INTRODUCTION

Oral communication is important because it is the primary means for interacting with others, for expressing feelings and ideas, for inventing anxieties and frustration, for making requests and demands, for controlling behaviors of others, and for learning about the world. It is a complex process as it involves understanding, using of abstracts, and utilizing many different combinations of phonemes, morphemes, words, and inflexions; it also integrates millions of neurons, nerve fibers, and multiple synaptic connections of the neurological system ***(Hulit and Howard, 2002).***

The process of communication entails four basic processes, which help to make oral expression possible, these four processes including:

1. Respiration: That provides effector energy source, which set the vocal folds into vibration.
2. Phonation: that is the process of producing sound (primary laryngeal sound) through the vibration of the vocal folds of the larynx.
3. Articulation: in which shaping of speech sounds occur through the adjustment and movements of speech structures and vocal tract, which is necessary for modifying the breath stream to produce the phonemes and prosodic -linguistic features of speech. It is considered the principal vehicle for conveying meanings, thoughts, ideas, concepts and attitudes into sounds, words, phrases and sentences**.**

4. Resonation: which is the process of modifying the voiced breath stream by amplifying and damping certain frequency components of the speech sounds ***(Curtis and Mary, 2007).***

An articulation disorder is a speech disorder that affects the phonetic level where there is difficulty in saying particular consonants and vowels. A classic system for classifying articulation disorders includes (dyslalia, apraxia, and dysarthria) ***(Wood, 1971).*** Many articulation problems may be also observed with cases of nasality ***(Bzoch, 1997).***

Various approaches for treating articulation disorders have been used over the years beginning with the phonetic placement approach of the 1920s and continuing to those currently being developed for phonological deviations (or processing). All of these approaches imply the existence of a treatment sequence; planning, establishment or learning of a sound, transfer or generalization, and maintenance or stabilization. Although these common elements exist, different rationales and philosophies relative to the nature and the causes of articulation disorders have influenced specific procedures and techniques ***(Curtis and Mary, 2007).***

The most common approach is the phonetic (motor) approach which focuses on the mechanism of speech production. The second most common approach is the stimulus approach where auditory training or speech perception training

is preceding and accompanying speech production. Other approaches like distinctive feature or contrastive pairs approaches are focusing on the speech sound system not on special phonemes in order to learn to produce sounds that are missing from the speech sound inventories of the patient ***(Curits and Mary, 2007).***

As might be expected some clinicians prefer to use certain approaches, even though other approaches may be more effective for some patients than others. In reality, clinician often uses components of the various approaches, even incorporating procedures from one approach to another ***(Curtis and Mary, 2007).***

Although traditional approaches have been proven effective in the treatment programs, a need exists for objective, immediate, and continuous feedback of the motor performance, which can be provided in biofeedback systems ***(Murdoch et al., 1999)***.

Speech rehabilitation often includes compensatory strategies that address subsystems "components" of speech production ***(Freed, 2000),*** and it aims to help patients with articulation disorders to speak more intelligibly. So carefully planned therapy program can minimize the frustrations and maximize the patient feeling of making progress ***(Gentil, 1993).***

Aim of the Work

The aim of this work is to discuss different therapeutic techniques for rehabilitation of different types of articulatory disorders in order to formulate the appropriate way of management of each case.

Chapter (I)

Physiology of Communication

Oral communication is important because it is the primary means for interacting with others, for expressing feelings and ideas, for inventing anxieties and frustration, for making requests and demands, for controlling behaviors of others, and for learning about the world. It is a complex process as it involves understanding, using of abstracts, and utilizing many different combinations of phonemes, morphemes, words, and inflexions; it also integrates millions of neurons, nerve fibers, and multiple synaptic connections of the neurological system ***(Hulit and Howard, 2002).***

Communication involves several physiological processes namely: respiration, phonation, resonation, articulation and symbolization ***(Kotby, 1977).***

Respiration: provides effector energy source that set the vocal folds into vibration. Speech occurs only during the expiratory phase of the respiratory cycle, so what occurs in speech is rapid inspiration followed by expiration that is more prolonged. The role of respiratory muscles (intercostal muscles, abdominal muscles and diaphragm) in speech is to produce rapid inspiration and regulate outflow of air from lungs to maintain subglottic pressure at a level adequate for phonation. When the subglottic pressure reaches an adequate level, the vocal folds are set into vibration with the production of the laryngeal sound ***(Stell and Evans, 1979).***

Phonation*:** is the process of producing sound (primary laryngeal sound) where voice is produced by the larynx as the vocal folds set vibrating by the expiratory air stream, these vibrations effectively chop off the air stream into a series of rhythmical segments which produce a complex motion of the air column. The most accepted theory for vocal fold vibration is the aerodynamic theory, which is based on the Bernoulli energy law. It states that when a stream of breath is flowing through the glottis, a push-pull effect is created on the vocal fold tissue that maintains self-sustained oscillation. The push occurs during glottal opening, when the glottis is convergent, whereas the pull occurs during glottal closing, when the glottis is divergent. During glottal closure, the airflow is cut off until breath pressure pushes the folds apart and the flow starts up again, causing the cycles to repeat ***(Prater and Swift, 1984).

Articulation*:** That refers to movements of the tongue, pharynx, palate, lips and jaw to produce speech sounds. Speech sounds are divided according to articulatory movements by which they are produced. There are two main classes of sounds (vowels and consonants). Vowels can be classified as front, back and central vowels, or as closed, open and half closed half opened vowels, while consonants can be classified according to their place of articulation into bilabials, labiodental, alveolar, palatal, velar and glottal, or according to manner of articulation into affricates, nasals, liquids, fricatives and glides or according to the vibration of the vocal folds into voiced and unvoiced ***(Stell and Evans, 1979).

Resonation*:** That refers to the acoustic response of air molecules within the oral, nasal and pharyngeal cavities to some source of sound. The air can be sit into vibration in response to a sound from the larynx or a sound created in the oral cavity ***(Bordon and Harris, 1980). Although the larynx is the primary contribution to the production of voice, the human sound produced from larynx is thin and weak without the acoustic influence of the resonatory structure situated above the larynx. Most of the quality and loudness characteristics that are commonly associated with the human voice can be attributed to the unique arrangement of the supraglottic resonators ***(Prater and Swift, 1984).***

Most of the speech sounds are resonated in a two-part tract consisting of the pharyngeal and oral cavities. There are three exceptions, in English sounds which require added resonance in the nasal cavities /m/, /n/, /ŋ/. During continuous speech, the velopharyngeal valve closed only during the production of oral sounds and yet must be open for the three nasal sounds ***(Bordon and Harris, 1980).***

Chapter (II)

Anatomy of the Articulators

The articulators are structures located in the vocal tract (the pharyngeal, oral, and nasal cavities), they are responsible for speech structures movements and resonance characteristics of speech. Because resonator adjustments are an unavoidable consequence of speech movements, speech and resonance are considered inseparable aspects of oral communication. The active or movable articulators move to contact the passive or immovable articulators that serve as a point of contact. The primary movable articulators include the lips, mandible (lower jaw), tongue, and soft palate or velum, while the immovable articulators include the alveolar ridge, hard palate, teeth, and nose. The cheeks and pharyngeal cavity (serves primarily as a resonator) contribute to the articulation of speech sounds as well although not an articulator per se, the larynx as a vocal tract cavity and sound generator is directly involved in the production of every voiced phoneme ***(Curtis and Mary, 2007).***

Movable articulators

I- **The tongue*:*** the most important and active articulator is the tongue; it fills large part of the oral cavity and is the primary modifier of the oral cavity configuration. It is involved in the production of the phonemes and its resonation. It is attached only at one end, The tongue may be divided into tip, blade, dorsum, body, and root. Its

two distinct functional parts are the anterior two thirds and the posterior one third. The tongue consists of four intrinsic muscles (superior and inferior longitudinal, transverse, and vertical), which change the shape of the tongue and are more important to consonant production, and four extrinsic muscles (genioglosses, hypoglosses, palatoglosses, and styloglosses), which move the tongue within the oral cavity and are important to vowel production. A restricting factor in tongue mobility is the frenulum (lingual frenulum), a slip of connective tissue attached to the anterior undersurface of the tongue and if this frenulum is attached too far forward or too near the tip of the tongue, tongue tie is the result that could result in impairment of /r/ or /l/ sounds articulation. Because tongue is the most important articulator, its malfunction (because of paralysis, injury, or atrophy for example) can result in severe articulatory disorders ***(Seikel et al, 2005).***

II- ***The lips:*** which are made up mainly of the orbicularis oris muscle and insertion of other muscles of the mid and lower face including the buccinator, risorius, levator labii superior, levator labii superior alaeque nasi, zygomatic major and minor, depressor labii inferior, mentalis, depressor and levator anguli oris, and platysma muscle. The action of orbicularis oris is to close the mouth and pucker the lips while the action of other muscles variously to retract the lips, elevate the upper lips, elevate the corners of the mouth, depress the lower lips, depress

the corners of the lips, and to protrude the lower lip. The lips are primary responsible for production of /p/, /b/, /m/, and /w/ and are partially responsible for /f/ and /v/, while other consonant and vowels requiring various degree of lip movement ***(Zemlin,1998).***

III- ***The mandible (the lower jaw):*** it is involved in the process of articulation and resonance; it can increase and decrease the size of the oral cavity and can facilitate tongue elevation by narrowing the vertical dimension of the mouth. The masseter, temporalis, lateral and medial pterygoid, digastric, geniohyoid, and mylohyoid muscles are responsible for variable mandibular movements ***(Seikel et al, 2005).***

IV- ***The soft palate (the velum):*** That begins at the end of the hard palate and extends backward to the pharynx terminating at the uvula. It completes the back portion of the roof of the mouth and the floor of the nasal cavity. It is the site of contact for back of mouth phonemes as /k/ and /g/, and adds the final component for adequate velopharyngeal closure necessary for all phonemes except the three nasal sounds. It contains the following muscles: levetor palataii, tensor palataii, palatoglossus, palato-pharyngeus, and muscularis uvulae ***(Seikel et al, 2005).***

V- ***The pharynx:*** Is an important movable vocal tract cavity in the production of sounds, this tube like structure is

surrounded by muscles and can be divided into nasopharynx, oropharynx, and laryngopharynx. It serves as a variable sized resonating cavity and as an articulator for closing off the nasal cavity with the help of the soft palate for all but the three nasal phonemes ***(Zemlin, 1998).***

Immovable articulators

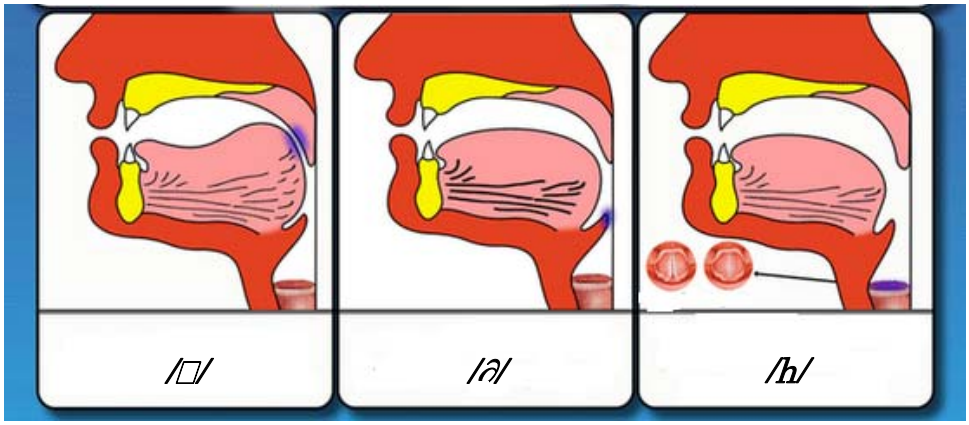
I- ***The hard palate:*** is located immediately behind the alveolar ridge, it forms the roof of the mouth that separates the nasal cavity from the oral cavity and extends from the alveolar ridge to the soft palate. It serves as passageway for the oral breath stream. The hard palate and the tongue are directly involved in the production of some sounds like /r/, /j/ ***(Brenthal and Bankson, 2004).***

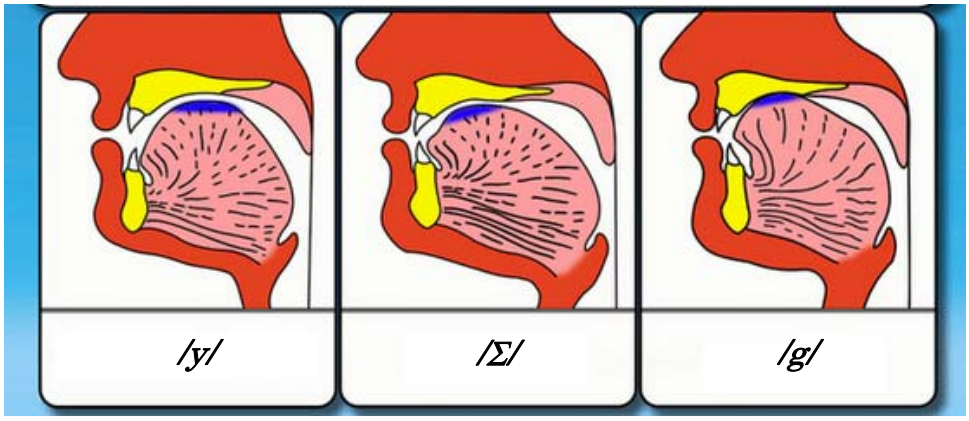
II- ***The teeth:*** that is housed within the maxillary and mandibular dental arches providing an articulation surface for production of various speech sounds ***(Brenthal and Bankson, 2004).***

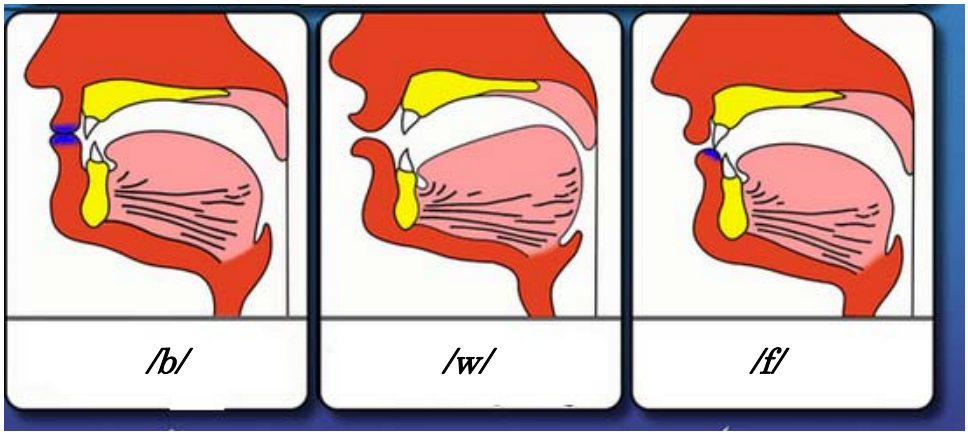
III- ***The alveolar ridge:*** is located directly behind the upper front teeth, It is involved in the production of some of front consonant like /t/, /d/, /n/, and /s/. These sounds are produced by the tongue tip making contact either with a part or most of the alveolar ridge ***(Zemlin,1998).***

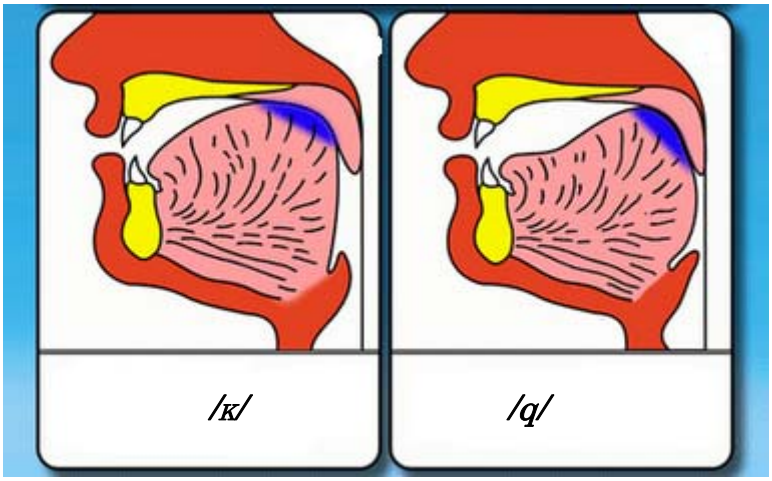
The nose: that serves as a passway for the air for production of the three nasal sounds ***(Zemlin, 1998).***

The following figures representing various articulatory postures for different speech sounds production





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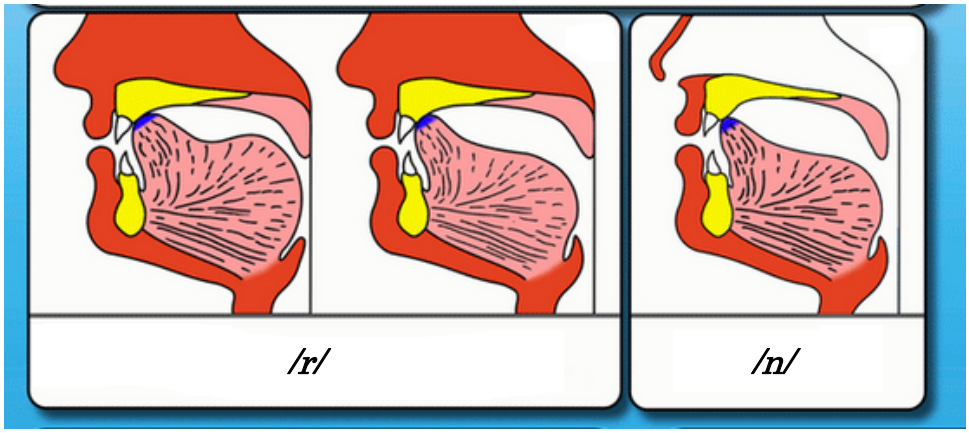
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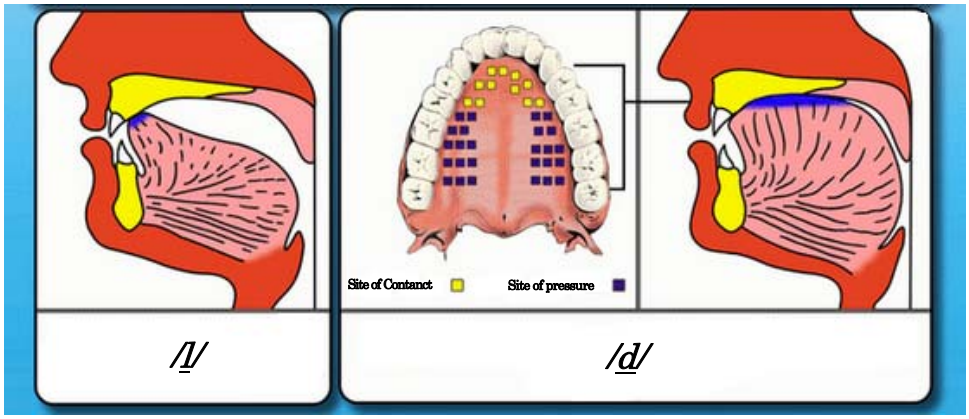
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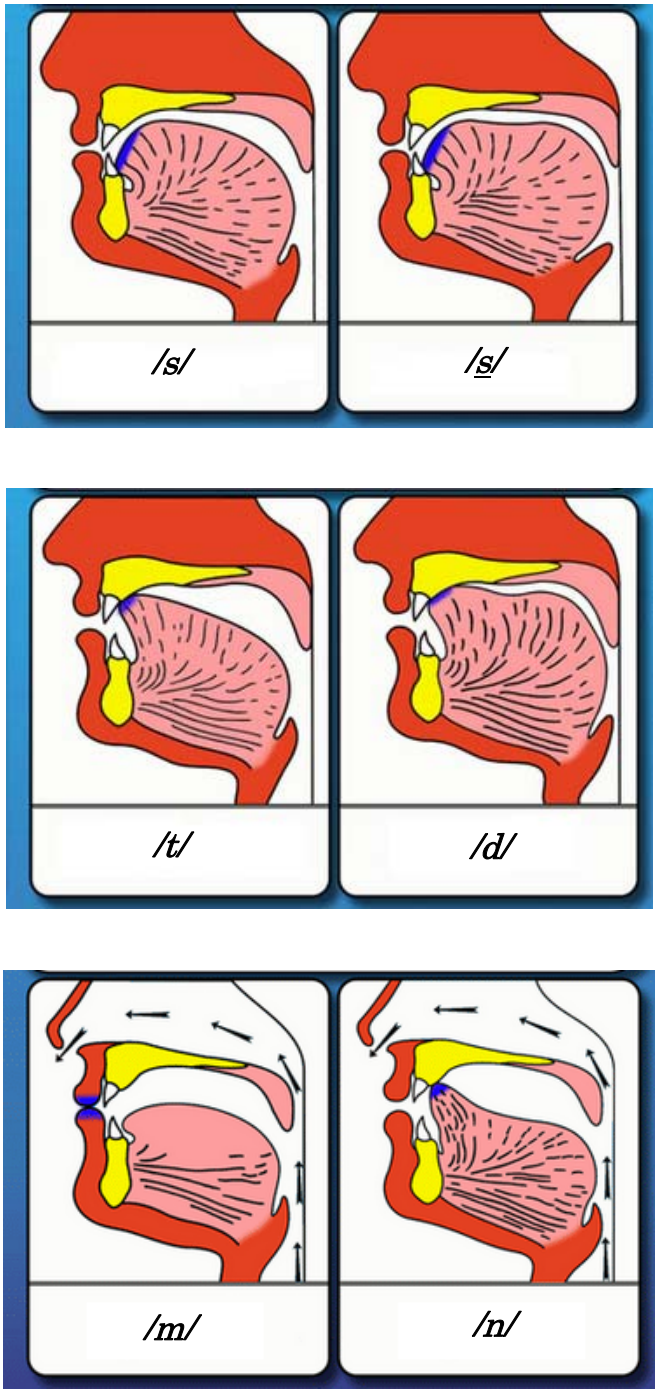

Fig. (1): Articulatory postures for different speech sounds production *(Curtis and Mary, 2007)*

Chapter (III)
Types of Articulation Disorders

Articulation disorders are based mainly on difficulty learning to physically produce the intended phoneme, they have to do with the main articulators (lips, teeth, alveolar ridge, hard palate, velum, glottis, and the tongue). A classic system for classifying articulation disorders includes (Dyslalia, apraxia, and dysarthria) ***(Wood, 1971***). Many articulation problems may be also observed with cases of nasality ***(Bzoch, 1997).***

1. **Dysarthria** is described by ***Sellar et al., (2005)*** as a neurological motor speech impairment that is characterized by slow, weak, imprecise, and/or uncoordinated movement of the speech musculature, and may involve respiration, phonation, resonance, articulation, and or prosody.

The following table represents different types of dysarthria and its perceptual characteristics: