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# Surgical management of advanced hidradenitis suppurativa via a one-stage procedure: A single-center experience

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ABSTRACT

*Background:* Hidradenitis suppurativa (HS) is a debilitating skin condition; in severe forms it requires excision and skin grafting for cure. This is commonly performed as a multi-stage procedure; we explored single-stage operation as a more efficient alternative.
*Methods:* Retrospective review 2007–2018 evaluating outcomes of patients undergoing single-stage surgery.
*Results:* 139 one-stage procedures were performed: 35 excision and primary closure, 104 split-thickness skin grafting (STSG). Success rate was higher for STSG at 75% versus 60% with primary closure. Of failed primary closures, 57% required revision by grafting due to recurrence. Axilla procedures were most successful at 91% compared to 70%, 54%, and 50% for inguinal, gluteal, and perineal areas, respectively. Infection was the most common complication (17%), with 38% requiring readmission.
*Conclusion:* Compared to prior literature on multi-stage HS treatment, one-stage operations are a feasible, cost-effective alternative. STSG should remain the procedure of choice, even when primary closure appears feasible.



## Introduction

Hidradenitis suppurativa (HS) is a chronic painful inflammatory condition, affecting approximately 98 of 100, 000 people.[1] HS is predominantly seen in women, and is associated with obesity and smoking.[1,2] HS usually presents with painful nodules, which may be complicated with abscess and sinus tracts formation in hair follicles of apocrine gland-bearing areas.[3] While the pathogenesis is not entirely clear, it involves genetic, hormonal, and environmental factors. While not life-threatening, HS in its severe form significantly impacts a patient's quality of life, due to the near-constant copious drainage of foul-smelling purulence from multiple sites. The inability to use deodorant on the intertriginous areas affected, frequent doctors' appointments for exacerbations, and long-lasting treatment regimens harm a patient's ability to work, and adversely affect their personal and sexual relationships resulting in substantial negative psychological impact.[2,4,5]

A variety of treatment options have been described for management of HS, however, there is no consensus on the best method.[3] Different treatment methods are used based on the severity of the disease; options include, but are not limited to, antibiotics, laser therapy, localized excision, or wide excision with skin grafting.[6–8]

For severe advanced cases of HS that do not respond to medical treatment, a surgical approach involving wide excision with split thickness grafting is warranted,[9] which has been shown to be the most effective method of achieving durable symptom resolution. Available literature on surgical management of HS mostly focuses on a two-stage approach, which involves excising the involved skin and placing a dressing, often a negative-pressure vacuum device at the first operation, followed by a second operation scheduled in ≥ 3-days to place a split-thickness skin graft (STSG).[10]

At our institution, the majority of advanced HS has been managed in a one-stage procedure, where wide excision and STSG are performed during the same operation. We aimed to investigate success rates, complications, and short and long-term outcomes of the patients who underwent one-stage procedures, which included either split-skin grafting or a primary closure.

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## Materials and methods

We performed a retrospective chart review of all patients with HS managed with one-stage closure between January 1, 2007 and March 31, 2018. ICD 9 code 705.83 or ICD 10 code L73.2 was used to identify HS, followed by manual screening and verification. Included patients were all those who underwent excision and reconstruction of the affected area as a one–stage procedure. Patients who had a two-staged surgery, with excision first and split thickness skin graft at a later date, were excluded. This study was approved by the Texas Tech University Health Sciences Center IRB.

### *Surgical procedure*

Surgical procedure was determined by the attending surgeon. In general, very mild cases or cases where a very small skin area was involved would have medical management, or incision and drainage in the office. However, the majority of cases referred to the service were severe stage III HS requiring surgical treatment. The default operation was a single stage excision; occasionally a multiple-stage procedure was chosen due to specific patient or disease factors. All procedures were performed under general anesthesia, and pre-operative antibiotics targeted at skin flora, or specific cultures if available, were administered. The entire diseased area was excised to a depth where healthy tissue was discerned, to include all areas of disease. Based on the size of remaining defect, primary closure was considered in the early stages of the study; as we gained experience with the results, we have shifted almost entirely to STSG.

Often, autologous donor skin was harvested, from the ipsilateral thigh. Either chlorohexidine or mineral oil was used to reduce friction with the dermatome. In recent years, we have added the injection of liposomal bupivacaine to the donor site to relieve postoperative pain; anecdotal evidence suggests this helps with patient satisfaction of post-operative pain management. Harvested skin was meshed 2:1 or 1:1 based on wound size. The donor bed was dressed with Opticell™ wound dressing (Medline Inductries, Inc., IL) and an Exu-Dry® Anti-Shear wound dressing (Smith & Nephew, Inc., MA). The dressing was secured in place with skin staples, Kerlix™ gauze (Covidien/Medtronic, MN) and ACE™ elastic bandage (3 M, MN).

ARTISS fibrin glue (Baxter Healthcare Corporation, IL) was sprayed onto the wound bed prior to applying split-thickness skin graft, which was secured using staples. Anchoring stitches were sometimes used at the center of the graft bed to help the skin graft lay flat. Antibiotic-covered ADAPTIC® gauze (Acelity, TX) was then applied on top of the skin graft and a final dressing was applied. The final dressing provided resistance to shearing of the skin graft. Next, a pressure dressing or a negative pressure wound vacuum was applied on the skin graft. The patients were followed up in clinic in five days to take down the vacuum dressing. During this clinic visit, the staples of the skin graft were removed and the donor site was evaluated. If the patient was admitted to the hospital after the index operation, the donor site was taken down on postoperative day 3 and the skin graft dressing was taken down for evaluation on postoperative day 5 (Fig. 1).

### *Statistical analysis*

Cases were subdivided into six categories based on anatomical site (i.e., inguinal, axillary, perineal, gluteal, truncal, and other (unspecified) regions). Complications such as infections, hematomas, and seroma, and length of hospital stay were recorded. Our primary outcomes of interest were the percent graft take for each anatomical region and the requirement of a secondary surgery to determine success of the procedure. Successful graft take was defined as > 20%. Some cases lacked graft take percentage criteria and instead, readmission and reoperation were used to determine failure rates.

Statistical analysis of collected data was limited to calculations

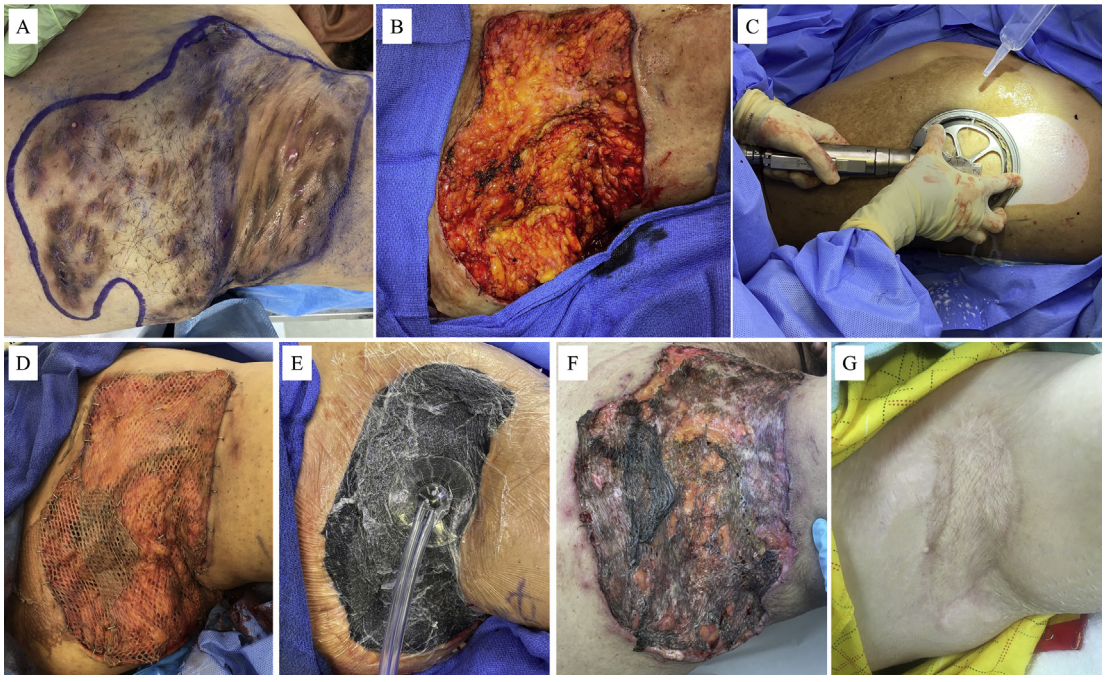


**Fig. 1.** One-stage Procedure for the Management of Hidradenitis Suppurativa. A. Pre-excision appearance of axilla in a patient with hidradenitis suppurativa. The area of excision has been outlined. B. Post-excision appearance of axilla. C. Harvesting of autologous donor skin graft. D. Application of meshed split skin graft on the wound bed. E. Application of a negative pressure wound vacuum on the skin graft. F. Appearance of skin graft after 5 days post grafting. G. Appearance of skin graft after 1 year (from a different patient).

of proportions. Success for main anatomical regions (i.e., axillar, inguinal, perineal, gluteal, truncal and other) were analyzed using mixed-effects logistic regression models constructed using the *lmerTest* package (version 1.1–21) in R statistical software (version 3.5.3). Graft success was considered as the dependent variable and the surgical site was modeled as a categorical independent variable, accounting for the possible nested nature of the regions within a given patient (i.e., when multiple regions of the same patient was evaluated). Axillary region was designated as the reference.

## Results

We screened 109 patients with a diagnosis of HS (Fig. 2). Fifty-seven patients underwent a total of 139 single-stage procedures on different body areas, and were included in this study. Hundred and four cases were one-stage procedures (in 46 patients) with STSG and 35 cases had primary closure (in 13 patients). The average age of the patients who underwent one-stage procedure was 35.2 ± 9.1 (range 16–56) years and average BMI was 35.8 ± 7.8 kg/m$^2$. Female predominance was also noted, with 61% patients being women. Hypertension was seen in over half of the patients (53%), and diabetes in 39% of the total patient population. Furthermore, 53% of patients who underwent one-stage procedure were either previous (14/59) or active (17/59) smokers. Overall success rate for one-stage procedure was 71.2% (99/139 cases). The more frequent area to be treated was the axilla (39.6%). The mean length of in-hospital stay (LOS) for one-stage closure was 3.4 ± 2.8 days (range 0–27 days). LOS for STSG and primary closure were 4.11 ± 2.9 days (range 1–27 days) and 2.82 ± 1.2 days (range 0–7 days), respectively. Summary of overall findings of one-stage procedure is shown in Table 1.

Of the 104 cases successful graft take following the initial operation. The success rate for axilla was 90.1% (40/44 cases). Success rates for inguinal, gluteal and perineal areas were 70% (21/30 cases), 53.8% (7/13 cases), and 50% (1/2 cases), respectively. Out of 22 cases of graft failure, two cases had reappearance of HS after initial successful graft intake, four cases had information of graft failure but no information of revision surgery due to loss to follow up and one case had no information of graft intake or revision surgery. 77.72% of graft failures (17/22 cases) underwent revisional surgery.

Of the 35 primary closures, 60% (21 cases) were successful without the need to progress to STSG. Of the failed primary closures, 57.2% (8/14 cases) underwent revisional surgery with STSG due to reappearance of HS. These cases were confined to either the axillary or inguinal regions. Failed primary closures in the trunk, breast, and occiput were subsequently managed by revisional surgeries with primary closure (42.9%).

When the success of one-stage procedure was regressed on the site of disease including axillary region as the reference category, a significant negative effect was observed for other regions ($\beta = -1.28$, SE = 0.59, $z = -2.17$, $p = 0.03$). Negative effects were also observed for inguinal and gluteal regions; however; the difference didn't reach statistical significance ($p = 0.069$ and $p = 0.082$, respectively) (Table 2). Hence, the results indicated that the success rate of one-stage procedure in perianal and trunk regions were similar to the success rates in axillary region. In contrast, other (unspecified) regions (e.g., mons pubis, breast, thigh, hip, occiput, and posterior neck) showed a lower success rate. Furthermore, inguinal and gluteal region showed a trend toward lower success rate in comparison to the axillary region (Table 2).

Infection was the most common complication at 17.3% (24/139), with 37.5% (9/24) requiring readmission. There were 17 (16.3%) cases of infection following one-stage procedure with STSG of which only 23.5% (4/17 cases) required readmission. All readmissions for infection were in patients with inguinal disease. Although the gluteal region had the highest rate of infection of 30.8% (4/13 cases) overall. Inguinal and axillary regions showed infection rates of 30% (9/30 cases) and 8.9% (4/45 cases), respectively. Somewhat surprisingly, the perineum, trunk and other

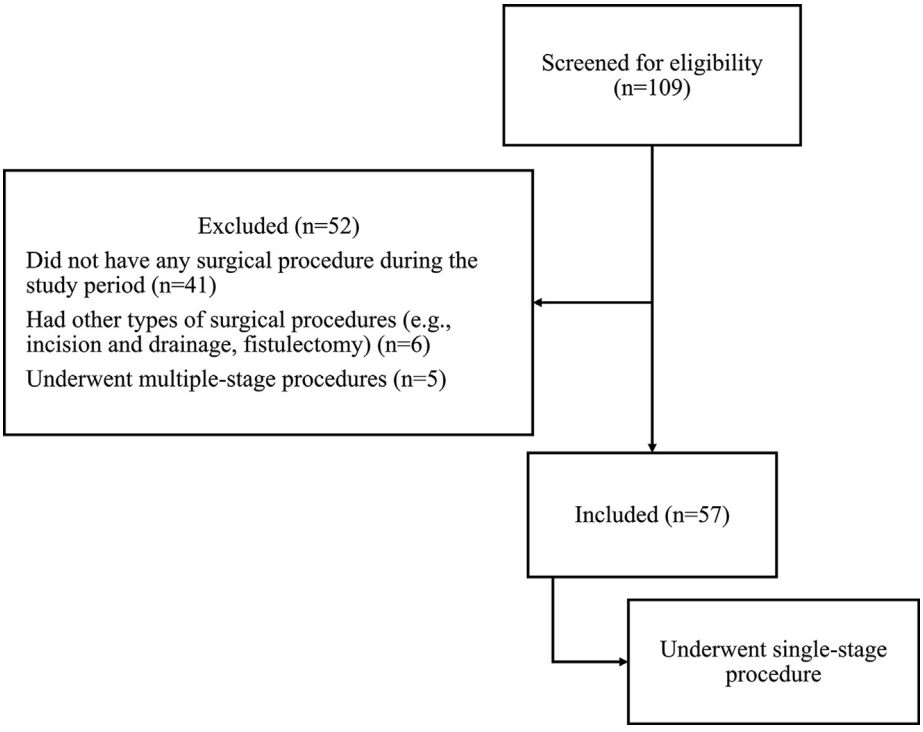


**Fig. 2.** CONSORT diagram.

**Table 1**
Summary of number of cases treated with one-stage procedure.

| Region | Total | Successful One-stage Procedure | Failure | Managed with Revisional Grafting | Managed with Revisional Primary Closure | Mean Length of Stay (Hospital days/duration) ± SD |
|---|---|---|---|---|---|---|
| **Axillary** | 55 (1*) | 44 | 9 (2*) | 6 | 1 | 3.4 ± 1.8 |
| **Inguinal** | 37 | 24 | 13 (3*) | 10 | 0 | 3.5 ± 1.7 |
| **Perineal** | 6 | 5 | 1 | 1 | 0 | 2.5 ± 2.1 |
| **Gluteal** | 15 | 9 | 6 | 6 | 0 | 5.0 ± 6.1 |
| **Trunk** | 8 (1*) | 7 | 1 | 0 | 1 | 1.9 ± 0.7 |
| **Other:** | | | | | | 2.1 ± 2.3 |
| Mons Pubis | 4 | 2 | 2 | 2 | 0 | |
| Thigh | 2 | 2 | 0 | 0 | 0 | |
| Hip | 2 | 2 | 0 | 0 | 0 | |
| Posterior Neck | 1 | 1 | 0 | 0 | 0 | |
| Breast | 8 (2*) | 5 | 3 | 0 | 3 | |
| Occiput | 1 | 0 | 1 | 0 | 1 | |
| **Total (%)** | 139 | 99 (71%) | 36 (26%) | 25 | 6 | 3.4 ± 2.8 |

* Lost follow-up; SD-Standard deviation.

**Table 2**
Summary of Regressing Success of One-stage Procedure vs. Anatomical Location.

| Region | β | SE | z-value | p-value | OR [CI] |
|---|---|---|---|---|---|
| **Intercept (Axillary)** | 1.504 | 0.350 | 4.302 | **<0.001** | 4.500 [2.268, 8.929] |
| **Inguinal** | −0.891 | 0.491 | −1.816 | 0.069 | 0.410 [0.157, 1.073] |
| **Perineal** | 0.105 | 1.150 | 0.092 | 0.927 | 1.111 [0.117, 10.582] |
| **Gluteal** | −1.099 | 0.632 | −1.737 | 0.082 | 0.333 [0.096, 1.151] |
| **Truncal** | −0.993 | 0.810 | −1.227 | 0.220 | 0.370 [0.076, 1.811] |
| **Other regions** | −1.280 | 0.590 | −2.174 | **0.030** | 0.278 [0.088, 0.882] |

OR: Odds ratio; CI-95% Confidence Interval.

**Table 3**
Summary of number of cases with complications.

| Region | Infection | | Seroma | Hematoma |
|---|---|---|---|---|
| | One-stage procedure with skin grafting | Primary closure | One-stage procedure with skin grafting | One-stage procedure with skin grafting |
| **Inguinal** | 9 | 2 | 0 | 1 |
| **Axillary** | 4 | 0 | 1 | 0 |
| **Perineal** | 0 | 0 | 0 | 0 |
| **Gluteal** | 4 | 2 | 0 | 0 |
| **Trunk** | 0 | 1 | 0 | 0 |
| **Other:** | | | | |
| Mons Pubis | 0 | 0 | 0 | 0 |
| Thigh | 0 | 0 | 0 | 0 |
| Hip | 0 | 0 | 0 | 0 |
| Posterior Neck | 0 | 0 | 0 | 0 |
| Breast | 0 | 2 | 0 | 0 |
| Occiput | 0 | 0 | 0 | 0 |
| **Total** | 17 | 7 | 1 | 1 |

regions did not have any reported cases of infection following the one-stage procedure. There was one case of seroma reported in axillary region, and one case of hematoma reported in gluteal region. In contrast, 20% (7/35 cases) managed with primary closure presented with infection and 71.4% of the infected cases (5/7 cases) required readmission. Cases requiring readmission for infection had lesions in the gluteal region (2 cases), breast (2 cases), and the trunk (1 case). Two cases with lesions in inguinal region received outpatient treatment for infection (Table 3.).

## Discussion

The management on HS is still controversial, without clear treatment guidelines or concensus.[11] Therefore, management is largely at the clinician's discretion based on the patient's Hurley score—a score of Hurley stage I being mild and a Hurley stage III being severe.[12] Clinicians can choose between a variety of medical therapies for mild to moderate cases, with surgery usually being reserved for more severe cases. There are also multiple surgical treatment options, the most common being excision with primary closure, flap, or skin graft. Due to the high risk of infection, a multi-staged procedure has been described as the default surgical option in much of the literature. This series demonstrates that a one-stage procedure with or without STSG is an acceptable alternative, with good success rates especially in the axillary region, and shorter hospital stays resulting in less cost and utilization of healthcare resources.

Recurrence rates after excision and STSG for HS in the literature range from 0 to 33%.[13–16] This wide range is seen due to difference in technique, region, patient factors and study design.[13] For instance, Romanowski et al.[6] reported that in 114 cases undergoing two-stage procedure, 12.2% had graft failure, with only 6.1% requiring regrafting due to recurrence. Comparatively, our study reported 25% graft failures and 14% revision surgeries out of 104 total cases. Even though the overall percentage of graft failure and the percentage needing a revisional surgery were high with one-stage procedure with STSG, most graft failures were confined to inguinal and gluteal regions. In contrast, axilla, perineal, trunk, breast, thigh, hip, and neck regions were shown to be favorable areas for successful one-stage STSG, indicating that careful patient selection will be one key to implementing a successful one-stage surgical treatment strategy.

The best results in this series were seen in patients with axillary HS, who had the lowest failure rates with a graft loss of 9.1%, infection rate of 8.9% and recurrence rate of 4.5%, compatible with available literature.[15,17] In contrast, patients with inguinal disease, although demonstrating a 70% success rate, had inferior results compared to published results of two-stage procedures (90% success rate in 10 cases)[6]; they also had a higher infection rate of 30%, with 44.4% needing readmission for treatment. Another area of high incidence of infection was the gluteal area (30.8%), although the results in this series are comparable with what is reported with two-stage closure.

A wide range of recurrence rates, ranging from 0 to 70% is reported in the literature for primary closure.[13,18] Primary closure seems to be effective in certain areas, however, high rate of recurrence and a greater rate of infection, which resulted in hospital admission are potential challenges when managing HS using primary closure.[18] The recurrence rate for our study was around 40%, which is consistent with the available literature.[14] While this

method can provide pain relief and eliminate HS for a period of time, it should likely not be presented as a definitive treatment of severe HS.[13,14]

The LOS for multiple stage procedure are usually extended due to the gap between the excision and grafting.[6,11] For instance with the two-stage procedure, the time between excision and grafting averaged 4.59 days in the literature, resulting in a total hospital stay of > 5 days.[6] The LOS for one-stage procedure in this series was notably shorter, indicating that a one-stage procedure can reduce hospital burden and patient cost due to prolonged hospital stay.

Limitations of this study included the retrospective nature of the design and nested nature of the cases within subjects. As our study was a retrospective review of patient's charts, there were certain factors that could not be assessed, such as reason for graft loss, or compliance with discharge instructions. There are number of cases that were lost to follow up. It is not clear whether these patients did not follow up due to a completely successful procedure, or gave up due to poor outcome (i.e., they may not have been missing completely at random). Moreover, as the observations were nested within subjects (i.e., multiple subjects had lesions in more than one region) and were readmitted for recurrence in the same region, this posed challenges in comparing the results to other studies.

We did not have any cases where rotational or free flaps were used for reconstruction; therefore, we cannot comment on comparative success rates of these methods.

## Conclusion

HS is a chronic inflammatory condition, which is difficult and complex to treat. Among the surgical options available for management of HS, one-stage surgery with STSG, particularly in axillary disease, is an effective and cost-efficient alternative to standard two-stage procedures.

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## Authors contributions

Conceptualization: Sharmila Dissanaike; Study design: Sharmila Dissanaike; Administrative support: Sharmila Dissanaike and John Griswold; Data collection and acquisition: Donna Ayala, Kyle Thomas, Virginia Tran, Audrey Le, Audrey Hand, and Adel Alhaj Saleh; Data analysis: Chathurika S. Dhanasekara; Manuscript preparation: Chathurika S. Dhanasekara, Donna Ayala, Kyle Thomas, Virginia Tran, Audrey Hand, and Audrey Le; Critical revision: Chathurika S. Dhanasekara and Sharmila Dissanaike.

## Declaration of competing interest

No direct support was received related to the preparation of this manuscript. The authors do not have any conflicts of interest to declare.

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