Tutorial

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Principles and Procedures of Orofacial Examination

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ABSTRACT

This article discusses various principles and clinical guidelines for a systematic examination of the structure and function of the orofacial areas. The article is intended to provide background information and an examination framework for the clinician who is concerned with describing oral form and function.

The examination of a patient in the typical clinical setting usually includes a description of the status and function of the facial and intraoral structures. Assessment of orofacial form and function provides a basis for understanding the physical system the patient is using and how speech and swallowing are propagated in that system.

In the typical examining situation in speech pathology, dentistry, and myofunctional therapy, the clinician is concerned with compiling sufficient information about the patient in a relatively short period of time. Consequently, efficient utilization of the orofacial examination will accomplish this goal. Since the examination findings may be sent to a physician or dentist, the author recommends the use of "orofacial examination" rather than "oral-peripheral examination" in clinical description and report writing. The use of "oral-peripheral" begs the question: "Peripheral to what?" Clarity of descriptions should be one goal of examination reporting.

Purpose

In this paper, principles and guidelines are provided for the systematic and efficient examination of the structure and function of the face and intraoral mechanisms.

Examination of the Face

General Considerations

In conducting an examination of the face, the clinician should remember that facial expression, coloration, skin conditions and other findings help to assess the general health and personality of the patient. General

appearance or expression (facies) is important and often characteristic. The child with a congenital heart defect usually presents an aura characterized by a blue or purple tint to the tissues of the lips, under the eyes, and around the cuticles of the fingers. These signs are important to recognize since children with heart problems are not good risks for surgery and associated general anesthesia. In such patients, speech problems of hypernasality, when present, often assume a secondary role to more important problems. Accordingly, the clinician should exercise caution in recommending surgery to correct hypernasality in patients with heart defects. This situation arises with some frequency in cleft palate patients, who have a 10% incidence of congenital heart defects (Gorlin and Pindborg, 1964).

Not all auras are associated with clearly observed physical symptoms as found in patients with heart defects. Some children possess indefinite characteristics that confuse the clinician, resulting in descriptions such as the "Funny Looking Kid Syndrome" (FLK). Rather than representing a definite constellation of findings, the "FLK" syndrome denotes that the clinician recognized that vague facial variations are present, but was unable to accurately describe them.

Frontal Observation of the Face

Normal facial structures are not exactly symmetrical on the two sides of the face, and differences should be recorded. The midline is a handy reference for the examiner to use in observing symmetry and function of the face.

The Upper Face Area. The eyes and adjoining areas constitute an important part of facial form. The many variations in spacing, degree of protrusiveness, and bordering bony and

soft tissue support account for many individual differences in facial form.

It is not unusual to find the orbits positioned on different planes in the vertical dimension. This is especially marked in children with hemifacial hypertrophy (Gorlin and Pindborg, 1964). In comparing the relative horizontal position of the eyes, the generalization can be followed that the face is five eyes wide. That is, there should be room for one eye-width in the space occupied by bony tissues that separate the eyes, as shown in Figure 1. This observation is helpful in determining whether the orbital globes are separated excessively. Such spacing between the eyes (hypertelorism) is a common finding in mental retardation and other syndromes. The individual with hypertelorism should *not*, however, be arbitrarily catalogued as mentally retarded. The interested reader can find a table of normal bony interorbital distances by age in the research of Currarino and Silverman (1960).

FIGURE 1. Frontal view of the face demonstrating the normal spacing between the eyes.

Individuals vary as to size of the bony orbits. This accounts for the observation of deep-set eyes (*enophthalmos*) or protrusiveness of the eyes (*exorbita*, *proptosis*, *exophthalmos*). Enophthalmos may also be related to orbital tissues which lose moisture or fat causing the eyes to sink into the sockets. Exorbita may be associated with hyperthyroidism or other metabolic factors.

One of the auras linked to unusual facies is the presence of *proptosis* (bulging) and *ptosis* (drooping) of the upper eyelid. The resultant appearance most often dominates the facial features. *Ptosis* of the eyelid need not accompany *proptosis*, however. When the eyelid is ptotic, the examiner should suspect damage either to Cranial Nerve III or to the cervical sympathetic nerve supply.

The inability to close the eyelids is seen with weakness or paralysis of Cranial Nerve VII. This can be evaluated by having the patient attempt to close the eyes tightly against efforts of the examiner to open the eyelid by pressing upward under the eyebrow. Evaluating the strength of the sphincteric response of the ocular muscles, and the stability of muscular resistance, provides a basis for commenting on the neuromotor status of

the upper face in all patients. In the normal, considerable ocular muscle resistance should be noted during attempts to force the eyelid open.

In examining the orbit area, the supporting areas below the orbits also contribute much to the appearance of the face. Underdevelopment of bony or soft tissues in the maxillary and zygomatic areas can dramatically modify facial appearance - the face can be made to appear either more horizontal or vertical. When tissues are *hypoplastic*, the eyes may seem more prominent. From a frontal view, hypoplasia can be assessed by palpation of suspicious areas to distinguish whether the reduction is because of deficiency in soft tissue or underlying bony support.

Examination of the external nose quickly reveals that deviations in the nasal septum are commonplace in the normal population. The variety of noses seen in clinical work is very impressive! The most important attribute of the nose (from the examiner's standpoint) is that the nasal airways are patent for breathing and speech purposes. Chronic nasal obstruction, especially if it occurs early in childhood, can produce narrowing of the nose and lead to mouthbreathing. This is thought by some clinicians to result in the development of an adenoid facies.

The nose is examined by: 1) palpating from the nasal bridge downward to identify any anterior septal deviation; 2) by observing the nares; and 3) examining the nasal cavity through the nostrils. The external nares may show variations in symmetry and width of alar cartilages. A useful "rule of thumb" in evaluating alar width is that this dimension should be equivalent with intercanthal width (space between the medial corners of the eyes) for normal lateral balance of the face. In individuals with repaired complete cleft lip deformities, the nasal ala may be flared laterally and inferiorly on the side of the cleft. This is related to the disturbance of the nasal floor, as shown in Figure 2. Additionally, there may be some reduction in the length of the column of tissue that separates the nostrils and joins the nasal tip with the base of the nose. Shortening of the *columella*, and related lateral flaring of the nasal alae, is characteristic of

the condition of bilateral complete cleft lip.

In examining the nasal cavity, the nostrils should be spread individually using either a speculum or, perhaps, part of a tongue blade. On the lateral wall of the nasal cavity, the clinician examines for the presence and color of the inferior nasal concha (or turbinate). The characteristic color of a normal turbinate is deep red. When the turbinate appears pale or gray, this suggests the possibility of allergic rhinitis (as with hay fever). At or near the midline of the nasal cavity is the septum. The examiner looks at the septum in relation to the turbinates. In instances where there is contact of the septum with the inferior turbinate, as shown by representation in Figure 2, the resulting nasal configuration can lead to hypernasality (anterior blockage on the affected side, and an excessively large opening in the opposite nasal chamber). The nasal configuration for the individual in Figure 2 is typical of many repaired unilateral cleft lip conditions and may account for residual hypernasality subsequent to pharyngoplasty in some cases. With air being recirculated on the side of the cleft (excessive nasal resonance) and increased nasal turbulence on the non-cleft side (excessive nasal emission), the preoperative hypernasal speech complaints are maintained by the unresolved anatomical problems in the nasal cavity. Such patients sometimes require nasal reconstruction to eliminate the speech and breathing problems. It is encouraging that these individuals can be identified initially by orofacial examination.

The *midface area* may show variations in amount of available tissue between the base of the nose and upper lip. This *philtrum* area is highly variable among individuals. This is often related to connective tissue variations in the upper oral vestibule (sulcus) or to the configuration of the dental arch. Absence of a vestibule, as in some repaired cleft lip and palate cases, may require surgical undermining to lengthen the philtrum and free the upper lip for more efficient function in sphincteric activities of the mouth.

In the noncleft individual, the length of the upper and lower lip is of considerable diagnostic importance to

FIGURE 2. Frontal view of the nasal cavity in a patient with a repaired unilateral complete cleft lip and palate. (From Mason and Grandstaff, 1971).

the myofunctional clinician. Children can be inappropriately identified as mouthbreathers who show adequate nasal respiration by aerodynamic studies. Such children are usually found to be lip incompetent rather than mouthbreathing.

Lip incompetence relates to separation of the lips at rest. Recent data indicates that lip incompetence is normal in children (Vig and Cohen, 1979). The upper and lower lips continue to grow vertically up to age 20 years, and the lower lip elevates considerably between the ages of 9 and 11 with an accompanying reduction in lip separation (Vig and Cohen, 1979).

The clinical implication of these data are that some spontaneous improvements in lip posture and seal occur with growth of the lips in the absence of any type of therapy (Vig and Cohen, 1979). Myofunctional procedures to improve lip tissue and seal, or to decrease mouthbreathing, should apparently be dispensed sparingly, or at least with recognition of other variables that can account for the clinical observation made that the lips do not meet in repose. In other words, while current therapies can improve muscle tone, there is no evidence that clinical procedures can "grow lips," or increase resting lip length. Further, the observation of lip incompetence does not automatically imply mouthbreathing. Where mouthbreathing is associated with a small posterior airway, working for a lip seal may not be physiologically desirable in some patients who are obligatory mouthbreathers due to respiratory demands. Where mouthbreathing is an unnecessary habit with a clear airway and adequate lip length, therapy for lip posture is appropriate. Obviously, the key to patient selection for such therapy is based upon a thorough evaluation of the airway.

The middle face and mouth area can be assessed efficiently by having the patient exaggerate productions of /i/ and /u/. These tasks involve symmetrical excursions of the facial musculature, permitting evaluation of the relationship of the mimetic muscles (muscles of facial expression) with the orbital ring around the mouth. The /i/ and /u/ tasks also constitute a basic neurological assessment of the integrity of the facial

nerve (Cranial Nerve VII). This should be supplemented by diadochokinetic testing of the lips on /p/. The rapid sequential responses of the lips on repeated utterances of /p/ may provide the examiner with information concerning the neuromotor readiness of the lips for speech production purposes.

The upper lip-line should conform to "Cupid's bow", the anatomical name for this line - the derivative of which is an example of anatomy as a descriptive science. If there is a deficiency in upper lip-line from cleft lip repair, there may be an underlying muscular deficiency. On exaggerated /u/, it would be expected to observe asymmetrical pursing of the oral sphincter in such cases. This observation may be appropriately followed by consultation with a plastic surgeon regarding eventual revision of the upper lip and underlying musculature.

If the upper lip musculature is not joined properly to form adequate muscular union across the midface, a typical related problem is drooping or protrusion of the lower lip. Since the lip area is a sphincter of musculature, when one part of the sphincter is

defective, sagging or weakness can occur at the opposite side of the sphincter.

Oral habit behaviors involving the lips can be detected in the form of severe chapping and/or indents in the vermillion border caused by lip sucking and chewing.

Examining the Lower Face. From a frontal view of the face, the mandible can be assessed in comparison to overall facial form. The role of the mandible in contributing to facial form is important. Figure 3 shows the overall growth cycle of the mandible in comparison with other tissues of the body. The mandible grows slowly and steadily in a child, tapering off somewhat between ages eight and twelve years, and then undergoing a pubertal and post-pubertal growth spurt up to around eighteen years. Additional increments in mandibular growth are seen into and past the twenties in some patients. The vertical portion of the mandible, the ramus, grows more slowly than the mandibular corpus during the elementary school years. In spite of growth differences within the two major parts of the mandible at various ages,

FIGURE 3. Main types of postnasal growth of various parts and organs of the body. Lymphoid, neural, general body, and genital types after Scammon (1930). Growth of the mandible and tongue extrapolated from data by Brodie (1952, 1961, 1962), Bjork (1963), and Woodside (1970). (From Mason and Proffit, 1974).

the ramus is generally about 1/3 shorter than corpus length at any age. This can be estimated by measuring from mandibular condyle to the angle of the mandible, and comparing this measure with the distance recorded from mandibular angle to chin point.

The prolonged growth potential of the mandible influences the progression of facial development changes observed from childhood into the twenties. Interruption of the growth pattern during any stage of development can be responsible for anomalous facial form. A classic example is the child who fractures a mandibular condyle with a resultant ankylosis of the affected joint area. If left untreated, a marked lower face asymmetry will develop. The restricted side of the mandible will appear shortened while ramus growth on the normal side appears elongated.

The mandibular condyles are isolated by placing the entire surface of two fingers vertically on each side of the head in front of the ear tragus. As the patient's mouth opens upon command, the condyles can be identified as they shift in and out of the mandibular (glenoid) fossa. In addition to isolating the condyles for purposes of measuring ramus height, the examiner has an opportunity to evaluate the symmetry of jaw opening on the two sides. As the patient opens the jaw, the examiner focuses visually on the central incisors of the mandibular arch to look for deviation of jaw movement off of the midline. If the mandible deviates to one side while the condyles are felt to move equally and symmetrically out of the glenoid fossa, it would appear that the mandible is smaller on the side where the deviation is seen. If, however, mouth opening is vertical (does not deviate laterally) at the front of the face while one condyle moves farther out of the fossa than the other, the side with greatest excursion out of the fossa is revealed as the smaller side of the mandible.

Other diagnostic characteristics of the mandible are best assessed from a lateral view of the face, and will be discussed in the appropriate section to follow.

Lateral Observation of the Face

The Facial Profile. Examination of facial features in the lateral dimen-

sion permits evaluation of the adequacy of the facial profile. As shown in Figure 4 there are four basic points to identify as referents for facial profile adequacy. These are: 1) the bridge of the nose; 2) the base of the nose; 3) the most prominent point on the chin; and 4) the base of the chin.

In a normal profile, the examiner should be able to connect points 1 to 3 with either a straight line or slightly convex line. Deviations of the lower or middle face from this imaginary reference can be described as either a *retrusion* (deviation posterior from the normal reference), or a *protrusion* (deviation in an anterior direction). The use of these terms permits descriptions of profile in the horizontal planes of space.

There are three basic facial patterns into which all facial skeletal combinations can be placed. Regardless of the superimposition of hard and soft tissue variations, the analysis

FIGURE 4. Lateral view of the face showing the points used to evaluate the facial profile: 1) the bridge of the nose; 2) the base of the nose; and 3) the most prominent point on the chin. An alternate and perhaps easier method is to use the eyebrow area as the upper reference. This divides the face into two equal parts as per eyebrow to point 2, and point 2 to base of chin (point 4). Thus at any age, using this method, upper face and lower face should account for 50% each of face height. (From Mason and Simon, 1977).

of mandibular and maxillary relationships to the cranial base and to each other prevails in a basic facial pattern. The influence of an anomalous condition (such as a swallowing variation) on the expression of the growth pattern over time is the special challenge for the clinician to understand.

The **Class One** facial pattern is considered normal, and refers to a good balance of skeletal and soft tissue components. The components of a Class One pattern are shown in block diagrams in Figure 5. One should always remember that ethnic characteristics alter concepts of profile evaluation (Peck and Peck, 1970).

The **Class Two** facial pattern (Figure 6) shows midface protrusion. This may be due either to maxillary protrusion or mandibular retrusion, or a combination of both. Such considerations relate to the denture bases or skeletal parts, not the teeth per se. Using the reference points shown in Figure 4, the clinician can identify midfacial protrusion by lateral facial analysis.

FIGURE 5. Class One facial pattern. (After Khouw, White and Proffit, 1970).

FIGURE 6. Class Two facial pattern. (After Khouw, White and Proffit, 1970).

The **Class Three** profile is characterized by procumbency of the lower face (Figure 7). Again, the relative position of the maxilla (deficient or retrusive) or mandible (protrusive), or a combination of each, may contribute to the Class Three pattern. It is interesting that although profiles may look alike, their etiology can be entirely different.

FIGURE 7. Class Three facial pattern. (After Khouw, White and Proffit, 1970).

In the vertical direction, the upper face accounts for about 40% of overall facial height in adults, while the lower face accounts for approximately 60%. While these figures are quite variable in children, these dimensions are of general use for all age groups. In the clinical situation, it is convenient to remember that lower facial height should generally be 20% greater than upper facial height (Bjork, 1947).

Upper facial height can be measured by placing the clinician's finger on the patient's nasal bridge (the upper limit of face height) with the thumb positioned at the base of the nose. While making sure to keep this dimension constant, remove the fingers from these points and reposition the index finger at the base of the nose with thumb now resting wherever it may touch on the chin. In the normal, the thumb fits into the soft tissue groove above the chin prominence leaving approximately 20% of additional facial height uncovered. Don't be too alarmed if you find in self examination that your thumb is resting under your chin! There is, of course, considerable variation in a normal population in the vertical dimension, and, apparently more variation among female adults.

In instances where lower facial height is reduced, it will probably be determined that the mandible is also retruded and reduced in overall size. Where lower facial height appears increased, excessive growth increments in the corpus of the mandible are expected to have occurred. These skeletal variations suggest accompanying dental problems, since the bony framework for occlusal relationships of the dental arch is modified. It should be noted, however, that a patient with a Class II or III skeletal pattern need not possess Class II or III dental characteristics. Nonetheless, dental malocclusions of Class II and III variety are typically attributed to skeletal form changes. Many can be treated successfully by orthodontic procedures, but severe problems most often require combined orthodontic and oral surgical (orthognathic) management for a stable result.

From a lateral view of the face, the examiner can study the configuration of each side of the mandible, with particular reference to the *mandibular plane*. The clinician is encouraged to palpate along the lower border of the corpus of the mandible. The mandibular plane should be roughly parallel with a plane established by a line connecting the upper margin of the ear to the nostril, in the lateral view.

A *steep mandibular plane* is a clinical finding in which there is an in-

FIGURE 8. Superimposition of mandibular plane types: normal (solid line); flat (dotted line); and steep (dashed line).

crease in lower anterior face height as in Figure 8. Often, this condition is seen with a short ramus, and a high posterior tongue position in the oral cavity. This can lead to a *skeletal* open bite malocclusion where the tongue adapts to this situation by resting forward against or between the anterior teeth. The mandible hinges open a few millimeters and the posterior teeth are seen to supraerupt while the anterior teeth are discouraged from erupting by the resting anterior tongue position. If this posture persists for an extended period, such as months or years, a skeletal open bite can be created. You will find in your clinical work that *skeletal* open bite malocclusions, almost without exception, will be accompanied by a tongue thrust swallow. Resist the temptation to blame the open bite on the swallow. The tongue thrust swallow is simply filling up a space that was already there. The resting anterior tongue posture, however, can be etiologic to the problem by creating the differential dental eruption pattern that causes supraerupted molars to contact prematurely and hinge the mandible open somewhat.

The Ears

In addition to assessing the profile from the lateral view, the clinician is interested in observing the status of the ears. When an external ear is malformed, the general term used most frequently to describe this is "microtia." A microtic ear may or may not be accompanied by closure (stenosis) or absence (atresia) of the external auditory canal.

External ear deformities are of clinical interest in that the outer ear is an embryonic derivative of the first branchial arch. Therefore, the presence of outer ear malformation should alert the examiner to the possibility of generalized variations in the maxilla and mandible. A poor correlation exists between the severity of the external ear malformation and the status of the middle ear cavity (Selder, 1971). Accordingly, it is important that air conduction audiometry be attempted in the presence of microtia and atresia.

Examination of the Intraoral Mechanisms

General Considerations

The process of intraoral examina-

tion involves making observations and decisions about form and function, normal and abnormal, and deficit and capability. The experience is therefore an exciting and difficult one and an especial challenge for the myofunctional therapist. There is a natural tendency for clinicians to generate cause-effect relationships following superficial evaluation of few variables in the oral cavity. This tendency can be avoided by developing an appreciation for the range of variation seen in the normal, and by assimilating signs and symptoms related to the abnormal.

Examination of the oral mechanisms proceeds logically if a systematic progression is followed. Observations should start at the front of the mouth and progress posteriorward in the oral cavity. Save the tongue for examination last, however. Tongue posture and functions should always be evaluated in light of contributing influences from adjacent anatomy.

The Oral Vestibule

As the upper or lower lip is pulled forward, the examiner can investigate the oral vestibule. The vestibule is lined with a pale mucosa which covers the inner surface of the lips and cheeks, and the periosteum of the jaws. Dentists prefer the term *gingiva* rather than gums to describe the dental periosteum.

Pyorrhea is a general term used to indicate most forms of inflammation of the gingiva. Where there is resorption of the gingival margins around the roots of teeth, the gingival disease may involve the presence of pus which can be squeezed out from the gingival margins. It is important to identify instances of gingival (gums) and periodontal (tooth attachment tissues) disease and make appropriate referral to a dentist since an individual can lose his teeth from periodontal disease in the absence of dental caries (cavities).

In addition to examining the oral vestibule to obtain a quick estimate of the general oral health of the individual, the vestibule should be examined for quantity and location of connective tissues. A midline frenum or frenulum is normal, as are small frenulae at the level of the cuspid teeth (canines). Multiple buccal frenulae in the maxillary vestibule are

a finding more prevalent among individuals with oropharyngeal malformations. Therefore, identification of extra connective bands in the buccal vestibule should alert the myofunctional clinician to the possibility of additional variations in the oral cavity and pharynx regions, especially cleft palate and submucous cleft palate.

The Dentition

Background Information

The child presents a unique dentition which is representative of his particular dental age. The dentition is time-linked to biological age, and as such is expected to exhibit constant change up through the final eruption of the permanent teeth. Therefore, the non-dentist may experience considerable difficulty in determining whether the state of the dentition represents a normal biologic change, or whether an anomalous condition has also extended to the teeth and supporting bone, or if there is a combination of effects. The tables in Zemlin (1968, pages 272 and 274) and Barrett and Hanson (1978, pages 22-25), which outline normal chronological development of primary and permanent teeth may be especially helpful in determining the chronological state of the dentition.

A tooth of primary importance in the dental arch is the cuspid because of its strategic location at the point of greatest curve in the arch. Removal of a single maxillary cuspid in the permanent dentition results almost universally in a midline shift toward the missing spot.

When the two dental arches are considered together in a contactual relationship, the most important teeth in each arch become the molar teeth. Their importance in occlusion is based upon the fact that they have large contacting surfaces for stability. Since the first molars erupt early and tend to be retained in the permanent dentition, occlusal relationships of the upper and lower dental arches are expressed with reference to first molar contacts.

The upper dental arch is longer and wider than the lower dental arch. Consequently, the upper teeth overlap the lower teeth around the entire dental arch. At the front of the arch, it is observed that the maxillary incisors protrude slightly ahead of the lower

teeth. In the posterior quadrants of the dental arch, this extension is also seen laterally, only not as pronounced as anteriorly. Dental *overjet* is a normal phenomenon expressing the horizontal relationship of the dental arches (anteriorly and posteriorly) in occlusion. An individual may have *excessive* overjet, however, such as the anterior discrepancy referred to generically as "buck teeth," as seen in Figure 9.

FIGURE 9. Dental overbite (vertical overlap) and overjet (horizontal overlap). The normal relationships are distorted for illustrative purposes. (After Graber, 1966).

Because of the added length and width of the maxillary alveolus, the upper teeth also overlap the lower teeth to a variable extent around the dental arch. That is, they cover over part of the mandibular teeth during occlusion. The term to describe this normal *vertical* overlap of teeth is *overbite*. Normal posterior overbite occurs when the upper back teeth cover over about 1 to 2 millimeters of the lower teeth crowns. At the front of the mouth, normal overbite is characterized by the upper incisors covering 1/3 of the crowns of the lower incisors. When a lower tooth is completely obscured by an upper tooth anteriorly, excessive overbite or *closed bite* is diagnosed. Since overbite is a normal phenomenon, exaggerations of overbite require an additional descriptive term to specify that the condition is abnormal, such as *excessive* overbite. The terms "overjet" and "overbite" are being replaced in dental vocabulary with "horizontal overlap" and "vertical overlap", respectively. These terms are easier to use, and easier to remember.

Since occlusion is a concept that pertains to the biting relationships of

the dentition in the jaws, some contact between teeth in the jaws is desirable around the entire dental arch. To facilitate this contact in light of the disparity in size of the two jaws, the mandible is positioned slightly ahead of the maxilla. When the teeth are in occlusion, therefore, it is not surprising to find that the mandibular first molar is positioned one-half tooth ahead of the maxillary first molar. In describing this situation by intraoral inspection by spreading the cheek laterally to afford inspection of the molars, it is seen that the cusp farthest forward on the outside of the maxillary molar fills in the groove which is in the middle of the first mandibular molar. In more appropriate terminology, the mesial-buccal cusp of the maxillary first molar occludes in the buccal groove of the mandibular first molar. These relationships can be seen in Figure 10. Further review of occlusal relationships can be found in Bloomer (1971), Zemlin (1968), Graber (1966), and Barrett and Hanson (1978).

FIGURE 10. Normal occlusion as seen in the adult dentition.

When occlusion is abnormal, the biting relationships of the jaws are modified. Occlusion, and malocclusions are currently described by an old system devised by Edward Angle (1907) and based upon horizontal relationships between the teeth. This system of classification has some inherent shortcomings, and newer systems of classification have been developed, such as by Ackerman and Proffit (1969). (See also Proffit and Ackerman, 1973). The Angle system prevails at present and is a convenient way of communicating information to individuals in dentistry and speech pathology. It should be noted that dentists prefer to use the designations of occlusal classes used by Angle, rather than the descriptive

terms such as "mesi-occlusion" and "distocclusion".

Malocclusions signify not only that the biting surfaces of the teeth fail to meet properly, but may also signal the presence of pain and degeneration of the temporomandibular joint area, or disease processes in the gingival and alveolar tissues. The molar relationships characteristic of the classes of malocclusion are shown in Figure 11.

Specific Dental Conditions. Of the many occlusal conditions seen in children that are within normal limits at various ages (such as end-on-end molar contacts between ages 5-8 years), some conditions are noteworthy and merit referral to a dentist. Such a situation occurs where the upper teeth lack the normal horizontal overlap relationship with the lower teeth. The condition of *crossbite* should be corrected in childhood if the crossbite involves more than one opposing pair of teeth. This condition, if left uncorrected, can result in occlusal problems when the permanent dentition erupts. The myofunctional therapist can play an important role in identifying children whose teeth are in crossbite, and in referring such children to dentists.

FIGURE 11. Representation of occlusal classes as seen in a buccal (facial) view of the right first molars: Class I occlusion (solid lines); Class II (dotted lines); and Class III (dashed lines). Additional detail is available in Zemlin (1968), Bloomer (1971), or Graber (1966).

When the upper teeth do not cover over part of the lower teeth at any given point along the dental arch, the teeth involved are said to be in *open bite*. The dental condition of openbite malocclusion has been a controversial topic in dentistry, speech pathology and myofunctional therapy for a long time because of the tongue thrusting behaviors that often accompany anterior openbite. Many clinicians feel that tongue thrusting is the cause of openbite. This appears to be a logical association if one only considers what is seen by clinical inspection. It should be noted that anterior or posterior open bite malocclusions may be related to dental eruption problems, or to skeletal problems. Also, persistent thumb sucking with distortion of the dental arch and delayed eruption of incisor teeth can result in dental and skeletal anterior open bite (Barrett and Hanson, 1978). Where anterior open bite and tongue thrusting coexist, the tongue thrust is probably the result of the dental condition rather than the cause. An anterior resting tongue posture may be implicated as an etiologic agent.

A clinical perspective about tongue thrust and open bite that seems logical in light of current data is to forget about form-function paradigms for designing therapy, and, instead, select goals that represent what you as a clinician can do. If your desire is to reposition the tongue at rest, in speech or during swallowing, this should be so stated. To go beyond this and assume responsibility for muscle balance or tooth relationships as a function of your therapy is unwarranted. Evolving clinical experience and documentation in myofunctional therapy indicates that tongue functions can be modified in spite of anterior open bite or incisor protrusion (Barrett and Hanson, 1978). If so, this is what should be claimed and performed.

Special Techniques for Dental Examination. To evaluate occlusal relationships, the clinician should instruct the patient to "bite on the back teeth" and separate the lips. This procedure is recommended since it is common for a patient to protrude the mandible and contact the mandibular and maxillary incisors end-on-end when attention is focused to the front of the

mouth. The recommended procedure usually eliminates the tendency to extend the mandible.

With teeth in contact, the antero-posterior, transverse, and vertical relationships of the denture are noted. The clinician should first note the dental midlines, as compared with the skeletal midlines. Where growth deviations have occurred, asymmetries in the midlines are expected findings.

Next, the clinician should count the number of teeth on each side of the midline in each jaw. Missing or extra teeth are common findings in patients with facial anomalies. The photos in Zemlin (1968, pages 271-275) or Barrett and Hanson (1978, pages 20-30) will clarify any confusion associated with the appearance of the primary and permanent dental arches.

Third, the clinician should evaluate posterior occlusal relationships as per the occlusal classes discussed above. The information shown in Figure 11 is designed to be helpful in identifying the occlusal relationships of the first molars.

While in occlusion, the patient should be asked to produce several speech sounds in isolation, especially /s/, /z/, /f/, and /v/. Although these sounds may not typically be produced by the patient with teeth in occlusion, the standardization of airspace dimensions and increases in pressure in the oral cavity can unmask a variety of functional relationships. For example, a child who usually exhibits an interdental lisp may be able to articulate /s/ surprisingly well with teeth together. This position can also unmask and/or counteract any habit pattern related to the protrusion of tongue and mandible on the selected sounds.

If the patient demonstrates a Class II Division One malocclusion, examination of the anterior dentition in occlusion should reveal excessive overjet. Such patients may also have problems with anterior fricative productions. These individuals should be instructed to produce /s/ with teeth in occlusion, and again for comparison, with incisors in an end-to-end relationship. This is accomplished by rotating the mandible forward until the incisal edges contact. It is not uncommon for /s/ to be produced correctly in such ex-

amination testing when the anterior airway dimension is constricted by approximating the front teeth end-to-end. In selected instances, the clinician may recommend teaching /s/ to this patient with mandible rotated forward as a means of adapting to the problem created by excessive anterior overjet. If the patient also has an open bite malocclusion anteriorly, this procedure may not be successful without added reduction of airspace by the tongue tip.

Finally, the patient should be instructed to open the mouth as wide as possible while the examiner notes the general state of each tooth. Decayed teeth, evidence of rampant caries, broken cusps on molars, and excessive crowding during eruption stages should be brought to the attention of a dentist.

Although dental problems are often linked with speech problems in individual cases, there is no basis for projecting a one-to-one correlation between the presence of dental abnormality and speech problems. Too many children with missing lateral incisors have normal /s/ productions to discourage the speech clinician from working on /s/ with those frontal or lateral lisps where incisor or canine teeth may be missing. The adaptation of speech function to oral form variations is a naturally occurring phenomenon that may, however, require some therapeutic encouragement in selected cases.

The Hard Palate

Since the hard palate is a bony platform into which the bulk of the soft palate finds attachment and support, it is logical to assess the hard palate before the velum. Inspection of the hard palate is most easily accomplished with the patient extending the head backward. This position is recommended because it provides exposure of the entire hard palate. Unlike the soft palate, there are no anatomical characteristics of the hard palate that would interfere with the examination as a function of head posture.

The primary guidelines for assessing the hard palate are midline coloration and location of the posterior

border. Normal midline colors are pink and white, whereas a blue tint on the midline should generate suspicion about the adequacy of the bony framework of the palate. Individuals with submucous cleft palate deformities often have a bluish tint at the midline of the hard palate and soft palate, denoting that the blood supply is abnormally close to the mucosal surface.

When a blue tint is seen lateral to the midline of the hard palate and taking the configuration of an oval, this is most likely associated with a developing *torus palatinus*. This is a bony variation which develops in about 1 in 5 individuals (Schaumann et al, 1970). A *torus palatinus* is an extra growth of bone (a benign exostosis) that develops over the mid-palate suture line of the hard palate. It begins to express itself in the child at around age six years, sometimes first as an oval coloration, and growing at varying rates until a prominent ridge of bone is clearly seen covering the midline. The blue coloration associated with a *torus* in some children is thought to be the outline of the displaced blood supply at the lateral edges of the tissue proliferation. At adulthood, the coloration distinction often disappears. A palatal *torus* only poses a problem in some adults who undergo fitting of a denture in the maxillary arch.

The location of the posterior border of the hard palate can usually be identified by the color differential between hard palate and soft palate. The characteristic scalloping of the posterior border of the hard palate aids in this identification in the normal as seen in Figure 12. The clinical guideline for evaluating the length of the hard palate is to connect an imaginary line between the posterior borders of the maxillae (tuberosities of the maxilla). The posterior nasal spine of the hard palate should fall within this reference line. Palpation along the midline for the posterior nasal spine should also be performed when the coloration differences are not clear, or in those instances where a submucous cleft of the hard palate is suspected. The intraoral and radiographic signs of the expected consequences of a normal and submucous cleft of the hard palate are shown in Figure 12.

FIGURE 12. Intraoral and radiographic findings in two individuals sustaining a vowel phonation. Normal findings (left) and anomalous findings (right) are portrayed in the hard palate, soft palate, and uvula. See text for discussion. (adapted from Mason, 1973a).

The contour or vault of the hard palate has been a subject of much discussion in speech pathology, dentistry and medicine. The height of the hard palatal vault is largely related to the width of the maxillary arch. Accordingly, those individuals with wide maxillary arches tend to have flat palatal vaults, and vice versa. Although the contour of the hard palate may influence lingual-alveolar contacts during speech, most individuals with unusual (especially, constricted) vaults learn to adapt by moving those tongue placements to a lower level against the gingival margins of the incisors. Individuals who have not adapted and whose problematic speech is related to the anterior alveolus, should be taught a different location for tongue contacts in speech therapy.

A determinant of maxillary arch form variations has been linked by many to oral habits such as thumb sucking. In most instances, speech behaviors are expected to adapt to form variations of the hard palate in spite of the unusual nature of the maxillary arch in many thumb suckers.

The Soft Palate

Controlling Examination Artifacts.

The ideal position for examining the soft palate is one which reflects the typical intraoral relationships used by the individual in speaking. For the majority of patients, this will entail sitting erect in a chair with eyes focused straight ahead. Accordingly, the ex-

aminer should resist the temptation to have the patient extend the head backward to afford easier inspection of the soft palate. Studies indicate that modification of the "natural" head posture can distort muscle relationships in the head and neck (Mason and Zemlin, 1966; McWilliams et al, 1968). These changes produce physiologic differences which do not reflect the normal function of the velum. Hence, intraoral inspection of typical muscular function of the soft palate should be accomplished with head in a natural, upright position. The author recommends seating patient and examiner in a relationship so that the patient's mouth, with head erect, can be aligned in a horizontal plane with the eye level of the examiner, as shown in Figure 13. (Mason and Grandstaff, 1971).

Assessment of velar elevation should not be attempted while the patient protrudes the tongue. The anterior faucial pillars attach inferiorly into the lateral borders of the tongue and are therefore pulled forward with the tongue during lingual protrusion. If the palatoglossus muscles are contracted excessively, the range of velar elevation can be restricted.

As the patient depresses the mandible to permit examination of the oral cavity, notation should be made of the position of the mandible for maximum

FIGURE 13. Tracing of lateral cephalometric x-ray films of patient phonating "ah," and with soft palate at rest (insert). During phonation, the clinician can identify the velar dimple by intraoral inspection (adapted from Mason and Grandstaff, 1970, 1971).

mouth opening. This position is unfortunately selected by some individuals in response to instructions to open the mouth. It is emphasized that this is *not* a recommended patient posture for examination. With mouth locked open, the musculature of the pharynx is also immobilized. This is due to the functional relationship between the oral and pharyngeal sphincters, as determined by anatomical communications between these areas. The oral ring of musculature connects with the pharyngeal ring at the pterygomandibular raphe, where fibers of the buccinator join with those of the superior constrictor. Upon dissection of the muscle bundles in this area, one is impressed with the continuity of many muscle bundles joining the buccinator and superior constrictor (Zemlin, 1972). As a consequence of the reciprocity between these oral and pharyngeal valves, when the mouth is open *maximally*, velar activity is *minimal*. Conversely, the individual who exhibits passive anterior oral activity during speaking also tends to possess hypernasal voice characteristics.

Examination of the function of the intraoral structures is recommended with the mouth open 3/4 of maximum distance. The comfort of the patient in maintaining this mouth opening can be checked by moving the mandible laterally to insure the facial muscles are not rigid.

Considerations And Guidelines In Velar Examination. Evaluation of the soft palate requires integration of a number of anatomical and kinesiological factors. A primary factor relating to the velum is adequacy of muscle union at the midline. The velum is, therefore, best examined in phonation when contraction of velar muscles is outlined under the mucosal surface. The examiner will be especially interested in the midline color of the velum, which should normally be pink and white, similar to that found in the hard palate. When the midline appears blue or purple, the presence of a submucous cleft of the velum is signalled. This indicates muscle deficiency at and across the midline of the velum and is usually accompanied by an "A" shaped, abnor-

mal, anterior coursing of velar musculature into the area of the hard palate. The normal communications of soft palate and hard palate are by attachments of velar musculature onto the aponeurosis at the posterior edges of the hard palate. In a submucous cleft of the hard palate, the aponeurosis forms along the margins of the bony cleft underlying the mucosa. A submucous cleft of the hard palate influences the soft palate by shortening the functional and overall lengths of the velum, as shown in Figure 12.

Some individuals with submucous clefts have normal nasal resonance balance. This is often due to the presence of adenoidal tissue which aids in obturating the excessive nasopharyngeal space created from anterior velar displacement. It is critical that the adenoid is maintained in these patients to insure adequate velopharyngeal function for speech. In such cases, the normal involution process of the adenoids does not usually render the individual hypernasal because the soft palate accommodates to the increased pharyngeal depth by stretching in phonation (Pruzansky and Mason, 1969).

For diagnostic purposes, the *effective length* of the velum is a more critical designation than overall velar length. The effective length of the velum represents that portion of the elevated soft palate which obturates the nasopharyngeal port. The effective velar length is defined as the amount of tissue filling the space between the posterior border of the hard palate and the posterior wall of the pharynx, measured in a line with the plane of the hard palate, as shown in Figure 13 (Calnan, 1969; Mason and Grandstaff, 1971).

The effective length of the velum can be extrapolated from the intraoral identification of the point where the soft palate buckles or dimples during phonation, in relation to the anteroposterior diameter of the pharynx. The velar dimple on the oral surface of the soft palate is an indication of the point of maximum velar elevation on the nasal surface of the velum. The farther forward that the dimple occurs on the elevated velum, the less the effective length of the velum. The

myofunctional clinician can estimate effective velar length by intraoral identification of the velar dimple, as depicted by the x-ray tracings in Figures 12 & 13 (Mason and Grandstaff, 1971; Mason, 1973a).

The dimple of a normal elevated soft palate is seen to occur about 3 to 5 millimeters in front of the posterior border of the soft palate. This represents a dimpling point at approximately 80% of the total length of the velum, including the uvula. In Figure 12 it is demonstrated that although the overall resting length of the velum is normal in both cases, the soft palate on the right buckles at approximately 50% of its overall length during phonation. This indicates a short effective length of the velum. In this situation, the abnormal muscle architecture and attachment cannot be remedied by speech therapy exercises (Mason and Grandstaff, 1971).

In addition to identifying the location of the velar dimple, it is also important to assess the amount of elevation of the soft palate. A normal velum elevates to the plane of the hard palate, and can also increase in overall length by stretching in phonation (Pruzansky and Mason, 1969). The judgment of whether the velum moves superoposteriorly with a "minimum," "moderate," or "excellent" range of excursion is valuable for comparing the function of the soft palate with activity in other parts of the velopharyngeal sphincter.

The Uvula

The uvula is often inappropriately regarded as a benign and innocuous extension of the soft palate. In spite of the fact that the uvula plays no important role in speech, it is treated as a separate category from the velum in this article because of the diagnostic importance of uvular variations. It is known that about 1 in 75 individuals has a bifid uvula (Meskin et al, 1964). Bifidity of the uvula can occur as an unrelated and isolated finding. However, the coexistence of bifidity of the uvula with submucous clefts of the hard and soft palates and excessive nasopharyngeal dimensions should be recognized (Pruzansky, 1960; Mason and Pruzansky, 1965). A

bifid uvula often goes unnoticed until the cleft uvular tags are separated by a conscientious examiner.

A bifid uvula which is held together by mucous can be identified initially by observing the heart-shaped scallops at the base of a bifid uvula. Any suspicion about the integrity of the uvula should be followed by attempts to separate it at the midline by gently stimulating the uvula with a tongue blade.

When a bifid uvula is confirmed, the examiner should check carefully in the areas of the hard palate, soft palate, and pharynx for other variations. Those individuals with bifid uvula who are candidates for adenoidectomy should be reviewed by lateral x-ray examination if the pharyngeal depth appears to be questionable by intraoral examination. An x-ray evaluation technique for such patients has been proposed by Mason (1973a).

Although bifidity of the uvula may not be a remarkable finding in a selected case, when bifid uvula is present, the clinician should be suspicious about the anatomy of the oral cavity and pharynx until these areas are closely inspected (Mason, 1973b).

Other variations in the uvula suggesting the same concern about adjacent areas as bifid uvula include a short uvula, thin uvula, and missing uvula. These variations have been found in accompaniment with submucous clefts and other abnormal findings (Mason and Pruzansky, 1965).

The Fauces

The myofunctional clinician should evaluate the area of the faucial isthmus as a part of the intraoral examination. Of special interest is the determination of the degree to which the faucial (or palatine) tonsils, if present, reduce the diameter of the faucial isthmus. Reduction in the faucial airspace can impede the normal flow of air into the oral cavity (Ricketts, 1968).

It is usually difficult to observe the bulk of the tonsillar masses in children due to the high position of the tongue in the oral cavity. In such situations, diagnostic information

about the presence and size of the faucial tonsils can be obtained by observing the uvula. If the uvula appears to be positioned in front of the posterior faucial pillar, as shown in Figure 14, this signals a history of large tonsils. Enlarged tonsillar masses displace the faucial pillars one from the other. The posterior faucial pillar is pushed away from the tonsils and the uvula often appears to have moved to an anterior position (Figure 14).

While much has been speculated about the role of the faucial tonsils in speech production, in most instances they are not a factor. The tongue usually adapts to the presence of enlarged tonsils by moving to a forward or lower position in the oral cavity. However, some tongue thrusting in children has been linked to reduced faucial airway size from enlarged tonsils (Ricketts, 1968).

The Pharynx

The clinician is afforded a view of the oropharynx during intraoral examination, while velopharyngeal closure efforts take place in the nasopharynx above the level observed perorally. Nonetheless, valuable information about velopharyngeal activity can be obtained by viewing the oropharyngeal area. A specific technique for evaluating velopharyngeal closure has been reported by Mason and Grandstaff (1971).

The anteroposterior depth of the nasopharynx is difficult to estimate by intraoral inspection, and becomes a

highly subjective judgment. Nonetheless, the clinician should evaluate this dimension in relation to the effective length of the velum during sustained phonation of "ah." Notation should be made of any movement of the posterior wall of the pharynx. Movements may be seen to occur in almost any direction (including posteriorward) and it is also common for no pharyngeal wall movement to be observed during phonation. The maximum amount that the posterior wall is expected to move anteriorly is 3 millimeters (Hagerty et al, 1958).

In some individuals a Passavant's cushion is observed on the posterior wall of the pharynx. This is a bunching up of the superior constrictor musculature as a horizontally-directed tissue prominence, seen at the approximate level of the hard palatal plane. It should be noted that, when present, the appearance of Passavant's bar is related *only* to functional activities of the velum and is not seen at rest. It appears in approximately 1/3 of the cleft palate cases and occasionally in normal speakers. The presence of a Passavant's pad should lead to a suspicion about the integrity of the velopharyngeal mechanism (Calnan, 1957; Smith, 1964). Contrary to popular belief, Passavant's cushion is *not* regarded as a typical clinical finding.

The adenoid mass, when present, may be regarded as the most anterior projection of the posterior pharyngeal wall. Adenoidal tissue cannot be observed in its entirety by unaided intraoral inspection in that the bulk of the adenoid is located in the naso-

FIGURE 14. Intraoral views comparing the configuration of the fauces without tonsils (left) and with tonsils (right). Note the anterior appearance of the position of the uvula, often seen when large tonsillar masses are present. See text for discussion.

pharynx. Ideally, the clinician should examine the velo-pharyngeal port and adenoid mass using a dental or guttural mirror, but this procedure is not feasible in most clinical settings.

One of the most obvious ways of determining whether adenoids are intact is to ask the patient. In addition, the clinician can equate the subjective appearance of the nasopharyngeal airspace with what is heard as the patient phonates. An individual judged to have a deep pharynx, but with normal nasal resonance balance, is probably contacting the velum against the adenoid pad during phonation to achieve a velo-pharyngeal seal.

Considerable diagnostic attention has been directed to the medial movement patterns of the lateral pharyngeal musculature (Podvinec, 1952; Chase, 1960; Morley, 1967; Kelsey et al, 1972). Where velar elevation is minimal or deficient, patients are often recommended for speech therapy because of compensatory medial movement of lateral pharyngeal musculature. Frontal cinefluoroscopy reveals that medial activity of the lateral pharyngeal walls, seen at the level of intraoral inspection, is not highly predictive of pharyngeal wall movements at the nasopharyngeal sphincter (Young, 1970; Mason, Young and Stallworth, 1973). Accordingly, the clinician should avoid being too encouraged about a hypernasal individual's potential to respond to speech therapy *solely* on the basis of observed medial activity of the lateral pharyngeal walls. However, active medial movements of lateral pharyngeal muscles during phonation substantiate that the nervous supply to the pharynx is intact.

The pharyngeal gag response, which is not a true reflex, can occasionally be a useful diagnostic sign. This activity may take a variety of forms. In the neurologically impaired individual, it can be heightened or diminished depending on whether damage is central or in the peripheral nervous system. Some individuals with intact nervous systems, however, will not respond to gagging stimuli.

Gagging is accomplished by either pressing firmly on the base of the tongue with a tongue blade, or stimulating the velum with the blade. Individuals who fail to demonstrate a

gag with these procedures often are successfully gagged by stimulating the posterior pharyngeal wall with the tongue depressor.

Gagging the patient will result in maximum excursion of the velum in an upward and posterior direction. This activity represents the potential of the velum to function. Also, marked medial displacement of the lateral pharyngeal muscles is expected.

The contraction of pharyngeal muscles produced by gagging provides a comparison with the pharyngeal muscles responses seen during phonation. While such differences may be of general curiosity, they probably offer nothing of value in treatment planning considerations. Altogether, gagging an individual is most likely an interesting inclusion into the oropharyngeal examination sequence, but of little value.

The Tongue

The tongue is the most adaptable organ of articulation. It has the capability to adjust to many of the structural variations found in the oral cavity. The postural and movement adaptations of the tongue are apparently made in response to structural variations and spaces available in the oral cavity (Subtelný, 1970). Due to its adaptive nature, it is appropriate to evaluate the tongue last in the sequence of orofacial examination, after variations in the structures and spaces contiguous to the tongue are identified.

The size of the tongue is impossible to determine accurately in living specimens due to its adaptive nature. Nonetheless, some notion as to the relative size of the tongue should be estimated in selected patients. Deviation in the overall size of the tongue is not a common finding in the caseload of any clinician (Tulley, 1969). Due to the growth discrepancy between tongue and jaws, especially in the elementary school years, a child may appear to have a tongue too large for the oral cavity. The situation is usually not one of macroglossia, but of disproportionate tongue size in relation to jaw and oral cavity size (Subtelný, 1970). (Macroglossia can be seen in patients with hemangioma of the tongue.) The clinical test for macroglossia involves having the patient bite down. If the teeth can ap-

proximate without biting the tongue, a case cannot be made for a diagnosis of macroglossia, in the view of many physicians.

There are many instances in children where the oral cavity is restricted in size and the posterior oral airspace dimension is reduced. This situation requires adaptive positioning and movements of the tongue. Such children have sometimes been subjected arbitrarily to tongue retraining exercises without appropriate regard for the presenting morphology. Subtelný (1970) points out that tongue adaptation is not always feasible, (either naturally or with training) when morphological limitations are present in the oral cavity and pharynx. In spite of this, for some patients, myofunctional procedures have demonstrated improvement in tongue posture and functions (Barrett and Hanson, 1978).

There is evidence to indicate that tongue movements for speech and non-speech activities show little learning reciprocity, as these movements are mediated by different control mechanisms in the central nervous system (Hixon and Hardy, 1964; Murphy, 1966; Shelton et al, 1966). Consequently, there is no logical rationale for testing non-speech tongue movements (such as swallowing) to assess the potential for tongue function in speech activities.

Protrusion and lateralization activities of the tongue provide basic information about the integrity of the hypoglossal nerve, and are suggested for use in screening Cranial Nerve XII function. Deviations of the tongue at rest and upon protrusion and lateralization should be correlated with information obtained from testing the pharyngeal gag response and from oral diadochokinetic testing. Suspicions about central or peripheral nerve damage should be based on several observations.

The degree of neuromotor maturation of the tongue for speech can be estimated in children from lingual diadochokinetic testing. In testing lingual function of rapid repetitions of "tuh" and "luh", a child under five years of age may show an anteriorly-directed tongue tip pattern in place of lingual elevation. This is a normal, expected pattern for a child of this age.

An alternate pattern seen in

children below age 7½ years on rapid "tuh" and "luh" repetitions is positioning the tongue tip interdentially and producing the sequence with vertical movements of the mandible as the primary gesture. By age 7 or 7½ years, a child should have experienced sufficient neuromotor maturation to produce rapid movements of the tongue independent of *mandibular assist*. Consequently, the child who retains a mandibular assist on diadochokinetic tasks at age 7½ or older, is suspected of having a neuromotor delay for speech, especially if exhibiting difficulty in elevating the tongue tip in speech activities.

In diadochokinetic testing with "tuh" and "luh", it is recommended that the examiner focus on the *pattern* of tongue movement and the *consistency* of contacts made, rather than counting repetitions per second. On testing with "kuh" (which is probably of limited value for assessing the posterior tongue), the gestures of the tongue are expected to occur more slowly. This relates to the added tongue mass posteriorly and the sparse motor and sensory innervation, in comparison with the front of the mouth.

In evaluating tongue function by intraoral inspection in tongue thrusters, it is suggested that diagnostic emphasis be placed on resting tongue posture, airway size, and skeletal growth variations (Ricketts, 1968; Subtelny, 1970; Mason & Proffit, 1974). Observed variations may be especially related to growth discrepancies involving the jaws, or disproportionate size between tongue and jaws that results in oral form changes and an anterior resting tongue posture (Subtelny, 1970; Speidel et al, 1972). This diagnostic emphasis on anatomy contiguous to the tongue appears to be a logical and conservative approach for relating lingual function variations to the orofacial milieu.

The clinician will also be interested in the relationship of the lingual frenum to speech production. Many individuals are able to speak normally in spite of restricted anterior tongue movements from a short lingual frenum. Too often, a short frenum is inappropriately isolated as the factor which accounts for delayed speech development.

The frenum can be evaluated by having the patient attempt to contact the tongue tip against the maxillary alveolus while biting on a tongue blade placed between the molar teeth. Many children who cannot elevate the tongue tip this high, however, demonstrate normal speech. If the child can contact the maxillary alveolus with the tongue tip, the length of the frenum is probably adequate for speech purposes. Such individuals may produce linguo-alveolar sounds by protruding the tongue tip in a compensatory movement against or between the teeth. This is a natural adaptation for a frenum which restricts the full range of anterior tongue movements.

Summary

The principles and guidelines in this paper represent some important factors of orofacial examination. The procedures of examination follow a logical progression of observations. Delineations should be made between form and function and their interactions in the facial area, oral cavity, and pharynx.

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Orofacial Examination Checklist

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(The following examination forms parallel the information in the preceding article by Dr. Mason. They were first published as an appendix to the article, "An Orofacial Examination Checklist," by Mason and Simon in "Language, Speech, and Hearing Services in Schools," July, 1977, Vol. VIII, No. 3, pp. 155-163, a publication of the American Speech-Language-Hearing Association, and are reprinted here with permission from the Director of ASHA Publications Office and from both authors. Editor)

Patient name: _____ Age: _____ Date: _____
Examiner: _____

I. Facial Characteristics

- A. General appearance: normal color _____; normal symmetry _____;
adenoid facies _____; other _____.
- B. Frontal view
1. eye spacing: normal (one eye apart) _____;
hypertelorism _____; other _____
 2. zygomatic bones: normal _____; hypoplasia _____;
other _____
 3. nasal area: septum (straight) _____;
or deviated _____; nares _____;
columella _____; septum/turbinate relationship _____
turbinate color _____; other notations _____
 4. vertical facial dimensions:
a. upper (40° of face) _____; other notations _____
b. lower (60° of face) _____; other notations _____
 5. lips: cupid's bow present _____; muscular union _____; neuromotor
functioning _____ / i / _____;
/ u / _____; / p-p-p / _____; other notations _____

C. Profile

1. normal (straight or convex) linear relationship between bridge of nose, to base of nose, to chin _____;

		maxilla _____;
retrusion	}	mandible _____;
		maxilla _____;
protrusion	}	mandible _____;

2. mandibular plane: normal _____; steep _____; flat _____.
- D. General notations: _____

II. Intraoral Characteristics

A. Dentition

1. general hygiene: good _____; needs improvement _____; caries _____; gingival hyperplasia or recession _____.
2. occlusal relationships ("bite on your back teeth" and separate cheek from teeth with tongue depressor)
 - a. first molar contacts:

Class I—normal molar occlusion (mandibular molar is one-half tooth ahead of maxillary molar) _____;

Class I malocclusion (normal molar relationship with variations in other areas of dentition) _____;

Class II malocclusion (maxillary ahead of mandibular first molar) _____;

Class III malocclusion (mandibular molar more than one-half tooth ahead of maxillary molar) _____.
 - b. biting surfaces: normal vertical overlap (overbite) _____; excessive vertical overlap A _____ / P _____; normal horizontal overlap (overjet) _____; excessive horizontal overlap A _____ / P _____; crossbite (mandibular tooth or teeth outside or wider than maxillary counterpart, or maxillary tooth or teeth inside mandibular counterpart) _____; notation of teeth involved _____; open bite (gap between biting surfaces) A _____ / P _____.
 - c. sibilant production with teeth in occlusion: normal /s/ _____; /z/ _____; /f/ _____; /v/ _____.

B. Hard palate ("extend your head backward")

1. midline coloration: normal (pink and white) _____; abnormal (blue tint) _____.
2. lateral coloration: normal _____; torus palatinus (blue tint surrounding a raised midline bony growth) _____.
3. posterior border and nasal spine: normal _____; short _____.
4. general bony framework: normal _____; submucous cleft _____; cleft _____; repaired cleft _____; other _____.
5. palatal vault; normal relationship between maxillary arch/vault _____; narrow maxillary arch/high vault _____; wide maxillary arch/flat vault _____; other _____.
6. general notations _____.

C. Soft palate or velum (Examiner's eye level should be at patient's mouth level. Patient's head erect, mouth three-fourths open, and tongue not extended out of mouth.)

1. midline muscle union (say "ah"): normal (whitish-pink tissue line) _____; submucous cleft (blue tint with A-type configuration during phonation) _____; cleft _____; repaired cleft _____.
2. length: effective (closure of nasopharyngeal port possible during phonation) _____; ineffective (hypernasality noted) _____.
3. velar dimple (where elevated soft palate buckles during phonation): normal 80% of total velar length (or 3-5 mm above tip of uvula) _____; other notations _____.
4. velar elevation: normal (up to plane of hard palate) _____; reduced _____; other _____.
5. range of velar excursion (up and back stretching during phonation): excellent _____; moderate _____; minimal _____.
6. presence of hypernasality during counting:

60s _____; 70s _____; 80s _____; 90s _____.
7. general notations: regarding air loss on unphonated sounds (nasal emission) and nasal resonance on phonated sounds _____.

D. Uvula

1. shape: normal _____; bifid _____; other _____
2. position: midline _____; lateral _____

E. Fauces

1. open isthmus _____; tonsillar obstruction of isthmus _____
2. tonsil coloration: normal (pinkish) _____; inflamed _____

F. Pharynx

1. depth between velar dimple and pharyngeal wall on "ah":
normal _____; deep _____; other _____
2. Passavant's pad: present during physiologic activity? _____
3. adenoidal surgery (ask patient): intact _____; removed _____;
date of tonsil/adenoid removal _____
4. gag response: positive _____; negative _____; weak _____
5. general notations: _____

G. Tongue

1. size: normal _____; macroglossia (rare) _____; microglossia _____
2. diadochokinetic rate—an estimate of neuromotor maturation for speech (observe consistency and pattern of rapid movements during the 15-repetition sequence)
 - a. normal movement patterns: tuh _____; luh _____; kuh _____;
puh-tuh-kuh _____; describe variations _____
 - b. mandibular assist: normal (until age seven and one-half) _____;
possible neuromotor delay for speech (after seven and one-half) _____
3. lingual frenum: normal (tongue tip to alveolar ridge when mouth is one-half open) _____;
short _____
4. general notations: _____

III. General Observations and Other Findings

OROFACIAL EXAMINATION CHECKLIST—SHORT FORM

I. Facial Characteristics

- A. Frontal view—eye spacing; zygomatic bones; nasal area; vertical dimensions; lips
- B. Profile—straight/convex; excessively convex; concave

II. Intraoral Characteristics

A. Dentition—general

- 1. occlusal relationships—anterior and posterior
- 2. bite—normal: excessive overbite or overjet; openbite; crossbite
- 3. sibilant production/teeth relationships: /s/; /z/; /f/; /v/

B. Hard palate—bony shelf formation

- 1. coloration—midline; lateral
- 2. bony midline (palpate): normal; submucous cleft (short)
- 3. contour—vault/maxillary arch relationship

C. Soft palate or velum

- 1. midline muscle union—complete; submucous cleft
- 2. length at rest and effective length during phonation
- 3. location of dimpling on velum from nasal spine to uvula tip
- 4. velar elevation and range of velar excursion
- 5. acoustic correlates: amount of nasality during counting in 60s, 70s, 80s, and 90s

D. Uvula—shape and position

E. Fauces—isthmus opening and coloration; tonsils intact?

F. Pharynx

- 1. depth between velar dimple and pharyngeal wall on "ah"
- 2. observation of Passavant's pad during function
- 3. ask patient if adenoids removed and subsequent speech status
- 4. gag response

G. Tongue

- 1. size related to oral environment
- 2. diadochokinetic rate on: tuh; kuh; puh-tuh-kuh
- 3. lingual frenum

III. General Observations and Other Findings