Abstract

Pressure ulcers are defined as soft tissue wounds that arise from external pressure that most commonly affect the ischial tuberosities, greater trochanters, sacrum, lateral malleoli, and heels. The predisposing factors to pressure ulcers are health status, comorbidities, and lifestyle of patients. The cornerstone of wound management involves relieving pressure from the involved area, debriding necrotic tissues, cleansing the wound, eradicating infection, and proper healing. The primary role of this paper is to demonstrate the success of surgical flap procedures in the resolution of stage 4 pressure ulcers in adult patients with high-comorbidity who adhere to our preoperative and postoperative management. The data gathered in this study was obtained via chart review. If a patient underwent no surgical intervention within this 6-month period, the flap was considered a failure. If a patient required surgical re-intervention in the same location as the flap operation, the flap was considered a failure. Of the 73 cases, 2 (2.7%) required a re-operation within 6 months. A chi-squared analysis of our results produced a x^2 of 44.8 (using 1 degree of freedom: flap success vs flap failure) and critical values of 0.05. Using the Chi squared analysis of our results produced a x^2 of 44.8. Of the 73 total patients who underwent flap operation, there was a total of 2 failures within the 6-month follow-up period. We defined a flap failure as the re-operation within this time. Of the 73 cases, 2 (2.7%) required a re-operation within 6 months (n = 2). Location of flap intervention and flap selection differ as patients in the surgery operation are diverse, however, the most common complications following surgery include wound dehiscence, surgical site infection, and recurrence. The complications observed in our study included all of these complications, with infection and dehiscence in Patient 1, and recurrence in Patient 2 (Table 1).

Several risk factors for flap failure have been previously cited in the literature, and flap failure remains a common problem in the wound community. The most commonly reported risk factors include: prealbumin, HbA1c, pressure ulcer wound size, underweight BMI (1.8-24.9 kg/m^2), and active smoking (1,4,8). Suboptimal prealbumin is the most commonly reported independent risk factor for early flap failure in reconstructive wound surgery. Based on our results, we believe that adequate control of pre-existing comorbidities in the preoperative and postoperative phases of flap reconstruction is critical to ensuring successful surgical outcomes. Our patients underwent rigorous pre-operative preparation controlling for prealbumin, diabetic control, weight optimization, smoking cessation, fecal diversion, and controlling the use of topical wound infections, including a full course of tailored antibiotics therapy for existing osteomyelitis. We believe that our flap intervention has proven to be successful because of our control of these important factors. We therefore recommend use of our pre- and post-operative protocol for the prevention of poor flap outcome in high risk populations.

Discussion

We identified 73 patients who received surgical flap reconstruction for pressure ulcers. We analyzed flap reconstruction success based on the number of patients who required a re-operation within 6 months of the initial flap operation. Flap failure was defined as the need for re-operation within that time. Using a chi-square analysis, we determined that our results strongly support the use of surgical flap intervention for the treatment of stage III and IV pressure ulcers when strictly adhering to pre- and post-operative protocols as outlined in materials and methods.

### Results

- **Flap Selection**: Included the tensor fascia lata (n = 23).
- **Flap Success**: Defined as successful flap closure or complete healing of wound.
- **Flap Failure**: Defined as wound dehiscence, surgical site infection, and recurrence.
- **Complications**: Included bacteremia and septicemia, potentially fatal sepsis, cellulitis, and frank lack of failures in the study.

- **Flap Types**: Included the tensor fascia lata (n = 23).
- **Flap Success vs Flap Failure**: Critical value of 0.05.

### Methods

The data gathered in this study was obtained via chart review. We generated a master list including every patient that had a pressure ulcer billing code from the years 2013 to 2015. We created a master list including only flap procedures performed by Dr. Matthew Finnegan on patients with pressure ulcers. If the patient had another flap in the same location within 6 months then we considered this a failure of the index operation.

In this study, we report the pre- and post-operative protocol enforced by the surgical team as part of the methods. Prior to preparation for flap operation, all patients were required to sign a procedural agreement, consenting to the pre- and post-operative guidelines of care. After providing consent, patients began the pre-operative optimization protocol as follows:

1. **Patient Preparation**: 50% reduction in smoking or smoking cessation.
2. **Diabetes Management**: HbA1c ≤ 6%
3. **Malnutrition**: BMI ≥ 18.5
4. **Optimal Immobility**: Mobility optimization, ambulatory status and sensory function, anatomical location, and local tissue availability.
5. **Wound Debridement**: Complete wound debridement and thorough cleansing of wound.
6. **Upper Body**: Complete wound debridement and thorough cleansing of wound.
7. **Lower Body**: Complete wound debridement and thorough cleansing of wound.
8. **Anatomical Location**: Mobile vs. wheelchair bound, optimizing ambulatory status and sensory function.
9. **Surgical Protocol**: Enforced by the surgical team.

### References


### Acknowledgements

We would like to give special thanks to our Lady of Lourdes Hospital (LOLUH) for the allowance to use their facility to perform the flap procedures, and care for our patients. In addition we want to thank the LOLUH staff for their care in the patients’ treatment and postoperative. Thank you to Dr. Matthew Finnegan for his work both in a surgeon and mentor, as well as to the surgical resident team who take part in caring for patients and selecting in research. Finally thank you to Rowan SOM for facilitating an environment conducive to learning and allowing us this presentation.

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**Table 1. Patient characteristics for study population by number of participants (n = 73).**

<table>
<thead>
<tr>
<th>Location</th>
<th>Biceps Femoris</th>
<th>Labrum</th>
<th>Tensor Fascia Lata</th>
<th>Gluteus Maximus and Tensor Fascia Lata</th>
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<tbody>
<tr>
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<td>19</td>
<td>32</td>
<td>14</td>
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<tr>
<td>Age (yrs)</td>
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<td>70</td>
<td>64</td>
<td>60</td>
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<tr>
<td>BMi (kg/m^2)</td>
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<td>16</td>
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<tr>
<td>Comorbidities</td>
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</tr>
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</table>

**Figure 1. Patient characteristics for study population by number of participants (n = 73).**

**Figure 2. Large-volume necrosis sacral wound.**

**Figure 3. Distal-muscle flap closure.**

**Figure 4. Pre-operative protocol flap reconstruction. Patients were assessed based on the following criteria: wound depth, exudative status, smoking status, local gluteal control, BMI, and other local factors.**

**Figure 5. Post-operative protocol following flap reconstruction.**

**Figure 6. Baseline characteristics for study population by number of participants (n = 73).**

**Figure 7A. Pressure ulcer distribution in patients at baseline by location.**

**Figure 7B. Flap distribution by location.**