NORTHERN OHIO FOOT & ANKLE FOUNDATION

The Northern Ohio Foot and Ankle Journal *Official Publication of the NOFA Foundation*

Partial Calcanectomy as a Treatment Option for Recalcitrant Pressure Ulcers of the Heel and Calcaneal Osteomyelitis: Review of Literature

by Tad Borland, DPM[1]

The Northern Ohio Foot and Ankle Journal 2(10): 1

Pressure ulcers of the heel pose as a very high risk factor for lower extremity amputation. Below the knee amputation is associated with a poor 5-year survival rate and a limb salvaging procedures such as a partial calcanectomy become an appealing alternative. The reported success rate of partial calcanectomies in literature has varied but has been relatively positive. Though calcanectomies provide a good alternative to amputations, many questions surround the procedure regarding surgical candidates, wound healing, and postoperative limb function.

Key words: calcanectomy, osteomyelitis, diabetes, pressure ulcers

Accepted: September 2015 Published: October 2015

Pressure ulcers of the heel are costly, debilitating, and have been reported to be the most serious type of foot ulceration leading to a proximal amputation (1). On average, ulcerations of the calcaneal region cost 1.5-times more than ulcers at the level of the metatarsals (2). It is expected that as our aging population continues to increase, the number of patients at risk of heel ulceration will also increase (3). Together, local wound care and offloading are the gold standard in treating ulcerations of the heel, however, the ulcers can become recalcitrant and ultimately complicated by osteomyelitis of the calcaneus requiring surgical intervention.

Surgical intervention can include more aggressive debridement of the wound, skin grafting, skin flaps, partial or total calcanectomy, and below-the-knee amputation (BKA). The 5-year survival rate of patients who've undergone a BKA and have concurrent diabetes or renal disease has been reported to be as low as 30% (4). Because of the poor outcome of BKAs in this population, a limb salvaging procedure such as a partial calcanectomy can be more appealing. Despite the appeal of avoiding an amputation, limb salvage of the heel has been reported to be 2-3 times less likely than metatarsal salvage (2). There are also special considerations when choosing a limb salvaging procedure such as a calcanectomy over a BKA including functionality and healing capabilities.

Address correspondence to: tborland@kent.edu.
[1]Resident, Department of Foot and Ankle Surgery, HealthSpan Physicians Group, Cleveland, OH

Pressure Ulcers

A pressure ulcer, also known as decubitus ulcer, is "localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction" (NPUN, 1989). Second only to

sacral ulcers, the heel is a common site for developing decubitus ulcerations accounting for 28-40% of all reported pressure ulcers (5).

Pathophysiology of pressure ulcers includes more than just pressure. There are both extrinsic and intrinsic factors that play major roles in the development of pressure ulcers (6). Extrinsic factors include pressure, shear and friction. Pressure is the amount of force exerted in an area. When pressure applied to an area becomes greater than capillary perfusion pressure, vessels become compressed causing ischemia to overlying tissue. Shear is a strain on tissue when the layers are laterally shifted in relation to one another. This can occur when the patient's body is moved while their tissue sticks to underlying bedding causing a separation of the dermis and epidermis resulting in bulla formation. Friction is the force resisting motion of a mass moving against another mass. This is seen when a patient's heels are dragged across bed linen during transfers causing removal of outer protective layer of the epidermis known as the stratum corneum.

Intrinsic factors that place an individual at a higher risk for developing pressure ulcerations include immobility, increased age, malnutrition, and chronic illness. Immobility increases length of time areas of bony prominences are subjected to pressure and therefore causing prolonged local ischemia. Increased age is associated with loss of muscle mass, diminished inflammatory response, and reduced cohesion between dermis and epidermis causing reduced tolerance to extrinsic factors. Malnutrition also decreases muscle mass and subcutaneous tissue accentuating areas of bony prominences making them more susceptible to pressure ulceration.

A major intrinsic factor is diabetes. Diabetics have a much higher risk for developing pressure ulcers than the general public due to loss of protective sensation. Loss of protective sensation permits the initial damage to the heels to go unnoticed which, in turn, delays initial treatment. Additionally, vasculopathy associated with diabetes is an independent risk factor for foot ulcers (2). Pressure applied to the heels of a patient with lower extremity vascular disease leads to a faster progression of ischemia and tissue necrosis. Understanding the concept of angiosomes allows the physician to assess vascular status of the lower extremity and healing potential from a vascular standpoint. The heel is supplied by two main source arteries, the peroneal and posterior tibial arteries. These give rise to the lateral and medial calcaneal arteries which comprise the two angiosomes of the heel.

The ultimate complication of a long standing ulceration is infection. The exact epidemiology of pressure ulcer infection, either soft tissue or bone, has not been well documented in literature. A small prospective study done by Nicolle et al followed 16 patients with pressure ulcers over 2184 days and found the incidence of infection was 1.4 cases per 1000 patient-ulcer days (7).

Clinically, osteomyelitis associated with pressure ulcers is not easily diagnosed and often times requires advanced imaging. In patients with suspected osteomyelitis, having an MRI prior to proceeding with a partial calcanectomy can prove to be invaluable in accurately delineating the margins of osteomyelitis for planning of partial resection. It's been documented that contrast-enhanced MRI scans are able to identify osteomyelitis with a sensitivity of 89% and specificity of 94% making it superior to other imaging techniques in terms of identifying infection and delineating affected areas (2).

Partial Calcanectomy

The partial calcanectomy procedure was first presented by Gaenslen in 1931 (8) but has been described as early as 1896 (9) as an alternative to amputation. Indications include chronic heel ulcerations that have failed conservative treatments, wounds complicated by underlying osteomyelitis of the calcaneus, and deformity after a severely comminuted fracture. Goals of the procedure include healing the wound with durable soft tissue, minimizing the risk of repeat ulceration, maintaining function of the limb for walking and transfer, and avoiding leg amputation. Surgical candidates are those that have a minimum level of activity for the limb during transfers, such as to and from a bed or wheelchair. Patients that do not use the extremity for at least transferring are better served by leg amputation. Also, patients with poor periwound tissue, extensive chronic edema, or a wound that

encompasses too much of the plantar foot/heel are not ideal candidates for this procedure (10).

Gaenslen (8) originally described the partial calcanectomy as a "split heel approach". The calcaneus is split into 2 halves, medial and lateral allowing for visualization of infected and nonviable bone and its removal. Since Gaenslen's original procedure was described, multiple other approaches and modifications have been presented in literature. Boffeli et al (10) performed a case series of 3 patients with differing locations, or "zones", of pressure ulcers of the heel with underlying osteomyelitis. They excised the ulceration, resected as much calcaneus necessary and, depending on wound location, were able to primarily close the wound with different flap techniques.

Excision of part of the calcaneus is usually accompanied by detachment of the Achilles tendon. In chronic pressure ulcers of the heel, the Achilles tendon may become necrotic and ruptured at the site of its insertion making preservation difficult. An article by Randall et al (11) described reattachment of the Achilles tendon to the calcaneus after partial calcanectomy was performed. They found that ambulatory status, plantarflexory power, range of motion, and strength were comparable to those in which the Achilles tendon was not reattached.

What's the reported success rate of the procedure?

The reported rate of healing after undergoing a calcanectomy has varied from study to study. Randall et al performed a literature review of partial calcanectomies and found 148 cases with a total healing rate of 89% (11). Some studies have looked at rate of healing in diabetic patients versus that of nondiabetic patients. A study published in 1981 by Crandall and Wagner (12) reported a failure rate of 65% in diabetic patients versus 23% in nondiabetic patients. Smith et al (13) performed the partial calcanectomy in 12 patients, 9 of which were diabetic, and reported healing of the wound in 10 of the 12 patients. The two failed cases, one diabetic and other having peripheral vascular disease, went on to have BKAs. Cook et al (14) reviewed 50 partial calcanectomy cases performed on 46 patients (45 diabetic and 1 nondiabetic). They found the average rate of healing was around 71.4% after 1 year which increased to 76.2% beyond the first year follow-up period. There are other published literature that comment on wound healing rates after undergoing calcanectomy, however, most have small sample sizes.

Factors Influencing Postoperative Course

A review article by Cook et al (14) looked at different factors they deemed would affect rate of closure after undergoing a calcanectomy. These factors included BMI, vascular status, preoperative albumin levels, wound grade, presence of methicillin-resistant Staphylococcus aureus (MRSA). They found that patients with more involved wounds, such as grade 3 Wagner ulcers, those with poor albumin levels, those infected with MRSA, and those with PVD have a substantially worse prognosis than their counterparts without these confounding factors.

Per Cook et al's findings, 83.3% of grade 2 Wagner wounds closed within 1 year, whereas only 51.5% of grade 3 wounds closed within the same time period. Patients with an albumin level of 3.0 g/dL or lower required an average of 62.4 days longer to heal than those patients with an albumin level greater than 3.0 g/dL. The healing rate, however, was equivalent between the two groups. Presence of MRSA greatly increased the time of healing by an average of 249.1 days compared to patients with nonMRSA isolates. Regarding PVD, 88.2% of patients who were vascularly compromised dehisced despite vascular intervention, whereas only 35.7% of patients with adequate circulation suffered this complication.

Question remains for the functionality of the limb after undergoing a calcanectomy. Smith et al (13) debrided the Achilles tendon without reattachment and noted that nine of the ten patients in whom the wound healed had been able to walk preoperatively, were able to maintain their preoperative level of mobility with use of a custom-molded ankle-foot orthosis. Though they noted weakness with manual testing of plantar flexion, patients still maintained enough muscular strength to walk comfortably. Van Riet et al's article (15) proposed a questionnaire to fourteen patients who had undergone a partial calcanectomy regarding their functional status. Eight patients reported walking without any external support, three used 1-2 crutches or a cane, 2 routinely

used a wheelchair, 1 remained wheelchair bound. After a calcanectomy procedure, fitting the patient in an ankle foot orthosis to accommodate for loss of heel height and Achilles tendon function is imperative to maintaining any functional weight bearing activity.

Conclusion

The partial calcanectomy procedure is a valuable alternative to BKA when osteomyelitis of the calcaneus is present. Since Gaenslen's description of the partial calcanectomy in 1931, little research has been done on the procedure.

When considering the partial calcanectomy as a treatment option for a patient, special consideration to the patient's candidacy for the procedure and their healing potential is needed. Patients that do not use the limb for at least transferring may benefit from a BKA over a limb salvaging procedure. Surgical wound healing can be delayed or compromised in the presence of certain factors including peripheral vascular disease, severe wounds, low albumin levels, and presence of MRSA isolates.

Though some studies have reported poor wound healing in diabetic patients, other studies have shown that complete healing in diabetics is not impossible and that the partial calcanectomy procedure can be performed as a limb salvage attempt. With an aging population and an expected increase in the incidence of pressure ulcers and their complications, the partial calcanectomy procedure may gain in popularity and be an invaluable alternative to major amputation of the lower extremity.

References

1) Younes NA, Albsoul AM, Awad H.Diabetic heel ulcers: a major risk factor for lower extremity amputation. Ostomy Wound Manage 50: 50 – 60, 2004.

2) Cevera JJ, Bolton LL, Kerstein MD. Options for diabetic patients with chronic heel ulcers. J Diab Comp 11:358-36, 1997.

3) Lehmann S, Murphy RD, Hodor L.Partial calcanectomy in the treatment of chronic heel ulceration. J Am Podiatr Med Assoc 91:369 – 372,
2001.

4) Aulivola B, Hile CN, Hamdan AD, Sheahan MG, Veraldi JR, Skillman JJ, Campbell DR, Scovell SD, LoGerfo FW, Pomposelli FB Jr. Major lower extremity amputation: outcome of a modern series.Arch Surg 139:395–399,2004.

5) Barczak CA, Barnett RI, Childs EJ, Bosley LM. Fourth national pressure ulcer prevalence survey. Adv Wound Care . 1997;10(4):18-26.

6) Graff MK, Bryant J, Beinlich N. Preventing heel breakdown. Orthop Nurs 19(5): 63-9, 2000.

7) Nicolle LE, Orr F, Duckworth H, Brunka J, Kennedy J, Urias B, Murray D, Harding GK. Prospective study of decubitus ulcers in two long term care facilities. Can J Infect Control 9(2):35-8, 1994

8) Gaenslen FJ.Split-heel approach in osteomyelitis of os calcis.J Bone Joint Surg 13:759 –772,1931.

9) Landerer A. Medianer Fersenschnitt. Centralbl. F. Chir XXIII:857,1896.

10) Boffeli TJ, Collier RC. Near total calcanectomy with rotational flap closure of large decubitus heel ulcerations complicated by calcaneal osteomyelitis. JFAS 52:107-112, 2013

11) Randall DB, Phillips J, Ianiro G. Partial calcanectomy for the treatment of recalcitrant heel ulcerations. J Am Podiatr Med Assoc 95: 335–341,2005.

12) Crandall RC, Wagner FW Jr.Partial and total calcanectomy: a review of thirty-one consecutive cases over a ten-year period. J Bone Joint Surg Am 63:152–155,1981.

13) Smith DG, Stuck RM, Ketner L, Sage RM, Pinzur MS. Partial Calcanectomy for the Treatment of Large Ulcerations of the Heel and Calcaneal Osteomyelitis. J Bone Joint Surg 74:571-6, 1992

14) Cook J, Cook E, Landsman AS, Basile P, Dinh T, Lyons T, Rosenblum B, Giurini J. A Retrospective Assessment o Partial Calcanectomies and Factors Influencing Postoperative Course. JFAS 46(4): 248-255. 2007.

15) Riet V, Harake R, Stuyck J. Partial calcanectomy: A procedure to cherish or to reject? Foot and Ankle Surgery 18:25-29, 2012