



12 Month Retrospective Review of Pressure Injury Plastic Surgical Flap Techniques Utilizing Pure Hypochlorous Acid (pHA) Preserved Wound Cleanser for Wound Bed Preparation



Caleb W. Fligor, MD¹, Carly A. Askinas BS¹, Abigail E. Chaffin MD, FACS, CWSP, FAPWCA²

INTRODUCTION

- Chronic stage IV pelvic pressure injuries (PIs) are full thickness defects with exposed tendon, muscle, and/or bone that are often refractory to outpatient wound management and may only be cured with ulcer excision and plastic surgical flap reconstruction.¹
- There is a high rate of pressure injury recurrence and complications even after surgical flap reconstruction.²
- Hypochlorous acid is a component of the innate immune response, aiding in pathogen killing via the neutrophil oxidative burst.³
- Management of stage IV PIs may be complicated by polymicrobial infection, heavy microbial colony formation, and altered pH affecting tissue health.¹ Utilization of pHA preserved wound cleanser has been shown to:
 - Improve fibroblast and keratinocyte migration⁴
 - Cause less damage to surrounding tissue due to skin neutral pH⁴
 - Kill microbes and disrupt microbial colonies⁵
 - Have a high therapeutic index⁴

OBJECTIVE

Outline a comprehensive treatment plan with high surgical flap success rates for chronic stage IV pressure injuries using pHA preserved irrigation solution for wound bed preparation.

METHODS

- A retrospective chart review was conducted on 18 chronic stage IV pressure injuries that required surgical flap coverage over a 12-month period.
- All reconstructive flap procedures were performed at a single academic medical center by a single plastic surgeon.
- pHA preserved wound cleanser was used prior to surgical flap coverage in all cases to help eradicate heavy wound colonization.
- Surgical flap technique varied depending on wound location and size.

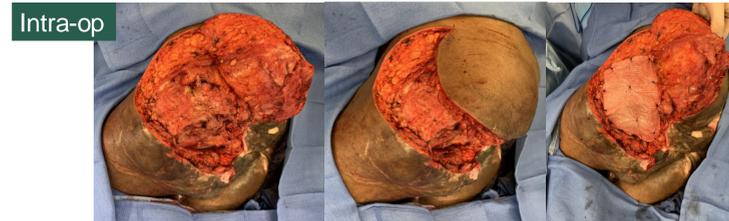
RESULTS

AGE, SEX	DATE OF OPERATION	WOUND CHARACTERIZATION	PROCEDURE, COMPLICATIONS
1 32, M	3/22/22	Sacral (15 x 7 x 4 cm) +Bacteroides +Staph Lugdunensis	(L) gluteus FC advancement (R) gluteus FC advancement complications: Post-operative bleeding requiring transfusions (AC for UE DVT)
2 53, M	4/20/22	Sacral (12 x 6 x 4 cm) +Proteus (ESBL) +Enterobacter cloacae	(L) gluteus M advancement (R) gluteus M advancement complications: none
3 53, M	4/20/22	L Ischial (12 x 6 x 7 cm)	(L) hamstring M advancement complications: none
4 58, M	3/22/22	Sacral (10 x 8 x 4 cm) +Proteus vulgaris	(L) gluteus M advancement (R) Gluteus M advancement (R) gluteus FC advancement complications: none
5 59, M	2/10/22	Sacral (16 x 35 x 4 cm)* +Proteus mirabilis +Klebsiella pneumo +Bacteroides	(L) gluteus FC advancement (R) gluteus FC advancement complications: none
6 59, M	2/10/22	R Ischial (16 x 25 x 4 cm)*	(R) hamstring M advancement complications: none
7 52, M	7/18/22	L Ischial (25 x 10 x 4 cm)* +Enterococcus faecalis (ESBL)	(L) gluteus MC rotation OFM matrix as implant complications: dehiscence requiring reoperation
8 52, M	7/18/22	L Trochanteric (25 x 10 x 4 cm)*	(L) gluteus MC rotation OFM matrix as implant complications: none
9 75, M	8/1/22	L Ischial (12 x 7 x 5 cm) +Diphtheroid +Staph Lugdunensis	(L) gluteus M rotation (L) gluteus FC advancement (L) hamstring M advancement complications: none
10 52, M	10/3/22	Sacral (13 x 8 x 2 cm) +Proteus (ESBL)	(R) gluteus FC advancement complications: none
11 24, M	8/23/22	L Ischial (11 x 7 x 6 cm)	(L) gluteus M rotation (L) gluteus FC advancement (L) hamstring M advancement complications: none
12 24, M	8/23/22	R Ischial (12 x 8 x 6 cm)	(R) gluteus M advancement (R) gluteus FC advancement (R) hamstring M advancement complications: none
13 67, M	8/15/22	Sacral (10 x 6 x 5 cm)	(L) gluteus M advancement (R) gluteus M advancement (R) gluteus FC advancement complications: none
14 62, M	7/11/22	Sacral (16 x 12 x 4 cm)	(L) gluteus M advancement (R) gluteus M advancement (R) gluteus FC advancement complications: none
15 49, F	10/10/22	Sacral (12 x 6 x 7 cm) +Diphtheroid	(L) gluteus M advancement (R) gluteus M advancement (R) gluteus FC advancement complications: none
16 56, M	11/17/22	R Ischial (15 x 8 x 8 cm) +E. Coli +Staph epidermidis	(R) gluteus M advancement (R) hamstring M advancement Revision FC thigh flap complications: none
17 25, M	11/7/22	Sacral (7 x 5 x 2 cm) +Proteus +Enterococcus faecalis	(R) gluteus MC advancement complications: none
18 25, M	11/7/22	L Ischial (11 x 13 x 4 cm)	(L) hamstring M advancement (L) gluteus M rotation complications: none

*Combines wound field with neighboring injury site
(R) Right (FC) Fasciocutaneous (L) Left (MC) Myocutaneous (M) Muscle

- 12 patients with 18 total stage IV pressure injuries
- 9 sacral, 8 ischial, and 1 trochanteric injury were treated with complete ulcer excision and pHA preserved wound cleanser, and varying plastic surgical flaps
- Average wound volume: 534 cm³
- Average # of surgical flaps required for wound coverage: 2.05
- All patients admitted to LTAC or hospital for ≥4 weeks post-op
- 10/18 wounds had positive wound cultures
- 9/10 contaminated wounds colonized with known complex microbial colony producing organisms

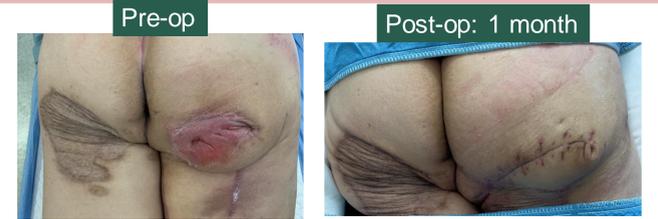
CASE 1: 52M with paraplegia for 35 years and multiple prior pelvic pressure injuries requiring flap reconstruction. Patient was free of pressure injuries for 7 years until Hurricane Ida power outage resulted in loss of usage of motorized wheelchair and relocation to facility without proper offloading services. Patient developed complex stage IV trochanteric and ischial PIs.



CASE 2: 58M with acute quadriplegia who was unable to obtain a motorized reclining wheelchair for 6 months resulting in the development of a stage IV sacral PI.



CASE 3: 56M with uncontrolled DM and nicotine use who developed a 3rd degree burn to the bl buttocks while working as a roofer. STSG performed at burn center and initial R ischial thigh FC transposition flap at outside center with early dehiscence. FLIR imaging used intraoperatively to assess intact flap perfusion in revision flap coverage of ischial wound and revision of prior FC thigh flap.



CONCLUSIONS

- Stage 4 PI excision, wound irrigation with pHA preserved wound cleanser, plastic surgical flap reconstruction, and comprehensive perioperative team-based PI flap protocol over 12 months at a single institution have led to 100% surgical flap success at discharge from hospital/LTACH for stage 4 PIs.
- pHA preserved wound cleanser is effective for wound bed preparation with a high therapeutic index, which assists with reduction in necrotic tissue, tissue inflammation, formation of complex colonies specifically of pathological species which occur frequently in stage 4 pressure injuries. pHA use may provide an environment for accelerated angiogenesis and wound healing after plastic surgical flap reconstruction of stage 4 PI to decrease surgical complication rates.
- This work demonstrated low surgical complication rates with successful closure rates of stage 4 PIs.

REFERENCES

- Ricci, Joseph A, Lauren R Bayer, and Dennis P Orgill. "Evidence-Based Medicine: The Evaluation and Treatment of Pressure Injuries." *Plastic and reconstructive surgery* (1963) 139.1 (2017): 275e-286e. Web.
- Khansa I, Barker JC, Ghatak PD, Sen CK, Gordillo GM. Use of antibiotic impregnated resorbable beads reduces pressure ulcer recurrence: A retrospective analysis. *Wound Repair Regen.* 2018 Mar;26(2):221-227. doi: 10.1111/wrr.12638. PMID: 29770531; PMCID: PMC7173798.
- Maliyar K, Persaud-Jaimangal R, Sibbald RG. Associations Among Skin Surface pH, Temperature, and Bacterial Burden in Wounds. *Adv Skin Wound Care.* 2020 Apr;33(4):180-185. doi: 10.1097/01.ASW.0000655488.33274.d0. PMID: 32195721.
- Wang L, Bassiri M, Najafi R, Najafi K, Yang J, Khosrovi B, Hwang W, Barati E, Belisle B, Celani C, Robson MC. Hypochlorous acid as a potential wound care agent: part I. Stabilized hypochlorous acid: a component of the inorganic armamentarium of innate immunity. *J Burns Wounds.* 2007 Apr 11;6:e5. PMID: 17492050; PMCID: PMC1853323.
- Rembe, Julian-Dario et al. "Antimicrobial Hypochlorous Wound Irrigation Solutions Demonstrate Lower Anti-Biofilm Efficacy Against Biofilm in a Complex in-Vitro Human Plasma Biofilm Model (hpBiom) Than Common Wound Antimicrobials." *Frontiers in microbiology* 11 (2020): 564513-564513. Web.