Wound healing

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INTRODUCTION

Wound healing is a mechanism whereby the body attempts to restore the integrity of the injured part.

Factors influencing healing of a wound

- Site of the wound
- Structures involved
- Mechanism of wounding
- Incision
- Crush
- Contamination (foreign bodies/bacteria)
- Loss of tissue

Other local factors

Vascular insufficiency (arterial or venous)

Previous radiation

Pressure

Systemic factors

Malnutrition or vitamin and mineral deficiencies

Disease (e.g. diabetes mellitus)

Medications (e.g. steroids)

Immune deficiencies (e.g. chemotherapy, acquired immunodeficiency syndrome (AIDS))

Smoking

Summary box 3.1

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  - Crush avulsion
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  - Smoking

NORMAL WOUND HEALING

This is variously described as taking place in three or four phases,
the most commonly agreed being:

1 the inflammatory phase;
2 the proliferative phase;
3 the remodelling phase (maturing phase).

Occasionally, a haemostatic phase is referred to as occurring before the inflammatory phase, or a destructive phase following inflammation consisting of the cellular cleansing of the wound by macrophages.

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•The inflammatory phase begins immediately after wounding and lasts 2–3 days. Bleeding is followed by vasoconstriction and thrombus formation to limit blood loss. Platelets stick to the damaged endothelial lining of vessels, releasing adenosine diphosphate (ADP), which causes thrombocytic aggregates to fill the wound.

•Bleeding is followed by vasoconstriction and thrombus formation to limit blood loss.

• Platelets stick to the damaged endothelial lining of vessels.

•When bleeding stops, the platelets then release several cytokines from their alpha granules.

• These are platelet derived growth factor (PDGF), platelet factor IV and transforming growth factor beta TGF*B*

•Macrophages remove devitalized tissue and microorganisms while regulating fibroblast activity in the proliferative phase of healing.

The proliferative phase lasts from the third day to the third week, consisting mainly of fibroblast activity with the production of collagen and ground substance (glycosaminoglycans and proteoglycans), the growth of new blood vessels as capillary loops (angioneogenesis) and the re-epithelialisation of thewound surface. *Fibroblasts require vitamin C to produce collagen. The* wound tissue formed in the early part of this phase is called granulation tissue. In the latter part of this phase, there is an increase in the tensile strength of the wound due to increased collagen, which is at first deposited in a random fashion an consists of type III collagen.

The remodelling phase is characterised by maturation of collagen (type I replacing type III until a ratio of 4:1 is achieved).
There is a realignment of collagen fibers along the lines of tension, decreased wound vascularity and wound contraction due to fibroblast and myofibroblast activity.

A more historical (Latin) description of this phase is described
in four words:
rubor (redness),
tumour (swelling),
calor (heat)
and dolour (pain)

ABNORMAL HEALING

•Delayed healing may result in loss of function or poor cosmetic outcome.

• The aim of treatment is to achieve healing by primary intention and so reduce the inflammatory and proliferative responses..

• Delayed primary intention healing occurs when the wound edges are not opposed immediately, which may be necessary in contaminated or untidy wounds.

•The inflammatory and proliferative phases of healing are well established when delayed closure of the wound is carried out.

•Secondary healing or healing by secondary intention occurs in wounds that are left open and allowed to heal by granulation, contraction and epithelialisation.

Classification of wound closure and healing

_ Primary intention

Wound edges opposed

Normal healing

Minimal scar

_ Secondary intention

Wound left open

Heals by granulation, contraction and epithelialisation

Increased inflammation and proliferation

Poor scar

_ Tertiary intention (also called delayed primary intention)

Wound initially left open

Edges later opposed when healing conditions favorable.

Wounds

Break in the integrity of an epithelial surface

Classification

A. Tidy wounds:

*Caused by sharp instrument

*Contain no devitalized tissue

*Can be closed (primarily). Primary healing

Examples: surgical incisions

Cut by glass or knife

B. Untidy wounds:

* Results from crushing, tearing, avulsion, vascular injury or burn. Contain plenty of devitalized tissue

Skin wounds are multiple and irregular

Tendons, arteries and nerves may be exposed

Fractures are common

Must not be closed primarily

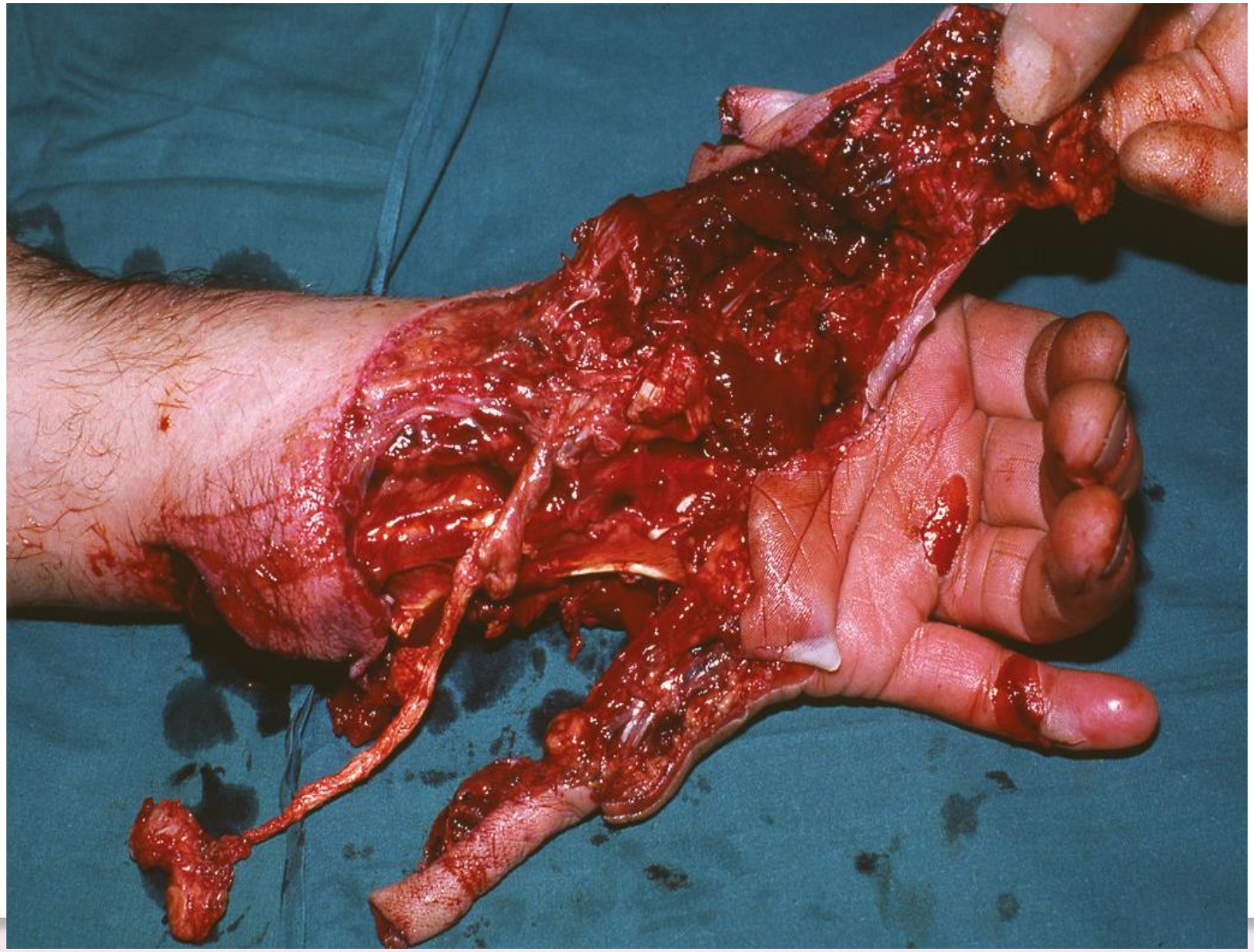
Management by wound excision of all devitalized tissues, then either closed (primarily) or left to heal by (second intention)

TYPES OF WOUNDS – TIDY VERSUS UNTIDY

TIDY WOUNDS	UNTIDY WOUNDS
Incised	Crushed or avulsed
Clean	Contaminated
Healthy tissues	Devitalized tissues
Seldom tissue loss	Often tissue loss

• Primary repair of all structures (e.g. bone, tendon, vessel and nerve) may be possible in a tidy wound, but a contaminated wound with dead tissue requires debridement on one or several occasions before definitive repair can be carried out (the concept of ‘second look’ surgery).

•Multiple debridement are often required after crushing injuries in road traffic accidents or in natural disasters such as earthquakes, where fallen masonry causes widespread muscle damage and compartment syndromes.



MANAGING THE ACUTE WOUND

The surgeon must remember to examine the whole patient according to acute trauma life support (ATLS) principles

- Ç leansing
- Exploration and diagnosis
- Debridement
- Repair of structures
- Replacement of lost tissues where indicated
- Skin cover if required
- Skin closure without tension
- Tetanus cover should be noted and appropriate treatment with antibiotics carried out.

Wound management

A. Tidy wounds : primary closure

B. Untidy wounds:

Wound excision (debridement) with excision of all devitalized tissues followed by closure of the wound with any of the following:

- Direct closure
- Partial thickness skin graft
- Full thickness skin graft
- Skin flap
- Fasciocutaneous flap
- Musculocutaneous flap
- Free tissue transfer

SOME SPECIFIC WOUNDS

Bites

Most bites involve either puncture wounds or avulsions. Small animal bites are common in children and require cleansing and treatment usually under general anaesthea

Puncture wounds

. Needle-stick injuries should be treated according to the well-published protocols because of hepatitis and human immunodeficiency virus (HIV) risks. X-ray examination should be carried out in order to rule out retained foreign bodies in the depth of the wound.

Haematoma

If large, painful or causing neural deficit, a hematoma may require release by incision or aspiration.

Degloving

Degloving occurs when the skin and subcutaneous fat are avulsed from its underlying fascia,. Examination under anaesthea is required with a radical excision of all non-bleeding skin

Scar

it is the inevitable consequence of wound healing
the final step of wound repair is the process of remodeling and scar maturation

the early scar is red , raised, firm , itchy contracting nodule.
Maturation lead to the formation of a pale, flat, soft, and static symptomless area

How do we get ideal scar

- achieve quiet primary healing
- clean , incised edges with no tissue loss
- avoid dehiscence or infection
- minimize tension
- align scar with wrinkles , junction or relaxed skin tension lines

SCARS

• An atrophic scar is pale, flat and stretched in appearance,often appearing on the back and areas of tension.

•A hypertrophic scar is defined as excessive scar tissue that does not extend beyond the boundary of the original incision or wound.

•. A keloid scar is defined as excessive scar tissue that extends beyond the boundaries of the original incision or wound

Treatment of hypertrophic and keloid scars

- Pressure – local moulds or elasticated garments
- Silicone gel sheeting (mechanism unknown)
- Intralesional steroid injection (triamcinolone)
- Excision and steroid injections
- Excision and postoperative radiation

Intralesional excision (keloids only)

- Laser – to reduce redness
- Vitamin E or palm oil massage (unproven)

Types of adverse scars

- Wrong direction
- Poor alignment of features
- Stretched scar
- Contracted scar
- Contour deformity
- Pigment alteration
- Tattooing
- Stitch marks