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# Wound repair in children

**BACKGROUND**

Minor injuries in children are extremely common in the general practice setting.

**OBJECTIVE**

This article describes a systematic approach to the assessment and treatment of wounds in children.

**DISCUSSION**

Wound management goals are to avoid infection, minimise discomfort, facilitate healing and minimise scar formation. The care of the patient as a whole should be the first management priority. Successful examination requires gaining the child's trust, relieving pain early, and using a flexible and creative examination technique. Superficial abrasions and lacerations can be safely cleaned with good quality water, and all foreign material removed. Deeper wounds with suspected damage to nerves, tendons or circulation need formal exploration under general anaesthetic. Good local anaesthesia can be produced by topical preparations, and many wounds can be closed with tissue adhesives with an excellent cosmetic result. All children with injuries should be checked for adequate tetanus cover for prophylaxis.

**Minor injuries in children are extremely common. The combination of a developing physical ability, lack of recognition of dangerous situations and a willingness to robustly explore their environment means that children are more likely than adults to injure themselves.**

The most common types of wounds that children sustain are soft tissue bruising, abrasions, lacerations and puncture wounds (including human and animal bites). Management goals of these wounds are to avoid infection, minimise discomfort, facilitate healing and minimise scar formation. Meticulous attention to wound care and repair should ensure the best possible outcome and functional result. In children this will often require sedation in addition to adequate local anaesthesia and analgesia.

**Wound assessment**

The care of the patient as a whole should be the first management priority. The airway, breathing and circulation should be assessed and treated as appropriate. A thorough secondary survey may then be undertaken; if serious injuries are detected, immediate intervention may be required.

Wounds can be classified into various types including

abrasions, lacerations, avulsions, punctures, and bites. Regardless of the type of wound, there are basic steps in the initial evaluation and management of skin wounds that all clinicians should be familiar with (*Table 1*).

**History**

While haemostasis is being achieved, a thorough history should be taken to include the following:

- time of injury
- mechanism of trauma (cut, crush, fall, bite, burn) including details of inflicting object
- likelihood of foreign body
- motor function and sensation distal to the affected area
- health status of the patient especially with regard to chronic illness that may impact wound healing
- current medications (important for both drug interactions with antibiotics that may be prescribed and for medications that may interfere with wound healing)
- history of allergies, and
- immunisation history.

In wounds that require general anaesthesia or sedation, a history of when the child last ate or drank is important. Nonaccidental injury should be considered, especially when the history and injury are inconsistent.

## Examination

Assessing wounds in children can be challenging. The cooperation achieved and the comprehension level of the child influence wound examination and therefore the information gained. A calm, unhurried, friendly approach with assistance from parents will maximise the chances of cooperation. Useful strategies include:

- bobbing down to the child's eye level
- leaving the child in a parent's arms
- gaining trust by talking to the child, as well as to the parents, and explaining what is happening in a manner appropriate for the child's age
- dealing with pain early by using analgesics, splinting and distraction.

It is important to minimise the amount of additional pain by handling limbs slowly and sensitively, soaking dressings off wounds, and avoiding unnecessary movement.

Observe the wound, looking for the site, shape and size, the presence of a tissue flap, and possible contamination by dirt or other foreign material. Decide what deeper structures may be involved and specifically test for each. In children, testing the integrity of nerves and tendons needs to be done creatively and flexibly, using simple instructions relayed through parents. This may involve the use of mimicry, toys and playing. Assess the circulation locally and distally to the wound. While conducting the examination, make an assessment of the likelihood of the child being cooperative during a procedure and the type of analgesia and sedation that may be necessary.

Unfortunately, even despite good preparation and technique, not all examinations will be successful. If the wound is deep or there is any doubt as to the integrity of nerves, tendons or circulation, the wound must be formally explored, a procedure best done in hospital under sedation or general anaesthesia.

## Investigation

If the presence of a foreign body is expected, radiological investigation is advised. In wounds caused by glass, all but superficial wounds should be investigated with plain, soft tissue X-ray to exclude a glass foreign body. Ultrasound can also be useful to both confirm the presence of a foreign body and to provide a guide to its depth and location in the wound. Plain X-rays may also be indicated for injuries where underlying fracture is possible (eg. crush injury to the finger).

## Wound treatment

After assessment of the wound and the child in general, a treatment strategy can be devised. This should include:

- whether the child needs analgesia and sedation

**Table 1. Overall wound management**

- Haemostasis
- History of wound mechanism and patient health (including tetanus immunisation history)
- Thorough wound cleansing, removal of debris
- Debridement of devitalised tissue
- Closure of wound (if indicated)

- how the wound will be anaesthetised
- how the wound will be closed, and
- whether any other treatment such as splinting, tetanus vaccination or antibiotics is needed.

Clearly, the expertise of the doctor and other treating staff, the availability of drugs and equipment and the wishes of the parents and the child will influence treatment.

## Pain management

### Analgesia and sedation

A number of therapeutic options are possible.<sup>1,2</sup> Select the appropriate agent depending on the wound, the degree of pain, the experience of the staff, and the procedure that is likely to be performed. A summary of options is listed in *Table 2*. Some agents such as morphine provide both analgesia and sedation. Be generous with the provision of analgesia and allow time for it to work, as poor pain control is one of the major causes of procedural failure in children.

### Local anaesthesia

Local anaesthesia options are listed in *Table 2*. Topical anaesthesia is painless, easy to apply and has a similar efficacy to infiltrated lignocaine.<sup>3</sup> EMLA (an eutectic mixture of lignocaine and prilocaine) is a cream usually applied to intact skin, however, it appears to be safe and effective for simple extremity lacerations even though it is not licensed for this use.<sup>4,5</sup>

Regional nerve blocks, such as digital, ulna or femoral nerve blocks, are very effective in children. A number of reference books are available that provide the anatomical knowledge and practical instruction necessary to perform them.<sup>2</sup>

## Cleaning wounds

All dirt and foreign material in the wound must be located and removed before closure. Superficial wounds may be safely cleaned with good quality tap water.<sup>6</sup> Preparations such as aqueous chlorhexidine are painful to apply and of doubtful benefit. Irrigation with saline under pressure (using a 19 gauge needle on a 10–20 mL syringe) is a good way of dislodging and removing foreign material. Abrasions should be covered with a nonstick dressing and secured with tape or a bandage.

## Wound closure

Small superficial wounds with opposed edges do not require closure and can be managed with dressings alone. Other wounds may be closed with tissue adhesives, adhesive strips, sutures or a combination of these.

## Tissue adhesives

Tissue adhesives are most successful on wounds that are less than 3 cm long, have clean straight edges, do not require deep sutures, and are not under tension when the edges are opposed. They do not require local anaesthesia and are quick and easy to apply. The cosmetic result for a wound closed with tissue adhesives is the same as for wound closure achieved with sutures, staples or adhesive strips.<sup>7</sup> There is a small increase in the incidence of wound dehiscence with tissue adhesives compared with sutures, but all other wound complications appear to be the same for both wound closure methods.<sup>7</sup>

Any area of the skin may be glued, however, gluing in the vicinity of the eye requires extreme care to prevent any glue dripping into the eye or onto the eyelashes. If gluing the scalp, remove any hair from the wound but do not shave or cut the surrounding hair. Before gluing, the wound must be dry and not bleeding.

To apply tissue adhesive, position the child so the

wound is uppermost to minimise the glue running. Ensure the operator is wearing gloves; this is not only for hygiene reasons, but to ensure that it is the glove, not the operator, that is stuck to the child if adhesive inadvertently runs on to the operator's fingers. The hand can then be removed from the glove, and the glove fingers cut close to the child's skin and left to spontaneously detach. The edges of the wound are brought together with the edges slightly everted and a thin layer of adhesive applied on each side of the wound; the wound is then bridged by applying a layer from side-to-side. Take care not to get adhesive in the wound. The child and parents should be informed that the adhesive will feel warm as it polymerises.

The wound should be kept clean and dry, but a dressing is usually not required as the wound is covered by the adhesive. The adhesive does not require removal and comes off spontaneously in 1–2 weeks.

## Adhesive strips

Adhesive strips are adequate for closing simple wounds that require opposition of slightly separated skin edges on nonhairy areas of the body. They are particularly useful for aligning small flaps of skin back over a wound. They do not remain in place for long periods and should not be used if there is skin movement or tension across the wound. Make the strips as long as possible and separate them with sufficient space between each to allow drainage of fluid from the wound. Dress the wound and ask the parent to keep it dry for 72 hours.

## Sutures

The techniques of suture placement vary with the size, shape and position of the wound. Detailed description of these techniques can be found in reference books on emergency medicine.<sup>8,9</sup> Adequate analgesia and anaesthesia of the wound is essential before commencing suturing; this is often more difficult and time consuming than the suturing itself.

Scalp wounds can often be closed by the nonsurgical techniques already described. However, deep wounds will often need to be sutured in two layers to prevent a cavity forming in the tissues.

Forehead wounds should have minimal debridement and the eyebrow should not be shaved. Modern absorbable sutures should be used in small children.

Wounds on the chin are often much deeper than they first appear and are prone to scarring. Deep sutures are often necessary to prevent tension on the skin sutures.

Eyelid lacerations involving the lid margin or tarsal plate require accurate opposition and repair, and children with

**Table 2. Pain management in children with minor injuries**

### Analgesia and sedation

Options include:

- paracetamol 20 mg/kg orally as an initial dose (ongoing doses should be 15 mg/kg)
- codeine 0.5 mg/kg orally
- paracetamol/codeine mixtures (at doses given for paracetamol above) orally
- morphine 0.05–0.1 mg/kg intravenously
- midazolam 0.5 mg/kg orally
- nitrous oxide/oxygen mixture inhaled, concentration of nitrous oxide up to 70%<sup>12</sup>
- supplement pharmacological agents with distraction and guided imagery

### Local anaesthesia

Topical anaesthetics

- lignocaine gel
- EMLA (eutectic mixture of 2.5% lignocaine and 2.5% prilocaine)

Infiltrated local anaesthetics

- 1% lignocaine; maximum dose 5 mg/kg (0.5 mL/kg)
- 1% lignocaine plus adrenaline; maximum dose 7 mg/kg (0.7 mL/kg)

Regional nerve block

- 1% lignocaine; maximum dose 5 mg/kg (0.5 mL/kg)
- 0.5% bupivacaine; maximum dose 2 mg/kg (0.4 mL/kg)

such injuries are best referred to an ophthalmologist or plastic surgeon. Other simple lacerations can be glued or sutured under low tension with fine absorbable sutures.

Wounds around the mouth need careful consideration. If the wound crosses the vermilion border, very accurate approximation of the edges is necessary to achieve a good cosmetic result. In young children, this is often best achieved under general anaesthesia. Wounds that pass completely through the lip need to be closed in layers. Lacerations of the inner lip rarely need any intervention. Children with lacerations of the gum margin (eg. degloving injury) need to be referred for debridement and repair under general anaesthesia.

Wounds of the palate and tongue heal exceptionally well with little or no intervention. They do not require suturing unless they are gaping widely, extending through the free side margin of the tongue or continuing to bleed.

Fingertip wounds with or without skin loss are very common. Areas of skin loss up to 1 cm are treated with tulle dressings and heal with good return of sensation. Children with any greater degree of tissue loss should be referred for plastic surgical opinion.

Partial amputation or crush injuries of the fingers or toes need to have the integrity of the nail bed assessed. If this is damaged, referring the child for plastic surgery repair is warranted. Fracture of the distal phalanx implies damage to the nail bed, therefore an X-ray may be warranted. If the nail bed is intact, the wound may be closed using adhesive strips or sutures.

Hand wounds need to be carefully examined, as deeper structures are often involved. Lacerations through the dermis risk tendon injury. If any such structures are damaged or there is any doubt, refer for plastic surgical opinion. Neurological function should be tested before local anaesthetic infiltration.

## Antibiotics and immunisation

For most lacerations, antibiotics are not indicated for prophylaxis against infection, but wound cleaning and decontamination are most important. Antibiotics should be prescribed for specific circumstances such as animal or human bites, and wounds with extensive contamination or tissue damage. Recommended antibiotics for animal or human bites are amoxicillin/clavulanic acid (22.5 mg amoxicillin component per kg up to a maximum of 875 mg) 12 hourly orally for 5 days. Procaine penicillin (50 mg/kg up to a maximum of 1.5 g) intramuscularly may be added if there is likely to be a delay in commencing oral antibiotic medication.<sup>10</sup>

All children should be checked for adequate tetanus cover for prophylaxis. The recommendations of the National

**Table 3. Indications for tetanus prophylaxis**

History of tetanus vaccination		Type of wound	Tetanus booster vaccine	Tetanus immuno-globulin
3 or more doses	<5 years since last dose	All wounds	No	No
	5–10 years since last dose	Clean minor wounds	No	No
		All other wounds	Yes	No
	>10 years since last dose	All wounds	Yes	No
<3 doses or uncertain		Clean minor wounds	Yes	No
		All other wounds	Yes	Yes

Health and Medical Research Council should be followed in determining the need for additional vaccinations (*Table 3*).<sup>11</sup>

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