# Essential intervention No. 2

## Wound management

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## KEY OBJECTIVES

- To know the function of skin and understand the phases of normal tissue repair in the healing process.
- To be aware of factors that may delay or interfere with wound healing.
- To know wound-management procedures which facilitate the healing process and prevent disability.
- To know what are the correct functional and antideformity positions for the body and particularly the hand.

The skin is the largest organ in the body, representing 15% of body mass. It has three layers. The external layer, or **epidermis,** has the primary function of protecting the body. The second layer is the **dermis,** which is made up of dense, elastic, fibrous, connective tissue (collagen) and which is where the blood vessels, nerves, sweat and oil glands, and hair follicles are found. The **subcutaneous** fatty layer is deepest, functioning principally as a thermal insulator, shock absorber, and reservoir for nutritional reserves.

In tissue repair, healthy cells must replace damaged cells through a process of either **regeneration** or **replacement**. **Regeneration** occurs when new cells are the same as the destroyed cells and normal function is restored. The process of **replacement** involves the production of a new type of tissue – called scar tissue – which usually results in loss of certain functions.

The body has excellent ability to repair itself, providing that nothing interferes in the repair process. Good hygiene, nutrition, rest, protection, and psychological support facilitate the healing process.

The healing process is **often impeded by inappropriate wound-management techniques** by doctors and health workers (iatrogenic factors). This includes misuse of topical antiseptics and antibiotics, poor application or removal of dressings, and allowing the wound to dry out. Specific examples are seen with trauma from using high-pressure irrigation, rough removal of dressings, or excessive pressure application with pressure wraps.

Other factors affecting wound healing include poor nutrition and smoking. People who have immune suppressive diseases such as diabetes or HIV, or who are using immune suppressor medications such

as steroids, may also experience a delay in wound healing (*Table 5.2.1*).

Skin repair can be either by **primary closure** (edges are brought together and sutured together) or by **secondary closure** (edges are wide apart and the wound fills in on its own). The healing process is complex, but a simplified explanation is given below (*Table 5.2.2*).

## Nutrition

Diets should be high-calorie, high-protein, and rich in vitamins A and C – with consideration given to the cultural practices and dietary habits of the person affected. Families should be encouraged to prepare locally-available foods such as local nuts and grains, eggs, fish, and meat.

## Prevention of cross-infection

Measures should be taken to prevent cross-infection, especially by HIV and hepatitis B viruses. Gloves should be worn while dressing wounds, and must be replaced with a clean set between persons treated. Clean, single-use disposable gloves are preferred. A new set of sterile instruments should be used for each individual treated. Where dressings are not readily available, re-use of bandages and even some dressing materials may be unavoidable. Those responsible for washing bandages and dressings should be educated about how to handle the infected materials safely.

## Signs of infection

Infection is suspected if the person complains of pain in the lymph glands of the axilla or groin. Redness, warmth, swelling, and yellowish exudates with an unpleasant odour are also signs of infection. These persons should be referred immediately for clinical assessment and systemic antibiotic treatment.

| Intrinsic factors | Extrinsic factors | Health worker iatrogenic factors |
|---|---|---|
| Malnutrition | Infection | Ischaemia |
| Ageing | Medication | Trauma |
| Chronic disease | Necrotic tissue | Inappropriate wound-care management |
| Circulatory disease | Psychological stress | |
| Neuropathy | Immune suppression | |
| | Irradiation | |

**Table 5.2.1**
Factors that delay or impede wound healing

**Table 5.2.2**
Phases of the healing process

| PHASE | WHAT HAPPENS | DURATION |
|---|---|---|
| **PHASE I**<br>**Active/ inflammatory**<br>■ Skin grafting best at this stage | **Response**<br>Inflammatory response;<br>local vasodilatation, fluid leakage into the extravascular space and blocking of lymphatic drainage<br><br>**Signs**<br>Redness, swelling, heat, and pain | 24–48 hours |
| ■ Injury happens<br>■ Blood clot:<br>– epidermis<br>– dermis<br>– subcutaneous fat | Injury cuts through epidermis and dermis (epithelium and connective tissue of the skin) and a blood clot forms. Chemical messengers are released immediately. | |
| **PHASE II**<br>**Repair or proliferation** | **Response**<br>Two overlapping processes occur:<br>• granulation tissue is formed (fibroplasia)<br>• wound contraction (scar formation)<br><br>**Signs**<br>• the pale pink tissues become bright red<br>• the open area of the wound is reduced and the shape changes | 2 days – 1 month |
| AFTER 1 WEEK:<br>FIBROBLASTS | AFTER 2 WEEKS:<br>SCAB<br>FIBROBLASTS | |
| After about 1 week epithelium is growing around the wound. Fibroblasts are very active. | After about 2 weeks, the epithelium has grown around the wound completely. | |

| PHASE | WHAT HAPPENS | DURATION |
|---|---|---|
| **PHASE III**<br>**Maturation or remodelling**<br>■ Tension and movement are important to increasing tensile strength<br>■ Light constant compression helps smooth scar tissue | **Response**<br>• Collagenase is a regulator of the balance between collagen synthesis and collagen lysis (natural debrider). It organizes the collagen fibres laid down by the fibroblasts.<br>• Myofibroblasts are responsible for wound contraction during normal wound healing.<br>• During hypertrophic scarring, skin deformations depend on the inappropriate action of stress fibres that – for unknown reasons – persist even after the epithelialization of the wound.<br>**Signs**<br>• **Balanced:** elastic, smooth, strong fibres for the repaired scar tissue.<br>• **Unbalanced:**<br>– hypergranulation – more synthesis from too much oxygen;<br>– hypertrophic scars and keloids – inhibition of lysis. | 3 weeks – 2 years |

AFTER 1 MONTH:
FRESHLY HEALED NEW CONNECTIVE TISSUE

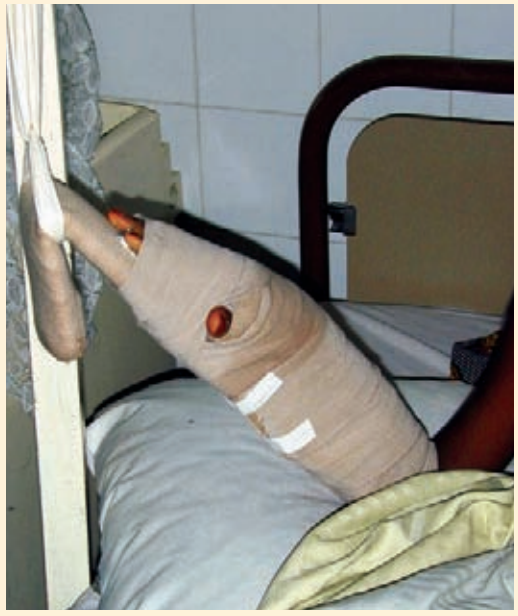
AFTER ABOUT 1 MONTH:
THE WOUND HAS CLOSED, THE SCAB HAS FALLEN OFF AND THE GRANULATION TISSUE IS BEING CHANGED INTO CONNECTIVE TISSUE.

## Wound care procedures

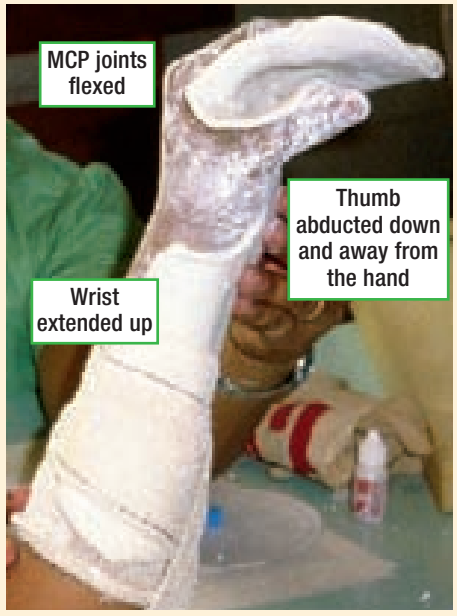
Wound-dressers (including surgeons, doctors, nurses, therapists, and family members) are a very important part of the POD team. Their skill can help the affected person use each joint in activities of daily living (ADL) during the healing process, to maintain mobility. Their understanding of correct antideformity positions is essential for preventing disability.

Many of the disabilities found in BU are related to inadequate wound-dressing procedures. This is particularly noted when the hand is immobilized in an extended flat position instead of an antideformity position (wrist extended, with metacarpo-phalangeal joints (MCP) flexed, interphalangeal (PIP and DIP) joints extended and the thumb abducted with minimal extension).

Poor positioning can lead to loss of function that is very difficult to correct. Therefore, special care is essential when positioning the hand.



▲ The hand is elevated but the **flat position** will make the hand non-functional, limiting grasp.




▲ The hand is elevated but positioned to permit the hand to **grasp.**

**Figure 5.2.1** Contrast of flat, non-functional hand positioning with an antideformity functional hand position

| | |
|---|---|
| **RED GRANULATION** | **Surface appearance**<br>■ Pale pink to deep dark 'beefy' red<br>**Phase of healing**<br>■ Inflammatory or proliferation phase<br>**Care**<br>■ Clean with saline solution<br>■ Cover to protect and keep wound bed moist |
| **YELLOW SLOUGH** | **Surface appearance**<br>■ Pale ivory, various shades of yellow, green, brown<br>■ Presence of 'slough' (dead but moist tissue)<br>■ Generates much wound fluid (exudate)<br>**Phase of healing**<br>■ Proliferation phase<br>**Care**<br>■ Clean with saline solution<br>■ Debride to reduce slough<br>■ Use absorbent wound covering with much exudate, change before there is "strike-through", and keep wound bed moist |
| **BLACK NECROTIC TISSUE (eschar)** | **Surface appearance**<br>■ Black/brown or tan (thick, hard, and leathery)<br>■ Dead tissue that is dehydrated<br>**Phase of healing**<br>■ Proliferation phase<br>**Care**<br>■ Clean with saline solution<br>■ Debride eschar if blood supply is adequate and keep wound bed moist<br>■ Use absorbent wound covering with exudate and keep wound bed moist |

**Table 5.2.3**
Classification of wound by colour and treatment considerations

***Source:*** Adapted from works of Cuzzell, 1988 & Krasner, 1995.

Best practice in wound care involves the following.

- The wound should be evaluated (*Figure 4.4*) and classified (*Table 5.2.3*) periodically to monitor change and adapt treatment accordingly.
- The wound should be thoroughly cleansed with saline solution (0.9%) without causing damage to the newly formed tissues. The saline should be warm – at about body temperature or 40 °C. If saline solution is not available, it can easily be made by using clean – preferably boiled – water and salt. Three tablespoons of salt should be combined with a litre of water. All the saline solution should be immediately used and not stored.

  **Cleansing the wound** is done by gently spraying (with a pressure of 4–15 psi) the saline solution on the wound until most or all dead tissues are removed. The correct pressure can be achieved with a 35-ml syringe and 19-g angiocatheter or by squeezing a plastic bottle with a needle hole in it. Care should be taken not to cause tissue damage by using high-pressure irrigation, hard mechanical debridement, or harsh antiseptics (*Tables 5.2.4* and *5.2.5*). These will only destroy delicate new cells and delay wound healing. Additional mechanical or chemical debridement may be necessary to remove necrotic tissues but much care is needed. Wounds should be exposed for the shortest time possible as the exposure causes a drop in surface temperature and drying out of the wound bed, delaying new cell production.
- **The type of covering or dressing for the wound depends on the amount of wound exudates (drainage).** If there is much exudate, an absorbent dressing should be used and changed before there is "strike-through" (exudate is visible through the last dressing). Strike-through will cause micro-organisms to enter the wound and a loss of heat – delaying new cell production. If the wound bed has little exudate or is dry, the application of sterile vaseline permeated gauze maintains a moist wound surface to facilitate healing.

**Table 5.2.4** The effects of commonly-used topical agents on wound healing

| TOPICAL ANTIMICROBIALS | TOPICAL ANTISEPTIC AGENTS |
|---|---|
| ■ Infections should be treated with systemic antibiotics<br>■ Topical ointments are usually not needed; however, they can be used in special situations (i.e. silver sulfadiazine in burns) | ■ Antiseptics are essential for hand-washing and preparation of the patient's intact skin prior to surgery<br>■ Antiseptics are used to clean things (tanks, drains, etc.) – not open tissues |
| **Problems with topical antimicrobials**<br>■ Can retard or delay healing<br>■ Harmful cytotoxic effects<br>■ Minimal antimicrobial effectiveness<br>■ Sensitivity and local allergic reactions<br>■ Causes emergence of antibiotic resistant strains of pathogens | **Problems with antiseptics**<br>■ Can retard or delay healing<br>■ Destroy bacteria and normal body flora<br>■ Are irritating to the skin<br>■ Have limited cleansing effectiveness |

The vaseline also reduces the chance that the gauze will stick to the wound bed causing damage when the dressing is removed. If the gauze does stick to the wound bed, saline solution can be applied until the gauze is freed easily from the wound. If the wound is infected, systemic antibiotics should be given, as antibiotic ointments have limited effectiveness. Covering the wound **protects it** from infection, injury, and drying out. There are many different products that can be used to improve wound healing (*Table 5.2.6*). The product used will depend on availability of the material and the accessibility of the health service to the affected person. The cost-benefits ratio should be calculated considering the time of both the patient and health worker, the number of hospital days, expenses involved in outpatient treatment, and materials.

- The affected part should be **bandaged and splinted in the best antideformity position, avoiding the immobilization of adjacent body parts which are not involved.** A carefully-applied light elastic bandage provides light compression to decrease oedema and hypertrophic scar formation. The bandage should not restrict movements or be too tight.
- The frequency of **dressing change** is dependent on the amount of exudate produced by the wound.

## REMEMBER

### About wound dressing

- Maintain a stable wound temperature by limiting the time the wound is exposed.
- Cleanse the wound well with saline solution (at body temperature) and remove necrotic tissue without damaging the new skin.
- Use the correct pressure to cleanse the wound with saline.
- Limit use of topical antiseptics and antibiotic ointments.
- Use a dressing which removes exudates.
- Avoid strike-through with wounds with excessive exudate by using good absorbent materials and changing the dressing frequently.
- Prevent the wound from becoming dry by using vaseline dressings.
- Moisten dry dressings before removing them.
- Keep the wound edges well-lubricated with vaseline.
- Place the body part in an antideformity position.
- Special care needs to be given to skin grafts with dressing changes restricted and antideformity positions maintained for 5–10 days.

**Table 5.2.5** Common types of topical agents, their effects and problems

| COMMON TYPES OF TOPICAL AGENTS | PROBLEM |
|---|---|
| **Povidone-iodine solution**<br>■ Useful antimicrobial agent to be used only on intact skin<br>■ Useful antiseptic action to clean tanks and drains to prevent cross-contamination<br>■ Destroys *Pseudomonas aeruginosa, Staphylococcus*<br>**Cadexomer iodine**, a newer iodine compound, has less negative effects on wound-healing rates. | The literature regarding the effects of povidone-iodine is conflicting. Reasons for the discrepancies are related to the use of animal versus human models and differences in parameters of wound healing evaluated.<br>■ Toxic to skin and mucous membranes<br>■ Cytotoxic for fibroblasts responsible for healing<br>■ Reduced wound epithelialization and tensile strength<br>■ Questionable effectiveness in infected wounds<br>■ The active antiseptic agent released from the solution is inactivated by binding to serum protein, so any exudate weakens antiseptic effect<br>■ May cause iodine toxicity when used in large wounds over prolonged period of time |
| **Sodium hypoclorite solution** (household bleach, Chlorpactin Dakin solution 0.45–0.5%)<br>■ Useful bactericide<br>■ 0.25–0.5% is a useful antimicrobial agent in controlling sepsis when cleaning tanks and drains | ■ Cytotoxic to fibroblasts at 0.5 % and delays epithelialization<br>■ Must protect intact skin around wound to prevent breakdown. With repeated exposure, the skin around the wound becomes irritated |
| **Acetic acid solution**<br>■ Effective against both gram-positive and gram-negative microorganisms<br>■ 0.5% removes certain pathogens such as *Pseudomonas aeruginosa* | ■ Does not significantly enhance the healing process<br>■ Changes the colour of the exudates, which can give a false assurance that the infection has been eliminated<br>■ Local irritation to skin surrounding the wound border and in wounds with repeated exposure |
| **Hydrogen peroxide**<br>■ Effective mechanical cleansing agent to loosen dried exudate or debris, but other techniques can be used | ■ Non-selective debriding agent with little bactericidal action in wounds<br>■ Harmful to newly forming granulation tissue<br>■ Toxic to fibroblasts<br>■ Deactivated when mixed with blood<br>■ **Should never be applied** to closed wounds or to pack sinus tracks, as the gas build-up can cause air embolism<br>■ **Should not be used for forceful irrigation**, as it can cause subcutaneous emphysema mimicking gas gangrene |

| COMMON TYPES OF TOPICAL AGENTS | PROBLEM |
|---|---|
| **Potassium permanganate**<br>■ Antiseptic agent | ■ Few know how to prescribe and teach others to use correctly.<br>■ If crystals are not dissolved completely, they will cause chemical burns to tissues<br>■ Dries skin<br>■ Cytotoxic |
| **Methylrosanilinium chloride (gentian violet)**<br>■ Astringent<br>■ Antifungal and antibacterial agent<br>■ Use on closed, intact skin | ■ Dries skin<br>■ Irritation to skin<br>■ May permanently stain (tattoo) skin area<br>■ Possible cancerous effects if ingested, or used on mucous membranes or open wounds |
| **Neosporin ointment, Silvadene (silver sulfadiazine) and Furacin**<br>■ Topical bactericidal agents used to prevent excessive bacterial contamination and infection of wounds<br>■ Neosporin and Silvadene promote re-epithelialization | ■ Patients frequently become sensitive to Neosporin and Furacin, causing skin allergies<br>■ Furacin retards the rate of epithelialization, suggesting it may be cytotoxic to epidermal cells |
| **Mercurochrome and Methiolate**<br>■ Mercury compounds are commonly used for their bacteriostatic and fungistatic properties<br>■ Antiseptic | ■ Mercury toxicity with possible anaphylaxis (shock from allergic reaction) and aplastic anaemia.<br>■ Toxic to epidermal cells<br>■ **Not recommended** |
| **Soap**<br>■ Cleansing effect and mild antibacterial action | ■ Dries out the wound |

**Table 5.2.6** Common types of wound dressings

| TYPES | OBSERVATIONS |
|---|---|
| **Saline-soaked gauze** | ■ Inexpensive – but labour-intensive to keep moist all the time; best for deeper wounds |
| **Vaseline soaked gauze** | ■ Inexpensive – keeps the wound bed moist and prevents gauze from sticking to the wound bed; best for wounds with little exudate |
| **Polyurethane films** | ■ Semipermeable – can stay on wound several days; best for keeping wound moist when there is little drainage; promotes granulation and epithelialization; protects skin breakdown |
| **Hydrocolloids** | ■ Promotes autolysis – rehydrates and loosens eschar; can stay on wound several days; keeps wound moist when there is light drainage |
| **Hydrogels** | ■ Fills deeper ulcers – removes slough and absorbs moderate drainage; must be changed daily |
| **Alginates** | ■ Highly absorbent for heavy drainage – maintains moist environment and promotes granulation and epithelialization; requires a cover; usually changed daily; can be too drying |
| **Dispension dressings (bandages working on capillary action)** | ■ Highly absorbent for heavy drainage – but maintains moist environment; requires a cover; initially changed daily, then every 2–3 days |