

Minor Oral Injuries in Children

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Abstract

Traumatic injuries involving the oral cavity in children often result from falls or collisions with stationary objects. Repair of lacerations involving the soft tissue structures within the oral cavity is described. These injuries often can be managed by emergency department personnel, with referral to an oral and maxillofacial surgeon for follow-up care. Initial management of more extensive injuries such as dentoalveolar fractures, penetrating injuries and burns is also described. Immediate consultation with the appropriate specialist is suggested, because significant deformity and/or morbidity may result from minor oral injuries.

Key Words: Oral soft tissue injuries, dentoalveolar trauma, pediatric patient.

Introduction

Traumatic injuries involving the oral cavity in children most often result from falls or collisions with stationary objects. Other incidents in which injury to the oral structures frequently occurs are sports-related accidents, motor vehicle accidents, and assault. According to one review of emergency department admissions of children, more than 50% of oral injuries were the result of falls. When the injuries were categorized, it was reported that lacerations to the lip account for 62% of the injuries, followed by injuries to the soft structures of the oral cavity. Injuries of the teeth and bones collectively accounted for only about 22% of the total injuries (1). Other studies (2, 3) report similar data. Accidental injuries such as electrical burns, penetrating injuries, and animal bites involving the oral cavity are also seen in children, but less often than lacerations and dental trauma. Most of these injuries require urgent or emergency treatment to prevent untoward sequelae. Given the myriad of situations with which emergency department personnel are presented, it is imperative that the attending physicians, dentists, and staff are well versed in the evaluation, treatment, and possible complications of major and minor oral injuries in children.

Maxillofacial injuries occur in about 20% of patients with multiple injuries (4). Life-threatening injuries to children, such as head and spinal cord injuries, thoracic and abdominal injuries, limb and craniomaxillofacial fractures, may be accompanied by traumatic injuries involving the oral structures. Such injuries necessitate immediate, comprehensive evaluation of the overall status of the child. Each child presenting for urgent or emergency treatment of injuries should be examined carefully for signs of abuse or neglect. Soft tissue injuries account for more than 90% of all injuries attributed to neglect or abuse (5). A description of the events leading up to and culminating in injury, and initial management of the injury by the parent or caretaker, including time lapse between injury and presentation for treatment, should be obtained from the patient and parent/caretaker, preferably in separate interviews. Discrepancies which may indicate patterns of abuse or neglect should be noted. Accounts of previous emergency room admissions should be obtained, including histories of the injuries for which treatment was sought. A seemingly excessive number of emergency room admissions may also point to a situation of abuse or neglect. Even in the majority of cases, where abuse or neglect is not suspected, accurate documentation of this information is required for medical and legal reasons. It is the obligation of all health care providers to report cases of suspected child abuse or neglect to the proper authorities.

In the otherwise stable patient, careful medical history, including vaccination history, should be obtained. The injured child should be observed for extraoral signs of injury, including swelling, changes in color of the skin, and asymmetry of the face and head. The skull, facial bones and mandible should be palpated to assess the mouth opening. Cranial nerve function should be thoroughly examined and evaluated. Any areas of ecchymosis, crepitus or pain upon palpation, or dysesthesia may indicate the presence of underlying fractures. The presence of emphysema in soft tissues of the head and neck is often indicative of fractures of the craniomaxillofacial skeleton. A thorough intraoral examination of the oral cavity and pharynx is performed, including inspection and palpation of the buccal and alveolar mucosa, teeth, alveolus, pharynx, tongue and floor of the mouth (6, 7). To rule out the possibility of aspiration, immediate chest and abdominal radiographs are required when teeth or portions of teeth are missing and unaccounted for. Soft tissue radiographs

Minor Oral Injuries in ChildrenCBanks

are helpful in determining displacement of radiopaque objects into adjacent soft tissues. Function of the major salivary glands is assessed by palpation of the gland while observing salivary flow from the respective duct orifices. Lacerations must be probed to evaluate the extent of the injury, and injury to adjacent structures.

Soft Tissue Injuries

Soft tissue injuries can be classified under categories according to the type of wound. The general types of soft tissue injuries that will be discussed are: contusion, abrasion, laceration, burns, and penetration injuries.

Contusions

A contusion (Fig. 1) results from injury to the soft tissues in which the epithelium or



Fig. 1. Contusion injury to the lower lip illustrating edema and ecchymosis typically seen in this type of injury.

epidermis remains intact. Usually this type of injury is created when the soft tissues are crushed between two surfaces. For example, a contusion involving the soft tissues of the cheek results when they are crushed between the underlying bony prominence of the zygoma and a fist. The injured portion of the soft tissue is concentrated in the layers of the dermis and underlying muscles. It is possible for the deeper fascial layers to be involved. The crushing injures capillaries and blood vessels, initiating an inflammatory response in the tissues. Extravasated blood and escape of fluid from damaged cells cause the color change and swelling of the injured area. Since the protective barrier of the epithelium or epidermis remains intact, there is little risk of bacterial infection. Evaluation should include thorough examination for fractures of underlying bones. Severe pain, mobility, ecchymosis and air embolization in the soft tissues, which presents as crepitus upon palpation, are clinical indicators of fractures in the craniomaxillofacial area. Contusions should be treated with ice applied to the injured area to arrest further extravasation of blood by constricting capillaries. Warm compresses should be applied later to cause vasodilation and encourage lymphatic drainage. The extravasated blood will be broken down and removed, and revascularization of the

Minor Oral Injuries in ChildrenCBanks

area will result in complete healing (7).

Abrasions

Abrasions are soft tissue injuries in which the epithelium or epidermis is removed, leaving the dermal elements exposed. “Brush burns” are abrasions that may follow a tangential blow which generates friction between the skin and a surface of the implement. Since the epithelium or epidermis is breached, abrasions are considered contaminated wounds. Treatment of abrasions includes initial cleansing of the injured area with an antibacterial solution followed by careful debridement of the wound to remove foreign material and devitalized tissue. Scrubbing the wound with brushes or sponges should be avoided since this practice may further injure and devitalize the dermal or submucosal tissues. Soft tissue radiographs may be helpful in determining if deeply embedded foreign materials remain in the wound following debridement. A final, thorough cleansing of the abrasion is followed by the application of a topical antibiotic cream. Due to the nature of the wounds, suturing is usually unnecessary. Systemic antibiotics are recommended in severely contaminated or deep abrasions, but should never be used in lieu of proper wound cleansing (7).

Immunization history should be obtained, since potentially dangerous pathogens such as *Clostridium tetani* may be introduced into the wound by dirt or gravel. Immunization against diphtheria, tetanus and pertussis is usually initiated within the first 6-8 weeks of life, with boosters at 18 months and when the child reaches school age. Thereafter, boosters are administered at 10-year intervals. At the time of injury, administration of tetanus toxoid is indicated to augment the protective antibody level only in the patient who has been previously immunized. Tetanus immune globulin and adsorbed tetanus toxoid are administered to the patient who has not previously been immunized against tetanus. The administration of tetanus antitoxin is indicated only if tetanus immune globulin is not available (8, 9).

Lacerations

Lacerations are wounds created by tearing of the soft tissues; these wounds may extend through all layers of the epidermis, dermis, and muscle layers, and into the fascial planes of the head and neck region. Perioral lacerations may extend from the skin surface, creating a communication with the oral cavity. Such lacerations are referred to as “through and through” lacerations. Lacerations are contaminated wounds, with the potential of bacterial inoculation from skin surface, or from the objects or surfaces causing the laceration. Evaluation of lacerations should include assessment of extent of the wound, including length, depth, affected structures, avulsion, and devitalization of tissue. Hemorrhage should be controlled immediately, with identification of the source of bleeding and ligation or cauterization of affected vessels. Lacerations should be thoroughly irrigated and debrided to remove foreign material, as well as devitalized and necrotic tissue, and to prepare the

Minor Oral Injuries in ChildrenCBanks

wound margins for closure. Lacerations involving the oral mucosa of the cheek mandate a careful examination of parotid salivary flow from Stenson's duct. The duct orifice is located on the buccal mucosa opposite the maxillary first molar. The flow of saliva from the orifice is observed while palpating the gland. Injuries involving these structures should be referred to an oral and maxillofacial surgeon for repair.

Simple closure of the oral mucosa with 3-0 chromic or plain gut suture is sufficient to promote adequate healing in minor lacerations. Deeper lacerations will require layered closure of the muscular layer followed by closure of the mucosa. 4-0 slow-resorbing polyglactin 910 suture is useful for the approximation of muscle, since it is more slowly resorbed and maintains wound strength for approximately 30 days. Antibiotic therapy is reserved for more severe wounds, grossly contaminated wounds, wounds with significant contusion of the marginal tissues, and wounds where there has been a delay in treatment. Penicillin, clindamycin, and erythromycin are appropriate antibiotics for empiric therapy against the oral flora.

Gingival lacerations occur when force applied to the lips creates tension on the gingival tissue such that the entire mucoperiosteal layer is traumatically elevated from the alveolar bone toward the apices of the teeth. This type of laceration usually involves one or more vertical tears, which may be partial to full in thickness. The alveolus should be observed directly for fractures or avulsions of alveolar bone and teeth, and the presence of foreign materials. Following thorough irrigation and removal of debris, reduction of alveolar bone and displaced teeth is accomplished. In severe degloving injuries involving the mucoperiosteal tissues, laceration may extend to the level of the muscle attachment. Deep, slow-resorbing sutures are used to repair the muscular layer. Failure to close lacerations within the muscle layer may result in soft tissue deformities that are difficult to correct in the postoperative phase. Closure of the gingiva is accomplished by replacing the displaced mucoperiosteal curtain and aligning the edges of the vertical components at the margin next to the teeth. It is best to avoid removal of any devitalized tissues, especially along the scalloped edge of the interdental papillae, until the mucoperiosteum has been properly repositioned. Each of the interdental papillae will have a corresponding interdental embrasure into which it fits. Closure of the gingival lacerations begins with simple interrupted sutures passed through the central portion of the facial interdental papilla, through the embrasure space between the teeth, and through the palatal or lingual papilla. The suture is then passed back through the same embrasure space, without being passed through tissue, and tied on the facial aspect of the papilla. An absorbable suture such as 3-0 chromic gut with a 3/8 round cutting needle is used, since this needle is a good shape and size for suture passes through the interdental embrasures.

Lacerations of the frenum attachments will be V-shaped and include a small muscle layer deep in the mucosa. The muscular component of the frenum is responsible for hemorrhage that sometimes necessitates suturing. Otherwise, a small laceration involving the frenum may be irrigated and allowed to granulate secondarily (Fig. 2). When required, repair of small lacerations

Minor Oral Injuries in Children

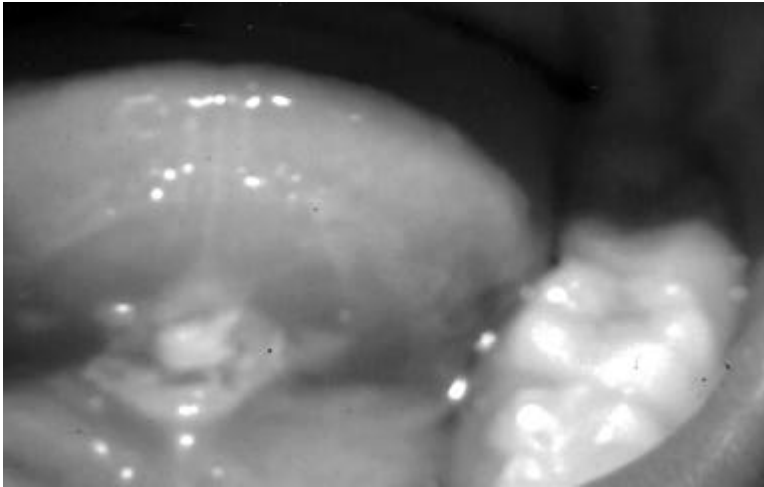


Fig. 2. Small laceration of the lingual frenum. The wound did not require surgical intervention and healed uneventfully by secondary intention.

of the frenum is easily completed with one or two vertical midline absorbable sutures. Due to the nature of the muscular attachment of the frenum, some wounds may appear to be wide and gaping. Healing by secondary intention in these cases may lead to significant scar formation and interference with normal function and mobility of the tissues.

Tongue lacerations present a challenge to the surgeon, in that the tongue is a muscular organ with a large range of physical animation. It is also in constant danger of being injured by the teeth since it plays an essential role in the mastication and deglutition of the food bolus. Lacerations involving the tongue, especially those extending into the musculature, tend to gape open as the tongue is moved. The sutures placed need to withstand the trauma of the teeth and intrinsic muscle pull. Injuries to the tongue, especially those involving the ventral surface, are prone to hemorrhage, owing to the extensive collateral vascular blood supply. Significant edema of the tongue poses a very real risk of airway embarrassment via occlusion in the postoperative phase. Hospital admission is recommended for the patient with severe tongue injury and accompanying edema, in order to facilitate airway observation and maintenance. Tongue lacerations limited to the mucosal surface are closed with simple interrupted sutures. Deeper lacerations require layered closure, with the muscular layer and mucosal layers being closed separately. It may be advisable to bury the suture knots so that the patient is not prone to manipulate and break down the wound closure. Minor lacerations which are less than 1 cm in length may not require suturing, especially in the very young child, since the tongue has an enormous propensity for healing. Care must be exercised in suturing lacerations in the very young child, especially if the child is sedated, since blood and secretions pose an aspiration risk.

A thorough understanding of lip anatomy is required for all lacerations involving the lips (9). The soft tissue contours of the philtral columns, the junction of the lip vermilion with the skin of the upper lip, and the cupid's bow form important aesthetic structures. Failure to align the edges of the vermilion and the skin properly will result in significant step deformity. The wet-dry line demarcates the transition from oral mucosa to lip vermilion. Alignment of the wet-dry line will also

Minor Oral Injuries in ChildrenCBanks

assist in the orientation of tissues. The orbicularis oris muscle will create tension on the wound when animated and must be properly repaired to restore proper function. Significant hemorrhage from the inferior or superior labial arteries may be brisk and require treatment (10).

Complicated lacerations crossing the vermilion border should be closed in a layered approach, beginning with repair of the orbicularis oris muscle. Closure of the oral mucosa is then completed with care taken to align the wet-dry line. Final closure of the skin and vermilion begins with a single suture carefully placed at the junction of the vermilion and skin wound margins to align the red line of the vermilion and the white line of the skin (10). Failure to properly align these structures will result in an esthetically unacceptable result. Wound care is performed twice daily with hydrogen peroxide followed by application of topical antibiotic ointment.

Electrical Burns Involving the Oral Cavity

Home safety precautions with respect to electrical appliances cannot be overemphasized, as shock, cardiac arrest, arrhythmias and even death may result from electrical burns. Oral electrical burns can produce devastating, full thickness destruction of the lip and cheek, resulting in severe functional disabilities and facial deformities (11, 12). Electrical burns occur when the child places the female end of a live extension cord in the mouth, or bites into a cord, resulting in injury to the commissure of the lip, tongue, or floor of the mouth. Electrical burns may also result from contact with the male end of an incompletely plugged-in cord (12B14) (Fig. 3).



Fig. 3. Electrical burn involving the lip commissure, demonstrating the magnitude of tissue destruction and deformity of the oral structures. Note the central zone with peripheral erythematous margin demarcating the area of tissue necrosis, and edema of the adjacent soft tissues.

The magnitude of the tissue injury depends on the duration of the contact, the voltage, tissue resistance, and path and type of current (14, 15). Visible electrical discharges or arcs do not require direct contact of the electrical source with the tissues to produce injury. Saliva serves as a conduction medium connecting the polarity gap of the wires of the electrical source. The electrical discharge in the form of an arc may produce temperatures exceeding 2500EC (12-15). Contact burns result from direct application of electricity to the tissues. In contact burns, the current is transmitted from the electrical source and travels through the tissues along the path of least resistance. The immediate response of the tissues to the applied energy is coagulation of the tissues, resulting in necrosis. At first presentation, there is a central gray or white zone of necrotic tissue surrounded by a raised, reddish, coagulated-appearing border. The adjacent tissues will be edematous. A fibrinous exudate will cover the wound in several hours. Coagulation of the tissues

Minor Oral Injuries in ChildrenCBanks

results in thrombosis of blood vessels and will usually prevent acute hemorrhage in the immediate post-injury phase. However, it should be kept in mind that bleeding from adjacent vascular structures, such as the labial arteries, might occur at any time following injury. The neural tissue component will also be damaged; thus, the injury may be surprisingly painless. Inflammation of the circumferential tissues progressively enlarges and peaks at about the first day following injury. As the wound matures, an eschar develops which will eventually slough, resulting in bleeding. There is a risk of significant hemorrhaging from arterial vessels during this phase. The resulting scar will have a tendency to contract, resulting in cosmetic and functional defects (11-15).

When the child presents following such an accident, initial management should include evaluation for systemic effects of electrical current such as shock and arrhythmias. If the child is otherwise stable, a thorough evaluation of the affected area is performed. Since the actual extent of tissue involvement cannot be determined in the immediate post-injury period (11, 12, 15), no attempt should be made to debride the wound. Electrical burns involving the tongue and floor of the mouth may result in damage to the vessels, culminating in uncontrollable bleeding, which requires ligation of vessels. The possibility of bleeding in the oral cavity places these patients at risk of aspiration. Edema of the tissues of the tongue surrounding the central necrotic zone and elevation of the tongue produced by swelling of the floor of the mouth place the patient in danger of airway occlusion. Swelling may also limit oral intake, placing the patient at risk of dehydration and nutritional deficits. Admission for airway observation and maintenance, as well as parenteral support, is justifiable and advisable in cases of severe electrical burn injuries of the orofacial region.

Considerable success has been reported with the use of appliances designed to stent the commissure during the healing and scar maturation phase (12-15). Appliances serve to maintain the dimension of the oral aperture and to prevent or limit the amount of scar contraction (12, 16). The appliances are usually designed in such a way that they are retained by the dentition in a removable or fixed manner stabilized by the dentition and alveolar ridges. Alternately, Barone et al. (16) describe an appliance that is retained by an earpiece resembling the temple of an eyeglass frame. The connection between the earpiece and the stent is elastic and allows for adjustment of the position of the commissure. Stenting the commissure during the healing phase may limit the magnitude of reconstructive surgery required in the future, or it may even eliminate the need for reconstruction altogether in certain cases (12, 16). Appliance therapy is usually initiated in the first weeks following injury, after the loss of the eschar. The appliance is worn for 6-12 months (12, 16). The need for surgical intervention and the timing of surgical repair or reconstruction are variable, depending on the needs of the patient and the practices of the treating surgeon.

Minor Oral Injuries in ChildrenCBanks

Penetrating Injuries

A penetrating or puncture wound of the oral cavity is an accidental injury which most often results when a child falls with an object such as a pen or toy held in the mouth (Fig. 4).



Fig. 4. Minor penetrating injury of the buccal mucosa, which requires only removal of the foreign object and observation during the healing phase. It is important to confirm protection against tetanus when penetration or puncture wounds are sustained.

Occasionally, the child will be impaled when falling on an object with the mouth open (17-19). The resultant injury most often is a puncture or deep laceration located in the oral cavity. The most frequently involved sites are the posterior palatal areas and lateral pharyngeal walls (18). Severe hemorrhage is an unusual presentation; spontaneous cessation of insignificant hemorrhage is the usual case (18, 19). Evaluation of the patient includes taking the history of the injury followed by a thorough head and neck examination. The wound is first examined to determine the extent of the injury and the presence of foreign materials. Then the wound is observed as the patient performs maneuvers that animate the palatal vault and pharyngeal walls. The gag reflex is tested, and phonation is evaluated to determine the presence of air escape to the nasal cavity from the oral cavity.

Surgical intervention is indicated in cases of uncontrollable hemorrhage, severe laceration or avulsion of tissues, impaired function of the oropharyngeal walls, or in cases where it is suspected that foreign materials may be embedded in the wound. In most cases, however, the laceration or puncture wound does not require surgical management (17-19). If there is no significant gaping of the wound, no muscle contraction, and no foreign materials present, appropriate management includes thorough irrigation of the wound and observation during the healing phase. Possible complications include airway obstruction, symptomatic carotid artery injury, and loss of function (17B19). Localized infection may result from the introduction of bacteria present in the oral cavity

Minor Oral Injuries in ChildrenCBanks

or from the surface of the object entered into the tissues. Infrequent occurrences of facial cellulitis following oral penetrating injuries have been reported, but they are not common (17, 18). For this reason, appropriate prophylactic antibiotic therapy is advisable.

Dentoalveolar Injuries

Dentoalveolar injuries include fracture, subluxation or avulsion of teeth, and fractures of the alveolar processes of the maxilla and mandible. The alveolar processes are those portions of the maxilla and the mandible which house and support the dentition. Dentoalveolar injuries commonly result from falls, sports-related injuries, motor vehicle accidents, and assaults (20). In one study, patients less than 15 years of age accounted for more than 75% of injuries to teeth treated in hospital emergency rooms (21). While most dental injuries result from accidents at home or school (1, 2), a considerable proportion of dental injuries are related to sports (20-23). It has been shown in several studies that most dental injuries are preventable if protective devices such as mouthguards are used while participating in sports (22, 24). However, injuries to the teeth as a result of accidents in the home or from falls are not always foreseeable events. Several studies have identified anatomical or morphological characteristics that may predispose certain children to traumatic injuries to the teeth. These include a forward position of the maxilla and procumbent maxillary incisors with respect to the position of the lower jaw and teeth, and inability of the upper and lower lips to meet when the teeth are interdigitated at the rest position; this is known as lip incompetence (25, 26).

Injuries to the teeth and dentoalveolar structures can potentially result in severe disfigurement. Disability as a result of injury or defects in the dentoalveolar apparatus may produce difficulty in phonation and masticatory function. Abnormalities in the appearance and function of the structures of the face and mouth have been shown to place patients at risk of developing problems with self-image and self-acceptance, and may lead to development of abnormal psychosocial behavior patterns (21). It is, therefore, important that every effort is made to preserve the integrity and function of the teeth and dentoalveolar structures.

Fractures of the teeth are rarely considered life-threatening emergency situations except in the case where there is aspiration of a tooth. If the tooth is not accounted for in the clinical examination, a chest radiograph is indicated to rule out this possibility. Prompt referral to a pulmonologist is required for retrieval in the case of aspiration. Swallowing of teeth is also a possibility, but carries a significantly lower morbidity than aspiration. The swallowed foreign object may be visualized on abdominal radiograph, and intervention is seldom required. Serial radiographs will track the tooth as it progresses through the gastrointestinal tract.

Even though it is possible for primary teeth to be fractured, intrusion, luxation or avulsion injuries are more common (27). The root and alveolar bone support of the primary teeth are minimal and may predispose the primary dentition to avulsion and luxation injuries. The permanent teeth are more firmly embedded in alveolar bone and may be more likely to fracture.

Fractures of the teeth limited to the enamel do not generally produce pain, but the tooth may feel rough and irritate the tongue, lip or mucosa. If exposure of the tooth to air or cold fluids causes

Minor Oral Injuries in ChildrenCBanks

mild to moderate sensitivity, these stimuli should be avoided. The patient should be referred to a dentist for follow-up care and treatment (6, 24). Fractures involving the enamel and dentin may be exquisitely sensitive, especially when exposed to cold air or liquids. Unless there is a contraindication, pain can be alleviated temporarily by infiltration of 1-2 ml of local anesthetic solution, such as 1% lidocaine, into the buccal gingival mucosa over the root apices of the injured tooth. This technique will reliably produce pulpal anesthesia in most teeth. Mandibular molars may require a dental nerve block of the inferior alveolar nerve to alleviate pain. In almost all cases, the injured tooth is restored with a good prognosis (6, 24). Fractures of the crown of the tooth, in which the dental pulpal tissues are exposed, may also be painful. The administration of local anesthesia will alleviate pain temporarily and allow for careful examination. The direct exposure of the pulpal tissues to the oral cavity provides an entry route for bacteria. Infection of the pulpal tissues will ensue if treatment is delayed beyond several days. Most often, the tooth will require endodontic therapy. Prompt follow up with a dentist is recommended (6, 24).

Vertical fractures of teeth may be painful as a result of movement of loose portions that will stimulate pain fibers in the periodontal ligament system. On examination, bleeding from the sulcus of the tooth is usually minimal. This bleeding stops spontaneously and requires no intervention. If the fractured portion of the tooth is quite mobile, it may become dislodged. In this case, the tooth should be removed to prevent possible aspiration. Infiltration of local anesthetic is administered to relieve pain and allow for removal of the fragment. The airway should be protected with a gauze screen and the tooth fragment grasped with a small rongeur or hemostat for removal. The prognosis of restoring the tooth depends on the extent of damage to the tooth. In general, the further the vertical fracture extends toward the apex of the root, the poorer the prognosis.

Horizontal fractures involving the roots of teeth are suspected when there is mobility of a tooth following a blow to the mouth or teeth. The tooth may be displaced and there may be bleeding from the gingival collar of the tooth. These injuries may cause pain due to stimuli within the periodontal ligament structure and the dental pulp. Dental radiographs may be used to confirm suspicion of root fracture. Interim care includes relief of pain and stabilization of the tooth if it is very mobile (6). There are a variety of methods used to stabilize the tooth. As described by Medford (28), periodontal dressing material may be placed to provide short-term, temporary stabilization. Other, more time-consuming and technically difficult means of stabilizing the tooth include the application of a wire splint to the teeth with dental bonding material and the use of an arch bar with circumdental wiring. The prognosis of the tooth is determined by the position of the fracture with respect to the apex of the tooth. In general, the closer the fracture is to the apex of the tooth, the better the prognosis. Definitive treatment usually requires endodontic therapy and possibly extraction of the unsalvageable tooth.

Fully formed permanent teeth which are subluxated (displaced, but still positioned within the socket) have an excellent prognosis if properly managed. Subluxation injuries involving teeth with incompletely formed root structures have a poorer prognosis, because the dentinal formation within the root structure will be compromised and more susceptible to subsequent root fracture (29). On examination, the tooth will be displaced but still positioned within the socket. A more severe

Minor Oral Injuries in ChildrenCBanks

type of luxation injury is the intruded tooth, where the tooth is traumatically displaced deeper within the alveolar bone. The presence of associated gingival lacerations may be indicative of involvement of the alveolar bone. There will be significant pain due to disruption of the periodontal ligament and injury to the gingival tissues. Infiltration of local anesthesia to the buccal mucosa and gingival tissue will provide relief from pain and allow the physician to temporarily stabilize the tooth. Following thorough irrigation with a physiologic solution, the tooth should be replaced in the proper position in the socket with bimanual palpation. The patient should then close gently on a gauze sponge to assure complete apical seating. The tooth can be stabilized by any of the methods described above.

Displacement of primary teeth is common in children following trauma to the orofacial region; the child may complain of pain and the tooth may be displaced within the socket either laterally, medially, or vertically. There is usually bleeding from the gingival collar around the injured tooth, and there may be associated gingival lacerations. The injured area should be thoroughly irrigated with physiologic solution, followed by debridement of foreign materials. Infiltration of 0.5-1 ml of local anesthetic with vasoconstrictor into the gingival tissues surrounding the tooth will usually be adequate to relieve pain and allow the repositioning of the tooth through bimanual manipulation. Intruded primary teeth may erupt spontaneously and can be left in the intruded position. If the tooth is very loose following reduction, it presents a possible risk of aspiration and should be removed. Teeth which are not significantly loose do not require stabilization. In most instances, the displaced primary teeth will have a rather poor prognosis.

The prognosis of an avulsed permanent tooth depends on several factors: the amount of time spent out of the mouth, the storage method used to transport the tooth, the damage to the tooth, the condition of the periodontal ligaments still attached to the tooth, whether the tooth can be replaced and adequately stabilized (6, 24). The exposure of the tooth to air will desiccate the periodontal ligament fibers and the cementum layer of the tooth. Every effort should be made to maintain the tooth in a moist environment. The tooth may be transported in the buccal vestibule of the mouth, in milk, or in any of the commercially available tooth transport systems. If the emergency room admission is preceded by a telephone call, the parent should be instructed to rinse the tooth under running water and then to place the tooth into the socket immediately. The best prognosis occurs when the tooth is replanted within the first twenty minutes (6, 24). At the very least, teeth should be replanted upon arrival at the emergency room. Ideally, a wire splint fixated to the tooth with dental bonding material is used to stabilize it. Periodontal dressing material can be used to provide temporary stabilization of the tooth until the patient can seek care from a dentist. Primary teeth should never be replanted, as the developing permanent tooth may be injured.

When excessive traumatic forces are applied to the teeth and mouth, the resultant injuries may involve not only the teeth but also the alveolar bone supporting the teeth. Signs of dentoalveolar fractures include displacement and mobility of a portion of the alveolar process containing one or more teeth. There is a noticeable discrepancy in the level and alignment of the teeth when compared to the other teeth in the dental arch (Fig. 5). In children, occlusal dental radiographs and panoramic images are useful in confirming the presence of suspected fracture. Dentoalveolar fractures are open, contaminated fractures. There is significant risk of infection due

Minor Oral Injuries in Children

to the plethora of bacteria that normally inhabit the mouth. Additionally, there is the possibility of bacteria being introduced via foreign materials embedded within the tissues. Empiric antibiotic therapy should be initiated prophylactically. Penicillin is a good choice due to its activity against the oral flora, but erythromycin or clindamycin may be used in the penicillin-allergic patient. Every attempt should be made to ensure the best prognosis for the fractured alveolar bone and involved



Fig. 5. Dentoalveolar injury involving anterior teeth, demonstrating the malposition of the teeth with respect to the alignment of the dental arch. Note the gingival laceration and the bleeding of the gingival sulcus, which are indicative of dentoalveolar trauma.

teeth. Improperly treated injuries may result in malalignment of the teeth and alveolar bone or in the loss of the entire dentoalveolar segment. If the teeth are improperly aligned or the fracture is not adequately reduced, major functional interference may occur due to tooth position. The loss of teeth coupled with the loss of the alveolar bone results in significant functional and cosmetic deformity.

Prosthetic rehabilitation of the missing tissues is most often an unsatisfactory substitution for the missing teeth and alveolar bone. Extensive surgical reconstruction, including bone and tissue grafting to the deficient area, followed by prosthetic restoration with dental implants, is the best alternative when replacing the dentoalveolar components. Unfortunately, these procedures are not always successful and the cost may be prohibitive for many patients.

Conclusion

Management of traumatic and accidental injuries in children is often complicated by the emotional response of the patient and parent. The emergency department setting provides an environment that is not conducive to cooperative patient behavior in most children. As some injuries are extensive and have the potential for creating functional, esthetic, and psychosocial problems in the developing child, it is important to carefully evaluate each step of the treatment performed. Every effort must be made to preserve the permanent dentition, supporting dentoalveolar structures, and perioral soft tissues. Even minor injuries can cause permanent damage when treated improperly. When the behavior of the patient interferes with the correct treatment of the injury, employment of alternate management techniques such as sedation, or even general anesthesia, should be considered. Deformities resulting from the improper treatment of injuries to the pediatric

Minor Oral Injuries in ChildrenCBanks

patient are avoidable when proper techniques are used and timely referral is made.

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Minor Oral Injuries in ChildrenCBanks

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