Wound Care For People Affected by Leprosy: A Guide for Low Resource Situations

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A Guide For Low Resource Situations

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The Publication of this book was sponsored by

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Wound Care in Leprosy

Introduction

This guide has been compiled for people who have responsibility for wound care amongst people affected by leprosy. It gives readers an opportunity to learn about the normal body response to tissue damage and seeks to encourage readers to use simple methods of treatment to assist the body as it tries to repair itself.

Some technical terms have been included in the text deliberately. This is because readers are encouraged to seek further information from other sources which may be aimed at readers who are more familiar with technical terms. Where technical terms are used in this guide, they have been highlighted in ***Italic***. Where ***highlighted italic*** text is found, a simple definition for the term can also be found in a glossary at the end of the section. There is a glossary at the end of each major section throughout the guide.

Skin Ulceration in Leprosy

1. Tissue and Tissue Repair

Tissue repair involves the exchange of healthy cells for damaged cells. The method of repair will depend on the type of tissue that was damaged, but the repair process usually involves either ***regeneration*** or ***replacement***.

Regeneration

The new cells will be the same as the cells that had been destroyed and normal function will be restored.

Replacement

A new type of tissue will be made which eventually produces scar tissue and usually loss of tissue function.

Cell Types

Skin is formed from a collection of ***labile*** cells. Labile cells continue to regenerate through life anyway, so if the skin is damaged the body is able to restore the tissue to function easily.

Organs and connective tissue (bones and tendons etc.) are formed from ***stable*** cells. These cells do not usually change after full growth, but they can ***regenerate*** if they are required to do so.

The cell bodies of neurons (nerves) are ***permanent*** cells and if they are destroyed they do not regenerate. They are ***replaced*** by other cells. Muscle cells do not regenerate either, but they are able to repair themselves.

Repair of the skin can take place either by ***primary union*** or ***secondary union***. If the wound edges are close together (e.g. Surgical incision) the wound will heal by primary union, but if there has been a wide loss of tissue the wound will heal by secondary union.

1.1. Primary Union

When tissue cells are destroyed they release chemicals into the surrounding area. One of the many effects that these chemicals has is that it converts some of the blood plasma proteins into a thread like structure called ***fibrin***. Fibrin immediately starts to bind the edges of the wound together.

Other chemicals that had been released cause blood vessels to widen so that more blood is supplied to the area. The microscopic openings in the walls of the widened blood vessels also expand allowing more fibrin, nutrients and white blood cells to move into the damaged area. (These activities explain why a wounded area is always swollen and hot).

The fibrin, whilst binding the wound together, also acts as a barrier against invading micro organisms and foreign bodies. Defences are strengthened by ***neutrophils*** (a type of white blood cell) which consume and destroy micro organisms and any fragments of destroyed tissue (this process is called ***phagocytosis***). The fibrin, white blood cells, platelets, nutrients and other body defences collect in the wound space to form a clot which dries at the wound surface to form a scab.

With all the defences activated, new ***epithelium*** (cells that cover surfaces or form the bulk of body structures) begins to ***regenerate***. The regeneration process usually starts from the edges of the wound and usually takes a few days to complete. The cells multiply from each side and migrate under the scab until they meet to form a new cover. The process continues and the epithelium gradually changes to form new ***epidermis*** (the outer layer of the skin). When the ***epidermis*** is fully restored the scab falls away, however this does not mean that the healing process is complete.

As the epidermis is being formed a different type of white blood cell (***macrophages***) migrate to the area to remove dead neutrophils and any remaining tissue debris. With the arrival of the macrophages come ***fibroblasts***. Fibroblasts are cells that produce the fibrous parts of connective tissue. Their function in wound healing is to produce a protein called ***collagen*** which unites and strengthens skin tissue. As the fibroblasts fill the space with collagen, the fibrin is no longer needed so chemicals are released to dissolve it.

New blood capillaries grow into the area from blood vessels at the edge of the wound and gradually the temporary repair tissue is replaced by delicate new connective tissue.

1.2. Secondary Union

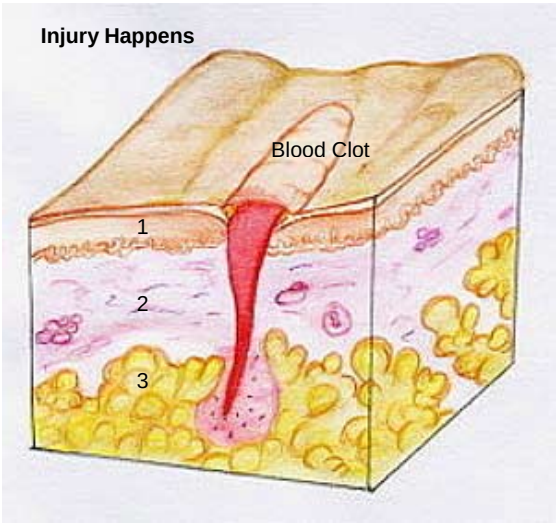
The repair process uses basically the same pathways as that in primary union, but the cavity, being much greater demands the replacement of tissue which will require an epithelium cover over the surface. Union takes very much longer because the epithelium regenerates and has to move across the wound surface. The process will be discussed in more detail under the heading “How Ulcers Heal”.

Tissue and Tissue Repair : Glossary

collagen	One of the proteins used to make connective tissue, especially ligaments, tendons and bone.
epithelium	Cells that cover internal and external body surfaces. There are many different types of epithelium. Epithelium is classified by the shape of the cell and by the number of layers that form a lining.
epidermis	The outermost layer of the skin. It does not have blood vessels
fibrin	A protein that is essential in the clotting process.
fibroblasts	A fibre producing cell that can adapt to produce different types of connective tissue.
labile	Can divide and reproduce
macrophages	Large cells found in the walls of blood vessels and connective tissue. Usually immobile but are stimulated by inflammation. Their main function is phagocytosis.
neutrophils	Type of white blood cell
phagocytosis	The process of destroying solid substances (e.g. other cells, bacteria and foreign bodies) by engulfing and digesting them

Figure 1: Primary Union

A

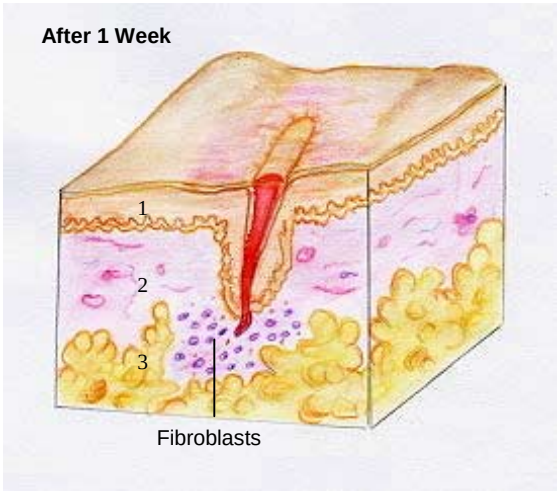


1. Epidermis
2. Dermis
3. Subcutaneous Fat

A Injury cuts through epidermis and dermis (epithelium and connective tissue of the skin) and a blood clot forms. Chemical messengers are released immediately.

B After about a week epithelium is growing around the wound. Fibroblasts are very active

B



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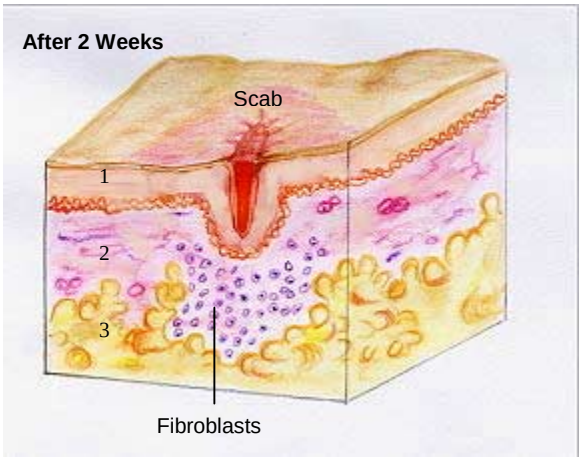
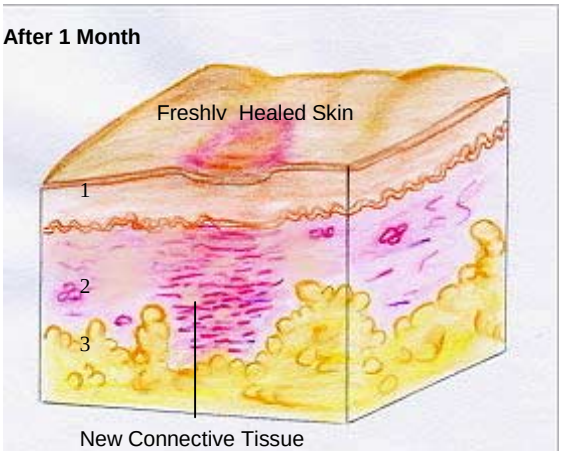


C After about 2 weeks the epithelium has grown around the wound completely.

B After about a month the wound has closed, the scab has fallen off and the granulation tissue is being changed into connective tissue.

D



2. How Ulcers are Formed

Although all ulcers are wounds they are not usually caused by sudden trauma. Compared with a sudden wound, ulceration is a process of slow, sometimes hidden, breakdown of tissue. Ulcers will close by secondary union, just like any large wound, but the process of union will only begin when the destruction stops.

The composition of soft tissue varies from one part of the body to another. It develops in such a way that it can adapt to different stresses without being damaged during normal activities. Collagen and ***elastin*** are two types of fibre that give soft tissue strength (collagen) and elasticity (elastin). In certain body parts (e.g. the foot) globules of specialised fat also help by acting as shock absorbers. If these fibres are put under too much stress they will become weak through ***fatigue***. Fatigue can be caused either by vertical forces that create pressure or by horizontal forces that cause shearing stress.

Pressure ulceration (also known as ischaemic ulceration) is the result of low, but continuous pressure being applied to tissue for several hours thereby blocking the supply of oxygen and nutrients. This type of ulcer is common amongst patients who are not able to move without assistance (geriatric patients or immobilised patients) but can also be caused by the poorly applied plaster of Paris.

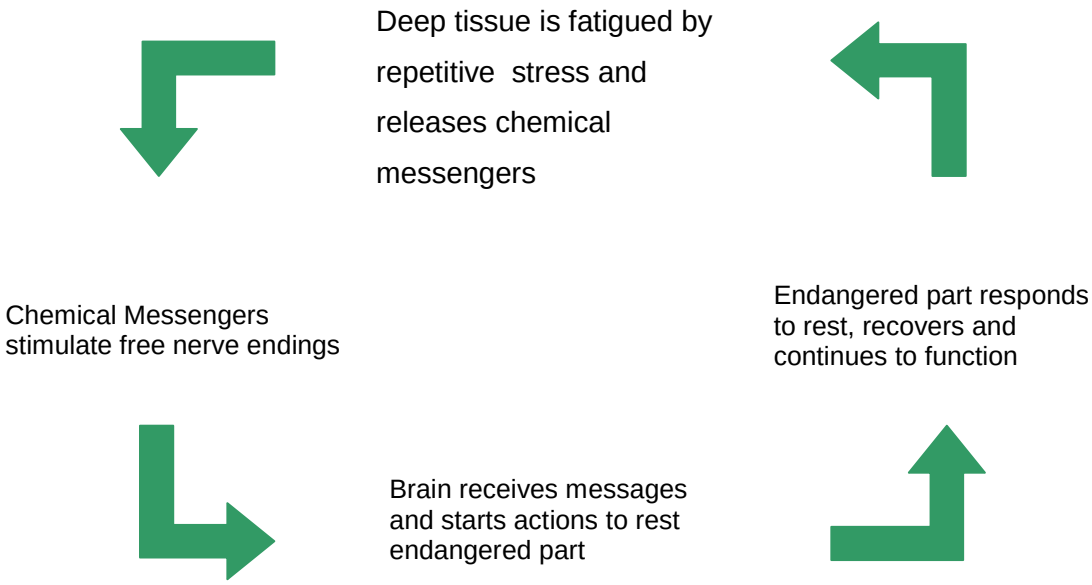
The ulcers commonly found in the feet of people affected by leprosy or diabetes are more often the result of moderate pressure or shearing stress that is applied repeatedly over a long period of time.

When tissues are under too much stress they release substances which stimulate nerve endings. Nerve impulses are carried to the brain. Usually theses impulses are not recognised as pain but they are sufficient to cause the body to alter the way it is working (similar to reflex actions) so that the part under stress can be rested. If the stress is very severe there will be a greater amount of chemical messenger released to more nerve endings. The greater the stimulus the more likely it is that the impulses will be registered as pain. Pain causes us to rest the damaged part. During a period of rest the tissue manages to recover. Once fully recovered the tissue can then continue to provide its usual function.

If there is no nerve function (as in leprosy or diabetes) the tissue may be put under stress but no signals are sent to the brain because the nerves do not function. No information is received by the brain so no action is taken to protect the threatened part. Eventually the tissue that is under stress reaches a point of fatigue and breaks down.

The normal body responses to tissue damage begin as the broken down cells release their chemical messengers. In response, the area around the damaged tissue becomes packed with fibrin, neutrophils, ***platelets*** and ***plasma*** as the body tries to repair the damage. However the massing of repair chemicals and blood causes ***edema***. Body tissue is usually confined in very tight compartments so the build up of edema puts pressure on the small blood vessels that serve the tissue and eventually blocks off the blood supply. When the tissue becomes starved of ***nutrients*** more tissue dies. As more tissue dies more chemical messengers are released and again the body responds by activating an even stronger tissue repair response. Unless immediate action is taken to stop the cycle the area under stress breaks down to such an extent that that there is no more space for further accumulation of plasma and broken down tissue. The skin gives way to internal pressure and eventually it breaks to allow an escape of fluid and an open ulcer appears.

Normal Body Response to Tissue Stress



Tissue Breakdown

Deep tissue is fatigued by repetitive stress and releases chemical messengers.

Chemical messengers are released but damaged nerves cannot relay message to brain.

No action is taken to rest endangered part.

Fatigue becomes too great and tissue cells are destroyed.

Enzymes released from destroyed tissues stimulate repair response (inflammation).

Inflammation causes edema which blocks the supply of nutrients and oxygen.

Starved tissue breaks down, releases more chemical messengers and inflammation increases.

The amount of broken down tissue and plasma becomes too great to be confined. Skin bursts to release breakdown products and an ulcer is formed.

3. How Ulcers Heal

Provided that nothing interferes in the repair process, the body will heal itself effectively and efficiently. The body normally responds to ulceration in three phases:

1. The active phase
2. The rapid multiplication phase (proliferative)
3. The maturation or remodelling phase.

It is important to understand how the body works through these phases if suitable actions are going to be taken to help in the healing process.

3.1. The Active Phase of Ulceration

The same chemical messengers and ***enzymes*** that are released in response to sudden trauma are released as part of the repair process for ulcers (see Primary Union). ***Leucocytes*** are responsible for the first debridement of an ulcer because they actively break down damaged tissue. Whilst the leucocytes are actively breaking down dead tissue, ***monocytes*** release enzymes that break down collagen and other proteins. These destructive activities spread inwards until good viable tissue is reached. The inward spread of activity causes the ulcer to have an undermined appearance. An "undermined edge" is a characteristic feature of active ulcers.

During these activities ***transudate*** is released into the wound. Transudate assists the process by bringing nutrients and carrying away the breakdown products. The breakdown products change the clear, straw coloured ***transudate*** into a creamy, discoloured, fluid with a distinctive odour. The thick and sticky fluid that drains all the debris out of the wound is called ***exudate***.

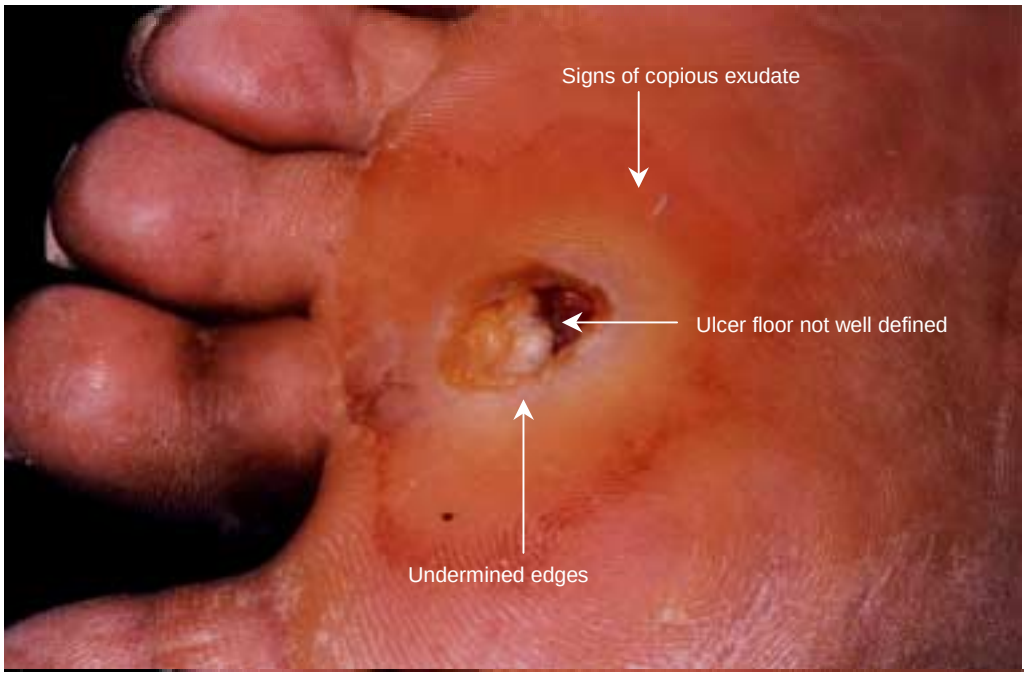
Very often the appearance of ***exudate*** causes observers to think that the wound is infected, but in the early active phase it is more likely that the ***exudate*** is sterile. This is an important observation because too often antibiotics are prescribed unnecessarily. The careless use of antibiotics may result in the development of resistant micro organisms.

Through the most destructive part of the active phase there will be a strong flow of fluid from the wound, but as the activity begins to reduce there will be less fluid and the fluid

may become thicker and more sticky. After the active phase (usually about a week), the cells and plasma particles of the ***exudate*** bond together into a ***necrotic coagulum***. This necrotic tissue (***slough***) may remain relatively fluid or dehydrate to become a hardened ***eschar***..

Another feature of active ulcers is that they have a mobile relationship with deeper tissues. The entire area around the ulcer is elastic and slight force at the sides of an active ulcer will result in the skin and ulcer being temporarily moved over the immobile deeper tissues.

Figure 4 **Active Phase of Ulceration**



3.2. The Rapid Multiplication Phase (proliferative phase)

If good conditions are maintained, the process of tissue repair moves on from the active phase to a phase in which cells multiply very quickly and new tissue is built up.

Granulation and Re-epithelialisation:

An important sign that an ulcer is healing is the appearance of granulation tissue at the base of an ulcer. Granulation tissue is a mass of vascular and lymph vessels that form in a gel-like substance known as the granulation matrix. The entire mass is held together in a fibrous collagen network. The granulation matrix is made up of necessary ingredients to build tissue and also of various chemicals that act as defences against infection. The blood vessels carry nutrients to macrophages and fibroblasts, whilst the lymphatic vessels prevent edema by constantly draining the area. Granulation tissue is produced until it fills the wound cavity, almost to the level of the surrounding skin. As granulation builds up to the level of the skin it releases chemical messengers that cause epithelium to start spreading over the wound surface.

If the best conditions for the wound are maintained there will be no exudate during this phase, but there may be a moderate amount of clear transudate from surrounding tissues. The edges of the wound will no longer be undermined and if epithelialisation has begun, the edges of the wound will have a gentle sloping appearance.

3.3. The Maturation or Remodelling Phase of Ulceration:

The process of restoring the tissue to its former condition is the same as that described under the section entitled Primary Union. When a large area of tissue has been damaged the problem of scar tissue becomes much greater. Scar tissue is not as elastic as normal skin tissue and has a maximum strength of 20% less than that of undamaged skin. As it forms it also contracts and can leave the body part seriously deformed and with very much reduced ability to function. During this phase the healed skin will give the impression that the repair process is complete. However, the process is not complete and much can be done during this phase to prevent the effects of scarring.

Figure 6 **The Rapid Multiplication Phase (proliferative phase)**

How Ulcers are Formed : Glossary

elastin	A tough protein that allows connective tissue to stretch and return to shape.
enzymes	Proteins that cause chemicals to change without changing themselves
eschar	A collection of discarded material formed from the breakdown of dead tissue.
exudate	Fluid that has escaped from blood vessels and has collected in body tissue
fatigue	Loss of power or ability to respond
Leucocytes	Large white blood cells
necrotic coagulum	A clot of dead tissue
nutrients	Food particles
edema	Build up of fluid in an enclosed body space
platelets	Particles in the blood that are used during clotting
slough	Necrotic tissue that has separated from healthy tissue
transudate	Very fluid substance that has passed through body tissue membranes

4. What Can Go Wrong

4.1. Chronic Ulcers

If the cause of an ulcer is not removed (usually repetitive pressure or shearing stress) the ulcer will not heal. If it cannot heal the likely results will be that it will either become a chronic ulcer or it may become a complicated ulcer (see below).

Although mechanical stress is the most common reason why ulcers don't heal, there are other factors that also delay healing. Throughout the active and rapid multiplication phases, vitamin C and oxygen are essential, not only for maintaining cell life but also for making the enzymes that breakdown proteins. Poor oxygen supply and lack of vitamin C can therefore delay tissue repair. It is also known that a lack of vitamin A delays re-epithelialisation. Lack of protein results in low levels of amino acid which can result in the lack of material to build granulation tissue. (Lack of protein can also lower resistance to infection.) Lack of ***trace elements***, particularly zinc and copper, have also been found to delay healing.

Medical treatments that can also slow down tissue repair include, ***antineoplastic*** drugs, ***haemostatic*** agents, non-steroidal anti-inflammatory drugs, and many systemic antibiotics. Steroid therapy is perhaps the most important threat to tissue repair. Local conditions at the wound surface can also be put at risk by the effects of toxic antiseptics, whilst unsuitable dressings can interfere with the repair process.

What Happens During Chronic Ulceration

When there is interference in the processes of tissue repair (usually because of repeated ***micro trauma***) uncontrolled inflammation becomes a problem.

A result of prolonged inflammation is that healthy tissue regeneration is delayed. The body produces fibrous tissue instead. The production of fibrous tissue results in the ulcer being "tied" to deeper structures, so the area around the ulcer becomes stiff. The hard and punched-out edges of chronic ulcers are also due to over production of collagen. Wounded tissue does not produce ***chalone***. Chalone is the chemical that limits the production of the cells that form the hard outer layer of the skin (***keratinocytes***). This may explain why there is usually a ring of callous around the edge of a chronic ulcer.

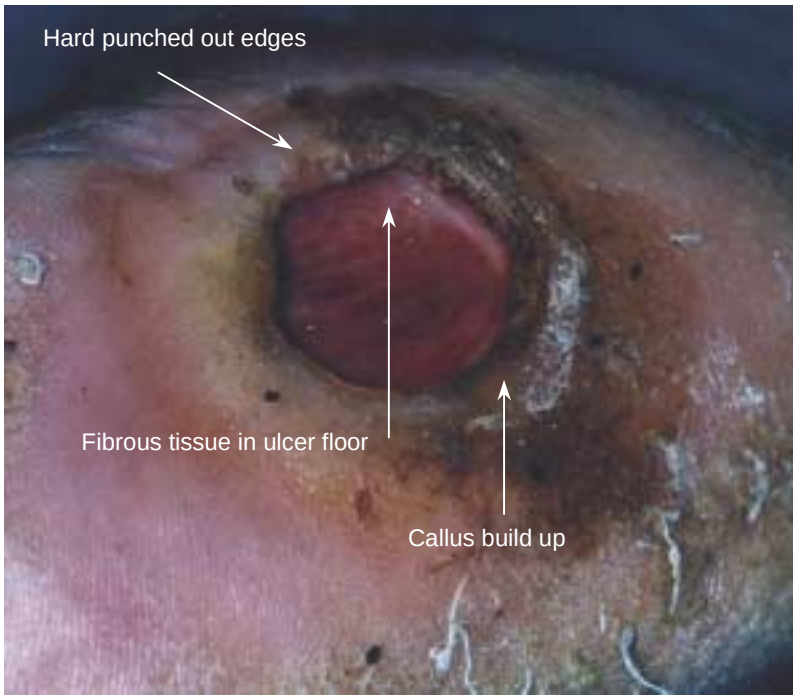
Callus then becomes a hard ring around the ulcer so that when the person walks the pressure (which first caused the ulcer) is increased so that even more damage is done.

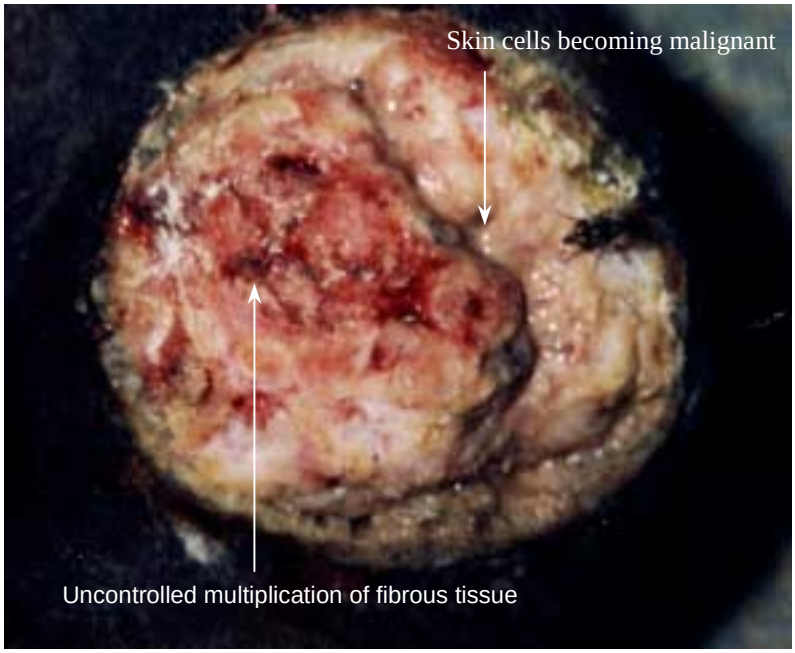
Chronic ulcers are a great cause of stress and depression for people who suffer with them, but apart from the unpleasant smell and unsightly appearance, chronic ulcers are a serious hazard for the people who suffer with them. Chronic ulcers are a constant opportunity for infection by life threatening micro organisms, but they also present the danger of developing into a cancerous state known as ***squamous cell carcinoma***. (see Complicated Ulcers)

Psychological Factors

Ulcers are one of the reasons that people affected by leprosy are rejected from their communities. When people are rejected they need to find ways to survive which is why some people become beggars. Beggars soon realise that they can use ulcers to their advantage. People passing by a beggar displaying wounds react with pity, horror or a mixture of both, but because of the shocking sight of open wounds people are more likely to give to the beggar. The ulcers then become the method of earning for the beggar and so the need for money prevents the beggar from seeking treatment for the ulcer. For many people, the causes of chronic ulceration, therefore, are not merely mechanical or physiological, but psychological as well.

Figure 7 Chronic Ulceration





4.2. Complicated Ulcers

If an ulcer is found to be broken down tissue only in the dermis and epidermis, it is termed a “simple ulcer”. If the breakdown of tissue goes deeper than the dermis and other body parts are affected (i.e. tendons, tendon sheaths, bones and joints) the wound is termed a “complicated ulcer”.

Complicated ulcers usually develop as a result of untreated simple ulcers and are almost always the result of infection. There are many different organisms that thrive in and around an ulcer and it is probably true to say that all ulcers will be infected to some extent, but not all ulcers are infected by dangerous and destructive organisms. If an ulcer is infected by pus forming bacteria (***pyogenic*** bacteria) the situation will be very dangerous, particularly if the person continues to move the infected body part and most especially if the person continues to walk on an ulcerated foot.

When pressure is put on an infected ulcer, the infection is helped to spread rapidly. The soft tissues and muscle contractions act like a pump that shifts the infecting micro organisms to unaffected parts deeper in the hand or foot. The spread of infection, continuous mechanical stress and the inflammatory response continue to break down body tissue and the ulcer increases in size.

The collection of pus is a cause for great concern because collections of pus can result in infection of the blood (***septicaemia*** - a life threatening condition). The body tries to prevent the spread of infection by forcing the pus to the surface so that it can drain away. If it is successful, the body will channel the pus through tracks called ***sinuses***. Sinuses are also used by the body to force out larger pieces of dead tissue (particularly bone) that cannot be broken down by phagocytes. Complicated ulcers will often be found to have sinuses.

Infection that affects tendons, joint capsules and bone are very destructive and are responsible for deformities and loss of function. However the body’s own inflammatory response can also be destructive. A chronic deep ulcer leads to long term inflammation (see Chronic Ulcers). One of the effects of prolonged increase in blood supply can be the weakening of bone (***osteoporosis***) . With bones weakened by osteoporosis there is an increased threat of fractures. If the bones fracture there will be an increase in the

inflammatory response and further weakening of bone which can lead to bone ***disintegration*** and ***absorption***. The disintegration of bones and destruction of joints in the foot is a very difficult problem to solve and often leads to amputation.

When the tissue around bones (***periosteum***) becomes infected the condition can lead to inflammation of bones (***osteomyelitis***). Osteomyelitis is very difficult to treat and can cause chronic, non-healing lesions in bones. Without enough nutrients and oxygen the infected bone dies. Small pieces of dead bone break away. These loose pieces of dead bone, called ***sequestra***, will cause irritation in the wound which will not heal until the sequestra are removed or fall out. If the normal process of granulation is continuously interrupted by the irritation of sequestra the wound responds by producing ***hypergranulation tissue***. Hypergranulation will be seen as masses of bright red tissue that bulge out of an ulcer . Wherever hypergranulation is seen it indicates that there is something irritating the wound and should be taken as a sign that further investigation is necessary.

Figure 8
Hypergranulation Tissue

The constant and long term drainage of fluids from complicated ulcers can create problems. It is thought that constant leakage can lead to irritation of cells in sinuses. The irritation stimulates the cells to change in structure (***differentiate***). The changes in the structure of skin cells can become malignant and squamous cell carcinoma can develop.

Figure 9 Complicated Ulcers

What Can Go Wrong : Glossary

absorption	When dissolved substances move into or through body tissues
antineoplastic drugs	Cancer drugs
bone disintegration	The breakdown of bone into minute fragments
chalone	A substance that slows down the multiplication of cells
differentiate	A process where cells that were the same begin to change and begin to be different
haemostatic	Stops bleeding
hypergranulation tissue	Over production of granulation tissue
keratinocytes	The outer most layer of skin cells
micro trauma	Minute wounds
osteoporosis	Thinning of bone tissue
osteomyelitis	Infection of bone tissue
Periosteum	Connective tissue that covers all bones
pyogenic bacteria	Pus forming bacteria
septicaemia	Infection of the blood
sinuses	A tunnel or channel that fluid can pass through
squamous cell carcinoma	Cancer of scale-like cells of the skin
trace elements,	Minerals that are essential for health

5. What can be done to help?

5.1. Prevent Tissue Breakdown

Awareness

Anybody who cannot feel what is happening to their feet should know that they are at risk of developing ulcers. Knowing that there is a risk is the first action in preventing ulceration. It is usually the case that when people walk, the force that is needed to move the body forwards is spread over the surface of the foot. The force may be great but because it is spread over a large surface it does not cause small areas of high pressure. Most foot ulcers are formed because some people have feet on which small areas of high pressure do build up. Although the pressure under such small areas is higher than on other parts of the feet it is not so great that it causes a wound immediately (as would be the case if a person stands on a nail) . With each step, however, the pressure is applied until the tissue fatigues and breaks down (see section 2 “How Ulcers Are Formed”). There are warning signs of tissue fatigue and if people are aware of these signs action can be taken to prevent frank ulceration.

What are the signs of tissue fatigue?

Heat – With any inflammatory process heat is generated. If people with anaesthetic feet are required to walk they should feel their feet frequently to try and find whether there are any places on the foot that feel hot. If any localised areas of heat are found the person should understand that the heat is a warning that tissue is beginning to break down.

Redness and Swelling – The other signs of inflammation are redness and swelling. As part of self examination therefore, whilst feeling their feet ,people with anaesthetic feet should look at their feet as well. Another early warning of developing ulcers is that there will be a small area of puffy redness . Some people are unable to feel the heat of an inflamed area so inspection is also essential.

If immediate action is taken during the fatigue phase it is still possible to prevent frank ulceration. The action needed is ***REST***. Tissue fatigue will have come about because the foot had not been able to respond to normal warnings of tissue damage. Under normal circumstances the body will have found ways of relieving the area of risk. Feeling for heat and then responding in the best way (i.e. rest) therefore is just another way of assisting in the normal process of protecting the body.

Protection

Soft cushioned insoles (e.g. rubber, EVA, Poron) in footwear are useful because cushioning reduces force. If force is reduced there will also be a reduction of pressure. Although soft insoles will not alter the reason that some people do develop high pressure areas, they will reduce the pressure and therefore the risk of ulceration.

For some people, foot appliances can be added to insoles. If the correct appliances are supplied, further relief for high pressure areas can be given. In some cases people can be issued with appliances that change the way they walk. By changing the way a person walks it is sometimes possible to remove the cause for the build up of high pressure.

Skin Care

When nerves are damaged the body's ability to control sweating can be lost. When the skin dries, there is considerable *tensile stress* in the epidermis which can eventually cause the skin to crack (*fissure*). Normal functioning sweat glands help to keep the skin elastic. This is an important feature because it allows the skin to stretch and reform every time weight is applied to the foot. When elasticity is lost, the skin is much more vulnerable to damage.

A person with damaged nerves should take care to ensure that the skin is kept as healthy as possible. The skin can be kept elastic either by daily soaking the affected part in water, or by the use of *emolient* creams (e.g. soft parafin, lanolin). If soaking is the method of choice, the hands or feet should be immersed in water for 30 minutes after which they should be mopped dry. When the excess water has been mopped away a *barrier ointment* should be applied (eg vaseline). The difference between using a barrier ointment and an emolient is that a barrier ointment seals the skin so that water is held in the skin. An emollient penetrates the skin taking water into the skin as it does so. Either method will help to keep the skin elastic.

In many situations where poverty is a factor, the advice is that the affected part should be soaked (as explained above) and that any oil should be applied after soaking. This advice is given with caution because it should be remembered that edible oils do attract rats and insects.

5.2. Breakdown

Very often people do not notice that there is a problem until frank ulceration is found. The earliest signs of breakdown should be considered an emergency. If the ulcer is not infected the most essential actions to be taken are

- REST
- Elevation
- Maintaining the best possible wound environment (This will vary according to the phase of ulceration. See Chapter 3 for details on the phases of ulceration.)

5.2.1. Maintaining an optimal wound environment

There are certain factors that will greatly affect the rate at which wounds heal. Many of these features are affected by the types of dressings used, so before applying dressings, the qualities of the ideal dressing for any particular stage of ulceration should be considered. In most situations where leprosy is a problem there is a very limited choice of dressings, but it is still important to consider the ideal dressing so that strategies can be made to modify what is available. In this way, the most effective use of available dressings can be made and the wound may be less compromised by inappropriate wound dressing.

5.2.2. The Qualities Of The Ideal Dressing

i. Removes exudate
ii. Maintains a humid environment at the wound surface
iii. Allows change of gasses
iv. Prevents entry of micro organisms
v. Maintains a suitable and stable temperature
vi. Does not stick to the wound surface or leak toxic substances

Removes exudate

- ❖ The removal of exudate is important because exudate is an ideal environment for the growth of bacteria.
- ❖ Exudate keeps the wound wet. Enzymes present in the exudate break down surrounding tissue much easier when it is wet.
- ❖ When exudate soaks through dressings it makes an excellent pathway for infecting organisms to gain access to the wound surface.

Maintains a humid environment at the wound surface

Until the early 1960s it was thought that it was good to keep wounds dry because this would inhibit bacterial invasion. It was then discovered that the spread of epithelium over the surface of the wound depended on the surface area being moist. Good quality wound healing at a steady rate depends on a moist environment (not wet).

Allows change of gasses

The presence of oxygen can either help or hinder the healing process depending on the stage of repair. During the early active phase, oxygen is helpful because it stimulates the production of epithelium and improves the activity of neutrophils. Dressings that allow a release of the CO_2 (formed as a product of the healing process) and easy access of O_2 during the active stage are helpful. In the later stages of repair, reduced oxygen at the wound surface is better because it stimulates the production of the tiny blood vessels that form granulation tissue. Dressings that restrict the changes of gasses are useful during the rapid multiplication and remodelling phases (see Sections 3.2. and 3.3.).

Prevents entry of micro organisms

The dressing should act as a physical barrier to micro organisms. It should always be remembered that if a dressing is soaked through with discharge from the wound (***strikethrough***) the situation at the wound surface is more at risk of infection than if it wasn't covered at all.

Maintains a suitable and stable temperature

After a wound surface has been exposed and the surface temperature has been allowed to drop, it takes more than three hours before cells can start to divide again. Wounds should therefore, only be exposed for the least possible amount of time. Heat can also be lost from a wound. If the temperature in a wound drops, it affects the way in which O_2 is released from red blood cells, so care should be taken not to use cold solutions in clean wounds. Strikethrough can also cause heat loss and delay healing.

Does not stick to the wound surface or leak toxic substances

Fibres from gauze dressings, and particularly cotton wool, can become enmeshed with granulation tissue causing damage to the delicate new tissue when the dressing is

removed. Fibres can also stimulate the same sort of inflammatory response that other foreign bodies may start. Dressings should always be kept away form contaminating sources so that they do not introduce toxins to the wound.

5.3. Summary of Basic Wound Care for Simple Ulcers

Active Phase

- No weight bearing for feet - immobilisation for hands
- Elevation
- Frequent change of dry absorbent dressings
- Hygiene

NB Strikethrough is a hazard

Proliferative Phase

- No weight bearing for feet - splinting for hands
- Moist dressings (gauze swabs soaked in saline and squeezed dry) changed after 2 days
- Hygiene

NB Dressings must be removed with great care (soaked off if stuck to the wound). Avoid destroying granulation tissue

Remodelling Phase

- Gradual weight bearing with protective footwear for feet – night splinting for hands
- Wound should be covered (semi permeable tape is best) clean cloth is suitable
- Foot / hand soaking should be started

NB If cloth is used to cover the wound it should be washed frequently

5.4. Complicated Ulcers

The first priority when starting the treatment of a complicated ulcer is to decide whether the wound is infected (it usually is). If the wound is infected it is essential to make sure that if there are any pockets of pus they are opened and drained immediately. Pockets of pus can build up in compartments of the hand or foot. If action is not taken to drain these reservoirs there is a danger that the patient may develop septicaemia. Septicaemia is a life threatening clinical emergency that requires intensive treatment.

Infection

If a wound is infected there are likely to be signs of ***cellulitis*** and ***lymphadonitis***.

- The area around the wound will be hot, red and swollen.
- The ***lymph nodes*** in the ***groin*** or ***axilla*** will be swollen and tender.
- There will be much foul smelling exudate from the ulcer.

5.4.1. Action to Address Septic Wounds

i. Search For Pus.

The wound should be explored with a probe. It is possible to damage and compromise good tissue with a probe so, when using a probe, only very light pressure should be used to test the wound surface. In cases of infection gentle use of a probe will usually allow the examiner to find the track where pus has collected.

Using gentle hand pressure around the wound, the surrounding hot and swollen tissue may also feel spongy. It may be necessary to make an incision through the skin to expose a pocket of pus. If using a probe, it can be useful to gently push the probe as far as it will go and then to feel the end of the probe through the skin. An incision, cut over the end of the probe, will ensure that the opening is made in the correct place and the pus can be cleared out of the wound more easily.

ii. Establish Drainage

Make a clear and open drainage system to allow the pus to be removed. Careful hand pressure, in a movement that forces the pus in a direction away from the persons heart, can help to clear pus from a wound.

iii. Flush The Cavity

Having forced as much pus out of the wound as possible use a 10ml syringe filled with saline to flush the wound out. Do this repeatedly until the wound is clear of pus.

iv. Elevation

Remove any loose tissue (including bone) but do not take immediate action to debride the wound. Draw a ribbon of gauze right through the wound, or lightly pack the wound with gauze to make sure that the wound doesn't close up again too soon. Apply gauze dressings, held in place with bandage, and elevate the part above the level of the heart.

v. Medication and Dressing

Start systemic antibiotic treatment immediately. The dressings will need to be changed daily at which time the wound should be examined for any further build up of pus. If there has been a build up of pus it must be removed as before. If there is no build up of pus the wound should be cleaned with saline and dressed as before. After three days, if there is no pus and the inflammation has reduced, the wound will be ready for surgical debridement and possible reconstruction.

vi. Debridement [1]

All dead tissue must be removed. Toxic substances which are the products of dead tissue, continuously leak into the wound and can seriously delay healing. Until all irritants are removed from the wound, the body will not be able to begin the repair phase of healing. ***Sequestra*** and ***osteomyelitis*** can be particularly damaging so all fragments of bone must be removed from the wound and all pieces of infected bone must be excised.

Cut away all overhanging skin with any other weak or ***avascular*** tissue and reduce all callus that may have built up around the ulcer. When all damaged tissue has been excised, pack the wound with gauze soaked in Betadine Solution and secure with bandage. The limb should again be rested in a position that is higher than the level of the heart.

[1] Where facilities and personnel are more than basic requirements demand , the author strongly recommends reference to chapters 3,4 and 5 in "Essential Surgery In Leprosy" Srinivasan H and Palande DD, WHO, 1997

vii. Follow Up

The dressing should be removed the following day at which time the wound should be examined. If there is still a build up of pus it should be taken as a sign that there is still necrotic tissue that must be removed. ***PUS MUST NEVER BE IGNORED***. The wound should be investigated further and the infected or necrotic tissue should be removed. After the procedure the wound should again be cleaned out with saline and packed with gauze soaked in Betadine Solution which should be held in place with bandage.

If there is no pus and the inflammation in the wound has reduced, clean the wound gently with saline and pack it with gauze dressings made moist with saline. Leave the wound for two days before examining it again.

If after two more days there is still no sign of pus or sloughy tissue, repeat a gentle cleaning action with saline. The wound may still need to be loosely packed with gauze made moist with saline. Leave the wound for two days before examining it again.

At intervals of two days continue to inspect the wound. The need for packing will soon decrease. The wound will improve with careful cleaning and replacement of saline-moist dressings. If the patient can be given crutches, or the use of a wheel chair it will help the healing process significantly. The wound will heal over time, but the duration will depend on the following factors:

- The depth and area of the wound
- The behaviour of the patient (if the patient does not rest the part it will take longer to heal).
- Patient self esteem and morale
- The general health of the patient (nutrition, cardiovascular status, nicotine intake etc.)
- Levels of personal and environmental hygiene.

5.5. Plaster Casting

Feet that have ulcers may be considered for plaster casting. Fourteen days after debridement the ulcer should show signs that it is in a stable condition (inflammation will be controlled, swelling will be reduced and only there will only be slight amounts of serous discharge). At this stage plaster casting may be considered. (See Appendix 1)

5.6. Chronic Leg Ulcers

Chronic leg ulcers (also known as stasis ulcers) are usually found on the front lower part of the leg or on the dorsum (top side) of the foot. A common cause of these ulcers is poor blood supply. These have been managed successfully with a preparation known as "UNNA Boot" (See Appendix 2)

5.7. Enhancing the healing process

When other potential problems are addressed, healing of ulceration for people with leprosy is usually faster than diabetic ulceration because leprosy is not complicated by vascular disease. The immune system may, however, be weakened by systemic and topical steroid therapy, malnutrition and nicotine. In general, infection control should be based on avoidance rather than combat:

- Essential hygiene rather than topical medication.
- Sound nutrition
- Maintaining the best possible environment around the wound

The widespread use of antiseptics and topical antibiotics is problematic for the following reasons:

- The toxic agents used in many antispetics destroy body tissues as well as microbes and can significantly delay healing. Some antiseptics also affect the bactericidal ability of the blood because they destroy leucocytes.
- Patients are lulled into believing that the medicine will cure the ulcer and as a result they do not take responsibility to change or modify their activities.
- There is evidence that resistant strains of bacteria are developing partly as an effect of the careless use of antiseptics.
- Valuable resources are used up unnecessarily (wounds heal without costly antiseptics)

Disinfection is essential when any area of the body is to be opened: i.e. if management demands surgical investigation or intervention. This is because the natural anatomical barriers to infection are broken the moment an instrument cuts through epithelium. The skin or any surface that is exposed to the environment is covered with microbes, some of which can be very damaging (pathogenic). Body surfaces need to be cleared of microbes before being opened to prevent the entry of such microbes into the more delicate environment inside the body. So, to protect uninfected tissue, it is important to

clean body parts with disinfectants or antiseptics before incisions (e.g. surgical spirit, iodine, povidone iodine, chlorhexidine gluconate). Immediate post operative antiseptic measures are also wise because they offer a barrier to infection for tissue that has been exposed, however, the continued application of most antiseptics into wounds will delay healing without giving long term antimicrobial action.

If antiseptics are to be used they should be chosen for a specific action against an identified organism. Some antiseptics are only effective against ***gram positive*** bacteria whilst others act against ***gram negative*** bacteria. There are other limiting factors that should also be considered, e.g. iodine based products are inactivated by body fluids (blood and pus) whereas others (e.g. those that contain polynoxylin) release their activity slowly and only in the presence of body fluids. Some antiseptics are quick acting whilst others release their activity over a long period of time (a quick acting antiseptic is useful for skin preparation, but is wasted if applied to wounds).

Metronidazole preparations are effective against anaerobic bacteria often found in necrotic tissue and reduce the bad odour form such wounds. Silver sulphdiazine is used mainly in the treatment of burns but it is a preparation that is active against a wide range of organisms and has been found to be useful in the treatment of infected leg ulcers.

5.8. Other Important Factors that Influence Wound Healing

- Vitamin C and oxygen are essential for the manufacture of collagen
- Vitamin A deficiency has been recorded as delaying re-epithelialization.
- Protein deficiency results in a reduction of amino acid. Poor supply of amino acid will affect the production of granulation tissue. (Protein deficiency also reduces defences against infection)
- Deficiency of trace elements, particularly zinc and copper, is also responsible for delay in healing. Zinc is essential for the process of re-epithelialization and collagen synthesis. Copper is essential for the production of the enzyme that links collagen molecules together.
- Psychological well-being. Where people are excluded from participating in normal social activities they are likely to suffer from low self esteem which can lead to poor motivation. Self esteem and confidence not only result in better levels of care, but low stress levels do result in better immune responses.

5.9. Assessment

Careful record keeping will benefit the patient and the clinician in the following ways:

- ❖ Ulcers can take a long time to heal and patients and clinicians may become easily discouraged unless they can see some real evidence that the ulcer is healing.
- ❖ Clinicians who evaluate their work carefully are able to serve their patients better, develop their own expertise and contribute to knowledge.
- ❖ Good record keeping helps others to follow and continue treatment when hand over from one clinician to another is necessary.
- ❖ In some countries clinicians can be protected against legal action if they can demonstrate, from good record keeping, that they have taken proper care of their patients.

Record keeping can take many forms but a good basic rule to follow is that it should follow this flow:

- ❖ What the patient complains of
- ❖ What is found on examination
- ❖ A treatment plan
- ❖ Evaluation

If this method is followed every time a patient is seen, the clinician will be able to discuss progress or problems with the patient and adjust the treatment until the best solutions can be found.

There are many good guides on taking medical history and I suggest that readers should look to them for more detailed guidance on the subject. Although this guide focuses on ulceration it should be noted very clearly that clinicians do not treat ulcers – *clinicians treat people who have ulcers*. Clinicians should never allow themselves to become so focused on ulcers that they forget people who suffer with the complaint. When this happens it is not only very discouraging for those concerned, but the clinician will be ignoring the most important source of help in the challenge to heal the ulcers :i.e. the people themselves.

5.9.1. What should be recorded and what do the findings mean?

Measuring the size of a ulcer

The main reason for measuring the size of the ulcer is so that it can be seen how treatment is progressing. It is important to know, therefore, where the ulcer must heal from. Since the body can only start to heal from healthy tissue it is important to remove all dead tissue (including callus) before measuring the ulcer area.

The volume of space inside an ulcer is the best measure of the size of the ulcer, but in practice it is very difficult to measure ulcer volume. A good indication of the progress of an ulcer can be gauged by the surface area. Many different methods for measuring an ulcer surface have been published, but using a simple rule and a mathematical formula the area of an ulcer can be calculated.

Ulcer Area

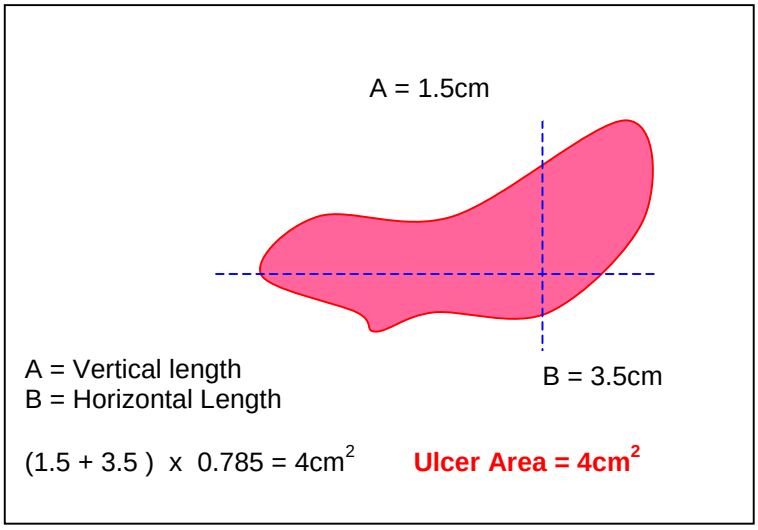
The greatest distance between 2 points on the edge, longitudinally.

The greatest distance between 2 points on the edge, horizontally.

The area of ulceration is then calculated using the formula:

(Horizontal length + Longitudinal length) x 0.785

Figure 10: Calculating Ulcer Area



The size of an ulcer will not be sufficient to allow a clinician to plan treatment or to make a prognosis: such decisions are based on the condition of the ulcer. Records of the

condition of an ulcer are also very useful therefore because they can give a baseline indication of the state of the ulcer at the start of intervention.

Important signs include:

- ❖ Ulcer edges
- ❖ Ulcer floor
- ❖ Type of discharge

At each stage of ulceration there will be signs that indicate the phase that an ulcer is in (See Section 3). There is often some cross over, particularly when ulcers are progressing from one stage to another, but a good general impression can be gained by routine examination and interpretation of the ulcer conditions.

Interpretation of Signs

	Edges	**Floor**	**Discharge**
Active	Undermined	• Irregular • Little or no granulation	Much exudate
Chronic	Punched out	• Granulation • Fibrous tissue	• Slight exudate • Hard eschar
Complicated	Mixed signs: • Inflammation • Undermined • hypergranulation	• Perforating to deep structures • Sinuses	Much exudate with pus when wound is infected
Malignant	Curling	Pushed out above skin level	Variable flow of transudate (sometimes dry)
Healing	Sloping with epithelium	Granulation	Slight transudate

Site of Ulcer

Recording the site of an ulcer is important because the position of the ulcer can give clues as to the cause of the ulcer. Part of the plan for ongoing care should take into account the risk factors for the patient so that ulceration can be avoided in future. Clearly recognised anatomical landmarks should be used to describe where the ulcer is situated (e.g. first metatarsal head). Some people also find it useful to have printed diagrams of the foot so that the site of the ulcer can be drawn on for reference.

6. Amputation

Decisions to amputate limbs should be taken only if it is absolutely impossible for the person to bear weight on the affected foot. It should never be considered to be the easy option to solve a chronic ulcer or to remove an ugly deformity. Although it is often thought that no limb, or a prosthetic limb, may be better than a deformed foot, this is very often not true. When supplying a prosthesis to a person with an anaesthetic stump, much more care needs to be taken than if the person has normal sensation in the stump. Prostheses that are found to be suitable for accident or land mine victims are usually unsuitable for people with anaesthetic stumps. Considerable pre and post operative exercise, gait training and counselling for psychological adjustment also needs to be done before a person is able to use the prosthesis safely. Countless prostheses that have been made and supplied to people with leprosy are left abandoned because they cause too many problems.

Many severely deformed feet can be kept ulcer free. Such feet do not function as feet should function, but they can still be useful as props to give stability so that people can carry out important activities without assistance from others: e.g. *squatting*

Figure 11: Healthy Stump

Although the person had lost his foot, with good self care and footwear that had been thoughtfully modified (by his daughter) he remained ulcer free. Such feet should never be amputated.

6.1. Indications For Amputation

Figure 12: Squamous Cell Carcinoma

If diagnosed and treated at a very early stage squamous cell carcinoma may be excised surgically. Advanced squamous cell carcinoma will not heal and will continue to get worse causing great distress to the sufferer. There are some reports of malignacy spreading to other parts of the body. Feet with squamous cell carcinoma should be amputated

Figure 13: Flail Foot

If the bones and joints of the foot are so badly damaged that the foot can only hang loosely on the end of the leg, it is better to amputate the foot because it will add to the possibility of ulcers developing.

Figure 14: Fixed Deformity

Sometimes the bones and joints of the foot are badly damaged, but eventually the foot becomes a fixed deformity. In such cases, the patients weight is put through the long bones of the leg on to a thin unprotected area of tissue. It is only possible to prevent ulcers if the patient does not bear any weight on the leg. In such circumstances it is better to amputate the foot.

Figure 15: Unhealthy Stump

The leg in Figure 15 shows the result of a foot that had chronic ulceration for a very long time (eventually the last part of the foot self amputated). Ulcers such as that in the photograph will not heal unless the patient never allows the leg to bear weight again. Surgical amputation is necessary. However it is important to consider that any amputated stump could develop the same sort of complications from a poorly fitted prosthesis.

avascular tissue	Tissue without any blood supply (in septic conditions, the blood supply to tissue can be cut off or very much reduced). Fibrous tissue also has a very poor blood supply.
axilla	The arm pit
cellulitis	Inflammation of connective tissue
debride	Removal of foreign materials or dead tissue
gram positive and gram negative bacteria	This is a method of classifying bacteria according to whether or not they take up a certain stain when prepared for microscopic examination. The significance of gram staining here is that is closely linked with antiseptic activity. Gram negative organisms are especially resistant to certain antiseptics. Foul smelling pus can be an indication that the wound is infected by Gram Negative Bactaria.
groin	Top of the leg. Where the leg meets the pelvis
lymph node	Collection of lymph tissue that forms an organ through which lymph vessels pass. Lymph nodes filter bacteria and toxins from lymph vessels. They are also a source of lymphocyte production.
lymphnoditis	Inflammation of a lymph node
osteomyelitis	Inflammation of bone due to infection
Sequestra	Pieces of bone that have been separated from healthy bone
strikethrough	Body fluid that has soaked through a dressing
systemic antibiotic treatment	Antibiotic treatment given orally or by injection

Appendix 1. Plaster Casting

The application of plaster is done in stages:

- ❖ Protect all bony prominences with non absorbent cotton wool, adhesive felt or pads of cotton gauze.
- ❖ Wrap the lower leg with a thin cover of non absorbent cotton wool which can be kept in place by a layer of bandage.
- ❖ Measure the length of plaster of Paris bandage needed (5cm proximal to the mid calf to the end of the toes)
- ❖ Using 6 inch Plaster of Paris bandage, measure out eight layers of bandage
- ❖ Apply the eight layers as a POP back slab
- ❖ Wrap the backslab to the leg using wet six inch Plaster of Paris Bandage
- ❖ Apply the POP from just below the bony prominence on the front of the leg, below the knee (tibial tubercle) to the toes, but do not cover the toes.
- ❖ Ensure that the POP is well moulded to the leg
- ❖ Leave the cast to dry for 48 hours
- ❖ Check the foot frequently to make sure that it is not swelling (which may indicate that the POP is too tight and should be removed)
- ❖ After 48 hours a walking device can be fitted (e.g. Bohler iron or a walking block) the device should be held in place by a few turns of POP bandage (at this time cover the toes as well but make sure that there is enough room for the toes to move freely).
- ❖ After another 24 hours the patient may be allowed to walk, but the patient must be advised that the cast should not be allowed to get wet (cover the cast with a plastic bag whilst bathing)

After six weeks the cast should be removed at which time the ulcer can again be assessed and further management options can be made. Usually by the time the plaster is removed the ulcer has at least progressed to the stage where it is simple ulcer. Management should then be based on maintaining the best possible environment for the wound to heal in and on addressing the mechanical causes of the ulcer.

Appendix 2. Unna Boot

100g of gelatine powder, clear without flavour

350g of distilled water

100g of zinc oxide

400g of glycerine

Mix water and gelatine together and set aside for a few minutes

Mix glycerine and oxide

Heat gelatine (do NOT boil). When gelatine is dissolved add oxide mixture.

3 or 4 layers of gauze bandage, (preferably elastic) are dipped into the mixture and wound around the affected area. The Unna Boot combination of medicaments and compression is helpful in hastening the healing process.

Appendix 3: Wound Care and Monitoring in the Field: