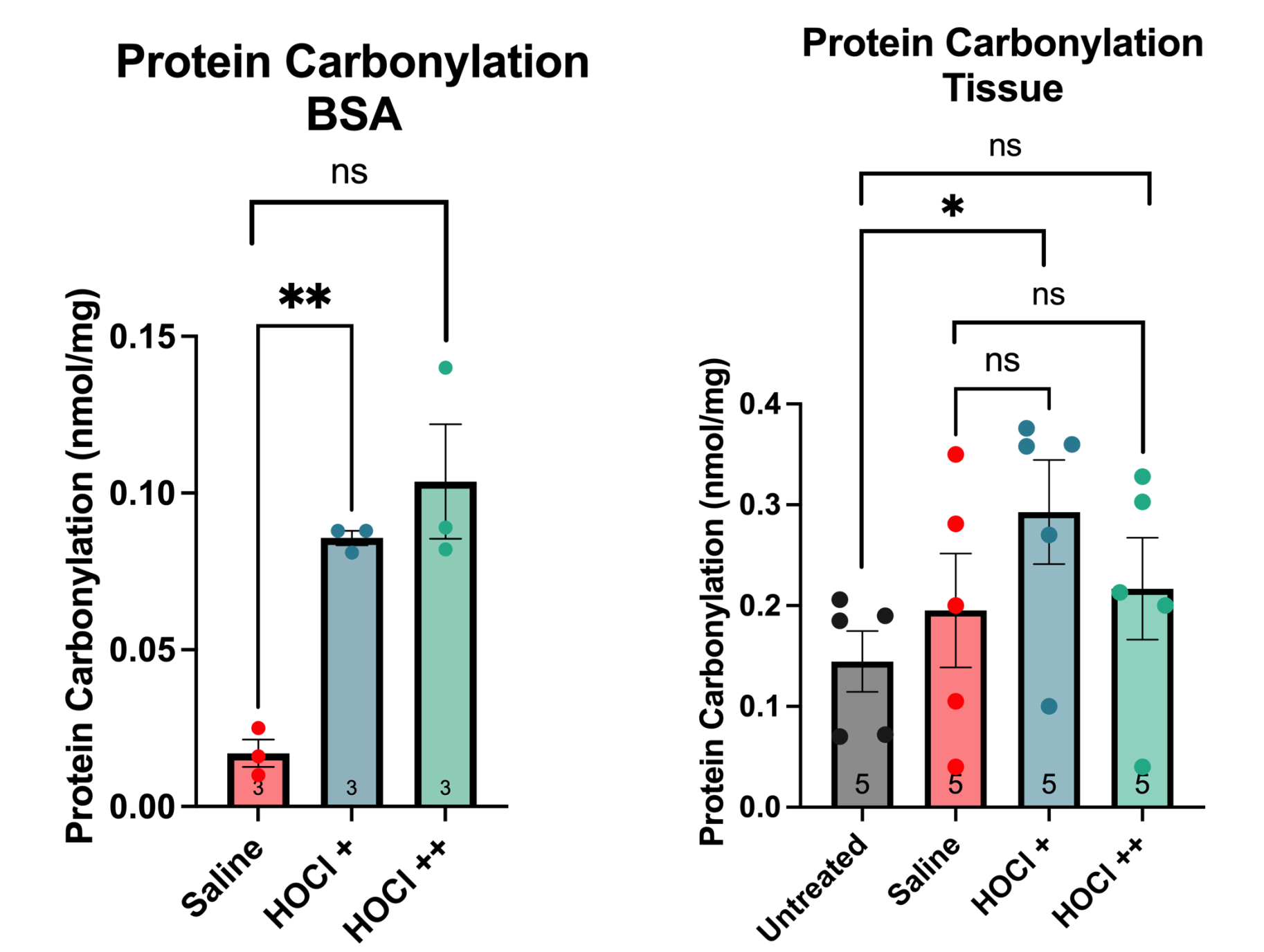


Saline treated tissue
CFU = 5.3 logs



HOCl++ treated tissue
CFU \approx 3.8 logs

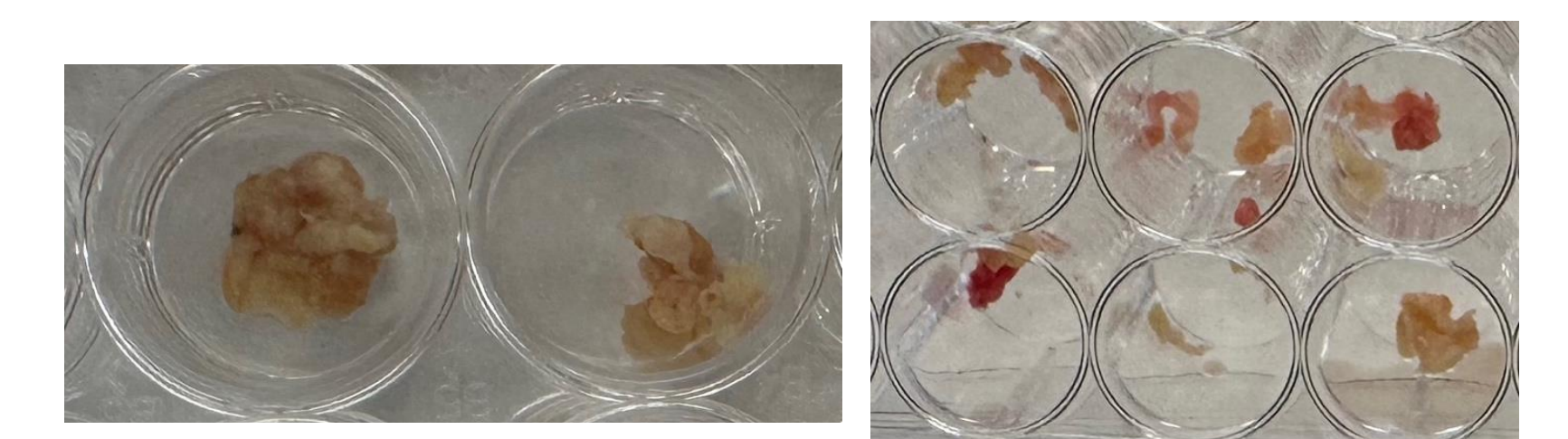
Results



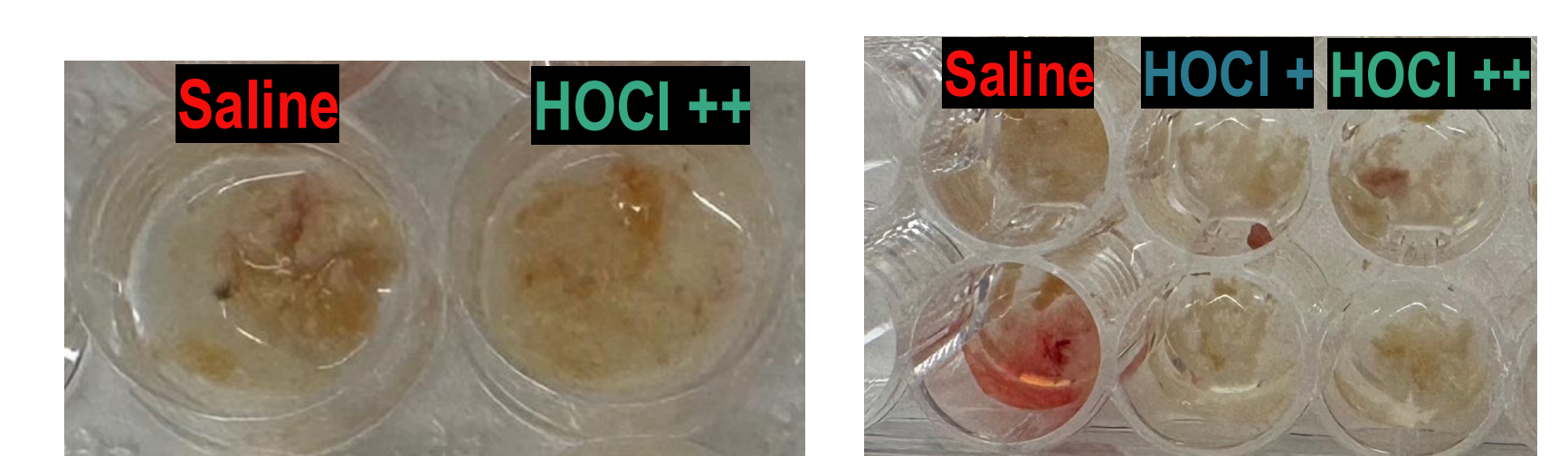
Data are shown as mean \pm SEM. ns = not significant; ** = p < 0.01

HOCl treatment increases protein carbonylation in bovine serum albumin (BSA) and chronic wound tissue. Chronic wound tissue treated with HOCl demonstrated higher protein carbonylation than untreated and saline treated tissue, supporting oxidative modification as a possible mechanism of tissue dissociation and debridement.

Before Treatment



After 10 Minutes of Treatment



HOCl promotes dissociation of chronic wound tissue *ex vivo*. Saline preserves tissue integrity while standard HOCl+ and high-concentration HOCl++ show increasing dissolution.

Conclusions

- Both standard HOCl and high-concentration HOCl solution significantly reduced bacterial load in debridement tissue compared to untreated and saline controls (p < 0.05 and p < 0.01, respectively), supporting HOCl as an effective wound antiseptic.
- In irrigation solution, both HOCl formulations demonstrated highly significant reductions vs. untreated (p < 0.0001) and saline (p < 0.01) controls, with high concentration of HOCl approaching complete lack of bacteria indicating potent bactericidal activity.

Acknowledgements

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