

Types of wounds

Tidy wounds

Tidy wounds are inflicted by sharp instruments and contain no devitalised tissue such wounds can be closed primarily with the expectation of quiet primary healing. Examples are surgical incisions, cuts from glass and knife wounds. Skin wounds will usually be single and clean cut. Tendons, arteries and nerves will commonly be injured in tidy wounds, but repair of these structures is usually possible. Fractures are uncommon in tidy wounds.

Untidy wounds

Untidy wounds result from crushing, tearing, avulsion, vascular injury or burns, and contain devitalised tissue. Skin wounds will often be multiple and irregular. Tendons, arteries and nerves may be exposed, and might be injured in continuity, but will usually not be divided. Fractures are common and may be multifragmentary. Such wounds must not be closed primarily; if they are closed wound healing is unlikely to occur without complications. At best there may be wound dehiscence, infection and delayed healing, at worst gas gangrene and death may result. The correct management of untidy wounds is wound excision, by this is meant excision of all devitalised tissue to create a tidy wound. Once the untidy wound has been converted to a tidy wound by the process of wound excision it can be safely closed (or allowed to heal by second intention).

Wound excision

The most important step in the management of any untidy wound is wound excision. In order to excise a wound adequate anaesthesia — local, regional or general must be provided. Where possible a bloodless field also aids identification of structures. Excision should proceed in a systematic fashion dealing with each tissue layer in turn, usually starting superficial and moving deep. Longitudinal structures such as blood vessels, nerves and tendons are identified and exposed, but left in continuity. With experience the surgeon learns to recognise dead tissues. Devitalised dermis is pink rather than white; devitalised fat is pink rather than yellow; devitalised muscle is a dark colour, has lost its usual sheen and turgor, and does not twitch when picked up with forceps. Bone fragments with no soft-tissue attachment or nonvital soft tissue attachments are also discarded. Normal bleeding should be observed from each layer. Occasionally in very extensive wounds this radical approach must be modified. Where radical wound excision would threaten the viability or function of the limb it is reasonable to excise what is definitely nonviable, carry out fasciotomy as appropriate and dress the wound, with a view to returning 48 hours later for a second look, and thereafter further serial wound excisions until a tidy wound is achieved.

Wound closure

Wound closure can be achieved by number of differing techniques. Most tidy wounds that do not involve loss of tissue can be closed directly. Some untidy wounds are healed by secondary intention (granulation tissue).

Where there is tissue loss a technique to import appropriate tissue is needed. Reconstructive plastic surgical techniques can range from simple skin grafts to complex composite free tissue transfers.

Types of wound**Bruises, contusions and haematomas**

A closed blunt injury may result in a bruise or contusion. There is bleeding into the tissues and visible discoloration. Where the amount of bleeding is sufficient to create a localised collection in the tissues, this is described as a haematoma. Initially this will be fluid, but it will clot within minutes or hours. Later, after a few days, the haematoma will again liquefy. There is a danger of secondary infection.

Bruises require no specific management, and no treatment is of proven value. The patient should be advised that the time required for bruising to clear is extremely variable and in some individuals, in some sites, discoloration may persist for months. A haematoma should be evacuated by open surgery if large or causing pressure effects (such as intracranially), or aspirated by a large-bore needle if smaller or in a cosmetically sensitive site. It may be necessary to await liquefaction (which may take several days) and to perform repeat aspirations, with appropriate antiseptic precautions. A haematoma will generally reabsorb without scarring, but on occasions there may be persistent tethering of the skin. Blunt injuries may cause a variety of fat injuries. A blunt injury to the breast may result in an area of fat necrosis that can masquerade as a breast lump. Blunt injuries to the face may result in lumpy subcutaneous collections due to haematoma in subcutaneous fat that may persist for several months.

Puncture wounds and bites

A puncture wound is an open injury in which foreign material and organisms are likely to be carried deeply into the underlying tissues. Common causes are standing on a nail or other sharp object. There may be little to see on the surface. Radiological examination may detect metal fragments or glass.

Treatment is essentially by wound irrigation, antibiotic treatment and tetanus prophylaxis. Large foreign bodies should be removed, but small particles may be surprisingly difficult to find without a destructive dissection and are better left undisturbed. The danger of puncture injuries is that they may give rise to an abscess deep within the tissues and on such occasions drainage may be required. It is likely that it will take 24—48 hours for an abscess to declare itself and arrangement should be made for review.

Bites are a particular type of puncture wound associated with a high incidence of infection, presumably from mouth organisms. Animal bites may result in small, sharp, incised wounds or in severe tissue crushing as in horse bites. Dog bites may also be associated with a degree of tissue avulsion, and often there are puncture wounds from upper and lower teeth and contusion of the intervening tissue. Human bites may be associated with avulsion of pieces of the nose or ear. Such wounds are best treated by surgical excision of skin margins, irrigation and antibiotic therapy.

Abrasions and friction burns

An **abrasion** is a shearing injury of skin in which the surface is rubbed off. Most are superficial and will heal by epithelialisation, but some may result in full-thickness skin loss. Abrasions may be dirt ingrained and if this dirt is not removed at the time of primary treatment permanent tattooing of the skin will

result. Treatment is by cleaning with a scrubbing brush, gently brushing along the grain of the scratch lines. A **friction burn** is similar, but there will be an element of thermal damage as well as abrasion. Treatment is as for other types of burn.

Laceration

A laceration or cut is the result of contact with a sharp object (the surgical equivalent is an incised wound). It is important to ascertain from the history the amount of force involved. The clinical examination must therefore assess the integrity of all structures in the area: arteries, nerves, muscles, tendons and ligaments. The ideal form of management of an incised wound is surgical inspection, cleaning and closure. The wound must be thoroughly inspected to ensure that there is no damage to deep structures or, where encountered, these must be repaired. Once all of the damaged layers have been identified, each structure must be repaired individually by the appropriate technique. Haemostasis must be ensured throughout the exploration. All patients sustaining open wounds should have prophylaxis against tetanus, and antibiotics should be administered where there is significant contamination, commencing generally with a broad-spectrum antibiotic active against Gram positive organisms.

Traction and avulsion

Such injuries occur when hands or limbs are trapped in moving machinery, such as in rollers, producing a degloving injury. Degloving is caused by shearing forces that separate tissue planes, rupturing their vascular interconnections and causing tissue ischaemia. This most frequently occurs between the subcutaneous fat and deep fascia. The danger of degloving or avulsion injuries is that there is devascularisation of tissue and skin necrosis may become slowly apparent in the following few days. Even tissue that initially demonstrates venous bleeding may subsequently undergo necrosis if the circulation is insufficient. Treatment of such injuries is to identify the area of devitalised skin and to remove the skin, and reapply it as a full-thickness skin graft. Avulsion injuries of hands or feet may require immediate flap cover using a one-stage microvascular tissue transfer of skin and/or muscle.

Crush

Crush injuries are a further variant of blunt injury and are often accompanied by degloving and compartment syndrome. Injury to tissues within a closed fascial compartment leads to bleeding, exudate and swelling of these tissues, and increased interstitial pressure. As the interstitial pressure rises above capillary perfusion pressure the blood supply to the viable tissues is reduced, resulting in further ischaemic tissue injury and swelling. This cycle causes a worsening **compartment syndrome** with muscle ischaemia and nerve ischaemia progressing to muscle necrosis, skin necrosis and limb loss. Muscle necrosis may result in renal failure. This process can be arrested by early recognition and decompression of the affected compartment(s) by fasciotomy.

The most reliable clinical sign of compartment syndrome is pain worsened by passive stretching of affected muscles. Where any doubt exists compartment pressure measurements can be carried out. Loss of peripheral

pulses is not a sign of compartment syndrome, but indicates major vessel damage. Where compartment syndrome is suspected or confirmed fasciotomy is advised. Longitudinal incisions are made in the deep fascia and it may also be necessary to make extensive longitudinal releases in the skin. It is important to release the fascia over each individual compartment in a limb.

Chronic wounds

✚ Ulcers

An ulcer is any breach in an epithelial surface. Chronic ulcers are wounds that fail to heal. Generally, they have a fibrotic margin and a bed of granulation tissue which may include areas of slough (necrotic tissue). Ulcers are particularly common in the lower third of the lower limb and foot. They have a number of different aetiologies, often being associated with arterial or venous insufficiency or a lack of normal skin innervation. The wound healing process is delayed by a variety of mechanisms including infection, mechanical irritation, ischaemia or other metabolic factors. Ulcers are common in diabetes and rheumatoid arthritis. Treatment consists of specific management of the underlying cause. The ulcer is managed either by dressings to allow healing by second intention or by surgical excision of granulation tissue and split-skin grafting. Recurrence is inevitable if the underlying cause is not corrected.

✚ Pressure sores

These are chronic wounds following tissue necrosis from pressure. They occur over bony prominences. Their pathogenesis is identical to compartment syndrome in that they arise where there is unrelieved pressure in the soft tissues overlying bone such that the external pressure exceeds capillary perfusion pressure and ischaemic necrosis occurs. They occur in paraplegic individuals who lack the usual sensory input that tissue ischaemia is beginning and may lack the ability to move themselves and relieve this pressure. They also occur in situations where perfusion pressure is low, such as hypotension and peripheral vascular disease. Sacral and trochanteric sores occur in bed-bound patients, both paraplegic and nonparaplegic. Ischial pressure sores occur in chair-bound paraplegics. Patients with peripheral vascular disease are prone to heel pressure sores. On occasions almost any bony prominence may be involved. Prevention is better than cure. This depends on an awareness of pressure sore risk in all patients and the implementation of appropriate measures that may include turning or lifting the patient, pressure-relieving mattresses and beds, special seating and cushions, and educating the patient and their carers in taking responsibility for pressure relief. Most sores will heal by second intention. Incontinence should be managed appropriately and nutritional support provided if needed. Surgical treatment can accelerate healing. The sore is excised and closed using a flap.

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