Management of Pediatric Wounds

KENNETH JACKIMCZYK, MD, AND EMILY S. POLLACK, MD

The primary care physician commonly encounters children with lacerations and abrasions and must be familiar with principles of wound management. Wound care involves more than just wound closure. This article reviews the basics of evaluating and anesthetizing wounds, wound closure techniques, special considerations for wounds in various locations, appropriate use of consultants, and principles of postinjury care. The primary care physician should be comfortable evaluating and treating most wounds while appropriately consulting specialists in selected cases.

WOUND EVALUATION

History
The goal of proper wound management is to maintain optimal function of the injured area with the best possible cosmetic result. A history should be taken that allows an assessment of the risk of infection developing in the wound (Table 1). The risk of infection is determined by both host and wound factors. Host factors include disorders that impair the immune system. Wound factors include location, time of injury, mechanism, and contaminants. Moist areas such as the mouth, axilla, and perineum and exposed areas such as the hands, feet, and nails contain large concentrations of bacteria and are prone to infection. Areas of high vascularity such as the face and scalp, on the other hand, are relatively resistant to infection. The time of the injury is an important factor in the development of wound infection since bacteria rapidly multiply in an open wound. Most simple lacerations that are less than 6 hours old can be closed primarily. Wounds on the face and scalp generally can be closed if less than 24 hours has elapsed. However, time should not be the only criteria used to determine whether a wound should be closed. The mechanism of injury should be considered since crush injuries are more prone to infection than cuts. The presence of...
contaminants in the wound also should be noted since organic soils, clay, and saliva from bites all make wounds more susceptible to infection.

The potential of a wound to harbor a foreign body should be determined. Facial cuts from impact with an automobile windshield and deep abrasions from a fall on a gravel surface have a high risk for foreign bodies, whereas a simple cut from a knife is a low-risk wound. Finally, the tetanus status and any history of drug allergies should be elicited.

Initial Physical Examination

Once the history has been obtained, a brief “triage” physical examination should be performed. At this point, the physician must make a judgement based on the age and demeanor of the child as to whether the child is best examined with or without the participation of the parent. Some children are most cooperative while seated in a parent’s lap, but in other instances, an anxious parent can impair your ability to evaluate the wound. An accurate physical examination requires an understanding of the functional anatomy of the injured part since looking for injuries to deep structures is a primary goal of the examination. The “triage look” includes noting the location and length of the wound and checking for sensation, motor function, and vascular status of the injured area.

Radiographs

Radiographs are helpful in a variety of circumstances. Most foreign bodies are radiopaque. Glass is a common foreign body and can reliably be seen if pieces >2 mm are present. Gravel is also radiopaque. Plant thorns and wood splinters, however, are not reliably visible on radiographs. Radiographs are used to detect fractures and should be ordered liberally because open fractures mandate specialty consultation. Radiographs also are used to evaluate bites from larger dogs, as fractures can be produced by the high (200 psi) force from these animals. Although joint penetration is demonstrated most clearly during exploration of the wound, the abnormal presence of air in radiographs may lead the physician to suspect joint penetration.

ANESTHESIA

Once the brief initial assessment has been performed, the wound should be anesthetized using local infiltration or regional blocks. Adequate anesthesia must be obtained to get cooperation from the child so that cleaning of the wound can be performed. Use of regional anesthesia is limited to older children who are cooperative enough to maintain a steady position and who can give the physician feedback about parathesias.

The three solutions most commonly used to anesthetize wounds are lidocaine, mepivacaine, and bupivacaine. Lidocaine and mepivacaine are relatively short-acting agents, whereas bupivacaine is a longer-acting agent (Table 2). The duration of all agents can be prolonged by the addition of epinephrine, but epinephrine inhibits local tissue defenses and should not be used in highly contaminated wounds. Epinephrine-containing solutions cause vasoconstriction, which makes them particularly helpful in bleeding lacerations of the face and scalp, but they cannot be used in tissues supplied by terminal arteries such as fingers, toes, ears, the penis, and the nose.

The maximum safe dose of an anesthetic agent can be reached easily in children with large lacerations (Table 2). For example, in a 20-kg child, the maximum safe dose of 1% lidocaine is 9 cc. Two percent lidocaine may be useful in certain situations. Pain sensation is carried in small nerve fibers that are easily blocked with 1% lidocaine, but pressure and temperature sensation are carried in larger myelinated nerves. A frightened or anxious child might become uncooperative if he or she detects light touch sensation when a wound is manipulated. This may be avoided by using 2% lidocaine.

A number of techniques can be used to minimize the pain of injection and maintain the cooperation of the child (Table 3). Anesthetic agents are packaged as acidic salts to maintain shelf life. Buffering the solution speeds the onset of anesthesia and markedly reduces the pain of injection. The speed of injection is a major determinant of pain, and a slow injection rate will minimize tissue swelling and pain. Warming the solution toward body temperature and using the smallest needle size possible also will reduce pain.

Regional nerve blocks can be useful in older cooperative children to numb large areas without distorting the wound or injecting toxic doses of anesthetic agents. The goal of the injection is to place the anesthetic agent in close proximity to the nerve without injecting directly into the nerve. If parathesias are produced by the needle, or if the needle enters a foramen, it should be moved slightly before the anesthetic is injected. Although numerous regional blocks are

<p>| TABLE 1 |</p>
<table>
<thead>
<tr>
<th>Wound Evaluation: History</th>
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<tbody>
<tr>
<td>Immunocompromising factors</td>
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<td>steroids, diabetes</td>
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<td>Wound characteristics</td>
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<tr>
<td>Location</td>
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<tr>
<td>Time of injury</td>
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<tr>
<td>Mechanism of injury</td>
</tr>
<tr>
<td>Contaminants</td>
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<tr>
<td>Foreign body potential</td>
</tr>
<tr>
<td>Tetanus immunization status</td>
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<td>Drug allergy</td>
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</table>

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TABLE 2

<table>
<thead>
<tr>
<th>Agent</th>
<th>Duration (Local)</th>
<th>Duration (Regional)</th>
<th>Maximum Dose (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine (Xylocaine)</td>
<td>30 to 60 minutes</td>
<td>1 to 2 hours</td>
<td>4.5</td>
</tr>
<tr>
<td>Mepivacaine (Carbocaine)</td>
<td>30 to 60 minutes</td>
<td>1 to 2 hours</td>
<td>5</td>
</tr>
<tr>
<td>Bupivacaine (Marcaine)</td>
<td>2 to 3 hours</td>
<td>3 to 6 hours</td>
<td>2</td>
</tr>
</tbody>
</table>

TABLE 3

Reducing Injection Pain

- Buffering agents:
  - 1 cc NaHCO3 to 10 cc lidocaine
  - 1 cc NaHCO3 to 10 cc mepivacaine
  - 0.1 cc NaHCO3 to 10 cc bupivacaine
- Inject very slowly
- Warm solution to body temperature
- Use small needle sizes:
  - 27-ga for regional blocks
  - 30-ga for local infiltration

Possible, blocks of the face and hand are most useful to the primary care physician. If the practitioner does not perform these procedures on a regular basis, several textbooks provide excellent diagrams of the surface anatomy and technique for these blocks, as well as the areas numbed by each block.3,4

Topical anesthetic agents are a useful tool for providing local anesthesia in children. Two preparations—TAC (tetracaine 0.5%, epinephrine 0.5%, and cocaine 11.8%) and LET (lidocaine 4%, epinephrine 0.1%, and tetracaine 0.5%)—are commonly used. Both have similar effectiveness in numbing wounds.5 Because inadvertent cocaine toxicity is a concern with TAC, some practitioners have used a TAC preparation containing half-strength (5.9%) cocaine with good results.6

Topical anesthetic agents are most useful in anesthetizing small superficial wounds. They allow anesthesia without discomfort to the child so that cooperation is maintained. Vasoconstriction is produced, and the wound margins are not distorted. Care must be taken to avoid applying the solution to mucous membranes, buccal mucosa, or burns since rapid absorption of TAC can result in cocaine toxicity. It should not be used in areas of end artery flow such as fingers, toes, and ears.

TAC is applied 10-15 minutes prior to wound repair on a cotton ball or 2×2 gauze saturated with 2 to 5 cc of solution. The presence of blanching indicates that numbness has been obtained. No more than 0.1 cc/kg of solution should be used. The applicator should be saturated but not dripping with solution, and the applicator should be handled with gloved fingers to prevent absorption through the fingertips.

Appropriate use of sedation is an important element of wound repair in children. An extensive discussion of conscious sedation is, however, beyond the scope of this review. Proper use of sedation can make wound repair a less frightening experience for the child and a less unpleasant experience for the parent and medical personnel. Sedation is especially important in large wounds, cosmetically important lacerations, and lacerations involving the face, mouth, or tongue. Short-acting opioids and benzodiazepines are most commonly used to provide conscious sedation, but other agents should be considered. Nitrous oxide has analgesic and axiolytic properties and can be used in older children as an adjunct to local infiltration or nerve block.7 Ketamine is an effective dissociative agent that provides sedation without loss of airway reflexes. Its effectiveness and safety has been demonstrated in large numbers of children.8

WOUND PREPARATION

Once the laceration has been anesthetized adequately, wound preparation can be performed. Wound preparation is the most important step in preventing infection and should not be done casually.9

Wound preparation has two components: mechanical scrubbing and irrigation. Soaking of the wound has no proven benefit and may introduce skin bacteria into the wound.10 Hair at the wound periphery can be cut using electrical clippers with a disposable blade or shaved by a razor with a recessed blade. Hair should not be shaved with a standard razor since it causes microtrauma at the skin surface and increases the chance of infection.

Mechanical scrubbing of the skin surrounding the laceration decreases the bacterial load and prevents further contamination of the wound during exploration and repair. A gauze sponge is placed in the wound during scrubbing to prevent accidental flow of cleanser into the wound. Contaminated wounds are scrubbed with an antiseptic (Betadine [povidone-iodine, Purdue Frederick Co, Norwalk, Connecticut] 10% scrub or Hibiclens [chlorhexidine gluconate, Zeneca Pharmaceuticals, Wilmington, Delaware]) or a nonionic surfactant (Shurclens [Calgon-Vestal Laboratories, St Louis, Missouri], or Pharmaclens). Antiseptic agents suppress bacterial growth but may impair host defenses. Surfactants mechanically lift bacteria from the wound surface and are less irritating, but have no intrinsic antibacterial properties. Clean wounds can be scrubbed with saline.
Once the wound periphery has been scrubbed, the wound itself is cleaned. Foreign material is removed from the wound, and devitalized tissue is debrided carefully. If the wound is grossly contaminated, it can be scrubbed with a nonionic surfactant or saline. Antiseptic agents and hydrogen peroxide should not be used to scrub a wound since they cause inflammation of the tissues.

Irrigation of the wound is a key step in minimizing the risk of wound infection. High pressure (5 to 8 psi) irrigation is used on all high-risk wounds and can be produced using an 18- to 20-ga plastic catheter and a 30-cc syringe. Saline (200 cc) or 1% Betadine solution (not scrub) is appropriate irrigation for most wounds. Irrigation can be made easier by using a spring-loaded syringe. In addition, a splash (Zerowet Splashshield, Palos Verdes, California) shield has been developed that provides high-pressure irrigation without splattering irrigation fluid. Clean wounds can be irrigated with saline using a bulb syringe that provides low-pressure irrigation (0.5 psi). Suggested protocols for both contaminated and low-risk wounds are listed in Table 4.

The literature has conflicting data on the effectiveness of topical and oral antibiotics in preventing wound infection. Topical antibiotics prevent desiccation but have not been proven to decrease infection rates. Oral antibiotics are reserved for selected high-risk wounds.

WOUND EXPLORATION

Once a laceration has been prepped, it must be explored for the presence of a deep structural injury. Good hemostasis and adequate lighting is mandatory for a satisfactory wound exploration. Careful exploration is especially important if suspected foreign bodies, on facial lacerations, on scalp lacerations with possible skull fracture, on wounds over joints, and on wounds to the distal extremities.

A tourniquet examination should be performed on all lacerations of the distal extremities to obtain a dry field for viewing the wound. If these wounds are not examined under a dry field, injuries to the deep structures can be missed. The first step in performing the tourniquet examination is to assemble an arm board, a surgical light, and a pneumatic tourniquet or blood pressure cuff. Once a motor and sensory examination has been performed and the wound has been anesthetized, the uninflated pneumatic tourniquet or blood pressure cuff can be wrapped around the extremity. The extremity is then exsanguinated by elevating it above the level of the heart for several minutes or by tightly wrapping it with an elastic bandage from the fingers or toes proximally to the level of the tourniquet. The cuff is then inflated to a level above systolic blood pressure to prevent arterial flow to the extremity. The deep structures then can be examined carefully in a dry field.

| TABLE 4 |
| Wound Preparation |
| **Wound Prep of Highly Contaminated Wound** |
| • Scrub periphery with antiseptic (Betadine scrub or Hibiclens) or nonionic surfactant (Shurcclens or Pharmacien) |
| • Remove foreign material |
| • Judiciously debride nonviable tissue |
| • Scrub wound with nonionic surfactant or normal saline solution |
| • Irrigate wound with high pressure (1% betadine solution or normal saline solution) |

| **Wound Prep of Low-Risk Wound** |
| • Scrub wound periphery with antiseptic, nonionic surfactant or normal saline solution |
| • Irrigate wound with low pressure (1% betadine solution or normal saline solution) |

WOUND CLOSURE

Materials

There are a wide variety of wound closure materials available. Because all suture material impairs the body's ability to resist infection, the smallest appropriate size suture and the fewest number of sutures possible should be used to close any wound. Sutures can be categorized as absorbable and nonabsorbable. Nonabsorbable suture (Ethilon and Prolene (Ethicon Inc, Piscataway, New Jersey)) is used for skin closure, and absorbable suture (Dexon, Vicryl, and chromic) is used for closure of the subcutaneous layers or in areas where suture removal is difficult. Deep placement of absorbable sutures removes tension from the wound edges and prevents wound dehiscence and development of a wide scar.

Tape, staples, and wound adhesives provide alternatives to placement of sutures. Taping of wounds is an attractive option for wound closure in children because tape is easy to apply, does not require suture removal, and has the lowest rate of wound infection of any closure method. There are some problems, however, associated with the use of tape. Children like to pull off tape, and the potential for intentioned tape removal must be considered before it is used. Small tidy wounds that will not be placed under tension are the best candidates for tape closure. Moist areas, areas with copious secretions, and wounds over joints should not be closed with tape.

Several steps must be taken to properly tape a wound. Wound prep is done, and if the wound edges are under tension, dermal sutures are placed. Next, benzoin is applied to the skin surface near the wound to improve tape adhesion. After the tape on its cardboard backing is cut to the appropriate length, individual pieces are applied to the wound. The first piece should bisect the wound and subsequent pieces should bisect the remaining areas. A single piece of tape is
placed parallel to each side of the wound at the distal tip of the tape to prevent skin blisters (Figure 1). The tape is kept clean and dry until it is to be removed.

Staples can be used on simple lacerations of the scalp or trunk as a quick alternative to suture placement. A disposable device with 10 staples is available that makes staple placement economical. Because approximation of wound edges is less accurate than with sutures, the scar is larger with staple closure and removal can prove to be uncomfortable.

Tissue adhesives are now used in Europe and Canada and will soon make their appearance in the United States. Adhesives rapidly polymerize when applied to wounds, forming a secure bond that is maintained for about 7 days. An Israeli study of 1500 wounds in children closed with a cyanoacrylates compound showed excellent results. Tissue adhesives, however, can burn when applied to the skin and are quite costly.

Wound Closure Techniques

A description of all wound techniques is beyond the scope of this review. Basic principles of wound closure, however, apply to all wounds regardless of the suturing technique chosen. The goal of wound closure is to produce reopposed epithelial edges that are free from tension. If the wound edges are uneven, the shadow occurring across the scar will be overly noticeable, and if the wound is under tension, a wide scar will develop when the sutures are removed. Wound tension can be evaluated by careful examination of the wound. If the wound edges in a cosmetically important area contract more than 5 mm, then significant static tension is present and a layered closure is needed. Dynamic tension can be assessed by having the patient contract the muscles or move the joint under the wound. If the wound edges widen noticeably with movement, a layered closure is necessary.

Proper suturing of a layered closure requires an awareness of the anatomy of the skin and subcutaneous tissues (Figure 2). First, if the muscle fascia is disrupted, deep interrupted sutures are placed to close the fascia. Next, a small number of buried interrupted intradermal sutures are placed to remove tension from the wound edges. Finally, percutaneous sutures are used to accurately align the epithelial surfaces of the wound. Percutaneous sutures may be used by themselves when skin tension is minimal. Placement of interrupted stitches allows meticulous opposition of the wound edges. Running stitches can be used for quick repair of simple straight lacerations. The placement of a continuous dermal suture with absorbable suture should be considered on straight lacerations in children because it produces a good cosmetic result and does not require suture removal (Figure 3). Guidelines for the type of suture material to be used and the time for suture removal are presented in Table 5.

If a wound is heavily contaminated, cannot be adequately cleaned, or is too old to close, a delayed primary closure can be used. In a delayed primary closure, the wound is anesthetized and prepped, and then is packed with saline-moistened gauze and covered with a bulky dressing. Oral antibiotics are prescribed and the wound is left undisturbed. During the next 4 to 5 days, the packed wound gains considerable resistance to infection, at the end of which time the dressing is removed, and if no overt evidence of infection is present, the wound is closed with interrupted percutaneous sutures or tape. Deep sutures are avoided.

SPECIAL CONSIDERATIONS

The primary care physician must be skilled not only in the evaluation and closure of simple lacerations, but should also be familiar with special consid-
erations for wounds in various locations and for specific types of wounds such as bites and amputations.

**Scalp Lacerations**

Scalp lacerations are sometimes difficult to evaluate because of the presence of hair about the wound. Hair should be clipped so that the full extent of the laceration can be visualized; hair distant from the wound can be controlled with vaseline. Use of an anesthetic agent with epinephrine will help to control bleeding. Next, the base of the wound is palpated to check for skull fracture or galea laceration. If the galea is lacerated, it should be closed with 4-0 sutures. Galea sutures are cosmetically important in the frontal area since the galea serves as a support for the frontalis muscle. After the galae is closed, primary skin sutures can be placed to close the wound and control bleeding. Staples or absorbable sutures are alternatives for wound closure. A dressing is rarely required.

**Facial Lacerations**

Initial evaluation of facial lacerations must include a check for injury of the facial nerve and parotid duct. The parotid duct runs along the middle third of a line drawn between the tragus of the ear and the corner of the mouth. All cheek lacerations in this area should be examined for parotid duct injury, and Stenson's duct should be examined for the presence of blood. The facial nerve exits from the stylomastoid foramen and divides into five branches. Facial muscle function must be checked when a laceration overlies the facial nerve. If the facial nerve or the parotid duct is cut, the patient should be referred to a specialist. Many general pediatricians will choose to consult plastic surgery if a significant facial scar is likely.

**Eyebrow**

The eyebrow is an important cosmetic area, and care must be taken to align the eyebrow margins exactly. During preparation of the wound, the eyebrow is never shaved since the hair provides a critical reference point for wound closure. Wound edges are not debrided. During suturing of the laceration, a single percutaneous stitch is placed at the upper and lower eyebrow margins to exactly align the hair, then a layered closure can be performed.

**Eyelid**

Careful examination of lacerations of the eyelid and the surrounding tissues is important. The globe should be checked for penetrating injury or a hyphema. Upper lid lacerations may disrupt the levator palpebrae muscle. Lacerations lateral to the orbit can cut the lateral palpebrae raphe, and wounds in the region medial to the eye can injure the medial palpebral raphe or the nasolacrimal system. Speciality referral is required for lacerations that traverse the lid margins, those that penetrate the entire eyelid, and wounds that involve a loss of lid tissue. Vertical lacerations of the eyelid can result in contracting scars and also should be repaired by a specialist.

**Nose**

Special care should be taken when evaluating children with nasal trauma to be certain that a septal hematoma is not present. A septal hematoma appears as an ecchymotic bulge on the septum and, if untreated, may cause pressure necrosis of the septum with development of a septal perforation or a saddle nose deformity. If a septal hematoma is seen, a horizontal incision is made through the dependant portion of the hematoma to drain the clot and the nose is packed to prevent reaccumulation of blood. The child is then started on antibiotics. When lacerations involve the alar rim of the nostril, care should be taken to align the wound margins precisely because scars in this area are particularly noticeable.

**Lip Lacerations**

Two distinct types of lip injuries occur in children: vermilion border lacerations and through-and-through lacerations. It is important to obtain exact alignment of lacerations involving the vermilion border of the lip since malalignment of 1 mm can be noticeable. Precise alignment of the lip margins is more easily attained if a regional block is used since wound margins are not distorted. Repair begins with
the placement of a single stitch that opposes the vermilion borders. The remainder of the closure is performed after that key stitch has been placed.

Through-and-through lip lacerations are a unique problem because oral flora contaminates the wound. After a regional block is performed, the lips are pulled away from the mouth, the mucosal wound prepped, and a watertight mucosal closure is done with absorbable sutures. After changing gloves, the physician prep the external skin wound and performs a layered closure of the external laceration using clean instruments. Most physicians prescribe prophylactic oral antibiotics for these injuries.

**Table 5**

<table>
<thead>
<tr>
<th>Location</th>
<th>Type of Suture</th>
<th>Suture Removal (Days)</th>
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<tbody>
<tr>
<td>Scalp</td>
<td>4-0 nylon or staples</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Face</td>
<td>5-0 Vicryl &amp; 6-0 nylon</td>
<td>3 to 5</td>
</tr>
<tr>
<td>Trunk/</td>
<td>4-0 Vicryl &amp; 4-0 nylon</td>
<td>7 to 10</td>
</tr>
<tr>
<td>extremities</td>
<td>4.0 or 5-0 nylon</td>
<td>7 to 14</td>
</tr>
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</table>

**Intraoral Wounds**

Many intraoral and tongue lacerations do not require repair. Large wounds of the buccal mucosa and gaping wounds of the tongue are exceptions. If the child is uncooperative, conscious sedation may be necessary for suturing of these lacerations. Repair is accomplished by placing inverted, interrupted absorbable sutures so that removal is not required and the child does not work the knots loose with the tongue. Glyoxyl, which is more palatable than hydrogen peroxide, is frequently used to rinse the mouth in the first 24 hours.

**Ear**

Anesthesia to the ear is accomplished by placing a tract of anesthetic solution without epinephrine anterior and posterior to the ear. If a hematoma is present, it must be drained so that pressure necrosis to the ear cartilage and a cauliflower ear does not develop. If the ear cartilage is damaged, small 5-0 or 6-0 skin sutures usually will suffice to realign the ear cartilage since the skin and cartilage are tightly adherent. If the cartilage needs suturing, 4-0 or 3-0 absorbable sutures are used. A pressure dressing can be constructed using petroleum gauze or moistened cotton balls to pack the pinna and prevent hematoma development. The dressing can be removed after 48 hours.

**Hand**

Hand injuries are common and require skillful evaluation and management if bad outcomes are to be avoided. Hand wounds have a high rate of infection, so a careful wound prep should be performed to decontaminate the cut. Once the laceration has been cleaned, a systematic evaluation of the deep structures should be performed under a tourniquet. Open joint injuries, flexor tendon injuries, and open fractures should be referred to a specialist. Extensor tendon injuries can be repaired by a trained primary care physician. Once the wound has been repaired, the hand is splinted or a bulky dressing is applied. Antibiotics are prescribed for high-risk wounds.

**Nailbed and Fingertip**

The goal in management of nailbed injuries is to preserve nail growth and to obtain an acceptable cosmetic result. If the anatomic structures can be closely realigned, the results in children are usually quite good. Initial assessment begins with an examination of the nail plate. Small subungual hematomas can be treated by simple trephination with a heated paper clip or disposable cautery device. It is best to remove the nail plate in patients with distal phalanx fractures or large subungual hematomas. The nail bed is repaired carefully with 6-0 absorbable sutures. If the germinal matrix is damaged, a specialist should be contacted regarding repair.

The goal in management of fingertip injuries is to preserve the sensory function and length of the digit. Management of these injuries is controversial, but in children good results usually can be expected. If the child presents with a fingertip amputation without bone exposure, the fingertip can be reattached with 6-0 sutures or allowed to heal using periodic dressing changes with nonadherent gauze. If bone is exposed or if significant nailbed injury has occurred, a consultant should be called. Amputations at or proximal to the distal interphalangeal joint are usually candidates for neurovascular reimplantation.

**Amputation**

Children are excellent candidates for reimplantation, so an aggressive coordinated approach must be taken with amputations, and the primary care physician should have a predetermined protocol for treatment and referral of these injuries. It is a natural response of any concerned physician to attempt to reassure the patient and the patient’s family. It is just as important, however, not to provide false hope. A successful reimplantation may well result in multiple surgeries, cosmetic deformity, cold intolerance, and some loss of function; therefore, the final decision to attempt reimplantation can be made only by the transplant surgeon.

In general, reimplantation is attempted for single digit amputations at or distal to the distal interphalangeal joint, thumb amputations, multiple digit amputations, upper extremity amputations, and lower extremity amputations. Sharp cuts and amputations with short ischemic times have the best prognosis.
Proper handling of the amputated part by the primary care physician will maximize the chance of a successful reimplantation. Bleeding from the wound stump is controlled with direct pressure rather than hemostats. Once bleeding is controlled, the wound should be washed gently with saline to remove gross contamination, covered with saline-moistened gauze, and then wrapped with a dry dressing. The injured extremity then is splinted and elevated. The amputated part is wrapped in saline-moistened gauze and then sealed in a sterile plastic bag. The bag then is immersed in a container of ice water that is marked with the time cooling began. It is important not to place the amputated part in direct contact with ice or frostbite may occur. A dose of intravenous antibiotic also should be given to the patient.

Mammalian Bites

Animal bites are considered a special category of wounds. Animal bites in children most often involve the face and scalp, which are low-risk infection areas, but regardless of location, contamination of these wounds by oral flora make all bites high-risk wounds. Large dogs can generate crushing forces that can result in fractures and significant areas of devitalized tissue. Therefore, radiographs should be obtained if a fracture is suspected, and careful debridement of devitalized tissue may need to be performed. Cats have small fang-like teeth that are more likely to cause puncture wounds than lacerations, and sputuring of these wounds is not always required. Cat bites are more likely to be contaminated with Pasteurella multocida than are other animals. Human bites do not usually cause significant tissue damage. One human bite that is particularly devastating, however, is the closed-fist injury. If a child punches someone in the mouth causing a laceration over a knuckle, it is likely that oral flora has been introduced into the metacarpophalangeal joint. These injuries require copious irrigation and intravenous antibiotics, and should be referred to a specialist.

All animal bites should receive a vigorous wound prep. Most large or cosmetically important lacerations that are not located on the hands or feet can be closed primarily. Most physicians then prescribe oral antibiotics for 3 to 5 days. The choice of antibiotics is controversial but dicloxacillin, amoxicillin plus clavulanic acid, or a second-generation cephalosporin are all considered acceptable regimens. Penicillin-allergic patients may be treated with erythromycin or ciprofloxacin. Bites that show signs of infection within 24 hours should be considered to be infected with Pasteurella and are treated with penicillin.

WOUND DRESSINGS

The physician's job is not finished when the laceration has been sutured. First, the sutured wound should be wiped with hydrogen peroxide to clean dried blood from the skin surface and wound edges. A thin film of topical antibiotic then is applied to maintain a moist environment for wound healing. Facial and scalp lacerations may not require any additional covering. Band-aids that provide a nonadherent protective dressing are often the best wound dressings for small lacerations.

If the wound requires more than a band-aid, a nonadherent dressing covered with a dry dressing is placed over the wound. If the dressing becomes saturated with secretions, the outer dressing must be changed to maintain a protective barrier. Once the wound has been dressed, wound care instructions should be explained in detail. The physician should explain to the parent that all lacerations leave a scar, regardless of how expertly the wound was repaired. The scar will not reach its final appearance for 6 months, and at that time if the result is cosmetically unacceptable, a revision can be performed. The use of sun block on exposed surfaces may help lessen scarring. The parent should be warned about the possibility of a retained foreign body in the wound and the possibility of infection.

Once 48 hours has elapsed, the ability of the closed wound to resist infection is markedly increased, and the dressing may be removed. High-risk wounds should be rechecked by the physician at 48 hours for signs of infection.

CONCLUSION

The primary care physician should be familiar with the principles of wound management and wound closure. Through careful adherence to these principles, the injured child will receive treatment that yields the best cosmetic and functional result.

REFERENCES

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