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Case Report
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Complex Reconstructive Plastic Surgery for End Stage Pressure Ulcers in Spinal Cord Injury Patients

*Caroline Yao, David Perrault and Salah Rubayi**

Division of Plastic and Reconstructive Surgery, University of Southern California, USA

Abstract

The development of pressure ulcers is related to many factors. Primarily the lack of sensation and unrelieved pressure resulting in ischemia of the tissue which eventually will progress to necrosis and development of stage pressure ulcers. The worst is stage 3 & 4.

If proper wound care and patient education may help to heal these wounds but unfortunately in spinal cord injury patients there is a high incident of recurrence of pressure ulcers, between 30-60%. Therefore with the advancement of reconstructive plastic surgery this becomes possible to repair the defect but there is a limitation to how many times using the same tissue or exhaustion of the tissue available. We describe in this case how a spinal cord injury patient approached the final limit of tissue available prior to final disarticulation. As a result a complex reconstructive surgery was performed and described.

Introduction

Patients with spinal cord injury (SCI), pressure ulcers are a commonly encountered with a costly problem. 27%-40% of those with SCI will develop a pressure ulcer during their initial hospitalization and/or rehabilitation. Furthermore, the rates of re-hospitalization for pressure ulcer disease are 17.7% within the first year and 37.4% by 20 years post-injury [1]. The cost of treating pressure ulcers in SCI patients has been reported as high as $1.2 billion per year in the United States, and is expected to climb to 7.5 billion by 2020 [2].

Pressure ulcers are an especially serious complication in those with SCI. They are difficult to treat, often recur, can impede rehabilitation, are socially isolating, and can result in devastating morbidity and even mortality [3,4]. Because of the increasing longevity of patients with SCI, multiple recurrent ulcerations and end-stage disease are more common [5]. "End-stage pressure ulcer patients" are often described as those with recurrent ulceration, multiple failed flap reconstructions and Girdlestone procedures [3]. Additionally, pressure ulcers are not typically an isolated complication of SCI. These patients commonly suffer from a multitude of related conditions that exacerbate the pressure ulcer, such as heterotopic ossification (HO) of the hip and pyogenic arthritis [6]. Therefore, treatment of pressure ulcers in the end-stage patient should address all of the contributing problems.

There are both non-operative and operative modalities for pressure ulcer treatment. Non-operative management includes local wound care, negative pressure wound therapy (NPWT), and electrical stimulation in select cases. Local wound care involves dressing changes and topical antimicrobial, cleansing, and debriding agents. Negative pressure wound therapy has been used with success, typically to improve primary wound healing in preparation for future soft tissue coverage [7]. Electrical stimulation is beneficial when applied in combination with local wound care [8]. The options for surgical treatment include debridement, skin grafting, flap coverage, the Girdlestone procedure, or lower extremity disarticulation and total thigh flap coverage [3].

As reviewed by Kruger et al. the choice of treatment is guided by the stage and location of the ulcer. When pressure ulcer has recurred and a patient has already undergone multiple reconstructive flap procedures, options for wound healing become extremely limited. End stage ulcer patients requiring surgery warrant special consideration, as previous flap incisions, previously harvested skin/fascia/muscle and multiple medical comorbidities must be accounted for [3]. Finally, the majority of soft tissue coverage options are typically exhausted for end-stage pressure ulcer patients and surgeons must think creatively to construct surgical solutions. As such, we present a patient with end-stage pressure ulcer disease treated with proximal femoral osteotomy and flap reconstruction (the Girdlestone procedure). We also outline the important considerations when treating those with

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Correspondence:
Salah Rubayi, Division of Plastic and Reconstructive Surgery, Rancho Los Amigos National Rehabilitation Center, Keck School of Medicine of the University of Southern California, 7601 E Imperial Hwy, Downey, CA 90242, USA,
E-mail: srubayi@dhs.lacounty.gov

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Figure 1: Pre-surgical photograph, depicting stage IV sacrococcygeal, perineal, bilateral ischial, and left posterior thigh pressure ulcers.

Figure 2: Pressure ulcer site after debridement of necrotic tissue.

Figure 3: Anteroposterior pelvis radiograph, note the bilateral heterotopic ossification of the hip.

end-stage pressure ulcers with the modified Girdlestone procedure, as developed by the senior author.

Case Presentation

Our patient is a 61-year-old African-American male who suffered incomplete T10 paraplegia secondary to spinal surgery in 1997 for spinal stenosis. His medical comorbidities include neurogenic bladder, hypertension, insulin-dependent type 2 diabetes, hyperlipidemia, chronic anemia, lower extremity spasm, chronic mixed essential tremor, and recurrent urinary tract infections. He has had a colostomy and a suprapubic urinary catheter for several decades.

He had received multiple flap surgeries since 2013 for pressure ulcers as follows:

For recurrent sacral ulcers, he has received: a right lumbar fasciocutaneous rotational perforator flap, a left gluteus V-Y sliding island flap, and a right gluteus maximus myocutaneous rotational flap that required re-rotation one year later. For recurrent bilateral ischial ulcers, he has received: bilateral gracilis rotational muscle flaps, bilateral medial thigh fasciocutaneous flaps, a right posterior thigh fasciocutaneous rotational flap, and bilateral ischial osteotomies for resection of osteomyelitis. For recurrent right trochanteric ulcers,

Figure 4a: Planned surgical incisions: extended Tensor Fascia Latafasciocutaneous flap. **b.**Planned surgical incisions: posterior thigh fasciocutaneous flap.

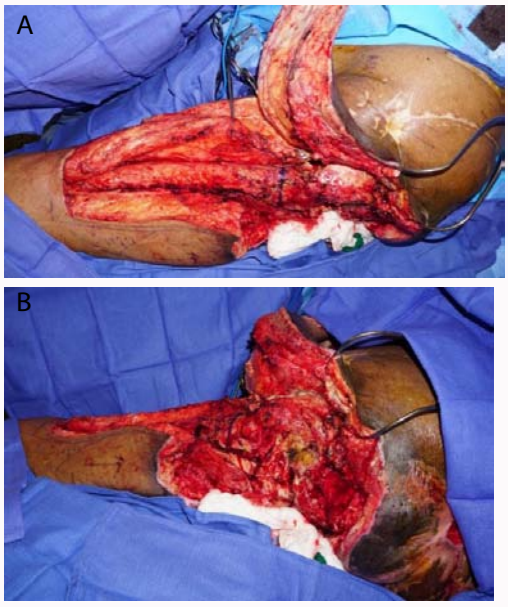

Figure 5: A & B Surgical exposure of the femoral head, with the planned transverse femoral osteotomy marked. Extended TFL fasciocutaneous flap has been raised.

he received: a right vastus lateralis rotational muscle flap and a right rectus femorisrotational muscle flap. Despite previously healed flaps and proper wheelchair cushioning in 2016, the patient developed extensive stage IV sacrococcygeal, perineal, bilateral ischial, and left posterior thigh pressure ulcers with localized gangrene soft tissue infection (Figure 1).

The reason for developing these multiple pressure ulcers was that patient admitted he sat too long without pressure relief. The second important reason is the ankyloses of both hips secondary to heterotopic ossification. In the previous flap surgeries patient refuse to have a Girdlestone procedure. In this presentation, considering the patient has a very limited muscle reserve, patient was advised that we

may need to perform a disarticulation and total thigh flap to close the present ulceration. Patient stated to leave this option as a last resort.

Operatively, in the first stage of the surgery, the patient was placed in right lateral decubitus position and all necrotic tissue was thoroughly debrided to healthy bleeding tissue (Figure 2). Given the patient's extensive soft tissue defect and heterotopic ossification (Figures 2 and 3), the following combination of surgeries was planned: left modified Girdlestone with excision of HO, with dead space filled by rotational vastus lateralis with rectus femoris muscles, and a combination of left tensor fascia lata extended rotational flap and V-Y Hamstring advancement flap to close the skin.

In the second stage of the surgery, incisions were marked for the extended Tensor Fasciae Lata (TFL) and posterior thigh fasciocutaneous flaps adjacent to the wound. A line drawn between the Anterior Superior Iliac Spine (ASIS) of the pelvis and anterior/lateral patella was used plan the anterior incision. The intermuscular septum was palpated and marked to plan the posterior incisions (Figure 4). The flap measured 30 x 10 cm and was elevated as an extended fasciocutaneous flap, including the distal gluteus maximus muscle for vascular support.

The posterior incision of the TFL flap was used to access the vastus lateralis muscle. The TFL fascia was incised sharply and the intermuscular septum was identified along the entire length of the vastus lateralis. The vastus lateralis, with the deep vastus intermedius, was isolated posteriorly from the biceps femoris. Distally, the vastus lateralis was horizontally divided where it became primarily tendinous. We then divided the muscle flap along its anterior border. The rectus femoris was included with the vastus lateralis muscle, as additional volume was needed to fill the space of the wound. The entire group of muscles was elevated as a unit, using the femur as a deep border/landmark, taking care to protect the pedicle as the deep dissection approached the proximal medial portion of the flap.

Figure 6: Intraoperative photograph after transverse femoral head resection. The grouped vastuslateralis and rectus femoris muscle flap and TFL fasciocutaneous flapsare shown elevated.

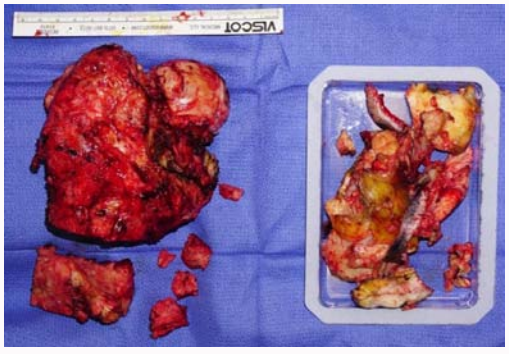

Figure 7: Intraoperative photograph of the surgically resected specimens. Note the large amount of heterotopic ossification about the head and neck of the femur (Left) and the remaining heterotopic ossification that was removed from the proximal femur (Right).

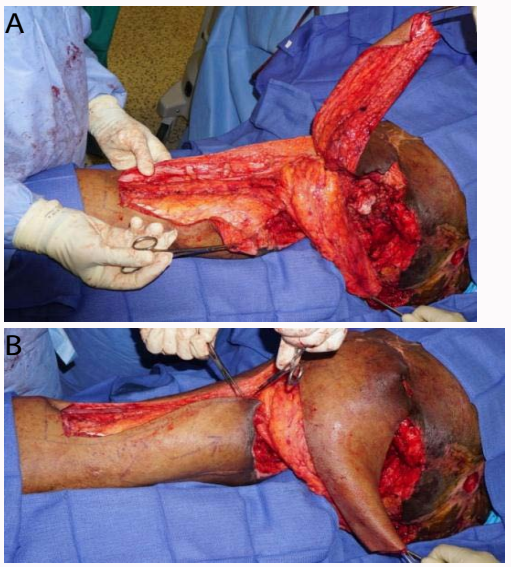

Figure 8: Isolated extended vastuslateralis with distal gluteus muscle flaprotated to fill the acetabular cavity and wound base (A), followed by coverage with the TFL fasciocutaneous flap and posterior thigh fasciocutaneous flap (B).

Figure 9: Intraoperative photograph, note the position of the drains.

To expose the proximal femur, a transverse incision was made over the origin of the vastus lateralis muscle 2 cm below the greater trochanter. The vastus lateralis muscle fibers were dissected from the proximal femur and the lateral attachment of the vastus lateralis to the intermuscular septum was dissected and transected. Once bone was exposed, Cobb elevators were used to protect the soft tissue surrounding the femur and a transverse osteotomy was made below the level of the lesser trochanter using an oscillating bone saw (Figure 5 and 6). The hip joint capsule was transected to expose the femoral head. A Cobb elevator was inserted into the joint space to dislocate the femur head from the acetabulum and the ligamentum teres was transected. The head, neck, and greater and lesser trochanter of the femur were removed en bloc (Figure 7). Remaining heterotrophic ossification on the proximal femur was removed with a straight osteotome. Sharp areas of bone were rasped until smooth.

The vastus lateralis muscle flap was rotated 90° counter-clockwise to fill the ulcer defect and inset with 0-vicryl interrupted, buried sutures (Figure 8). The TFL fasciocutaneous flap was rotated 90° counter-clockwise and inset using 0-vicryl buried scarp as sutures (Figure 8). Four drains were placed: 1 superior-lateral drain above the vastus muscle flap, 1 superior-posterior drain below vastus muscle flap, and 2 inferior drains along vastus harvest site (Figure 9). All skin

A. Lateral

B. Posterior

Figure 10: Closed wound with 8 x 3cm area of wound left open infero-medially.

Figure 11: Postoperative anteroposterior pelvis radiograph showing removed heterotopic ossification and proximal osteotomy.

was closed in a layered fashion, with 2-0 monocryl running external interrupted, 0-PDS running external interrupted, and then staples (Figure 10). Postoperative anteroposterior pelvic radiograph showed excision of HO and the proximal osteotomy (Figure 11).

Figure 12 shows the patient at 4 weeks post-operatively, with all flaps healing well. The distal aspect of the extended TFL fasciocutaneous flap underwent superficial epidermolysis, which healed. The distal-most aspect of these flaps must be closely monitored, as blood supply is most tenuous in these areas.

Post operatively, the patient underwent the senior author's protocol of 6 weeks of bed rest in an air fluidized bed with hip abduction pillow to allow for complete flap incision healing. At 6 weeks post-operatively, the patient began a gradual siting program with a physical therapist [9].

Discussion

The Girdlestone procedure was first described by Dr. Girdlestonein 1943. Initially, the procedure was presented as an effective treatment for pyogenic arthritis of the hip [10]. Since that time, it has additionally been shown to be an effective treatment for end-stage pressure ulcers and heterotopic ossification of the hip in spinal cord injury patients [6,10,11]. As previously reported, the senior author has extensive experience treating end-stage pressure ulcers and heterotopic ossification with a modified form of the Girdlestone procedure [6]. Based on the senior author's experience, we present an overview of the most pertinent considerations when

Figure 12: The patient 4 weeks post-operatively. Incisions were healing well with no evidence of infection or wound breakdown. Area left open infero-medially has nearly contracted to closure. Distal extended TFL fasciocutaneous flap has superficial epidermolysis that is healing and closed.

treating these patients.

The major distinctions of our modified Girdlestone procedure include: filling of the dead space secondary to bony resection, modifications to prevent femoral pistoning (proximal displacement of femur), a larger femoral resection, and a single-stage technique [6]. The elimination of dead space has been recognized as important for the outcome of this procedure since Girdlestone first described its use [10]. Unfortunately, although Girdlestone took measures to "flatten" the dead space, the original procedural technique often resulted in a tissue defect after bony resection [6,10]. Filling of the bone defect with vascularized tissue effectively mitigates wound healing and solves the dead space problem [6].

Perforator based, fasciocutaneous, and musculocutaneous flaps have all been shown to be effective as treatment options for pressure sores; outcomes of pressure sores treated with these flap types have been systematically reviewed and found to be equivalent in terms of complication rates and recurrence [12]. In the experience of the senior author, however, a pedicled rectus femoris muscle flap has been especially favorable, given that this preserves the vastus lateralis for later use [6].

As with elimination of the dead space, Girdlestone also noted that preventing proximal displacement of the femur (femoral pistoning), was vital in the post-operative care of these patients. Failure to prevent muscle spasm and subsequent femoral pistoning will result in detraction of the proximal femur from the surrounding muscle and blood supply and, ultimately, impaired wound healing [3,6,10,13]. Girdlestone recommended placing the limb in traction with a Hodgen splint or a plaster spica [10]. Since that time, more effective methods have been developed, e.g. external fixation [13]. Notably, however, the senior author has developed a less invasive technique for preventing femoral pistoning by using anti-spasmodic medication and an abduction pillow for 4 to 6 weeks post operatively, along with physical therapy [11].

The senior author's modifications to the Girdlestone procedure also include resection of a larger segment of the femur than initially described. Specifically, excising the head of the femur and greater trochanter to a level below the lesser trochanter. This eliminates all infected bone and functionally impairs the iliopsoas muscle by releasing its tendinous attachment, therefore ameliorating long term hip contractures and muscle spasms [6]. Decreasing the risk of hip contractures is significant in SCI patients, asup to 44% have been reported to develop at least one joint contracture at one-year post SCI [14].

The senior author also strongly recommends treating or ensuring adequate treatment of the chronic disease in end-stage pressure ulcer patients. These patients have often lived for decades with SCI, making anemia of chronic disease and hypoproteinemia with low albumin and pre-albumin blood levels common. These factors, along with more complex surgical needs, make end stage ulcer patients particularly challenging to treat.

Further recommendations for the management of these patients are a full nutritional workup, pre-operative cultures with sensitivities, and comprehensive pre-surgical planning. The importance of appropriate nutrition in spinal cord injury and pressure ulcer patients is well known [16-18]. Nutritional workup and management should include physical examination for signs of malnutrition, assay for biomarkers of nutritional status (albumin, pre-albumin, transferrin, nitrogen balance, creatinine, and total cholesterol), involve a dietitian as part of the medical team, and follow the NPUAP-EPUAP guidelines [3,18].

End stage pressure ulcers are often colonized with multiple organisms, including those with drug resistance [15]. Additionally, 25% of those with pressure ulcers have underlying osteomyelitis [19]. A recent Cochrane review found that there is a paucity of data on microbial colonization and infection in pressure ulcers [20]. However, it is widely accepted that that controlling microbial colonization and infection is important in the treatment of these patients. The senior author recommends collecting pre-operative microbial cultures with drug sensitivities.

Finally, pre-operative planning in these patients should incorporate the previously harvested or rotated flaps. If pre-operative records are not available, the scares from previous surgical incisions can be used as a general clue of what has been done. It is also important to consider the location of previous incisions as not to devascularize the created skin islands.

There are many challenges in caring for end-stage pressure patients. In addition to the mobility limiting result of SCI, these patients have been reported to be subject to a large number of other risk factors for developing pressure ulcers [2]. Furthermore, the number of those with end-stage pressure ulcers appears to be increasing, likely from improvements in long-term care. A systematic approach to the treatment of these patients is highly important given the increasing incidence of end-stage pressure ulcers and the complicated nature of these patients. Our recommendations for the care of these patients includes multidisciplinary care, including: a full nutritional work-up, pre-operative microbial cultures, careful pre-surgical planning, control of any chronic disease, physical therapy, and soft tissue coverage with boney resection as necessary, in conjunction with post-operative anti-spasmodic medication, use of an abduction pillow for 4 weeks, and post-operative use of an air-fluidized bed for 4-6 weeks.

References

1. Groah SL, Schladen M, Pineda CG, Hsieh CH. Prevention of Pressure Ulcers among People with Spinal Cord Injury: A Systematic Review. PMR. 2015; 7: 613-636.
2. Byrne DW, Salzberg CA. Major risk factors for pressure ulcers in the spinal cord disabled: a literature review. Spinal cord. 1996; 34: 255-263.
3. Kruger EA, Pires M, Ngann Y, Sterling M, Rubayi S. Comprehensive management of pressure ulcers in spinal cord injury: current concepts and future trends. J Spinal Cord Med. 2013; 36: 572-585.
4. Regan MA, Teasell RW, Wolfe DL, Keast D, Mortenson WB, Aubut JA. A systematic review of therapeutic interventions for pressure ulcers after spinal cord injury. Arc Phys Med Rehabil. 2009; 90: 213-231.
5. Rubayi S, Ambe MK, Garland DE, Capen D. Heterotopic ossification as a complication of the staged total thigh muscles flap in spinal cord injury patients. Anna Plast Surg. 1992; 29: 41-46.
6. Rubayi S, Gabbay J, Kruger E, Ruhge K. The Modified Girdlestone Procedure with Muscle Flap for Management of Pressure Ulcers and Heterotopic Ossification of the Hip Region in Spinal Injury Patients: A 15-Year Review with Long-term Follow-up. Ann Plast Surg. 2016; 77: 645-652.
7. Orgill DP, Bayer LR. Update on negative-pressure wound therapy. Plastic and reconstructive surgery. 2011; 127: 105s-115s.
8. Lala D, Spaulding SJ, Burke SM, Houghton PE. Electrical stimulation therapy for the treatment of pressure ulcers in individuals with spinal cord injury: a systematic review and meta-analysis. Int Wound J. 2016; 13: 1214-1226.
9. Rubayi S. Reconstructive Plastic Surgery of Pressure Ulcers. Springer Berlin; 2015.
10. Girdlestone GR. Acute pyogenic arthritis of the hip: an operation giving free access and effective drainage. Clin Orthop Relat Research. 2008; 466: 258-263.
11. Rubayi S, Pompan D, Garland D. Proximal femoral resection and myocutaneous flap for treatment of pressure ulcers in spinal injury patients. Ann Plast Surg. 1991; 27: 132-138.
12. Sameem M, Au M, Wood T, Farrokhyar F, Mahoney J. A systematic review of complication and recurrence rates of musculocutaneous, fasciocutaneous, and perforator-based flaps for treatment of pressure sores. Plast Reconstr Surg. 2012; 130: 67e-77e.
13. Klein NE, Luster S, Green S, Moore T, Capen D. Closure of defects from pressure sores requiring proximal femoral resection. Ann Plast Surg. 1988; 21: 246-250.
14. Diong J, Harvey LA, Kwah LK. Incidence and predictors of contracture after spinal cord injury--a prospective cohort study. Spinal Cord. 2012; 50: 579-584.
15. Rubayi S, Burnett CC. The efficacy of single-stage surgical management of multiple pressure sores in spinal cord-injured patients. Ann Plast Surg. 1999; 42: 533-539.
16. Thomas DR. The role of nutrition in prevention and healing of pressure ulcers. Clin Geriatr Med. 1997; 13: 497-511.
17. Pinchcofsky-Devin GD, Kaminski MV Jr. Correlation of pressure sores and nutritional status. J Am Geriatr Soc. 1986; 34: 435-440.
18. Dorner B, Posthauer ME, Thomas D. The role of nutrition in pressure ulcer prevention and treatment: National Pressure Ulcer Advisory Panel white paper. Adv Skin Wound Care. 2009; 22: 212-221.
19. Brown DL, Smith DJ. Bacterial colonization/infection and the surgical management of pressure ulcers. Ostomy Wound Manage. 1999; 45: 109S-118S.
20. Norman G, Dumville JC, Moore ZE, Tanner J, Christie J, Goto S. Antibiotics and antiseptics for pressure ulcers. The Cochrane database of systematic reviews. 2016.