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SPEECH CONSEQUENCES OF CLEFT LIP AND PALATE

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ABSTRACT

This article provides an introduction to speech defects in individuals with cleft lip and palate. The speech pathologist is involved in identifying speech disorders in infants and for initiating early intervention to prevent or correct articulatory disorders caused by the cleft. Even with early cleft repair, many children exhibit 'cleft palate speech' characterized by defective consonant productions, hypernasality, abnormal nasal airflow, and altered laryngeal voice quality. The purpose of this paper is to recognize the speech defects and communication problems in individuals with cleft lip and palate, which will enable us to design and modify our treatment accordingly. The orthodontist should be aware of the therapist's diagnosis of the relation between the malocclusion and the speech defect. Co-operation may be required between the orthodontist and speech therapist in the sequence of timing of their respective treatment programs.

KEYWORDS: Speech defects; cleft lip; palate; velopharyngeal incompetence

INTRODUCTION

In this modern world, billions of people pour out words in astronomical numbers. Civilization, culture, business, commerce and the infinite complexity of personal relationships all depend on speech but the infant with cleft lip and palate is potentially at a disadvantage in his ability to communicate as clefting causes speech to be perceptually deviant, phonologically distinctive and leads to disordered development of

articulatory gestures. Speech is the most complicated of man's learned responses and can be defined as communication through conventional vocal and oral symbols. It is so frequently and spontaneously used that its complexities are rarely apparent. The mechanics of sound production are usually maturely developed by 7 or 8 years of age.^[1-5]

NORMAL SPEECH PRODUCTION MECHANISM

To produce speech sound, air is expelled from the lungs and passes through the larynx. Air pressure below the glottis varies. Each sound is affected by the length and diameter of the vocal tract and by the location of constrictions along its way. Nearly all speech sounds must be emitted from the mouth, so the airway into the nose must be closed which is accomplished by the soft palate which is lifted upward and backward by the levator palati muscles and the palatopharyngeal constrictor towards the posterior pharyngeal wall along with the synchronous action of superior constrictor muscle which narrows the pharynx insuring complete velopharyngeal closure. The point of levator eminence of palate is at the middle third of the velum and firmness of contact varies according to the nature and sequence of sounds. It is essential that the soft palate be long and mobile enough to reach the posterior pharyngeal wall and sustain the rapid fine adjustments required. As the air passes through the mouth, it is changed by the movements of the tongue, mandible, and lips.^[6,7] Speech sounds are described by the manner in which they are produced and by the speech articulators involved. They are^[8]

- VOICED - vocal cords vibrate in their production

CLASSIFICATION OF SPEECH SOUNDS BASED ON MANNER OF ARTICULATION

Structural components of the articulatory valve	Closed		Constricted		Nasals
	Voiceless	Voiced	Voiceless	Voiced	Voiced
Bi-labial (lips)	p	b		w	m
Labio-dental (upper teeth and lower lip)			f	V	
Linguo-dental (tongue tip and upper lip)			th	th	
Linguo-alveolar (tongue tip and alveolar ridge)	t	d	s	z	N
Linguo-palatal (tongue blade and hard palate)	ch	j	sh	Zh, r, y	
Linguo-velar (tongue back and velum)					Ng
Linguo-velar-pharyngeal (tongue back, velum and pharyngeal wall)	k	g			
Glottal (glottis)			H		

- BREATHED - no vocal cord vibration

The two main groups of speech sounds are *vowels* and *consonants*. A vowel is the free emission of a speech sound through the mouth (ay, ee, ai, oh, oo). All vowels are voiced. A consonant is produced by the airstream being interrupted before it is released and is achieved by a series of variable musculoskeletal valves, which modify the breath stream as it is exhaled for speech.^[9,10]

These valves are functionally created by^[11]

- The glottis
- The palatopharyngeal mechanism
- The tongue and the soft palate
- The tongue and the alveolar ridge
- The tongue and the teeth
- The lips and the teeth
- The lips in relation to each other

In functioning, the valves close, constrict, or open the channels through which the air must pass and by these modifications determine the physical conditions of pressure change and air vibrations, which initiate the acoustic patterns. Consonants can be breathed or voiced and are (i) plosives, (ii) fricative, and (iii) nasal. Plosive *consonants* are produced by build of air pressure behind two firmly contacting articulators and air being released in a sudden, quick explosion e.g. p and b are made by pressure held behind closed lips before release. The soft palate must occlude with the pharyngeal wall to achieve this pressure. *Fricative consonants* are produced by air being squeezed slowly through restricted outlet the mouth and it also leaks through small space into the nasal cavities and requires good velopharyngeal closure. The voice is heard as friction of sound, e.g. f, v, th, s, z, sh. The *affricate* sounds, ch and j, contain both plosive and fricative elements and so depend on a tight

velopharyngeal seal for their articulation. Semivowels, w and y, and glides, l and r, require little oral pressure. *Nasal consonants* are all voiced (m, n, ng). The pharynx does not contract and soft palate is not fully extended during their production. Oral exit of air is prevented by the lips, the tip or back of the tongue so the air passes into the nose giving speech the characteristic nasal resonance.^[12-15]

THE EFFECT OF CLEFT LIP AND PALATE ON SPEECH

The comparison of early vocal sounds in normal babies and those with cleft palate (5-30 months) indicate that differences exist at this age because they learn to speak in the presence of articulatory organs, which differ both, structurally and physiologically. Also, high incidence of hearing impairment, dental and occlusal irregularities, adversely influence the developing speech. These individuals are below average in language development and in their ability to express themselves.^[16] In general, children with cleft lip only usually exhibit normal articulation. Children with both cleft lip and palate exhibit articulation skills slightly superior to those with cleft palate only. Those with unilateral clefts exhibit better articulation than those with bilateral complete clefts. Children with clefts of soft palate exhibit better articulation than subjects with clefts of both hard and soft palate. Individuals with unrepaired cleft palates exhibit poorer speech articulation than do those who have received palatal management.^[17] There is an articulation pattern, which is characteristic of individuals with cleft lip and palate. The various misarticulation patterns are:^[18]

1. Vowels often are nasalized.
2. Plosives, fricatives, and affricates are the most defective sounds. Greater retardation is

- exhibited on fricative than on plosive sounds.
3. Sounds which involve lingual contacts are much more defective than are sounds which involve only the lips.
 4. Breathed consonants are defective in cleft palate group.
 5. Consonants in the medial position are more defective than initial or final consonants.
 6. Individuals with cleft palate are inconsistent in articulation of specific speech sounds.^[19,20]

The general error types are

1. **Faulty sound substitutions:** individuals who do not attempt to use their palate, tongue and lips, substitute sounds, which are unlike normal speech sounds. A rasping friction of air at the back of the mouth or a pharyngeal nasal lisp may be produced for fricative (s, z, f, v, th, sh, z) and affricate (ch and j) sounds. A grunt or a glottal stop may be produced by approximation of the glottis for some plosives (p, b, t, d, k, and g) and fricatives. Speech becomes less intelligible as the number of sound substitutions increases.^[21]
2. **Sound omissions:** difficult consonants may be omitted altogether.^[21]
3. **Hypernasality:** excessive nasal resonance is quite prevalent among individuals with cleft palate because the oral nasal resonance is disturbed with more air being transmitted through the nose than usual. Associated tongue posture may contribute to nasality. Vowels requiring a high tongue position thereby decreasing the oral opening are more nasal than low vowels (a and ae). Vowels for which the tongue constriction is in the front of the oral cavity (i) are perceived as more nasal than back vowels (u and a). Less nasality is perceived at the higher pitch level than at the habitual level. Nasality is less severe at the higher sound pressure level.^[21]
4. **Language development:** Cleft palate subjects are advanced in recognition vocabulary and retarded in their ability to define words and communication skills and exhibit less verbal output. Recently, a number of studies have documented that the children with cleft lip and palate show delays in language development that may encompass both receptive (comprehension) and expressive (production) language. Some reports suggest that these early difficulties in the acquisition of language

may persist into childhood in some individuals. In the light of such evidence, it is important for infants and young children with repaired / unrepaired cleft lip and palate to be assessed for language development.^[21]

5. **Poor voice quality:** abnormal function of valving action of glottis and speech articulators disrupts the normal flow of speech patterns. Energy is lost through nasal cavities so greater subglottic pressure is needed for audibility. The speech may be described as “shrill” in pitch and sometimes changing with growth to an unnaturally “lo, gravel voice” and “uncontrolled in loudness”. A “flat monotone” intonation pattern is typical of the voices of individuals with clefts.
6. **Faulty phonation:** results in the voice qualities of “breathiness” and hoarse. Speech may be harsh or muffled in quality.^[21]

ETIOLOGY OF SPEECH PROBLEMS

Velopharyngeal incompetence affects speech production, intelligibility and results in defective articulation because of loss of intraoral breath pressure required in correct production of consonants. The many causes of velopharyngeal inadequacy are^[22]

1. Unrepaired cleft palate
2. Poor velopharyngeal surgical closure
 - Short soft palate and not used to full advantage, too short to reach pharyngeal wall even when fully extended
 - Restricted mobility caused by scar tissue, neuromuscular defect – unable to sustain rapid, continuous movements necessary for speech
 - Point of levator eminence more anterior than average
 - Clefting caused by breakdown of surgical sutures
3. Oral and perioral anomalies^[23]
 - Cleft lip: repaired cleft lip usually disturbs the sounds involving the upper lip (p and b). If the surgically repaired lip is of sufficient length, mass, and mobility to allow closing and opening the mouth, it probably is not etiologically significant in articulation problems.
 - Tongue motility and carriage: lack of normal height and width of the palate affects tongue posture providing insufficient space for the tongue tip to lift

behind the upper teeth. The tip is held down and contact is made instead by the blade against the lateral segments of the arch resulting in “splashing” articulation. Fistula: after surgical closure of a unilateral cleft lip and palate, there may be a groove along the hard palate ending anteriorly, which provides a channel along which air may escape over the tongue resulting in palatal lisp (on s and z). Fistulas affect both the articulation of consonants by weakening them and the tone of voice by allowing the air to escape into to nasal cavity.

4. Dental and occlusal deviations: important etiological factor because of the fact many children with clefts have malocclusions and teeth has an important role in production of speech.^[24]
 - Deviations in size and form of the arches, which alters the normal maxillary to mandibular occlusal relationships.
- A. Maxillary collapse:
 - Crossbite leads to lateral lisp of sibilants
 - Lowered palatal vault restricts tongue movements and contributes to articulatory inaccuracy particularly on t, d, n, l.
 - Complicates midline grooving, distorting s, z.^[25]
- B. Protrusive pre-maxilla (Class II malocclusion): alveolar place of production is displaced anteriorly; prevent adequate bilabial seal for p, b, m and w.
 - S, z, distorted becomes diffuse in production because anterior dental cutting edge relationships are altered.
 - F, v, become distorted when lower lip has to “reach forward” to effect a labiodental seal.^[25]
- C. Retrusive pre-maxilla (Class III malocclusion): cause the tongue to be carried forward by the functionally protruded mandible interfering with bilabials (p, b, m, w), labiodentals (f, v), and tip-alveolus (t, d, n, l) because the tongue has to reach back to contact the correct place for production. Scarred and immobile lip tissue may co-exist with this condition aggravating bilabials and distorting round vowels (o, u).^[26]

D. Open-bite: anterior invites frontal lisp and lateral open-bite invites lateral lisp.

- Dental deviations
- A. Missing maxillary teeth – central or lateral incisors lead to diffuse production of sibilants or frontal lisp; missing buccal teeth lead to lateralization of sibilants.
- B. Rotated anterior teeth distort sibilant fricatives (s, z)
- C. Ectopic teeth in pre-maxillary area, cause shift in tongue placement for t, d, n, and l and can distort s, z.

However, there is wide individual variability with respect to the impact of altered oral structures on speech performance.^[27]

1. Nasal cavities: enlarged adenoids help to compensate for small or inactive soft palate by diminishing the pharyngeal depth. Under these circumstances adenoidectomy cause hypernasality with sufficient air emission to weaken consonants. Some improvement in speech may take place within 2-3 months after surgery but normal speech will not be regained if palate is truly inadequate. When associated with normally functioning soft palate enlarged adenoids prevent usual nasal air emission. The nasal consonants are distorted and resonance becomes hyponasal. An improvement in speech would be expected to follow removal of the adenoids. Normal air emission may be restricted by a deviated nasal septum or by an abnormality of soft tissues. Tone may be muffled and hard to define and speech is a mixture of hyponasality and poor oral pressure.
2. Hearing acuity: a greater proportion of individuals with cleft palate have hearing losses. A child may not use appropriate speech sounds because he has not heard or has heard the sounds in a distorted manner during the early language developing years. The ear of the child becomes accustomed to the sound he hears himself producing but these abnormal sounds are being correlated in his mind with the normal sound he hears around him and which he is attempting to imitate. The child is completely unconscious of any difference between the sounds he hears from others.^[28]

MANAGEMENT OF SPEECH PROBLEMS

The management includes:

- Surgery
- Speech therapy
- Orthodontic and prosthodontic treatment^[29]

The surgeon will decide the best age for operative treatment, but from the point of view of speech development there is every reason for early operation, before defective speech habits become established. Speech intervention for individuals with cleft lip and palate can begin even before the palate is repaired. In very young infants, the emphasis is on training the parent / caregiver to stimulate the child's ability to understand and use language. Older children (about age three) can be involved in direct therapy for the correction of articulation errors. The goals are to establish the correct placement of the oral structures for speech sound production and directing the airflow appropriately. It should be kept in mind that errors due to structural defects cannot be corrected through speech therapy unless the structural deformity is corrected. Also, the structural correction should invariably be followed with speech therapy to correct the functioning / production of speech sounds. Speech evaluation properly belongs in the hands of trained speech specialist, but an orthodontist should be able to detect errors in speech and recognize those that may be related to malocclusion.^[30] The speech specialist has a number of important functions to perform in relation to the orthodontist and to the patient that include:^[31]

1. Speech diagnosis and professional consultation with the dental specialist.
2. Referral of speech patients suspected of having dental conditions that may interfere with speech, general health, or personality adjustment.
3. Speech therapy and consultation in connection with patients undergoing orthodontic treatment, prosthetic appliances, restorations, or surgical corrections.

Since modern orthodontics contemplates much more than merely achieving proper alignment of the teeth as it also aims at guiding the development of the bones and muscles of the whole head, it as a clinical science, has much to contribute to the restitution of the speech function in the person with cleft palate. It is helpful to the

speech clinician to know that the structures of the mouth, face and head may be by the use of early orthodontia be brought into greatly improved positions for function and appearance. It is not unusual to incorporate orthodontic devices into speech aids so that a child may have early speech help while undergoing oral orthopaedic correction.^[32] The deformities and constrictions of upper arch and palate, which otherwise impose severe limits on the articulatory processes, may be reduced through properly timed orthodontic treatment and it has favourable effects upon the nasal structures. The orthodontist should be aware of the therapist's diagnosis of the relation between the malocclusion and the speech defect. Co-operation may be required between the orthodontist and speech therapist in the sequence of timing of their respective treatment programs. The team concept has become increasingly popular and has shown considerable success. The specialists involved must strive to understand the aims, problems, and limitations of the other specialists, and to some extent, their treatment methods.^[5,19,21] Close cooperation of the surgeon, the orthodontist, the speech clinician and the prosthodontist in planning the stages of treatment produce more desirable outcomes than when each specialist proceeds alone. An open inquisitive mind is needed to avoid tunnel vision toward's one's own specialty.

CONCLUSION

As a member of the cleft care team, the speech pathologist should work closely with the surgeon and orthodontist to ensure that timely assessments and appropriate management are provided. The initial assessment of articulation skills should begin in infancy even before the child begins to speak, focusing on the language skills and sound production. In older children, accurate assessment is required to identify those children who would benefit from speech therapy and / or surgery for optimizing speech outcomes. Cleft care is most successful when services are not only comprehensive, but also interdisciplinary in nature. Thus, it is important for each member of the team to understand the fundamental principles of care in the area of expertise of other members of the team. An open inquisitive mind is needed to avoid tunnel vision towards one's own specialty.

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