CHAPTER 7

LOWER EXTREMITY

The plastic and reconstructive surgeon is often called upon to treat many wound problems of the lower extremity. These include leg ulcers of various etiologies, trauma with extensive soft tissue loss or exposed bone, vascular or neural structures, and lymphedema.

I. ULCERATIONS

An ulcer is an erosion in an epithelial surface. It is usually due to an underlying pathophysiological process. The proper treatment depends upon the etiology

A. Etiology
   1. Venous Stasis Ulcer
      a. Due to venous hypertension; related to venous valvular incompetence - usually found over the medial malleolus
      b. Increased edema
      c. Increased hemosiderin deposition (dark discoloration)
      d. Not painful
   2. Ischemic Ulcer
      a. Due to proximal arterial occlusion
      b. Usually more distal on the foot than venous stasis ulcers
      c. Most often found on the lateral aspects of the great and fifth toes, and the dorsum of the foot
      d. No edema
      e. No change in surrounding pigmentation
      f. Painful
      g. Doppler ankle/brachial indices 0.1-0.3
      h. Indicates advanced atherosclerotic disease
      i. Dirty, shaggy appearance
   3. Diabetic Ulcer
      a. Due to decreased sensation (neurotrophic) or occasionally decreased blood flow
      b. Usually located on plantar surface of foot over metatarsal heads or heel
      c. Edema ±
      d. No change in surrounding pigmentation
   4. Traumatic Ulcer g. Surgical treatment requires excision of the entire
      a. Failure to heal is usually due to compromised area of the ulcer, scar tissue, and surrounding blood supply and an unstable scar
      b. Usually occurs over bony prominence
      c. Edema ±
      d. Pigmentation change ±
      e. Pain ±
   5. Pyoderma Gangrenosum
      a. Frequently associated with arthritis and/or inflammatory bowel disease or an underlying carcinoma
      b. Clinical diagnosis - microscopic appearance non-specific

c. Zone of erythema at advancing border of the lesion

B. Treatment

Each ulcer type requires accurate diagnosis, specific treatment of the underlying etiology, and care of the wound. Not all ulcers of the lower extremity will require surgical intervention when appropriate management is pursued. The key to healing these ulcers is wound hygiene, correction of the underlying problem, and specific surgical intervention when appropriate. The plastic surgeon is an integral member of the treatment team from the onset of the problem. Remember that two different predisposing conditions may occur in the same patient. If so, the treatment must address both conditions.

1. Venous Stasis Ulcers
   a. Most will heal if venous hypertension is controlled
   b. Decrease edema with constant bed rest with foot elevation
   c. Clean wound 2-3 times a day with soap and water
   d. Topical antimicrobials may be required
   e. Systemic antibiotics are required if cellulitis is present or bactermia occurs
   f. "Unna boots" may heal ulcers in patients who are noncompliant with bed rest or must continue to work. These are changed on a weekly or bi-weekly basis
   g. Pentoxifylline therapy in combination or as substitute for compression therapy if compression is not tolerated.
   h. Surgical treatment requires excision of the entire area of the ulcer, scar tissue, and surrounding area of increased pigmentation (hemosiderin deposition). Subfascial ligation of venous perforators is also performed
      i. Skin grafting of large areas is usually not a problem. Intact periosteum or paratenon will take a graft well
      ii. Free flaps can be effective for recalcitrant ulcers
   i. Pressure gradient stocking (such as JobstTM garments) and a commitment to avoiding standing for long periods of time are necessary for long term success
2. Ischemic Ulcers
   a. Most require revascularization based upon angiographic findings
   b. Control associated medical problems such as congestive heart failure, hypertension, diabetes, etc.
   c. Bed rest without elevation of the foot of the bed
   d. Topical and/or systemic antibiotics are usually required
   e. If possible, it is best to perform bypass surgery first, and then healing of the ulcer by any means will be easier
   f. Usually a skin graft will close the wound; flap closure may be required. A more proximal amputation may be required if revascularization is not possible
3. Diabetic Ulcer
   a. Debride necrotic tissue and use topical and systemic antibiotics to control the infection
   b. Be conservative in care; early amputation is detrimental since many patients will have life-threatening infections in the other leg within a few years
   c. After control of bacterial contamination, small ulcers may be excised and closed primarily; larger ulcers may require flap coverage

d. Treatment should also include resection of underlying bony prominence
e. Rule out proximal arterial occlusion and improve arterial inflow when needed
f. Postoperative diabetic foot care at home is paramount to proper management. Patient education in caring for and examining their feet is extremely important
g. Hyperbaric oxygen and tissue cultured skin substitutes may be therapies which can assist in ulcer resolution.

4. Traumatic Ulcer
   a. Nonhealing is usually secondary to local pathology
   b. Resection of the ulcer, thin skin, and unstable scar is required
   c. Reconstruction with a local or distant flap is required
5. Pyoderma Gangrenosum
   a. Very difficult
   b. May include anti-inflammatory drugs or immunosuppressives, as well as local wound care agents
   c. Success in treatment has been reported with hyperbaric oxygen in conjunction with local wound care

II. TRAUMA

Lower extremity trauma is frequently very complex, and often requires a team approach involving the orthopedic, vascular and plastic surgeons. Limb salvage with bipedal ambulation and normal weight bearing is the goal of all surgical intervention

A. Initial Management
   1. All patients with lower extremity trauma should be evaluated for associated injuries, and treated according to ATLS criteria
   2. All life threatening injuries (intracranial, intrathoracic, and intra-abdominal) should be addressed initially in the operating room
   3. Surgical debridement of the wound in the operating room and irrigation with pulsatile jet lavage of a physiologic solution is the proper initial management. Specific management depends upon the level of injury, presence or absence of bony neurological injury
   4. Limb threatening injuries of vascular interruption or open fracture are best assessed in the OR with radiologic backup
   5. Fasciotomy is often required to maintain tissue perfusion in severe high energy or crush injuries
   6. Intra-operative evaluation for viability utilizing visual and surgical techniques may be supplemented by intravenous fluorescein to assess the viability of degloved tissue

B. Level of Injury
   1. Thigh
      Usually managed with delayed primary closure or skin graft. An abundance of soft tissue in the thigh makes coverage of bone or vessels rarely a problem
      a. Open joint wounds are usually managed by the orthopedic service with profuse lavage and wound closure
      b. Extensive soft tissue loss will often require flap rotation – the tensor fascia lata, gracilis, rectus femoris, vastus lateralis, and biceps femoris are primarily utilized

c. The medial and lateral heads of the gastrocnemius muscle are most often utilized to cover an open knee joint

2. Lower Leg
   a. Paucity of tissue in the pre-tibial area results in many open fractures which cannot be closed primarily
   b. General principles of wound closure and achieving bacterial balance prevail
   c. Delayed primary closure, healing by secondary intention, or skin grafts are good alternatives in the management of wounds where bone or fractures are not exposed
   d. Rigid fixation with vascularized tissue coverage is necessary for bone healing
   e. Fractures of the lower leg are usually classified by the Gustilo system (Table 7-1)
      i. Type I and II fractures usually have a good outcome with varied treatment
      ii. Gustilo Type III injuries have a worse prognosis

Gustilo Classification of Open Fractures of the Lower Leg

Type I	Open tibial fracture with a wound less than one centimeter
Type II	Open tibial fracture with a wound greater than one centimeter, without extensive soft tissue damage
Type IIIA	Open tibial fracture with adequate soft-tissue coverage despite extensive laceration or flaps, or high-energy injury accompanied by any size wound
Type IIIB	Open tibial fracture, extensive soft-tissue loss with periosteal stripping and bone exposure
Type IIIC	Open tibial fracture with arterial injury requiring repair

Table 7-1

   f. Depending on the level of injury, different muscle flaps can be used to close the wounds
      i. Proximal 1/3 of tibia
      ii. Medial head of the gastrocnemius muscle
          Lateral head of the gastrocnemius muscle
          Proximally based soleus
      iii. Middle 1/3 of tibia
          Proximally based soleus
          Flexor digitorum longus muscle
          Extensor hallucis longus muscle

iv. Lower 1/3 of tibia
Microvascular free tissue transfer

g. Fasciocutaneous flaps such as reverse sural flap are another alternative for closure of difficult wounds in the lower leg

3. Foot
   a. Split thickness skin grafts should be used if bone not exposed
   b. The heel may be covered by medial or lateral plantar artery flaps
   c. Weight bearing surface of foot ideally reconstructed with flaps that maintain protective sensibility such as medial or lateral plantar artery flaps that are innervated and taken from non-weight bearing arch
   d. Forefoot - toe fillet and plantar digital flaps
4. The technical feasibility of lower extremity reconstruction must be weighed against the option of amputation with early prosthesis fitting and ambulation. Extensive injuries may lead to rehabilitation and non-weight bearing of up to two years, and late complications may still require amputation. Loss of sensation to plantar surface of foot is a significant consideration for amputation.

III. LYMPHEDEMA

Lymphedema may be a congenital or acquired problem, and results in accumulation of protein and fluid in the subcutaneous tissue. It may be a very debilitating and disfiguring disease, and at this time has no good surgical answer

A. Primary (idiopathic)
   1. Female: Male = 2:1
   2. Classification - depends on age of onset
      a. Congenital - present at birth
         i. Milroy's disease - familial autosomal dominant incidence
         ii. 10% of all primary lymphedema
      b. Lymphedema praecox
         i. Usually a disease of females
         ii. 80% of all primary lymphedema
         iii. Appears at puberty or early adulthood
         iv. Localized swelling on dorsum of foot that gets worse with activity
         v. Meige's disease presents with significant symptoms of acute inflammation
      c. Lymphedema tarda
         i. Appears in middle or later life
   3. Diagnosis
      a. By history - sometimes hard to discern a component of venous stasis from the lymphedema
      b. Lymphangiogram - 70% have hypoplasia, 15% aplasia and 15% hyperplasia
B. Secondary: Acquired - Usually secondary to pathology in the regional lymph nodes
   1. Wucheria bancrofti - number one cause of lymphedema worldwide
   2. Post traumatic or post surgical
   3. Secondary to regional node metastases
   4. Treatment
      a. Nonoperative

i. Preferable in most circumstances and many patients are managed quite well
ii. Elevation and elastic support are the mainstays of therapy - intermittent compression machines may be of benefit
iii. Use of steroids controversial
iv. Benzopyrones may be of benefit in high protein lymphedema
v. Antiparasitic medications are indicated when appropriate
vi. Systemic antibiotics and topical antifungal medications are often required

b. Surgical management
   i. Ablative procedures - usually involve excision of tissue and closure with a flap or skin graft
   ii. Attempted re-establishment of lymphatic drainage by microvascular techniques has shown early improvement, but is prone to high late failure rate. May offer hope for patients with secondary lymphedema in the future

CHAPTER 7 - BIBLIOGRAPHY

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