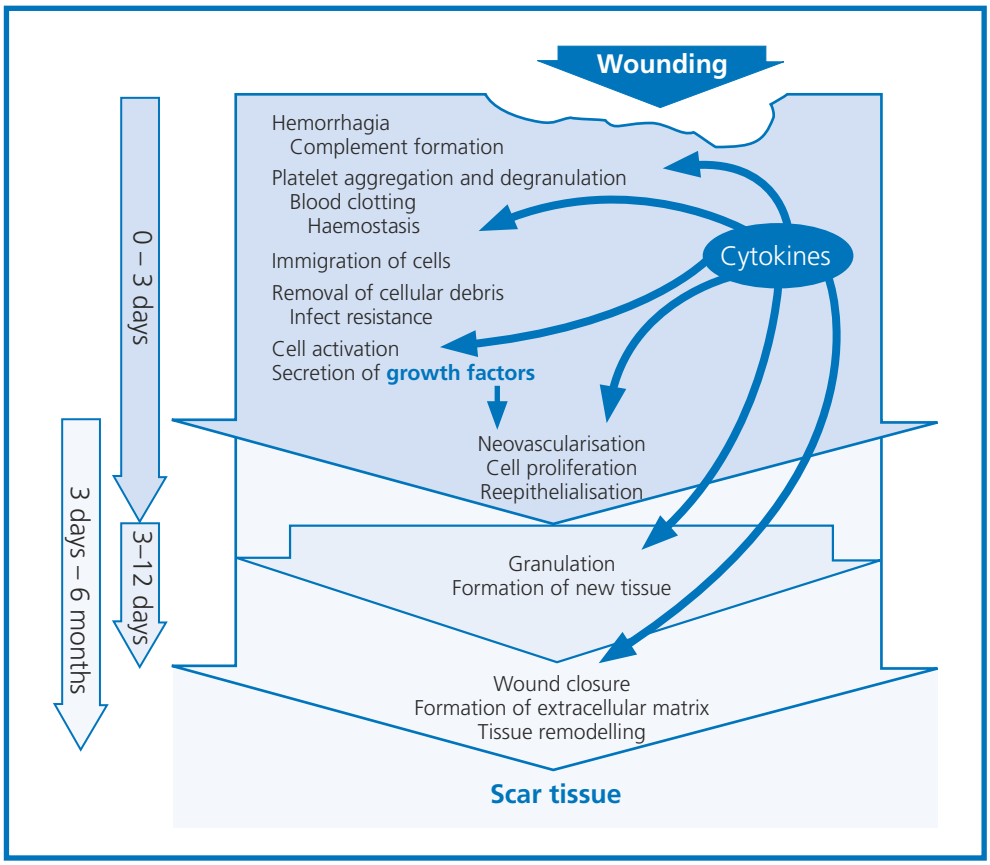
2. The Wound Healing Process

The healing of wounds progresses through several stages, the process is a continuous one although the stages are explained individually. Deep wounds heal firstly through the formation of granulation tissue and then through epithelialisation. Shallow wounds where only the epidermis has been damaged, heal through epithelialisation only. The basic stages involved in the healing process are;



Bennett NT and Schultz GS (1993)

2:1 Haemostatic, Inflammatory Stage (0 - 3 days)

The body responds quickly to any disruption of the skin's surface. Within seconds of the injury, blood vessels constrict to control bleeding at the site. Platelets coalesce within minutes to stop the bleeding and begin clot formation.

Damaged tissue and mast cells secrete histamine and other local hormones and enzymes causing vasodilatation of the surrounding capillaries. These capillaries become more permeable and white blood cells and serum are able to pass into the damaged area. The vasodilation and increased capillary permeability cause the signs of inflammation; ***redness, heat, swelling*** and ***pain.***

An influx of polymorphs and macrophages defend against bacteria, ingest debris and begin the process of repair. A number of local and systemic factors can slow or halt this influx of

white blood cells. For example, high doses of corticosteroids such as prednisolone can stop or slow this inflammatory response and subsequent wound healing.

Dead tissue and bacteria are removed in this stage to make way for new growth. Cells in healthy tissues are held together by proteoglycan – fibronectin cement. Where cells die due to injury, the body acts to dissolve this intercellular cement. Liquefaction of connective tissues in order to eliminate necrotic matter is called auto-debridement. Macrophages migrate into the wound and play a vital role in this stage by engulfing bacteria, any foreign bodies and necrotic tissue. With neutrophils, the macrophages attract fibroblasts and influence the growth of new blood vessels into the wound by chemotactic activity and the release of growth factors

2.2 Proliferation Stage 3-24 days

There is extensive growth of epithelial cells under the scab that bridges the wound. With the developing new blood vessels multiplication of the fibroblasts occurs. Fibroblasts begin to produce collagen, a process that depends on zinc, oxygen and ascorbic acid. This may be deficient in some disease states such as diabetes. Collagen strands are deposited in a haphazard way and form a fibrous network that supports the new capillary loops. The tissue formed is called granulation tissue. It has a moist translucent red appearance. Signs of inflammation disappear now and the fibroblasts contract pulling the wound edges together.

Wound contraction is an important part of wound healing as it means that the body does not have to make as much granulation tissue to fill in the wound cavity. The tensile strength of the wound is increased during this stage of the healing process and this process continues into the next phase, the maturation stage.

2.3 Maturation Stage 24 days – 1 year

During the maturation phase, fibroblasts leave the wound and collagen is remodelled into a more organized matrix. This changes the appearance from red granulation tissue to a pink early epithelialisation. Finally a white relatively avascular tissue develops, and the epidermis is restored to normal thickness. Tensile strength increases for up to one year following the injury. While healed wounds never regain the full strength of uninjured skin, they can regain up to 70% - 80% of its original strength.

2.4 Growth factors and their Influence on wound healing

It is thought that growth factors produced by various cells involved in wound healing act to communicate with each other as to 'what to do next'. Examples of growth factors include:

- Platelet derived growth factor
- Fibroblast growth factor
- Angiogenesis promoting growth factor
- Epidermal growth factor

- Transforming growth factor Alpha and Beta
- Vascular endothelial growth factor

Each of these has different roles and for instance epidermal growth factor promotes epithelial growth.