Guideline on Pediatric Oral Surgery

Originating Council
Council on Clinical Affairs

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Purpose
The American Academy of Pediatric Dentistry (AAPD) intends this guideline to define, describe clinical presentation, and set forth general criteria and therapeutic goals for common pediatric oral surgery procedures that have been presented in considerably more detail in textbooks and the dental/medical literature.

Methods
This guideline is based on a review of the current dental and medical literature related to pediatric oral surgery. A MEDLINE search was conducted using the terms "pediatric", "oral surgery", "odontogenic infections", "impacted canines", "third molars", "supernumerary teeth", "mesiodens", "mucocele", "eruption cyst", "eruption hematoma", "attached frenum", "ankyloglossia", "gingival keratin cysts", "Epstein pearls", "Bohn's nodules", "congenital epulis of newborn", "dental lamina cysts", "natal teeth", and "neonatal teeth". Also, the manual *Parameters and Pathways: Clinical Practice Guidelines for Oral and Maxillofacial Surgery*,[1] developed by the American Association of Oral and Maxillofacial Surgeons (AAOMS), was consulted.

Background
Surgery performed on pediatric patients involves a number of special considerations unique to this population. Several critical issues deserve to be addressed. These include:

1. preoperative evaluation;
   a. medical;
   b. dental;
2. behavioral considerations;
3. growth and development;
4. developing dentition;
5. pathology;
6. perioperative care.

Preoperative evaluation
Medical
Important considerations in treating a pediatric patient include obtaining a thorough medical history, obtaining appropriate medical and dental consultations, anticipating and preventing emergency situations, and being prepared to treat emergency situations.[2]

Dental
It is important to perform a thorough clinical and radiographic preoperative evaluation.[2,3] Radiographs often include 1 or more intraoral films and may include extraoral imaging if the area of interest extends beyond the dentoalveolar complex.

Behavioral considerations
Behavioral guidance of children in the operative and perioperative periods presents a special challenge. Many children benefit from modalities beyond local anesthesia and oral premedication to control their anxiety. Anesthetic management of children requires extensive training and expertise.

Special attention should be given to the assessment of the social, emotional, and psychological status of the pediatric patient prior to surgery.[4] Children have many unvoiced fears concerning the surgical experience, and their psychological management requires that the dentist be cognizant of their emotional status. Answering questions concerning the surgery is important and should be done in the presence of the parent. The dentist also should obtain informed consent[5] prior to the procedure.

Growth and development
The potential for adverse effects on growth from injuries and/or surgery in the oral and maxillofacial region markedly increases the potential for risks and complications in the pediatric population. Traumatic injuries involving the maxillofacial region can affect growth and function adversely. For example, injuries to the mandibular condyle may not only result in restricted growth, but also limit mandibular function as a result of ankylosis. Surgery for acquired, congenital, or developmental malformations may, in itself, affect growth adversely. This commonly is seen in the cleft patient, for example, where palatal scarring following primary palatal repair may result in maxillary growth abnormalities.

Developing dentition
Surgery involving the maxilla and mandible of young patients is complicated by the presence of developing tooth follicles. Alteration or deviation from standard treatment modalities may be necessary to avoid injuring the follicles. For example, distraction osteogenesis can be a successful treatment option for craniofacial abnormalities in pediatric patients. Nevertheless,

this technique can be associated with long-term dental sequelae, including damage to developing teeth, genesis of dentigerous cysts secondary to placement of pins in unerupted tooth follicle spaces, and subsequent malocclusion issues.[6] To minimize the effects of surgery on the developing dentition, careful planning using radiographs, tomograms, and/or 3-D imaging techniques is necessary to provide valuable information to assess the presence, absence, location, and/or quality of individual crown and root development.

Pathology

Primary and reconstructive management of tumors in children is affected by anatomical and physiological differences from those of adult patients. Tumors generally grow faster in pediatric patients and are less predictable in behavior. The same physiological factors that affect tumor growth, however, can play a favorable role in healing following primary reconstructive surgery. Pediatric patients are more resilient and heal more rapidly than their adult counterparts.

Perioperative care

Metabolic management of children following surgery frequently is more complex than that of adults. Special consideration should be given to caloric intake as well as fluid and electrolyte management and blood replacement. Comprehensive management of the pediatric patient following extensive oral and maxillofacial surgery usually is best accomplished in a facility that has the expertise and experience in the management of young patients (ie, a children's hospital).

Recommendations

Odontogenic infections

In children, odontogenic infections may involve more than 1 tooth and usually are due to carious lesions, periodontal problems, or trauma.[7,8] Prompt treatment of infections is important, as children are prone to dehydration—especially if they are not eating well due to pain and malaise.

With upper face infections, patients usually complain of facial pain, fever, and inability to eat or drink. Care must be taken to rule out sinusitis, as symptoms may mimic an odontogenic infection. Occasionally in upper face infections, it may be difficult to find the true cause. Infections of the lower face usually involve pain, swelling, and trismus.[7] They frequently are associated with teeth, skin, local lymph nodes, and salivary glands.[7] In lower face swelling, dental infection is diagnosed most frequently.[9]

Most odontogenic infections are not serious and can be managed easily. Treatment involves pulp therapy, extraction, or incision and drainage.[2] Infections of odontogenic origin with systemic manifestations (eg, elevated temperature of 102° to 104°F, facial cellulitis, difficulty in breathing or swallowing, fatigue, nausea) require antibiotic therapy. Severe but rare complications of odontogenic infections include cavernous sinus thrombosis and Ludwig's angina.[2,7] These conditions can be life threatening and may require immediate hospitalization with intravenous antibiotics, incision and drainage, and referral/consultation with an oral and maxillofacial surgeon.[2,7]

Extraction of erupted teeth

Maxillary and mandibular molars

Primary molars have roots that are smaller in diameter and more divergent than permanent molars. Root fracture in primary molars is not uncommon due to these characteristics and the potential weakening of their roots caused by the eruption of their permanent successors.[2] To avoid inadvertent extraction or dislocation of the permanent successor, consideration should be given to the relationship of the primary roots to the permanent successor crown. Primary molars with roots encircling the successor's crown may need to be sectioned to protect the permanent tooth's location.[2]

Molar extractions are accomplished by using slow continuous palatal/lingual and buccal force allowing for the expansion of the alveolar bone to accommodate the divergent roots and reduce the risk of root fracture.[2] When extracting mandibular molars, care should be taken to support the mandible to protect the temporomandibular joints from injury.[2]

Maxillary and mandibular anterior teeth

Primary and permanent maxillary and mandibular central incisors, lateral incisors, and canines all have conical single roots. Extraction of anterior teeth is accomplished with a rotational movement, due to their single root anatomies.[2] Care should be taken to avoid placing any force on adjacent teeth that could become luxated or dislodged easily due to their root anatomy.

Fractured primary tooth roots

The dilemma to consider when treating a fractured primary tooth root is that removing the root tip may cause damage to the succedaneous tooth, while leaving the root tip may increase the chance for postoperative infection and delay eruption of the permanent successor.[2] The literature suggests that, if the tooth root can be removed easily, it should be removed.[2] If the root is very small, located deep in the socket, situated in close proximity to the permanent successor, or unable to be retrieved after several attempts, it is best left to be resorbed.[2]

Unerupted and impacted teeth

Impacted canines

Maxillary canines are second to third molars in frequency of impaction.[10] Early detection of an ectopically erupting canine is important to minimize such an occurrence. Panoramic and periapical films are useful in locating potentially ectopic canines. When the cusp tip of the permanent canine is just mesial to or overlaying the distal half of the long axis of the root of the permanent lateral incisor, canine palatal impaction usually occurs.[11] Extraction of the primary canines is the treatment of choice when malformation or ankylosis is present or when trying to correct palatally impacted canines, provided there are normal space

conditions and no incisor resorption.[10,12] One study showed that 78% of ectopically erupting permanent canines normalized within 12 months after removal of the primary canines: 64% when the starting canine position overlapped the lateral incisor by more than half of the root and 91% when the starting canine position overlapped the lateral incisor by less than half of the root.[10] If no improvement in canine position occurs in a year, surgical and/or orthodontic treatment were suggested.[10] Consultation between the practitioner and an orthodontist may be useful in the final treatment decision.

Third molars

Panoramic or periapical radiographic examination is indicated in late adolescence to assess the presence, position, and development of third molars.[3] AAOMS recommends that a decision to remove or retain third molars should be made before the middle of the third decade.[1] Little controversy surrounds their removal when pathology (eg, cysts or tumors, nonrestorable or recurrent caries, infection or pericoronitis, detrimental changes of adjacent teeth or bone) is associated and/or the tooth is malpositioned or nonfunctional (ie, an unopposed tooth).[1,13] A systematic review of research literature from 1984 to 1999 concluded there is no reliable evidence to support the prophylactic removal of disease-free impacted third molars.[13] Although prophylactic removal of all impacted or unerupted disease-free third molars is not indicated, consideration should be given to removal by the third decade when there is a high probability of disease or pathology and/or the risks associated with early removal are less than the risks of later removal.[1,13-15] Removing the third molars prior to complete root formation may be surgically prudent.[1] Factors that increase the risk for complications (eg, coexisting systemic conditions, location of peripheral nerves, history of temporomandibular joint disease) should be assessed. Referral to an oral and maxillofacial surgeon for consultation and subsequent treatment may be indicated. When a decision is made to retain impacted third molars, they should be monitored for change in position and/or development of pathology, which may necessitate later removal.

Supernumerary teeth

Supernumerary teeth and hyperdontia are terms to describe an excess in tooth number. Supernumerary teeth are thought to be related to disturbances in the initiation and proliferation stages of dental development.[16] Although some supernumerary teeth may be syndrome associated (cleidocranial dysplasia) or familial, most supernumerary teeth occur as isolated events.[17]

Supernumerary teeth can occur in either the primary or permanent dentition.[17-20] In 33% of the cases, a supernumerary tooth in the primary dentition is followed by the supernumerary tooth complement in the permanent dentition.[21,22] Reports in incidence of supernumerary teeth can be as high as 3%, with the permanent dentition being affected 5 times more frequently than the primary dentition and males being affected twice as frequently as females.[17-19]

Approximately 90% of all single tooth supernumerary teeth are found in the maxillary arch, with a strong predilection to the anterior region.[17,20] The anterior midline of the maxilla is the most common site, in which case the supernumerary tooth is known as a mesiodens.[17-20] A mesiodens can be suspected if there is an asymmetric eruption pattern of the maxillary incisors, delayed eruption of the maxillary incisors with or without any over-retained primary incisors, or ectopic eruption of a maxillary incisor.[18,22] The diagnosis of a mesiodens can be confirmed with radiographs, including occlusal, periapical, or panoramic films. Three-dimensional information needed to determine the location of the mesiodens or impacted tooth can be obtained by taking 2 periapical radiographs and by using either 2 projections taken at right angles to one another or the tube shift technique (buccal object rule or Clark's rule).[23]

Complications of supernumerary teeth can include delayed and/or lack of eruption of the permanent tooth, crowding, resorption of adjacent teeth, dentigerous cyst formation, pericoronal space ossification, and crown resorption.[24,25] Early diagnosis and appropriately timed treatment are important in the prevention and avoidance of these complications.

Because only 25% of all mesiodens erupt spontaneously, surgical management usually is necessary.[22,26] A mesiodens that is conical in shape and is not inverted has a better chance for eruption than a mesiodens that is tubercular in shape and is inverted.[25] The treatment objective for a nonerupting permanent tooth mesiodens is to minimize eruption problems for the permanent incisors.[25] Surgical management will vary depending on the size, shape, and number of supernumeraries and the patient's dental development.[25] The treatment objective for a nonerupting primary tooth mesiodens differs in that the removal of these teeth usually is not recommended, as the surgical intervention may disrupt or damage the underlying developing permanent teeth.[24] Erupted primary tooth mesiodens typically are left to shed normally upon the eruption of the permanent dentition.[24]

Extraction of an unerupted primary or permanent tooth mesiodens is recommended during the mixed dentition to allow the normal eruptive force of the permanent incisor to bring itself into the oral cavity.[25] Waiting until the adjacent incisors have at least two thirds root development will present less risk to the developing teeth but still allow spontaneous eruption of the incisors.[1] In 75% of the cases, extraction of the mesiodens during the mixed dentition results in spontaneous eruption and alignment of the adjacent teeth.[24,27] If the adjacent teeth do not erupt within 6 to 12 months, surgical exposure and orthodontic treatment may be necessary to aid their eruption.[26,28] The diagnosing dentist may consider a multidisciplinary approach when treating difficult or complex cases.

Pediatric oral pathology

Lesions of the newborn

Oral pathologies occurring in newborn children include Epstein's pearls, dental lamina cysts, Bohn's nodules, and congenital epulis. Epstein's pearls are common, found in about

75% to 80% of newborns.[29-32] They occur in the median palatal raphe area[29-33] as a result of trapped epithelial remnants along the line of fusion of the palatal halves.[31,33] Dental lamina cysts, found on the crests of the dental ridges, most commonly are seen bilaterally in the region of the first primary molars.[31] They result from remnants of the dental lamina. Bohn's nodules are remnants of salivary gland epithelium and usually are found on the buccal and lingual aspects of the ridge, away from the midline.[29,30,32] Epstein's pearls, Bohn's nodules, and dental lamina cysts typically present as asymptomatic 1-mm to 3-mm nodules or papules. They are smooth, whitish in appearance, and filled with keratin.[30,31] No treatment is required, as these cysts usually disappear during the first 3 months of life.[30,33]

Congenital epulis of the newborn, also known as granular cell tumor or Neumann's tumor, is a rare benign tumor seen only in newborns. This lesion is typically a protuberant mass arising from the gingival mucosa. It is most often found on the anterior maxillary ridge.[34,35] Patients typically present with feeding and/or respiratory problems.[35] Congenital epulis has a marked predilection for females at 8:1 to 10:1.[34-36] Treatment normally consists of surgical excision.[34,36] The newborn usually heals well, and no future complications or treatment should be expected.

Eruption cyst (eruption hematoma)

The eruption cyst is a soft tissue cyst that results from a separation of the dental follicle from the crown of an erupting tooth.[30,37] Fluid accumulation occurs within this created follicular space.[29,32,37,38] Eruption cysts most commonly are found in the mandibular molar region.[37] Color of these lesions can range from normal to blue-black or brown, depending on the amount of blood in the cystic fluid.[29,32,37,38] The blood is secondary to trauma. If trauma is intense, these blood-filled lesions sometimes are referred to as eruption hematomas.[29,32,37,38]

Because the tooth erupts through the lesion, no treatment is necessary.[29,32,37,38] If the cyst does not rupture spontaneously or the lesion becomes infected, the roof of the cyst may be opened surgically.[29,32,37]

Mucocele

The mucocele is a common lesion in children and adolescents resulting from the rupture of a minor salivary gland excretory duct, with subsequent spillage of mucin into the surrounding connective tissues that later may be surrounded in a fibrous capsule.[30,32,39-41] Most mucoceles are well-circumscribed bluish translucent fluctuant swellings (although deeper and long-standing lesions may range from normal in color to having a whitish keratinized surface) that are firm to palpation.[32,39,41] Local mechanical trauma to the minor salivary gland is often the cause of rupture.[32,39-41] At least 75% of cases are found on the lower lip, usually lateral to the midline.[39] Mucoceles also can be found on the buccal mucosa, ventral surface of the tongue, retromolar region, and floor of the mouth (ranula).[39,40]

Superficial mucoceles and some mucoceles are short-lived lesions that burst spontaneously, leaving shallow ulcers that heal within a few days.[32,39-41] Many lesions, however, require local surgical excision with the removal of adjacent minor salivary glands to minimize the risk of recurrence.[32,39-41]

Structural anomalies

Maxillary frenum

A high or prominent maxillary frenum in children, although a common finding, is often a concern, especially when associated with a diastema. A comparison of attached frena with and without diastemas found no correlation between the height of the frenum attachment and diastema presence and width.[42] Recent trends justify significantly fewer frenectomies.[43] Treatment is necessary only when the attachment exerts a traumatic force on the gingiva or it causes a diastema to remain after eruption of the permanent canines.[43]

Treatment should be delayed until the permanent incisors and cuspids have erupted and the diastema has had an opportunity to close naturally.[43] In an older child, if a frenum is present and the papilla blanches when the upper lip is pulled, removal can be indicated.[44] Again, the frenectomy should be performed only after orthodontic treatment is completed and the diastema is closed as much as possible. When indicated, a maxillary frenectomy is a fairly simple procedure and can be performed in the office setting.

Mandibular labial frenum

A high frenum sometimes can present on the labial aspect of the mandibular ridge. This is most often seen in the central incisor area and frequently occurs in individuals where the vestibule is shallow.[45] The mandibular anterior frenum, as it is known, occasionally inserts into the free or marginal gingival tissue.[45] Movements of the lower lip cause the frenum to pull on the fibers inserting into the free marginal tissue, which, in turn, can lead to food and plaque accumulation.[45] Early treatment is indicated to prevent subsequent inflammation, recession, pocket formation, and possible loss of the alveolar bone and/or tooth.[45]

Mandibular lingual frenum/ankyloglossia

Ankyloglossia is a developmental anomaly of the tongue characterized by a short, thick lingual frenum resulting in limitation of tongue movement.[33] It can be categorized into 2 types. Total ankyloglossia is rare and occurs when the tongue is completely fused to the floor of the mouth. Partial ankyloglossia is variable and encompasses the remainder of the cases.

The significance and management of ankyloglossia are very controversial. Studies have shown a difference in treatment recommendations among speech pathologists, pediatricians, otolaryngologists, and lactation specialists.[46,47] Most professionals, however, will agree that there are certain indications for frenectomy.

A short lingual frenum can inhibit tongue movement and create deglutition problems.[47] Frenectomy for functional problems should be considered on an individual basis. If evaluation shows that function will be improved by surgery, treatment should be considered.[47,48]

Ankyloglossia also can lead to problems with breast-feeding, speech pathology, malocclusion, and periodontal health. During breast-feeding, a short frenum can cause ineffective latch, inadequate milk transfer, and maternal nipple pain, all of which can affect feeding adversely.[49,50] When indicated, frenuloplasty seems to be a successful approach to facilitate breast-feeding.[49] Although not as common as once thought, speech pathology has been associated with ankyloglossia.[2,43,51,52] In such cases, frenectomy can be a treatment option that improves tongue mobility and speech.[52] It should not be performed, however, until an evaluation and therapy by a qualified speech therapist have been completed.[2] Ankyloglossia also has been associated with Class III malocclusion.[53,54] The abnormal tongue position may affect skeletal development. Although there are no clear recommendations, frenectomy in these cases should be deferred until a complete orthodontic workup, diagnosis, and treatment plan have been completed and any necessary refer-rals obtained.

Natal and neonatal teeth

Natal and neonatal teeth can present a challenge when deciding on appropriate treatment. Natal teeth have been defined as those teeth present at birth, and neonatal teeth are those that erupt during the first 30 days of life.[55] The occurrence of natal and neonatal teeth is rare; the incidence varies from 1:1,000 to 1:30,000.[56] The teeth most often affected are the mandibular primary incisors.[57] Although many theories exist as to why the teeth occur, currently no studies confirm a causal relationship with any of the proposed theories. The superficial position of the tooth germ associated with a hereditary factor seems to be the most accepted possibility.[56,57]

If the tooth is not excessively mobile or causing feeding problems, it should be preserved and maintained in a healthy condition if at all possible.[56,58] Close monitoring is indicated to ensure that the tooth remains stable.

Riga-Fede disease is a condition caused by the natal or neonatal tooth rubbing the ventral surface of the tongue during feeding and causing ulceration.[58,59] Failure to diagnose and properly treat this lesion can result in dehydration and inadequate nutrient intake for the infant.[58] Treatment should be conservative, if at all possible, consisting of smoothing rough incisal edges or placing resin over the edge of the tooth to round it.[56-59] If conservative treatment does not correct the condition, extraction is the treatment of choice.[56,59]

An important consideration when deciding to extract a natal or neonatal tooth is the potential for hemorrhage. Extraction is contraindicated in newborns due to risk of hemorrhage.[60] Unless the child is at least 10 days old, consultation with the pediatrician regarding adequate hemostasis may be indicated prior to extraction of the tooth.

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