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Commentary: Foot and Ankle Surgery for Chronic Nonhealing Wounds

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Chronic wounds of the foot and ankle pose a significant challenge for a multidisciplinary team. The article "Foot and Ankle Surgery for Chronic Non healing Wounds" sought to highlight solutions to chronic wounds and demonstrate that these wounds must be managed from an orthoplastic perspective understanding both soft tissue healing principles, and the posed challenge of underlying osseous deformities[1]. Both nonsurgical and surgical interventions may be required for treatment of chronic wounds of the foot and ankle.

Non-Surgical Intervention

Total contact casting was the original gold standard for chronic non-healing wounds, however it is important to note that while studies have reported high rates of healing 50% healed after 5 weeks, there is also a reported 31% recurrence of wound and new ulcer formation[2]. As stated in the article, the use of glycerin-based gel/hydrophilic polymer over the wound is useful to reduce edema and prevent bacteria formation[3]. It is important to transition to custom insert and shoes following healing of the wound to prevent further formation.

The principles of non-surgical intervention include off-loading the wound or preventing future wounds through even distribution of pressure with custom shoe gear, full-length inserts, or bracing. A few examples of this highlighted in the article are extra-depth shoes providing room for rigid hammertoes contractures, while rocker-bottom shoes aid loss of ankle joint motion decreasing pressure on the forefoot, and a first ray cut out may be helpful with hallux limitus with ulceration of the distal hallux. Custom orthotic inserts can be pressure mapped to identify areas of concern with the goal to either increase or decrease motion at anatomic landmarks preventing wound formation. Orthotics should be customized preoperatively when attempting conservative management, and then employed following surgical intervention with new custom inserts to continue to prevent pressure points in the future. This is particularly important following amputations to provide appropriate shoe fillers. Regardless of the method of developing orthotics, when creating the orthotics simulated weightbearing should have the subtalar and ankle joint in neutral.

Off-loading boots such as the controlled ankle motion (CAM) boot and Charcot restraint orthotic walker (CROW) are critical to management of chronic wounds as well. The CAM boot is a great

temporary option while awaiting custom device production, but is not a long-term solution. The CROW is heavily used for Charcot neuroarthropathy deformities that must be braceable with major prominences or severe deformities corrected surgically. Custom bracing may include any of the following Ankle-Foot Orthoses (AFO), double upright calf lacer (DUCL), and the Arizona brace. The AFO is most often indicated when wounds occur secondary to ankle function and has many different options including solid or articulating AFO allowing ankle joint motion and variations in where the terminating forces exit proximally along the calf, femur, or patella and with options to control knee motion as well. The DUCL prevents any pressure between the brace and the foot transmitting all ground-reactive forces to the proximal leg most commonly used for motor paralysis. The Arizona brace is most commonly used for posterior tibial tendon dysfunction allowing some ankle joint motion with support of the arch of the foot. As demonstrated, there are several options for custom bracing to benefit patients, however providers must have an in-depth understanding of biomechanics and gait analysis to best serve patients with selection of these braces. It is imperative that any casting for braces be done non-weight bearing with ankle and subtalar joints placed in the neutral position and the use of a full-length foot plate with soft liner and a soft durometer shoe filler used for amputees.

Osseous Deformity

Abnormal osseous structures from a multitude of pathology may yield wounds at high risk for developing osteomyelitis. As demonstrated in the original article, the key points for treatment of osteomyelitis include repeat aggressive surgical debridement every 2- 4 weeks with removal of all hardware, frequent deep cultures including 16S polymerase chain reaction evaluation, and both local and systemic antibiotics. In the authors' experience, this is important to thoroughly evaluate and understand as many surgeons will employ reconstructive procedures when osteomyelitis has not been adequately treated and residual underlying infection yields suboptimal outcomes. When surgical reconstruction is employed it is inherent to understand the mechanical axis of the limb and the biomechanical alterations that will result secondary to the procedure. Due to the instability noted in many of the osseous abnormalities causing wounds, stability of the bone is critical which may require beyond simple resections to fusions. Simple resections can be useful, however may yield joint instability or tendon imbalance that needs to be analyzed or will yield deforming forces. Therefore, performing appropriate tendon release or lengthenings of soft tissue contractures is important. The most common procedure in the authors experience is lengthening of the tendo achilles complex to reduce forefoot pressure and allow reduction of many osseous deformities especially in Charcot neuroarthropathy. Digital deformities yielding wounds are often alleviated by flexor or extensor tenotomies. It should be mentioned that the previous article did not discuss the biomechanical importance of the posterior tibial tendon, peroneal tendons, and tibialis anterior tendon that if lengthened or released will provide relief of deforming forces yielding wounds particularly in the case of amputations, varus or valgus foot conditions, and Charcot neuroarthropathy. Reduction osteoplasty across a single bone or joint can also be utilized as first described with a calcaneoplasty for calcaneal osteomyelitis with a wound[4]. In the authors experience, these reduction osteoplasty procedures frequently allow primary closure of the defect and are useful in the setting of chronic osteomyelitis.

Soft Tissue Rearrangement

The basic principles of soft tissue wound healing include vascular inflow and outflow, neurologic status, and edema control. Local tissue rearrangement is highly considered for wound closure as well as including skin advancement, rotation, or local muscle transposition. Localized skin advancements are highly useful and should be employed first if possible especially in the plantar foot. The author has found great success in the V-Y flap and rotational flaps. The authors choice for muscle flaps for chronic wound coverage are the plantar medial artery flap for large heel defects, reverse sural flap for posterior wounds, reverse peroneus brevis flap for lateral ankle wounds, and abductor digiti minimi for lateral foot wounds. As discussed in the article, if a muscle transposition occurs, skin grafting can be utilized for closure with importance to recognize that a full thickness skin graft is preferred for areas of high-contact shear pressure such as the plantar foot and malleoli. The muscle-bone flaps can also be utilized for combined osseous and soft tissue defects, however are less commonly used. A free flap is the last option for soft tissue reconstruction due to the high risk procedure and microsurgical advanced knowledge base and skill set needed to perform this.

External Fixation

The use of external fixation in many of these procedures chronic wounds is an excellent option for several reasons including: avoiding the use of internal implants in the initial stage of infection, allowing for osseous deformity correction while minimizing the risk of soft tissue complications, enabling patients to weight bear while still offloading the wound reconstruction, and allowing the surgeon access to the surgical site for dressing or negative pressure wound therapy vac changes. These principles can be extrapolated to use of external fixator assisted closer[5]. As well as external fixator-based immediate postoperative prosthesis for major lower extremity amputations which the author C.B. has found very helpful in improving patient outcomes.

Chronic nonhealing wounds of the foot and ankle demonstrate significant challenges for the most experienced surgeons due to osseous and soft tissue pathology that must be addressed with an in-depth understanding of biomechanics and available surgical and non-surgical treatment options.

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