SPEECH CONSIDERATION IN COMPLETE DENTURE

INTRODUCTION

Speech is an integral part of human communication which makes human life superior to other life forms.Speech in humans is a learned habitual neuromuscular pattern.After the teeth are lost ,oral morphology of speech production also changes.Therefore accurate positioning of artificial teeth and maintaining the tongue space,maintaining the arch form are considered in bringing about normal speech morphology in completely edentulous patients.

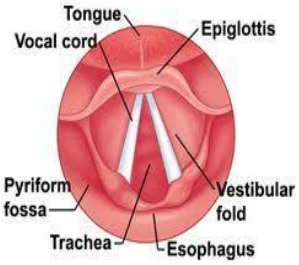
Speech:- The faculty or act of expressing or describing thoughts, feelings, or perceptions by the articulation of words.

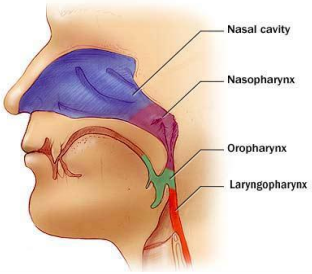
Phonetics:- The branch of linguistics that deals with the sounds of speech and their production, combination, description, and representation by written symbols.

MECHANISM OF SPEECH PRODUCTION:

The normal speech depends on proper functioning of five essential mechanisms namely,

1. The motor which includes lungs, associated muscle that supply the air.
2. The vibrator consists of vocal cord that give pitch to the tone
3. The resonator consisting of the oral,nasal, pharyngeal cavity and paranasal sinuses which creates overtones peculiar to each individual
4. The enunciators or articulators consisting of lip, tongue, palate and teeth which forms the musculoskeletal valves to obstruct the passage of air ,breaking up tones and producing the individual speech sounds
5. The initiator consisting of motor speech area of the brain and nervous pathway which convey the motors speech impulses to speech organs





COMPONENTS OF SPEECH:

According to Kantner & West (1941)

1.Respiration

2.Phonation

3.Resonation

4.Articulation

5.Neurologic integration

Chierici & Lawson(1973) added audition also

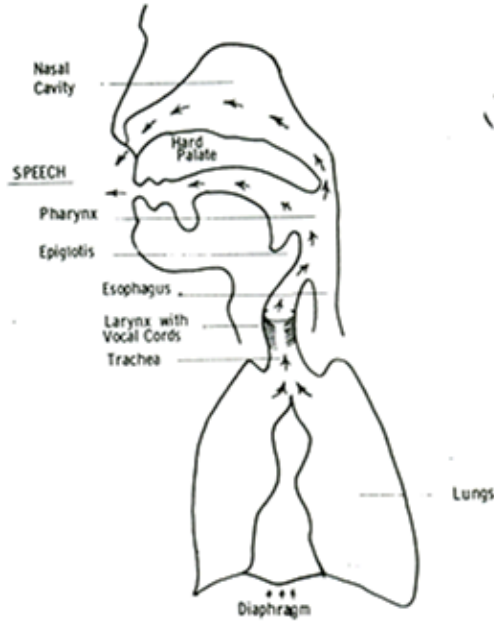
RESPIRATION:

The movement of air in the inspiratory and expiratory phases is essential to the production of sound. The power for this action is generated from the intercostals muscles and diaphragm in the complex motor activity related to, yet different from, solely life-maintaining respiration. During speech, the rate of air exchange per minute is accelerated; the number of breaths per minute is decreased, and breathing is deeper; the rate of inspiration is slightly increased, while the rate of expiration is decreased.

Irregularity, disruption, or reduction in the controls required for these events can deleteriously affect speech. Speech deviations associated with respiratory difficulties may be reflected in the alteration in speech rate and the superimposition of respiratory requirements on speech sounds

PHONATION:

During speech, the breath stream emanating from the lungs courses through the trachea and into the larynx where sound is produced by vibration of the vocal cords. Disturbances in this system may adversely affect the action of the vocal cords and cause disorders of voice production. Larynx provides first level of constriction controlling the respiratory air stream.Speech requires multitude of positions ,varying tensions,vibratory cycles and coordination of vocal folds with other structures.If vocal folds are closed or adducted-they impede the expired air.With sufficient tension-the vocal folds set in vibration and thus impart phonation.Hence vocal folds are abducted .



RESONANCE:

The sound produced at the site of the vocal cords is not the acoustic end result which is perceived as speech. The tone resulting from vocal cord vibration is augmented and modified by the various chambers through which it passes-the pharynx, the oral cavity, and the nasal cavities. The cranial and facial sinuses also add resonance properties. Certain of these resonators are dynamic in nature; alterations in their size and shape are produced by neuromuscular action in the pharynx, the soft palate, the tongue, cheeks, jaws, and lips.

Resonance refers to the way airflow for speech is shaped as it passes through the oral (mouth) and nasal (nose) cavities. The nasal cavity is used as primary resonating chamber for only three sounds ,M,N,ng(song,rang)

Choice of the chamber:Depends on the placement of soft palate.When it contracts against the pharyngeal wall,then oral cavity becomes the resonating chamber.When it contracts against the tongue,the nasal cavity is the resonating chamber

Congenital defects and acquired disease or injury may produce malfunction of these structures. Disruption in the normal resonance balance distorts the voice quality. Depending on the site and extent of the malfunctioning structures, the quality may be muffled, guttural, hypernasal, or hyponasal. Injury or obstruction of the nasal cavities produces a denasal quality, resembling a “cold in the head” sound. Dysfunctions of the velopharyngeal mechanism, resulting in failure of the soft palate to contact the posterior pharyngeal wall during speech, induce hypernasality and excessive nasal friction

CLINICAL SIGNIFICANCE:

Resonance and articulation plays an important role in maxillofacial prosthodontic rehabilitation.Patients with acquired or congenital defects of soft palate exhibit excessive nasal resonance because they are unable to control and divert sufficient airflow into the oral cavity.Resonance disturbances can be,

Excessive nasal resonance-Hypernasality,rhinolalia aperta

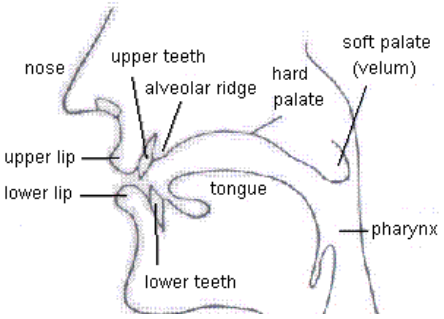
Insufficient nasal resonance-Hyponasality,denasality,rhinolalia clausa

ARTICULATION:

Sound that is produced is formed into meaningful words by movement of mandible,teeth,lips,tongue .Tongue is considered as single most important articulator of speech because of its ability to affect rapid changes in movement and shape .

It is composed of static component and dynamic component.Static components includes teeth,palate & alveolus which is relevant for anterior tooth placement.Dynamic component

consists of tongue,lips ,soft palate where tongue is relevant in positioning of posterior teeth



The functional problems that arise because of errors in articulation is classified into three types namely,

Omissions:The phoneme that should be present for normal pronounciation is absent

Eg:*ook* for *look*(*l* omitted)*ba* for *ball*(*ll* omitted)

Substitutions:The wrong word is used

Eg:*sink* for *think*(*s* replaces *th*)

Distortions:The substituted phoneme is nonstandard rather than standard.Although normal pronounciation is approximated ,it is not close enough to be acceptable

Eg:*ink* for *sink*(*s* distorted)

DYSFUNCTIONS IN SPEECH ARTICULATION:

Dysarthrias-imperfect articulation of speech due to disturbance of muscle control resulting from central or peripheral nervous system damage

Apraxia –partial loss of ability to perform coordinated acts

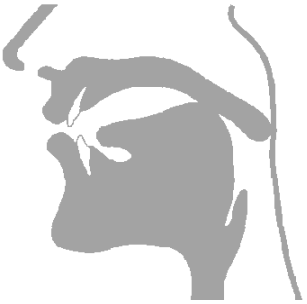
Dyslalia –impairement of ability to speak associated with abnormality of external speech organ

VALVING ACTION:

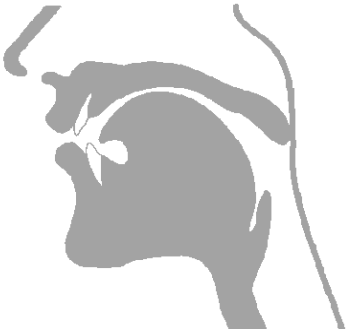
Speech is influenced by series of musculoskeletal valves.The vocal folds or glottal valve constitute first series of valves.Adduction of these folds-production of voiced tone.Abduction of these folds produce uninterrupted or voiceless passage of air.Palatopharyngeal valve constitutes the muscles of soft palate and pharynx which couples or uncouples the nasal cavities.

The tongue contact different part of oral cavity to produce different valving effects

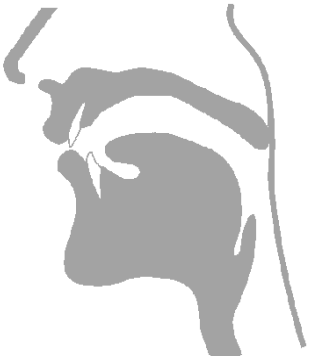
Linguoavelar valve where back of tongue touches the soft palate



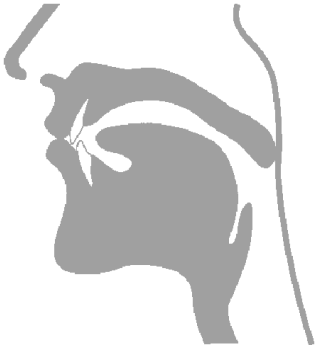
Linguopalatal valve where back of tongue raises to contact the hard palate



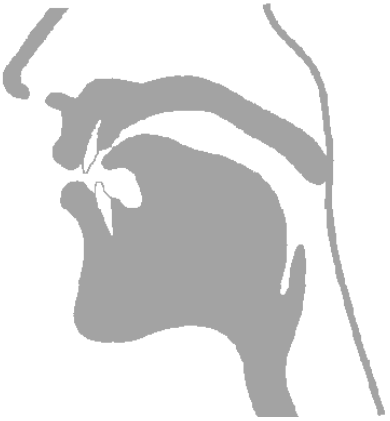
Labiodental valve which is formed by maxillary incisors and lower lip



Labial valve which is formed by lips together



Linguoalveolar valve-tip of tongue rises to touch the alveolar ridge



Linguodental valve-produced when tip of tongue ,protrudes between and touches the teeth

NEUROLOGIC INTEGRATION:

Speech involves mechanisms which are complexly integrated, either sequentially or simultaneously, by the central nervous system. Muscle activity does not result in speech unless there is sequential ordering of movement to produce recognizable signals. The integration of these signals into speech requires neuromuscular coordination at the peripheral level as well as brain function. Damage to areas affecting the motor control of speech results in some of the speech disorders previously described. Impairment sustained from a "stroke" may also disrupt the ability to comprehend and formulate language symbols. This condition of aphasia or dysphasia may be encountered in denture patients, particularly those of geriatric age.

AUDITION:

Speech communication entails three essentials,

1.Physiologic sequences required for producing

2.Substantive acoustic signals which are

3. Perceived and decoded by the listener

The hearing mechanism involves the reception and interpretation of speech.Compromised hearing precludes accurate feedback and hence affect speech

TYPES OF SOUNDS:

Those smallest units which not carrying meaning themselves are combined to form the smallest meaningful units of language-morphemes.Variable production of sound called allophones,recognized as variants of that sound and they are appropriately grouped into a family called phonemes.

Phonemes are divided into,

Vowels-These are open voiced sounds ,involving vibration of vocal folds and relatively unimpeded by oral valves(a,e,i,o,u,y)

Diphthongs-These are blend of two vowels spoken within a single syllable without interruption of phonation

Consonants-These are phonemes characterized by considerable impedence of breath stream and used adjacent to vowels and diphthongs to build syllables.Eg-church,judge,sauce,think

Combination-It is a blend of consonant and vowel.Eg-beauty

BASED ON LARYNGEAL ACTION:

In the production of some consonants,the air stream passes through the larynx without activating the abducted vocal cord.Aperiodic sounds subsequently produced by impedence within the oral cavity and are called *voiceless consonants(unvoiced or surd).*A voiced periodic counterpart produced similar to impedance within the oral cavity but characterized by voiced tone brought about by vibration of adducted vocal folds.These are called *voiced or sonants* .The pair of voiceless and voiced phonemes are called *cognate pairs.*

According to Boucher

Vowels.-Voiced sounds(a,e,i,o,u)

Consonants.-Voiced(b) or breath sounds(p)

Plosives/stops(p/t)-produced by stopping the airflow in the vocal tract and releasing the air in an explosive way

Fricatives or sibilants(s/z)-sharp & whistling sound quality created when air is squeezed through nearly obstructed articulators

Affricatives-a mix between plosive and frictatives

Nasal-produced without oral exit of air(m,n,ng)

Liquid-produced without friction

Glides-sounds produced by gradually changing articulator shape

CLASSIFICATION OF CONSONANTS BASED ON THEIR VALVE POSITIONS & MODE OF PRODUCTION

- Bilabial
- Labiodental
- Linguodental
- Linguoalveolar
- Linguopalatal
- Linguovelar

- Plosives
- Fricatives
- Affricatives
- Nasals
- Liquids
- Glides

PALATOLINGUAL SOUNDS FORMED BY TONGUE & HARD PALATE

Word like S, T D N and L belong to this category
S- the sound ‘s’ as in sixty six- is formed by a hiss of air as it escapes form the median groove of the tongue when the tongue is behind the upper incisor

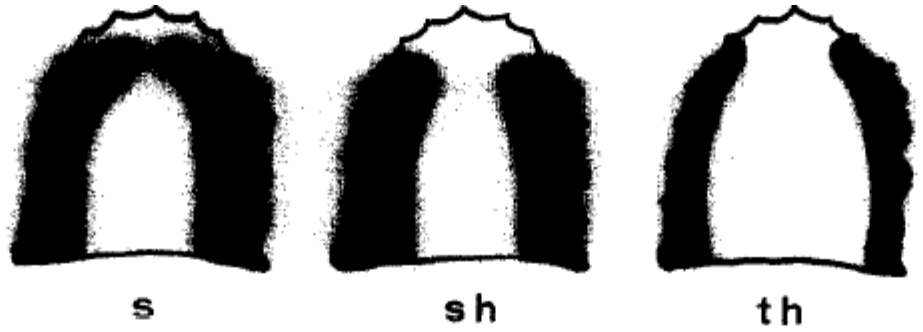
If groove is deep a ***whistling*** will be heard when s is pronounced

If groove is decreased ***s*** is softened towards ***sh (Lisping)***.Excessive thickness of denture base is also another cause for lisping

DETERMINATION OF GROOVE IN TONGUE(***Palatogram with the upper trial denture).***

Palatography is“the study of the areas of linguodental and linguopalatal contacts made during the articulation of consonants in combination with a vowel.The palatogram is made by drying the palatal surface of the upper trial denture and dusting it with talc. Then the denture is inserted in the mouth, and the patient pronounces the desired sibilant sound.

Upon removal and inspection of the denture, one will see where the powder has been wiped away by contact with the tongue. Corrections can be made according to the palatogram.



The position of anterior teeth is also involved in the production of s sound.When lower incisors are set further back,s is softened towards the lisp.When lower incisors are set labially,s will produce whistle .The sound s may be distorted to a slushy sh. This results from leakage of air at the lateral borders of the tongue when the tongue is not sufficiently confined in the bicuspid region. This phenomenon, known as *stigmatismus lateralis* .It is corrected by creating palatal eminences bilaterally on the denture base corresponding to the naturally occurring prominences of the alveolar ridges in the bicuspid molar regions.

Determination of proper vertical dimension for comfortable formation of s sound

Silverman uses sibilant s' as a phonetic means for determining vertical dimension. When s is pronounced, the upper and lower teeth are separated from each other by only 1 or 2 mm. When the patient says "sixty-six"and the vertical dimension of occlusion is too great, the teeth will come into contact causing clicking.

VERTICAL DIMENSION OF SPEECH-S POSITION:

Although the "s" position is considered as either mandibular or dental,it is the mandibular position that is key to the vertical dimension of speech.The anterior ridge is used as the operational platform.Two types of sharp "s" sounds are present,

Classic type: s"clearence exists around the incisal edges of upper and lower central incisors

Atypical type:Occurs when “s” clearance exists at any point on the lingual surface of upper central incisors

Third type is considered abnormal where the tongue intervenes between lower anterior teeth when S sounds are made.

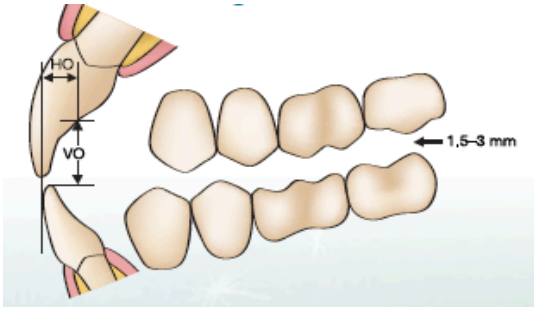
All three types must open to disclude the posterior teeth when s sounds and 1-1.5mm of clearence must be developed between the upper and lower central incisors.The degree of forward movement of teeth from centric relation to their s position determine the incisal guide angle and represents the vertical and horizontal overlaps of teeth.The greater the forward movement,greater the posterior disclusion and resultant s space or posterior speaking space

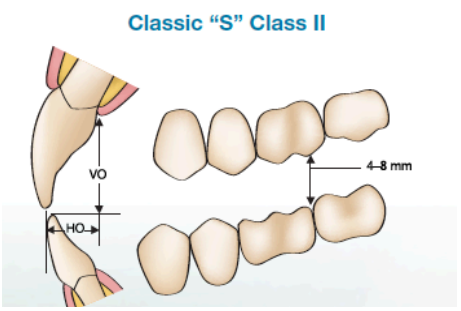
POSTERIOR SPEAKING SPACE:

It exists between the posterior teeth when S sounds are produced which helps in determining the vertical dimension of occlusion.The size of space is largely controlled by the distance the mandible moves forward from centric relation to its S position

THREE BASIC CLASSES OF ANTERIOR OCCLUSION:

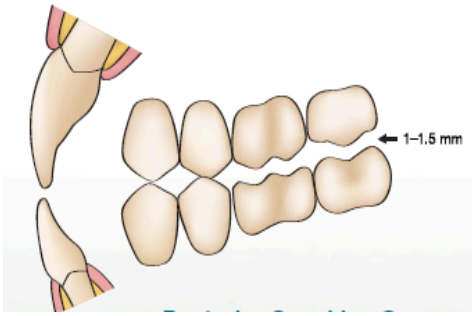
Classic S position in class I occlusion,with the vertical overlap of 1.5 to 5mm with the posterior speaking space of 1.5-3mm





Classic S space in class II occlusion with the vertical overlap of 1.5-10mm with the posterior speaking space 0f 2-8mm

Class III occlusion have no forward movement,no incisal guide angle and no vertical overlap,the posterior speaking space is not more than 1.5mm



PALATOLINGUAL SOUNDS FORMED BY TONGUE & SOFT PALATE

Consonant k, ng and g are representative of the palatolingual group of sounds.Sound is formed by raising the back of the tongue to occlude with the soft palate and then suddenly depressing the middle portion of the back of the tongue realising the air in a puff.If the posterior borders are over extended or if there is no tissue contact k becomes ch sound.

The soft palate must rise and form competent velopharyngeal sphincter closing the nasopharyngeal space in all speech sounds except n,m,ng .When soft palate is inactive ,the space remains open causing nasal tone.An overextended maxillary denture may cause irritation of velum with stiffening of muscles

LINGUODENTAL SOUNDS:

Dental sound Th is representative of the linguodental group of sounds. Dental sounds are made with the tip of the tongue extending slightly between the upper and lower anterior teeth.

The tip of tongue comparable in thickness to the interocc1usal distance, is grasped between the incisal edges of the upper and lower incisor teeth .

Air is forced into the channel formed by the palate and the dorsum of the tongue, then the tip of the tongue is retracted into the oral cavity. As the air escapes through the space created by the retraction of the tongue, the sound th is formed

Sound is actually made closer to the alveolus (the ridge) than to the tip of the teeth.

Interarch space or the labilingual position of anterior teeth-determines the th sounds

If about 3mm of the tip of the tongue is not visible, the anterior teeth are probably too far forward

If more than 6mm of the tongue extends out between the teeth when such sounds are made, the teeth are probably too lingual.Th is pronounced as t

Interarch space or the labilingual position of anterior teeth-determines the th sounds

An inadequate interocclusal distance may cause a sensation of tongue biting when th is articulated.

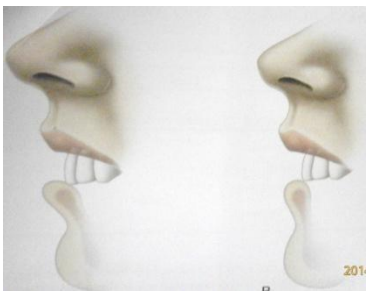
The patient may tend to place the tip of the tongue behind the anterior teeth instead of between them and th will be pronounced t. (Thin will become tin)

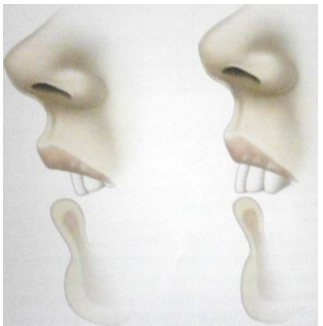
LABIODENTAL SOUNDS:

F and **V** are representatives of the labiodental group of sounds.It is formed by raising the lower lip into contact with the incisal edge of the maxilliary anterior teeth, forcing air through the interproximal spaces between these teeth and through the irregular gaps between the edges of the teeth and the occluding surface of the lower lip

Labiodental sound depends upon the labiolingual and superoinferior position (occlusal plane) of the maxillary anterior teeth.

Upper anterior teeth are too short (set too high up), V sound will be more like an F.If they are too long (set too far down), F will sound more like a V.Placing the maxillary anterior teeth too far lingually with reference to the lower lip muffles the sound f by allowing the lower lip to slide over the labial surfaces of the upper teeth.Distortion of f also occurs when the maxillary anterior teeth are placed too far labially, which allows the lower lip to slip up under the incisors.





LINGUOALVEOLAR SOUNDS:

T, D, S, Z, N & 1 are representative of the linguoalveolar group of sounds .Formed with the valve formed by contact of the tip of the tongue with the most anterior part of the palate (the alveolus) or the lingual sides of the anterior teeth

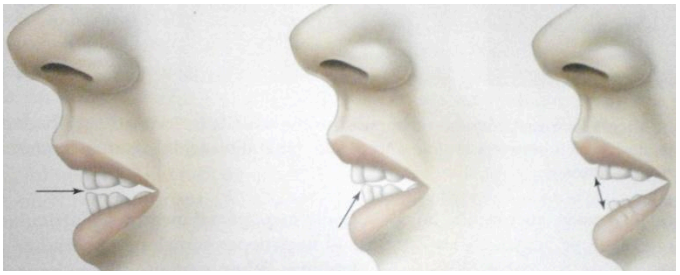
In case of t &d-palatopharygeal valve is closed

In case of n-palatopharyngeal valve is opened

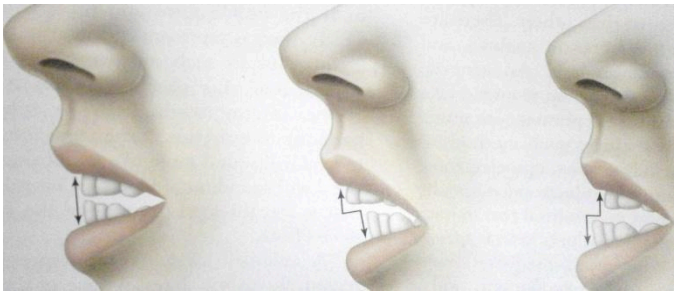
Sibilants **s, z, sh, ch & j** (with **ch & j** being **affricatives**) are alveolar sounds, because the tongue and alveolus forms the controlling valve.

Important observations when these sounds are produced are the relationship of the anterior teeth to each other. Upper and lower incisors should approach end to end but not touch. Failure indicates a possible error in the horizontal overlap of the anterior teeth .

Vertical length of anterior teeth during sibilant production



Horizontal relation of anterior teeth during sibilant production



BILABIAL SOUNDS:

B,p and m are representatives of the bilabial group of sounds.

Formed by the stream of air coming from the lungs which meets with no resistance along its entire path until it reaches the lip. To form **b** and **p**, the lips are closed and then opened suddenly with the expulsion of the air.The sound **m** is produced in a similar manner except that the air escapes in part through the nose as a nasal sound. Insufficient support of lips by the teeth or the denture base can cause these sounds to be defective

Depends upon a *correct interarch distance and a correct labiolingual positioning* of the anterior teeth. If the interarch distance is excessive, the patient cannot close the lips comfortably to form the air seal.When sufficient interarch distance exists, the lips contact prematurely.When the teeth are placed too far labially, the lips do not meet comfortably.With a lingual displacement of the anterior teeth, the lips meet prematurely. Therefore,the pronunciation of the bilabial sounds should be used to check the vertical jaw relation and to make sure that the lips meet comfortably without premature contact of the occlusion rims. The labial fullness of the occlusion rims should be observed during the pronunciation

VOWELS:

Vowel sounds are produced by the vocal cords imparting their vibrations to the expiratory column of air with the tongue and lip position imparting the overtone structure

FACTORS CONSIDERED

The position of the tongue and the

Shape of the lips

When producing vowel sound,the tongue body can move up or down (tongue height).The tongue can move forward or back (tongue frontness/backness).The lips can be rounded or not (lip rounding)

Factors affecting vowel sounds:

Vowel sounds are affected adversely by setting the lower anterior and posterior teeth lingually off the ridge. The tongue contacts the lower teeth and their alveolar process in most vowel sounds

CLINICAL SIGNIFICANCE

Vowel sound **a** as in father is useful in locating the vibrating line for correct placement of the posterior palatal seal.The soft palate is raised when this vowel sound is emitted, and a velopharyngeal sphincter is formed permitting the vibrating column of air to pass only through the oral cavity. The soft palate is activated, and the vibrating line becomes clearly demarcated

PROSTHODONTIC IMPLICATION IN DENTURE DESIGN AFFECTING SPEECH

Denture thickness & peripheral outline

Vertical dimension

Occlusal plane

Width of dental arch

Relationship of upper anterior to lower anterior teeth

DENTURE THICKNESS AND PERIPHERAL OUTLINE:

Thick denture bases-decrease of air volume and loss of tongue room in the oral cavity-loss of tone & incorrect phonation.In the production of the palate lingual sounds, the tongue makes firm contact with the anterior part of the hard palate, and is suddenly drawn downwards, producing an explosive sound; any thickening of the denture base in this region may cause in correct formation of these sounds .If the denture base too thick in this area, the air channel will be obstructed and a noticeable lisp may occur

VERTICAL DIMENSION:

Vertical dimension can be quantified in the physiologic relax mode,by asking the patient to pronounce letters “P”, “B”,or “M”

“P” and “B”, lips part quite forcibly that the resultant sound is produced with an explosive effect

“M” sound, the lip contact is passive.So,M can be used as an aid in obtaining correct vertical height

Increased in vertical dimension results in clicking of teeth and decreased vertical dimension results in lisping

THE OCCLUSAL PLANE:

If the occlusal plane is set too high the correct positioning of the lower lip may be difficult.If the plane is too low, the lip will overlap the labial surfaces of the upper teeth to a greater extent than is required for normal phonation

The Antero posterior Position of the Incisors,if they are placed too far palatally the contact of the lower lip with the incisal and labial surfaces may be difficult, as the lip will tend to pass outside the teeth

When the maxillary anterior teeth are placed too far labially, which allows the lower lip to slip up under the incisors

WIDTH OF DENTAL ARCH:

Too narrow is the arch, tongue gets cramped, affecting the size and shape of air channel, resulting in faulty pronunciation of f, d, s, m, n, k, l, a and h, where lateral margins of the tongue contact with palatal surface of teeth.

Relationship of Upper Anterior to Lower Anteriors:While producing /s/, /ch/, /z/ and/j/ sounds, the upper and lower anterior teeth almost come in contact with a narrow air channel provided between teeth

SPEECH ANALYSIS:

2 categories

1) ***Perceptual / acoustic*** **-**Based on broad band spectrogram, recording by Sonograph during the uttering of different phrases containing key phrases

2) ***Kinematic movement analysis :***

Ultrasonics

X-ray mapping

Cineradiography

Optoelectronic articulatory movement tracking

Electropalatography

If speech difficulties persists for more than 2-4 weeks ,Compare the old denture with the new denture to diagnose the possible design difference of significance of speech production.Observe the position of articulatory structures ,tongue,lips and transform them to the patients.Have the patient hearing checked.An auditory deficit will prolong the adaptation period and render it more difficult.If reported problems cannot be resolved,then refer the patient to speech pathologist

CONCLUSION:

Thus speech consideration in complete denture is important for identifying the correct vertical dimension ,an accurate periphery and an arch formation permitting natural tongue space ,so that adequate freedom for movement is ensured.It also plays an important role in reestablishing the palatopharyngeal integrity to provide the potential for acceptable speech.

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