MedStar Washington Hospital Center

The Vertical Contour Calcanectomy: An Alternative Surgical Technique to the Conventional Partial Calcanectomy

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Introduction

Heel ulcers have a significant impact on lower extremity morbidity and confer a high risk for major amputations. Although there are many conservative treatment options, once calcaneal osteomyelitis occurs or a heel ulcer becomes chronic or recalcitrant, more invasive management is required. The partial calcanectomy is a surgical solution which can address both pathologies; the ulceration and the infected bone. The conventional partial calcanectomy, however, does not ensure complete soft tissue closure and closure under tension may ensue which leaves patients at risk for further complications. The Vertical Contour Calcanectomy (VCC) incorporates improvements to an already accepted limb salvage technique. The purpose of this poster is to describe the indications, contraindications, intraoperative technique and postoperative management of the VCC for patients who present with heel ulcers in the limb salvage setting.

Perioperative Considerations and Contraindications

The primary indications for the VCC are patients with ulcers of the plantar and/or posterior heel secondary to pressure, ischemia, and/or infection [**Figure 1**]. The VCC is reserved for those patients with a heel ulcer who otherwise cannot be primarily closed without advanced methods, and/or those complicated with OM of the calcaneal tubercle. Other indications include patients with a calcaneal gait that does not warrant hindfoot reconstruction. Such patients include those who have minimal ambulation requirements, those who use their limbs to transfer, and non-ambulatory patients. Contraindications for this procedure include patients with a forefoot, midfoot or hindfoot pathology which decreases the likelihood for a functional outcome that may be better served with alternative treatments including the need for a proximal amputation.

A patient who presents with a heel ulcer is given a comprehensive evaluation aimed to stratify perioperative risk. A thorough discussion of the surgical plan and postoperative expectations are presented. Laboratory testing should include a complete blood count with differential, a chemistry panel, erythrocyte sedimentation rate, C-reactive protein, glycated hemoglobin level, international normalized ratio (INR), and other tests based on specific patient needs. Radiographic imaging should include plain radiographs of the foot and ankle, and depending on the circumstance, advanced imaging to rule out osteomyelitis. A thorough vascular assessment may be indicated to identify and optimize those with PAD and should only be delayed if an emergent decompression is obligatory. Endovascular angiography is encouraged and may delineate the need for a proximal amputation. If a patient presents with an ascending infection, the post-debridement viability of the extremity and the overall hemodynamic stability of the acute patient may require a drainage amputation.

Figure 1: Pre-op Clinical Photo. Large soft tissue defect noted to the inferior aspect of the heel.

Surgical Technique

The VCC technique involves four basic steps:

1) Split Heel Gaenslen Incision with full thickness medial and lateral flaps (preserve neurovascular supply)
2) Detachment of the Achilles tendon and the plantar fascia with/without Achilles tenectomy
3) *Performing three cardinal osteotomies with contouring*
4) Soft tissue closure without tension

Three Cardinal Osteotomies:

1) Two imaginary lines can be made dividing the superior and inferior aspects of the calcaneus. The first cardinal osteotomy (long horizontal line) should be placed just inferior to the bisection (thick line). [**Figure 2 and 2a**]
2) The second osteotomy is made midway between the remaining posterior calcaneus and the axis of the malleoli which also corresponds to the lateral process of the talus on imaging. [**Figure 3 and 3a**]
3) The third osteotomy is made at 45 degrees parallel to the posterior facet of the subtalar joint on imaging. Of note, this can be approximated and fluoroscopy is not required. This is followed by calcaneal contouring with burrs and rasps as indicated. [**Figure 4, 4a, 5, and 5a**]

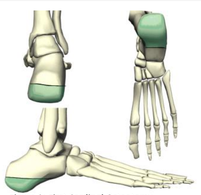

Figure 2: First Cardinal Osteotomy

Figure 2a: First Cardinal Osteotomy

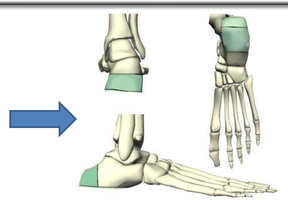

Figure 3: Second Cardinal Osteotomy

Figure 3a: Second Cardinal Osteotomy

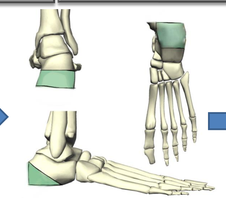

Figure 4: Third Cardinal Osteotomy

Figure 4a: Third Cardinal Osteotomy

Image 1: Pre-op lateral radiograph

Image 2: Pre-op CT 3-D Recon

Image 3: Interim Operative Clinical Photo

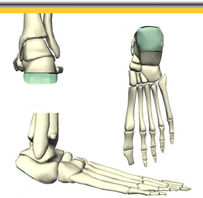

Figure 5: Calcaneal Contouring

Figure 5a: Status post VCC to the right heel secondary to osteomyelitis and large soft tissue defect

Image 4: Post-op Clinical photo. *Closure without tension.*

Case Report

This is a 62 year old male with past medical history of diabetes, dyslipidemia, peripheral vascular disease, and chronic bilateral heel ulcerations [**Figure 1**]**.** He underwent multiple right heel debridements and a percutaneous tendo-Achilles lengthening before presenting to our institution with non-healing ulceration to right heel. His BMI was 21.4kg/m^2 and hemoglobin A1c was 8.7%. The patient minimally ambulated with a diabetic offloading walker assisted with crutches. The patient was admitted to the hospital to receive medical and surgical intervention to address soft tissue infection and underlying osteomyelitis of the calcaneus as evident on x-ray and CT imaging [**Images 1 and 2**]. Initial presenting labs included WBC of 10 and a temperature of 36.2 degrees Celsius. The patient underwent a previous right lower extremity angioplasty a year prior, with palpable dorsalis pedis and posterior tibial artery pulses. All other labs and vitals were unremarkable. The patient underwent two debridement including initial partial resection of the calcaneus [**Image 3**]. Pre and post-debridement cultures were obtained during each operation. Once post-debridement cultures were negative, the vertical contour calcanectomy was performed and the wound primarily closed without tension [**Figure 5a and Image 4**]. At the 16 month follow-up, the patient is ambulating in custom diabetic shoes with bracing.

Literature Review/Discussion

Since the original operative technique was described by Gaenslen in 1931 (1) to treat heel ulcers complicated by osteomyelitis, many other surgical procedures have been described. The conventional partial calcanectomy has been portrayed as a viable alternative to a below knee amputation (2, 3, 4, 5). Currently however, the literature on the conventional partial calcanectomy report a wide degree of variance regarding healing rates, re-ulceration rates, major amputation rates and postoperative surgical site morbidity (3, 6).

When calcaneal OM coexists with a heel ulcer, surgical osseous resection of the infected bone is important. The degree of anatomic involvement of the calcaneus can predictably guide the surgical aggressiveness of the resection based on the Cierny-Mader classification for adult OM (7). Cierny-Mader Type III OM, and more so Type II OM, may only require minimal resection to ensure surgical eradication of calcaneal infection. In such cases, the remaining calcaneus may impede closure. The degree of tension required to approximate the wound edges for primary closure may be too excessive and can result in suboptimal postoperative results. Closure under tension, even if minimal, can become clinically problematic when postoperative edema occurs (8). An aggressive resection of the calcaneus can ensure definitive eradication of OM, decrease recurrence of OM and ulcerations, and allow the available post-debridement soft tissue envelope to wrap around the remaining bone with apposition of the skin edges without any tension.

Interestingly, the quantity of calcaneus removed for osteomyelitis does not affect patient function as assessed by the Lower Extremity Function Scale (LEFS). In a retrospective review by Oliver et al, patients who required aggressive resection with 13% remaining calcaneus had similar LEFS scores when compared to those with 74% of remaining calcaneus (9). Additionally, Attinger et. al. suggests that limb length is directly related to life expectancy, provided patient expectations are met (10). In the diabetic sedentary patient with multiple co-morbidities, preservation of limb length has a significantly lower morbidity than a below knee amputation (11). Patients who are less active have worse outcomes than those who remain active because of cardiopulmonary de-conditioning and musculoskeletal atrophy. The VCC provides patients with an aggressive resection which decreases the likelihood of recurrent OM and ulceration, a robust soft tissue closure without tension, and limb length that allows for continued ambulation at or better than baseline with proper bracing. Although, this technique has been described to ensure reproducibility, the VCC can be modified to a 2 osteotomy procedure to achieve the same overall results. The authors of this poster advocate this novel surgical technique as an alternative to the conventional partial calcanectomy and a viable limb salvage tool. The authors also encourage further studies to assess its merit.

REFERENCES

1. Gaenslen, F. J. (1931). Split-heel approach in osteomyelitis of os calcis. *J Bone Joint Surg Am*, *13*(4), 759-772.
2. Smith, D. G., Stuck, R. M., Ketner, L., Sage, R. M., & Pinzur, M. S. (1992). Partial calcanectomy for the treatment of large ulcerations of the heel and calcaneal osteomyelitis. An amputation of the back of the foot. *J Bone Joint Surg Am*, *74*(4), 571-576.
3. Schade, V. L. (2012). Partial or total calcaneotomy as an alternative to below-the-knee amputation for limb salvage: a systematic review. *Journal of the American Podiatric Medical Association*, *102*(5), 396-405.
4. Van Riet, A., Harake, R., & Stuyck, J. (2012). Partial calcanectomy: A procedure to cherish or to reject?. *Foot and Ankle Surgery*, *18*(1), 25-29.
5. Isenberg, J. S., Costigan, W. M., & Thordarson, D. B. (1995). Subtotal calcanectomy for osteomyelitis of the os calcis: a reasonable alternative to free tissue transfer. *Annals of plastic surgery*, *35*(6), 660-663.
6. Cook, J., Cook, E., Landsman, A. S., Basile, P., Dinh, T., Lyons, T., & Giurini, J. (2007). A retrospective assessment of partial calcaneectomies and factors influencing postoperative course. *The Journal of foot and ankle surgery*, *46*(4), 248-255.
7. Cierny Iii, G., Mader, J. T., & Penninck, J. J. (2003). The Classic: A Clinical Staging System for Adult Osteomyelitis. *Clinical orthopaedics and related research*, *414*, 7-24.
8. Bollinger, M., & Thordarson, D. B. (2002). Partial calcanectomy: an alternative to below knee amputation. *Foot & ankle international*, *23*(10), 927-932.
9. Oliver, N. G., Steinberg, J. S., Powers, K., Evans, K. K., Kim, P. J., & Attinger, C. E. (2015). Lower extremity function following partial calcaneotomy in high-risk limb salvage patients. *Journal of diabetes research*, *2015*.
10. Attinger, C. E., & Brown, B. J. (2012). Amputation and ambulation in diabetic patients: function is the goal. *Diabetes/metabolism research and reviews*, *28*(S1), 93-96.
11. Evans, K. K., Attinger, C. E., Al-Attar, A., Salgado, C., Chu, C. K., Mardini, S., & Neville, R. (2011). The importance of limb preservation in the diabetic population. *Journal of Diabetes and its Complications*, *25*(4), 227-231.