Chapter 2

Chronic Wounds and Ulcers

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Chronic wounds are likely the greatest cause of morbidity and cost to both patients and hospitals in Africa. With more surgeons and the availability of the Vacuum Assisted Closure (VAC)—commercial or home-made (see Chapter 4), this situation is gradually improving. Most chronic wounds are due to inadequate treatment, delayed closure of acute wounds or long standing ulcers, usually leg ulcers where the blood supply is not good. There are many risk factors involved and it is not just inadequate surgical care. Patients often live a great distance from a good health center. They may have to walk long distances to get to the health center/hospital. Often they do not have sufficient money to go by taxi or bus. Even at a health center there may not be adequate equipment or supplies for the care of their wounds. Most important the nurses and/or physicians may lack the experience and expertise needed to care for these chronic wounds and ulcers. Most chronic wounds occur on the lower extremity and these are caused by dependency, repeat trauma, and decreased blood flow with lack of underlying muscles.

Other contributing causes of chronic wounds include diabetes, HIV/AIDS, old age, infection including Buruli ulcer, vascular problems as seen in venous stasis ulcers, cancer as in Marjolin’s ulcer, etc.

There is an additional chapter on wound closure with the VAC and skin grafts. This chapter will discuss the preparation of wounds for the VAC, grafts or flaps.

In this chapter it is important to discuss the proper care of acute wounds in order to prevent the progression to a chronic wound. Closure of wounds can be classified as:

- Primary—closed at time of injury—may even be by skin graft or flap
- Delayed primary—closed within the first 7 days, usually within 2-3 days, and heals as well as a primary closure
- Secondary closure—when a chronic wound is sharply débrided and closed directly or by skin graft or flap as in a primary closure
Secondary Intention healing: wound allowed to granulate and to gradually close. This is NOT ACCEPTABLE, except in rare situations, as this will lead to a chronic wound. A variation of primary closure is the “clean closed wound concept” whereby the acute wound is closed initially after debridement and irrigation and vital structures as tendons and nerves are repaired several hours or days later when someone capable is available. This may require a referral and a delay even up to two weeks would not be harmful to the patient.

Timing of closure depends on time of injury, mechanism of injury, location, contamination, etc. Attempt should be made to close the wound immediately or at least before the 7th day post injury if the wound is significantly contaminated when first seen. If closure is delayed past 7-10 days, it will become a chronic wound. Primary closure should be the goal after initial débridement and irrigation. If an acute wound is too contaminated for primary closure on the day of injury, then further débridement and irrigation should be carried out on Day 2, Day 4, and Day 6 with a plan to close as soon as it is clean. A delayed primary closure should be carried out as soon as the wound is clean and any time before Day 7 if possible. If a wound with minimal tissue loss is not closed early, it will become increasingly more difficult to advance the edges for closure. On the other hand, if after débridement the wound is clean but too large to close because of tissue loss, a skin graft can be applied acutely. There is no reason to wait for granulation tissue to apply a skin graft or even to advance a flap. A meshed graft is ideal on the trunk or extremity in this situation as it allows drainage and molds better into wound crevices. If less than one cm. of bone or tendon is exposed, a graft can be placed over these structures in an acute situation with an excellent chance for take and bridging epithelialization. If the wound is clean but there are large areas of exposed tendon and bone and the wound cannot be closed primarily, then a flap should be performed before 7 days. There is no need to wait until there is granulation for flap coverage!

Débridement and irrigation are performed on every acute wound. For simple wounds of the face and upper extremity, this may be simply irrigation with normal saline as one prepares the wound for closure. If normal saline is not available, even sterile water can be used. Débridement involves the removal of devascularized tissue and foreign bodies. The amount of devascularized tissue depends on the nature of the injury as a sharp or a crushing injury, where the injury occurred as at home or on a farm or highway, and location on the body as the face or the arm or the leg. High velocity road traffic accidents with large
wounds and open fractures will need considerable débridement. If available, pulse lavage is an excellent method for irrigation as well as débridement in large contaminated wounds. Saline or Ringers Lactate should be used in pulse lavage. The need for further débridement is determined by the condition of the wound after the initial débridement. Often in large lower extremity wounds one cannot be certain if all devitalized tissue has been removed and another débridement should be scheduled in 2 days. Muscle that bleeds may not be viable; on the other hand, if it contracts it is usually viable. Bleeding from the edges of bone indicates it is viable. Unless there is severe arterial bleeding that must be controlled, one should not use a tourniquet at the first débridement. If a tourniquet is necessary because of significant bleeding, then one should release the tourniquet before one has finished in order to identify and débride non-bleeding/non-viable tissue. Ideally, wounds should be kept moist and the extremity elevated between débridements. Allowing tissues to dry out and desiccate between débridements and dressing changes is detrimental to the tissues. In some cases silver sulfadiazine may be used as a local antibiotic and also to keep the wound moist. Antibiotics are not used in the simple clean wounds that can be closed, but they may be used in severe contaminated wounds. Usually a cephalosporin is chosen but for severely contaminated road or farm wounds, better gram negative and anaerobic coverage should be used. Elevation of an extremity is often forgotten but it is very important in any extremity injury. (See Chapter 4 on use of the VAC)

When closure is delayed beyond 7 days, the wound begins to heal with secondary intention and soon becomes infected and colonized with greater than $10^5$ (100,000) microorganisms per gram of tissue—a special quantitative test carried out on a biopsy of 1 gram of tissue. (The definition of wound infection or colonization is a wound with greater than $10^5$ microorganisms per gram of tissue.) This colonization is seen after a wound is left open or exposed for 7 and certainly after 10 days. Intermittent extensive débridements, where the entire surface is excised down to normal tissue, may prolong the development of colonization in a wound, but often débridements are scheduled as the last case of the day and are performed by junior staff. When “more important” cases take longer in small hospitals with few operating rooms, these débridements are often postponed until the next day and often delayed again and again. These delays lead to a chronic colonized wound. After 7-10 days a wound will need a complete débridement with complete excision of the wound and wound edges before secondary closure directly or with a STSG or flap.
Waiting for granulation to cover bone or tendon will result in an infected wound and will require a long hospital stay with many dressing changes and with considerable cost to the hospital and patient for the necessary supplies. (See chapter on “Wound Closure with VAC.”) More than likely the patient will not be able to pay for his prolonged care. Outpatient treatment of such wounds is unsatisfactory with lack of proper wound care by OPD/PT staff, missed days due to weekends, lack of patient compliance and dependency of extremity while coming to the hospital each day. Soaking of the wound in a whirlpool-type bath leads to cross-contamination of the wound and is not recommended.

Clean Closed Wound Concept:

As mentioned above, one important concept is the Clean Closed Wound Concept. If an acute wound requires tendon or nerve repair but there is no one available to do this at the time of injury and the patient’s presentation to the hospital, a clean wound may be loosely closed after initial débridement with skin sutures 1-2 cm. apart. A delayed repair of the vital structures may be carried out the next day or several days later. The wound can then be opened for the repair of these structures and it is still a clean wound. This is especially helpful in upper extremity surgery.

Chronic wounds:

Chronic wounds occur because:

1. Delay in presentation
2. Delay in adequate débridement
3. Problems with healing due to age, Diabetes, HIV/AIDS
4. Other causes of chronic wounds as:
   - Underlying osteomyelitis
   - Buruli Ulcer—Mycobacterium marinum
   - Marjolin’s ulcer—squamous cell carcinoma
5. Vascular conditions especially venous stasis

Treatment methods:
Careful evaluation of possible causes for chronic wounds must be carried out before attempted closure. Even chronic wounds that occur in one’s own hospital will need evaluation.

There are three possible methods for the treatment of chronic wounds when first seen:

First, one can perform daily wound dressings with the hope that the wound will go on to secondary healing with epithelialization or finally granulate and be ready for a skin graft. As mentioned, this method requires significant nursing care and is costly for the patient. This method is commonly used but not recommended, but healing will be improved if the wound can be kept moist at all times. It is not easy to keep a wound moist, but it will accelerate wound healing. One possible method is to dress wound with a bulky gauze dressing once daily, place extremity on a Macintosh (rubberised fabric), and drip saline on the dressing every 1-2 hours. This requires dedicated nursing care.

Unfortunately, allowing the wound to granulate with minimal intervention is a commonly accepted practice. These wounds are often managed by junior staff members and aggressive débridements are not performed on a regular basis. The resulting granulation tissue is infected, heaped up, and not an ideal recipient bed for a skin graft. It must be sharply excised—tangentially excised—down to good bleeding “normal” tissue before skin grafting. If the débridement is only through the superficial granulation tissue, the graft may take but will be prone to breakdown with minor trauma, especially if the graft overlies the anterior tibia or other bones. (Note: superficial granulation tissue will always bleed but it is still infected.) On the other hand, if sharp tangential débridement of granulation tissue is carried down to bleeding dermis or subcutaneous tissue, the graft or flap should take and heal well.

Second approach is a more aggressive treatment and will lead to early wound closure. This method requires “ownership” of the wound by an experienced surgeon. An aggressive and extensive débridement is carried out when the patient is first seen. On Day 2, 4, etc. the wound is again radically débrided with a plan to close the wound as soon as it is clean, usually by 7 days and definitely by 10 days with either direct closure, skin graft or flap. The days of débridement are carefully scheduled after the initial débridement to ensure that closure will be done by Day 10 at the latest. (These days are scheduled to
coincide with the surgeon’s operating days.) This method decreases the hospital stay and saves everyone money. Between débridements an attempt is made to keep the extremity elevated and the wound moist throughout the day, using the method described above. Other methods used to keep the wound moist include gauze impregnated with silver sulfadiazine (“home-made”), honey or the use of the VAC. See below. Unless there is “ownership” of the wound by a senior staff surgeon, the wounds will often be neglected with inadequate débridement and Day 10 will pass without wound closure.

Summary of Technique:

1. Initial wide débridement with removal of devitalized tissue and foreign bodies is carried out. Initially the surgeon should be able to predict when and how the wound can be closed: direct closure, STSG or a flap.

2. Débride every 2 days and try to close by 7-10 days post initial débridement. This will require dedication and ownership of wound by experienced team member. The wound should be closed whenever the wound is clean and earlier than day 7 if possible.

3. Keep the wounds moist and the extremity elevated between débridements.

Third is a newer approach using the VAC—Vacuum Assisted Closure—or Negative Pressure Therapy (NPT). See Chapter 4. It is an excellent method for debridement and even gradual wound closure in chronic wounds. (It may also be used in acute wounds. See below.) After the initial debridement, the negative pressure suction can be applied and the dressing changed every 2-3 days. The supplies and suction for this are produced by KCI but home-make
varieties are possible anywhere in the world. This is described in Chapter 4 dealing with wound closure with VAC.

One should not forget “Honey” to keep wounds moist between débridements and for minimally infected wounds. Most plastic surgeons would rely on débridements rather than honey, but honey is hyperosmotic and antibacterial and it does keep the wound moist. Some types of honey produce an enzyme that produces very low concentration of hydrogen peroxide and at this concentration it is antibacterial and not harmful to the tissues. Honey does not have to be sterile to use. When one does not have silver sulfadiazine, honey is a good substitute for large burns. Wounds with honey dressings can be redressed every few days according to the amount of drainage and until the wound is ready for skin grafting. See Fig 4. Honey can be covered with gauze or with food wrap. The gauze and food wrap is removed every 2-3 days, the wound cleaned and honey reapplied. “Honey granulations” are clean, flat and not hypertrophic.
The author would use honey when other agents are not available or too expensive to use in the care of large wounds.

**Failure for wounds to heal** with these methods will require more thorough investigation. The following tests would likely have been performed earlier.

- Determine if tobacco products are being used
- Diabetes and HIV testing should be performed if not previously done.
- Albumin should be checked if possible
- Sickle Cell studies
- Biopsy to rule out Marjolin’s ulcer, Buruli ulcer and fungal infection, etc.

**Tobacco** use is not as common in Africa as in the West but it should be stopped if there is a chronic wound. The same is true for **betel nuts** which contain arecoline, arecaidine and guvacine which have vasoconstricting properties. These are used mainly in Southeast Asia but are also used in east Africa.

**Sickle cell ulcers** are chronic ulcers usually seen with homozygous sickle cell anemia and sickle cell thalassemia. They are usually seen on the lower extremities and just above the malleoli. They occur spontaneously or as a result of minor trauma. Possible causes are obstruction to vessels by the sickled cells, increased venous and capillary pressure, bacterial infection and reduced oxygen carrying capacity of the blood. Treatment is good local care, antibiotics, repeated débridements as described above, blood transfusions and skin grafting when the wound is ready. In addition, the use of the VAC to prepare the wound should be helpful though the author has not used the VAC in SS ulcers. Protecting the grafted area for prolonged periods is advised.

**Buruli Ulcers** are secondary to mycobacterium ulcerans. They are seen on almost every continent but especially in west and central Africa. The classic finding is undermining around edge of the ulcer. An acid-fast or Ziehl Neelsen stain may be positive. Biopsy with histopathology is the best diagnostic tool if available. Culture takes many weeks. Treatment includes wide débridement of edges back to good tissue with local wound care and later skin grafting or flap coverage. The main treatment is medical and is based on TB treatment regimens which include rifampicin and streptomycin/amikacin for a minimum of eight weeks. Surgical treatment should only be performed after the patient is on medical management.
Buruli Ulcer with characteristic undermining of the edges (Courtesy of Dr. John Tarpley)

**Marjolin’s ulcer** is a rare but aggressive cutaneous malignancy that occurs in long standing wounds and chronically inflamed skin, classically in chronic burn wounds but it may occur in any chronic wound as a decubitus ulcer or tropical ulcer. Most Marjolin’s ulcers are on the lower extremity but it can appear on the upper extremity as well as the scalp. Most commonly it is a well-differentiated squamous cell carcinoma though basal cell carcinoma, adenocarcinoma and malignant melanoma may be seen. It occurs in two forms, the exophytic and shallow but the exophytic type is most common. Usually the wound is present 10-25 years before malignant degeneration however an acute variant has been seen within a year of injury. Many authors describe early metastasis at the time of diagnosis with poor prognosis. SCC normally has a metastasis rate less than 3% whereas SCC in chronic burn scars has a metastasis rate of 10X or 30%. If associated with pressure sores metastasis is also higher.

Treatment begins with prevention of chronic wounds by proper wound care with wound closure. This will eliminate most cases of Marjolin’s ulcer. When a chronic wound is first seen, it must be treated with urgency to get it closed so it will not undergo malignant change. See Figures 1 and 3. Repeated breakdown of a wound may be an early sign of carcinoma. Diagnosis is made by histopathology if possible even though the ulcer may have a typical appearance. When it is on the scalp or lower leg, bony invasion may be found, see Figure 5 and 6. Recommended treatment includes wide excision with 2 cm.
margins. If there is bony involvement radical surgery is required. X-rays and a CT scan if available may help determine the depth of bony involvement in scalp and lower extremity lesions. Often an exploration is required to determine the extent. For scalp wounds, if the pericranium is involved, then the outer table may be removed with skin grafting or flap coverage. If both tables are involved, full-thickness skull may be removed with skin graft or flap on the dura. When the dura is involved, it may be excised and grafted with pericranium as long as the brain is not involved and as long as the graft can be covered with vascularized tissue, a flap. This would only be attempted in relatively young patients without metastasis.

Fig 15Fig 16Fig 17Fig 18

Full-thickness skull removed in a 12 year old with Marjolin’s. Entire forearm skin was taken based on retrograde flow through radial artery. Flap was divided at 20 days (courtesy Dr. Einar Eriksen)

Variables in Prognosis for Marjolin’s Ulcer

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<tr>
<th>Variable</th>
<th>Better</th>
<th>Poorer</th>
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<tbody>
<tr>
<td>Clinical</td>
<td></td>
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<tr>
<td>Latency to malignancy</td>
<td>Less than 5 years</td>
<td>More than 5 years</td>
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<tr>
<td>Tumor location</td>
<td>Head, neck, upper extremities</td>
<td>Lower limbs, trunk</td>
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<td>Tumor source</td>
<td>Post-burn, chronic osteomyelitis</td>
<td>Pressure sore carcinomas</td>
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<tr>
<td>Tumor diameter</td>
<td>Smaller than 2 cm</td>
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<tr>
<td>Tumor type</td>
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<td>Metastases</td>
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<tr>
<td>Tumor recurrence</td>
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<td>Present</td>
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<tr>
<td>Histological</td>
<td></td>
<td></td>
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<tr>
<td>Degree of differentiation</td>
<td>Well differentiated</td>
<td>Moderately-well and poorly differentiated</td>
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<td>Peritumor T lymphocyte infiltration</td>
<td>Heavy</td>
<td>Scarc or absent</td>
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<tr>
<td>Depth of dermal invasion</td>
<td>Superficial to reticular dermis</td>
<td>Reticular dermis or deeper</td>
</tr>
<tr>
<td>Vertical tumor thickness</td>
<td>Less than 4 mm thick</td>
<td>4 mm thick or more</td>
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If the tibia is involved, again x-rays and CT should be performed if possible. There are many variables in such cases including depth of bone involvement, age, comorbidities and general health, lymph node involvement, availability of prostheses, and quality of family support, etc. At one extreme are the elderly with deep aggressive ulcers, lymph node metastasis, generalized weakness, likely need for an AK amputation, no caretaker and probable difficulty in obtaining prosthesis or in using crutches. In these cases local care may be all that should be done as an amputation will lead to a bedridden state and early death. These patients may be allowed to live with the tumor as they will have a better quality of life during their remaining months. At the other extreme is an early skin lesion without bone involvement that only requires wide excision with a graft or flap. In all extremity cases the muscle fascia should be excised. If the ulcer is down to the periosteum but no bony invasion is evident, the periosteum should be removed with a flap or VAC coverage. If the periosteum is involved or the bone minimally involved in a young person, then a portion or all of the bone can be removed, antibiotic beads placed in the defect (methyl methacrylate mixed with an antibiotic, small beads made and sutured together as a necklace), an external fixator applied with a muscle flap and skin graft over the defect. Reconstruction can be carried out later with a bone graft, bone transport—fibula moved over into tibial defect, or a free fibula microvascular reconstruction but only after there is no evidence of recurrence.
Another older method of reconstruction is fusing the fibula to the tibia above and below the tibial defect through a posterior approach—just as was once done for tibial loss secondary to trauma. This is radical surgery and would only be used in the younger patients without lymph node metastasis. One should never perform such extensive multistage surgery unless a cure is possible. Early amputation may provide a more secure future for the patient without as much concern of recurrence. See Figure 6. Young people can easily learn to use crutches or prosthesis.

There is no consensus in the literature concerning lymph node dissection for Marjolin’s ulcer in the extremities. Though some have suggested prophylactic lymph node dissection, most would only do so if palpable suspicious nodes are present. Widespread nodal involvement would be a contraindication for node dissection though local surgical removal of the mass would still be performed. If the lesion is large, >10cm, but there are no obvious regional nodes, then a sentinel node biopsy could be done if one has experience with this technique. The limiting factor for most of us is adequate histopathology.

In relatively young patients with large aggressive ulcers, amputation with or without lymph node dissection is advised if they can obtain a prosthesis or will be able to use crutches. If there is a reasonable chance for cure, radical surgery with or without amputation is advised. If local care is an option, then an ostectomy of adjacent or involved tibia may be carried out with flap coverage and external fixation if necessary. When the wound is well healed, a bone graft may be inserted into the bony defect or an uninvolved segment of fibula can be
transposed over to the tibia. In the future more of our hospitals will be able to perform a free microvascular transfer with a contralateral fibula.

If a node dissection has not been done, it can be done later if nodal involvement appears. Where radiation is available, it has been suggested for such though the guidelines are not certain. Chemotherapy has also been used when there is lymph node metastasis.

As stated above, in long-standing extensive cases in the elderly when it will be difficult to obtain an adequate prosthesis and when the patient will have difficulty using a prosthesis or even crutches, it may be best to provide wound care and allow the patient to have “quality” life rather than have extensive surgery/amputation and be bedridden for life. This is especially true when the patient lives alone or does not have a family to care for him.

It is important that every surgeon that cares for wounds must strive to reconstruct any non-healing wound or fragile scar that continues to breakdown. Any chronic wound that fails to heal or continues to break down should be biopsied before extensive reconstruction.