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Pediatric oral anatomy

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Given the frequency with which operative intervention is undertaken in the pediatric oral cavity and oropharynx, knowledge of the anatomy is critical for all otolaryngologists. There are subtle, yet significant differences from adult oral anatomy that can affect the approach to operative intervention. Here, we present pediatric oral anatomy as it pertains to operative approach and technique.

Introduction

Pediatric anatomy is not just a scaled-down version of adult anatomy. Operative intervention is undertaken in the context of actively growing and developing structures. There are also differences in the types of procedures that are indicated in children. In otolaryngology, pediatric oral anatomy is no exception. The enlarging oral cavity and oropharyngeal space has changing anatomical relationships with surrounding neurovascular structures. Common pediatric oral procedures such as tonsillectomy, lingual frenulectomy, and cleft repair require a thorough understanding of this concept.

The pediatric oral cavity is composed of the lips, buccal mucosa, alveolar ridges and teeth, hard palate, anterior tongue, and floor of the mouth. It has an important role in air exchange, food processing, swallowing, and phonation. The oral cavity is continuous posteriorly with the oropharynx, including the soft palate, tonsillar fossae, posterior pharyngeal wall, and base of the tongue.

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Lips, cheeks, and oral vestibule

When approaching the lips, recognizing the subtle surface landmarks allows for good functional as well as cosmetic outcomes. The lips form the anterior border of and opening into the oral cavity. The upper lip begins immediately inferior to the base of the nose and extends laterally on both the sides to the alar sulci. The philtrum is a vertical depression in the midline of the upper lip and it is bordered by 2 pillars, or philtral ridges. The upper lip meets the lower lip at the corner of the mouth, or oral commissure. The lower lip extends inferiorly to the level of the mentolabial sulcus. There is a linear projection along both the upper and the lower lips which creates a border between the cutaneous lip and the vermillion, or red lip, which is called the vermillion border. Along the upper lip, the vermillion border has a midline depression associated with the philtrum, giving it the shape of an archery bow, also known as "cupid bow." The internal border of the vermillion is the red line, or wet-dry line, where the red vermillion skin meets the mucosa of the oral cavity. These are all important surface landmarks for ensuring good cosmetic outcome in procedures such as lip laceration repair and cleft lip surgery.

All the labial tissues are well vascularized and are supplied via branches of the facial artery in a ringlike fashion. Sensory innervation to the lips comes from the trigeminal nerve, via the infraorbital nerve, a branch of CN

V_2 to the upper lip, and the mental nerve, a branch of CN V_3 to the lower lip. Motor innervation to the muscles of the lips is similar to other muscles involved in facial expression and is through branches of the facial nerve.

Histologically, similar to the remainder of the face, the cutaneous lip is a keratinizing, stratified squamous epithelium. The vermillion is also composed of stratified squamous epithelium, but is less keratinizing, hairless, and translucent, revealing the color of the underlying capillaries. Deep to the dermis and subcutaneous tissue, the orbicularis oris muscle and the superior and the inferior labial muscles create the bulk of the lip. Internal to the muscle, there is a well-vascularized collagenous layer—the lamina propria—which also contains some glandular tissue. The inner surface of the lip is covered in the oral mucosa, a thick, nonkeratinizing, stratified squamous epithelium.

Technically, outside the oral cavity proper, the space between the alveolar ridges and the inner surfaces of the lips and cheeks is called the oral vestibule. It is continuous with the oral cavity posteriorly behind the last maxillary and mandibular teeth. Along the inner surface of the upper lip, there is a mucosal fold attaching to the buccal surface of the maxillary alveolar arch called the upper labial frenulum. The lower labial frenulum is a similar fold from the lower lip to the mandibular alveolar arch. There are some indications for labial frenectomy in children, including hypertrophied upper labial frenulum with dental diastema in the permanent dentition or impaired gingival hygiene.[1]

The mucosa of the inner lips is continuous laterally with that of the cheeks. Important anatomical points in the cheek mucosa include the openings, or papillae, of the Stensen ducts. The Stensen ducts allow parotid secretions to enter the oral cavity through openings in the mucosa at the level of the second maxillary molar on both the sides. These landmarks are helpful in identifying the small ductal openings and the ducts themselves during pediatric sialendoscopy.[2] Deep to the cheek mucosa and lamina propria, the buccinator muscle forms the framework of the cheek wall and functions as a muscle of facial expression. By pulling the cheeks in during chewing, it also assists in mastication, keeping food in contact with the teeth. Superficial to the buccinator muscle is the masseter muscle, a major muscle of mastication. Anterior to the masseter muscle, the buccal fat pad fills out the anterior contour of the cheek. Although significant in infants and young children, the buccal fat pad tends to lose volume with age, contributing to the ongoing change in facial features as children age.

Alveolar ridges and teeth

The maxillary and the mandibular alveolar ridges are the tooth bearing bony prominences of the respective bones. They contain alveoli, or tooth sockets, which are lined by cortical bone called lamina dura. The alveolar ridges and teeth are covered in a tightly adherent fibrous tissue and mucosa, which is referred to as gingiva.

In children, the teeth are an actively changing part of the anatomy. The deciduous teeth begin erupting at approximately 6-8 months of age, starting with the lower central incisors. From there, 20 deciduous teeth erupt including 2 central incisors, 2 lateral incisors, 2 canines, and 4 molars on the upper alveolar ridge, mirrored exactly on the lower alveolar ridge (Figure 1). In the United States, deciduous teeth are typically designated using a lettering system from A through T, with A being the most distal (or second) right maxillary molar and moving across the maxillary teeth from right to left and then coming back from left to right on the mandibular teeth and T being the second right mandibular molar. This system differs from the designation of permanent teeth that are numbered from 1-32, but in a similar directionality.

Tooth buds of secondary or permanent teeth are present in the alveolar arches near the roots of the primary teeth, starting approximately at 6 years of age until 12 years[3] (Figure 2). These developing teeth push on the roots of, the primary teeth, initiating root resorption and eventual shedding. During this age, any operative intervention for maxillary or mandibular fractures involving the alveolar arches requires special consideration for not only locations of the tooth roots but also the developing tooth buds.[4]

Palate

In the oral cavity, the palate forms the superior border, separating it from the nasal cavity and the nasopharynx. The structural relationships here are important during repair of cleft deformities. The hard palate forms the anterior two-thirds of the palate. It includes the horizontal processes of the palatine bones and the palatine processes of the maxillary bones. Embryologically, the hard palate is divided into the primary and the secondary palates. The primary palate develops from the fetal intermaxillary process and secondary palate from the horizontal shelves of the bilateral maxillary processes. Abnormal fusion of these processes is what leads to the cleft lip and palate abnormalities. The incisive fossa is a depression in the hard palate just posterior to the central incisors where the primary and secondary palates are fused. This fossa overlies the incisive foramen through which the sphenopalatine artery supplying the mucosa of the hard palate and nasopalatine nerves (branches of CN V) pass.

The hard palate is continuous posteriorly with the muscular soft palate. The muscles forming the bulk of the soft palate are the tensor veli palatini, levator veli palatini, palatoglossus, and palatopharyngeus. The levator veli palatini and tensor veli palatini muscles function together to elevate the soft palate and close off the nasopharynx during swallowing. In some children, abnormal insertion of these muscles onto the hard palate can contribute to eustachian tube dysfunction and velopharyngeal insufficiency. The palatoglossus and the palatopharyngeus muscles descend along the sidewalls of the posterior pharynx, attaching the hard palate to the lateral tongue and lateral wall of the posterior pharynx, respectively. They form the anterior and posterior tonsillar pillars and help to define the tonsillar fossae.