CHAPTER 2

NATURE AND TYPES OF DYSARTHRIA

2.0. INTRODUCTION

Speech is an important mode of human communication by the help of which the humans exchange their thoughts, feelings and information. Every speech act needs two individuals to make it a dialogue. When the speaker generates a meaningful speech message, it is received by the listener, who in turn responds to it. The smooth processing of this act is totally dependent on the smooth functioning of the nervous system. According to Murdoch (1990: 2),

'Speech is produced by the contraction of the muscles of the speech mechanism which include the muscles of the lips, jaws, tongue, palate, pharynx and larynx as well as the muscles of respiration. These muscle contractions, in turn, are controlled by nerve impulses which descend from the motor areas of the brain to the level of the brain stem and spinal cord and then pass out to the muscles of the speech mechanism via the various nerves which arise from either
the base of the brain (cranial nerves) or spinal cord (spinal nerves).

When there is any paralysis or weakness of speech musculature or inability to coordinate speech, the proper speech production is hampered. This condition is technically called dysarthria. Now to understand what causes dysarthria, it is first essential to know a bit about the nervous system. Only that much of information has been provided here, which is felt to be necessary for the purpose of this study.

Following Freed (2000: 53-90), Love and Webb (1992:14-28) and Murdoch (1990:1-50), the nervous system has been described in the following way:

2.1. THE NERVOUS SYSTEM

The nervous system is the main regulative and integrative system of the body. It is composed of billions of nerve cells known as neurons that are responsible for the conduction of nerve impulses of one part of the brain to the other. The nervous system monitors and controls almost every organ system of the body. It functions as an entity and not in part. The
nervous system is divided into the central nervous system (CNS) and the peripheral nervous system (PNS).

2.1.1. THE CENTRAL NERVOUS SYSTEM (CNS)

The CNS includes the brain and the spinal cord. During embryonic development the brain is first formed as a tube, the anterior of which enlarges into three swellings (fore-brain, mid-brain, hind-brain) that form the brain and the posterior part of which develops into the spinal cord.

The adult brain has the following major parts: Cerebrum, Brainstem and Cerebellum.

Cerebrum is the largest portion of the brain and is divided into two cerebral hemispheres. The right cerebral hemisphere and the left cerebral hemisphere are considered as the 'mirror twin' of the other. The left cerebral hemisphere is the seat of speech and language in most people. A convoluted layer of grey matter called the cerebral cortex covers the hemispheres. The convolutions are called gyri and the shallow depressions are called the sulci, if they are deeper then they are called the fissures.
The cerebral hemispheres are divided into four lobes. They are as follows:

- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe

The following two diagrams depict the different parts of the brain and what they do.

**FRONTAL LOBE**

Frontal lobe conducts three functions: motor activity and integration of muscle activity, speech and thought process. The central sulcus
demarcates the frontal lobe from the parietal lobe behind and the sylvian fissure demarcates the frontal lobe from the temporal lobe below. The gyrus in front of central sulcus is Precentral gyrus, where lies the Primary Motor area. It contains the motor homunculus (representation of different parts of the body). The function of this area is to carry out the movement of different parts of the body. The Motor Speech area is situated at the base of the inferior frontal gyrus above the sylvian fissure. This area is important on the left dominant hemisphere. Any lesion in this area results in the paralysis of the speech apparatus causing damage to the faculty of speech.

**PARIETAL LOBE**

It is situated behind the frontal lobe separated by the central sulcus and anterior to the occipital lobe. Behind the central sulcus, lies the post central gyrus containing the primary somaesthetic (sensory) area that receives the sensation from different parts of the body. It processes information about touch, pressure, pain and heat and cold. At the base of the post central gyrus lies secondary somaesthetic area. This lobe contains the angular Gyrus; the function of this area is to maintain the correlation between the visual language stimuli and the auditory language information during reading. Any lesion to this area causes
Alexia with Agraphia i.e. reading and writing difficulty. Supramarginal Gyrus is situated in the inferior parietal lobule. The function of this area is phoneme processing in language comprehension and phoneme production for repetition and speech.

TEMPORAL LOBE

It is situated below the frontal and parietal lobes and anterior to the occipital lobe. It receives auditory signals, processing language and the meaning of the words. The area named Wernicke's area is very important. It is located in the left dominant hemisphere in superior temporal gyrus extending around the posterior end of the lateral sulcus into the parietal lobe. It is connected to the Broca's area by Arcuate Fasciculus. Wernicke's area permits the understanding of the written and spoken language and enables a person to read a sentence, understand it and say it out loud.

OCCIPITAL LOBE

It is a part of the cerebrum situated most posteriorly. It receives and processes vision and visual information. The function of the area is to receive visual information from primary visual and other areas like
Thalamus. It helps the individuals to recognize and appreciate what he or she sees.

The other important areas of the brain are as follows:

BASAL GANGLIA

The basal ganglia play a major role in the control of posture and movement. Any lesion in the basal ganglia causes different movement disorders like bradykinesia i.e. slowness of movement, rigidity i.e. increased tone, tremor at rest, postural instability and dysarthria. The lesion in this area may result in diseases like Parkinson’s disease, a disorder of the brain characterized by shaking (tremor) and difficulty with walking, movement and coordination, Chorea, a movement disorder distinguished by random involuntary movements of the limbs, trunk, head and neck (Freed, 2000: 234), Wilson’s disease, a genetic metabolic disorder caused by inadequate processing of the dietary of intake copper; and Huntington’s disease, ‘a progressive disorder that is caused by the gradual degeneration of neurons in the basal ganglia and cerebral cortex’ (Freed, 2000: 236).
THALAMUS

The thalamus is one of the major sensory integrating centers of the brain and is sometimes referred to as the gateway to the cerebral cortex. It receives the information, integrates it and then sends it to the cerebral cortex for analysis.

HYPOTHALAMUS

The hypothalamus performs homeostatic role such as controlling body temperature, controlling emotional behaviour etc.

CEREBELLUM

At the back of the brain stem is the cerebellum (Latin word for "little brain"). Although the cerebellum constitutes only of 10% of the brain, it contains half of all the neurons in the brain. The main function of the cerebellum includes fine motor coordination, body movement, posture and balance. The cerebellum plays an important role in the coordination and smoothness of movements required for speech. Any lesion in this structure will result in limb ataxia (incoordination of movement) and dysarthria.
BRAIN STEM

Brainstem is made up of Midbrain, Pons and Medulla Oblongata. From the evolutionary viewpoint, the brainstem is the oldest and the most primitive part of the brain. The brainstem is continuous with the spinal cord.

2.1.2. THE PERIPHERAL NERVOUS SYSTEM (PNS)

The PNS contains only nerves (cranial and spinal nerves), which connect the central nervous system to the other parts of the body. There are twelve pairs of cranial nerves and thirty-one pairs of spinal nerves that arise from the base of the brain and the spinal cord. The cranial nerves which are vital for speech production are V, VII, IX, X, and XII. The function of the PNS is to convey the nerve impulses to and from the CNS by the various afferent and efferent nerve fibres. The afferent or the sensory nerve fibres carry nerve impulses arising from the sensory receptors to the CNS. The efferent or motor nerve fibres carry nerve impulses from the CNS to the effector organs, that is, the muscles and the glands.
The cranial nerves important for speech are detailed below:

**CRANIAL NERVE 5**

This nerve is also known as Trigeminal nerve. It has two components, i.e. Motor and sensory. The motor part supplies the muscles for chewing, e.g., Masseter and Temporalis. The sensory component carries sensation from the entire face.

**CRANIAL NERVE 7**

This nerve also called facial nerve is a motor and sensory nerve. It supplies the muscles of the face and is responsible for facial expression. It carries sensation from the anterior two third of the tongue.

**CRANIAL NERVE 9**

This nerve is also known as the glossopharyngeal nerve. It is a motor and sensory nerve. It supplies the muscles of the pharynx called stylopharyngeous and provides sensory branches to the mucous membrane of the pharynx and the posterior third of the tongue.
CRANIAL NERVE 10

This nerve also known as the vagus nerve is a motor and sensory nerve. It supplies the constrictor muscles of the pharynx and the intrinsic muscles of the larynx through its recurrent laryngeal branch. It also has autonomic control over the bronchi, heart and gastrointestinal system.

CRANIAL NERVE 12

This nerve is also known as the hypoglossal nerve. It is a motor nerve. It supplies the muscles of the tongue.

2.2. UPPER MOTOR NEURONS (UMN) AND LOWER MOTOR NEURONS (LMN)

Upper motor neurons are part of the CNS and they originate in the cortex and brainstem. The upper motor neurons are grouped into the pyramidal and the extrapyramidal systems. According to Freed (2000: 85) upper motor neurons are ‘all the descending motor fibres coursing through the CNS and carry information from centers of the brain that control the muscles of the body. The upper motor neuron includes the
two pathways of the pyramidal system and the pathways of the extrapyramidal system.' The pyramidal system and the extrapyramidal system are the neural pathways that carry motor impulses and travel from the cortex to the brainstem and the spinal cord. The pyramidal tract transmits messages directing voluntary motor movements.

According to Freed (2000: 136) 'The upper motor neurons that are part of the pyramidal system originate principally in the primary motor cortex and course down more or less directly to the lower motor neurons, which, in turn, travel out to the muscles. The upper motor neurons in the pyramidal system are divided into those that travel from the cortex to the cranial nerves (corticobulbar tract) and those that travel from the cortex to the spinal nerves (the corticospinal tract).'

The other collection of the upper motor neurons is called the extrapyramidal system, which will be discussed, later in this section.

As Freed (2000: 79) stated, the corticobulbar fibres end in the cranial nerve nuclei in the brain stem from where the lower motor neuron fibres start to supply to the muscles of larynx, pharynx, tongue, lips etc. As upper motor neurons cannot exit the central nervous system, they synapse with the neurons of another type called the lower motor neurons. According to Freed (2000: 85) 'Lower motor neurons, in
contrast, are the motor neurons in the cranial and the spinal nerves.' The cell bodies of these neurons are located in the brain stem and the spinal cord but their axons can leave the central nervous system and synapse with the muscles of the body. Lower motor neurons are sometimes called the final common pathway because these nerves are the only route by which information from any of the upper motor tracts can reach the periphery. So, when the lower motor neurons are damaged, the parts of the body that they innervate are deprived of input from the pyramidal and the extrapyramidal tract including the cerebellar pathways. Thus, voluntary, automatic and reflexive movements are all affected. Damage to the upper motor neurons results in spasticity and in case of damage to the lower motor neurons it results in muscle paralysis or paresis, that is, weakness.

According to Freed (2000: 82), 'the extrapyramidal system is composed of a number of different, interconnected descending motor pathways... between the higher levels of the nervous system and the cranial or spinal nerves.' 'The upper motor neurons in the extrapyramidal system originate primarily in the cortex and brainstem. The extrapyramidal system has numerous interconnections throughout the brain... and form an indirect pathway between the cortex and the lower motor neurons' (Freed, 2000: 136). The four descending
pathways of the extrapyramidal system are the rubrospinal tract, the reticulospinal tract, the vestibulospinal tract and the tectospinal tract. These neuronal motor pathways consist of neurons that regulate involuntary/automatic movements and are 'responsible for maintaining posture, regulating reflexes, and monitoring muscle tone' (Freed, 2000: 136). The extrapyramidal system works parallel with the pyramidal system. 'While the pyramidal system is transmitting its neural impulses for skilled movement to lower motor neurons, the extrapyramidal system also is transmitting its impulses for posture and muscle tone to the lower motor neurons. When these two systems are intact, their functions blend together remarkably well and allow us to accomplish complex movements effortlessly' (Freed 2000:136).

2.3. SPEECH AND LANGUAGE AREAS

Murdoch (1990: 45-48) stated that for majority of the people the left cerebral hemisphere is dominant for language functions. There are two major language areas, that is, the anterior or motor speech language area also known as Broca's area and the posterior or sensory speech language area also called the Wernicke's area. They are connected to each other by Arcuate Fasciculus. The other subcortical structures such as the basal ganglia also play an important role in language function.
a) **BROCA'S AREA** - This area is situated at the base of the inferior frontal gyrus, above the sylvian fissure. This area is responsible for the programming and execution of overt acts such as speaking, writing and gesturing. Any lesion in this area results in the loss of speech or paralysis of speech apparatus.

b) **WERNICKE’S AREA** - It is located in the superior temporal gyrus extending around the posterior end of the lateral sulcus into the parietal lobe. Wernicke's area permits the understanding of the written and spoken language and enables a person in the recognition, comprehension and formulation of language.

2.4. **TYPES OF LANGUAGE AND SPEECH DISORDERS**

According to Murdoch (1990: 48-50), for efficient execution of speech production, three basic neurological processes must work in proper coordination.

They are as follows:

i) **organization** of concepts and their symbolic formulation

ii) **motor production** of speech involving the processes of respiration, phonation, resonance, articulation and prosody,
iii) **programming** of the motor actions involved in speech production. Any lesion in any of these processes would lead to the language and speech disorders namely, Aphasia, Dysarthria and Apraxia.

### 2.5. APHASIA

Aphasia is defined as a loss or impairment of the language function due to brain damage. It is a multimodal disorder and is manifested in difficulties of speaking, reading and writing. The amount of loss in each of the areas however varies from one type of aphasia to the other (Murdoch, 1990: 49).

### 2.6. APRAXIA

According to Freed (2000: 279) in apraxia of speech the problem is with the sequencing of movements needed to produce speech. It is the result of the brain damage, which affects the capacity to program the positioning of speech musculature and sequencing the muscle movements for the production of phonemes. Thus, it results in the misarticulation of phonemes, especially consonant sounds. It contains inconsistent distortion and substitution of phonemes.
2.7. DYSARTHRIA AND ITS TYPES

According to Yorkston et al (1987: 7),

'Speakers use approximately 100 different muscles and produce recognizable sounds at a rate as high as 14 per second. Each of these sounds requires specific respiratory, laryngeal, and oral articulatory postures. Sound productions are not based on fixed patterns, rather, speakers appear to have the ability to produce a sound acceptable to the listener in a number of different ways. And, perhaps most remarkably, the speech motor activity is almost completely automatic. Although speakers may be consciously aware of formulating a message, they devote almost no conscious effort to planning motor speech activities. Given the complexity of motor speech, one would expect that impairment in motor control would have negative consequences in the form of reduced intelligibility, naturalness, and articulatory adequacy.'

Yorkston et al (1987: 2) defined dysarthria as 'a neurogenic motor speech impairment which is characterized by slow, weak, imprecise, and/or uncoordinated movements of the speech musculature. Literally,
the term comes from the Greek dys + arthroun, which means "inability to utter distinctly".

Darley, Aronson and Brown (1975: 6-7) viewed that "a stock expression used by many neurologists to identify the presence of dysarthria is 'slurred speech', a phrase which apparently overlooks the fact that articulation can be impaired in diverse ways that are significant diagnostically, and which ignores the concurrent impairment of other motor processes in speech."

According to Darley, Aronson and Brown (1975: 3) dysarthria is 'a collective name for a group of related speech disorders that are due to disturbances in muscular control of speech mechanism resulting from impairment of any of the basic motor processes involved in the execution of speech.' By impairment of the basic motor processes, Darley, Aronson and Brown (1975: 3) meant the "coexisting motor disorders of respiration, phonation, articulation, resonance and prosody."

'Dysarthria is associated with diseases and conditions that are chronic or long-term' (Yorkston et al, 1987: 9). So according to the models of
chronic disability (Yorkston et al, 1987: 9) adapted from Bettinghaus (1980) dysarthria can be defined on at least three levels:

- **Impairment** - 'any loss or abnormality of psychological, physiological or anatomical structure or function.'

- **Disability** - 'restriction or lack (resulting from an impairment) of the ability to perform an activity in the manner or within the range considered normal for the human being.'

- **Handicap** - 'disadvantage for a given individual (resulting from an impairment or a disability) that limits or prevents the fulfillment of a role that is normal (depending on age, sex, social, cultural factors) for that individual.'

From the point of view of impairment 'dysarthria is a neurogenic motor speech impairment that is characterized by abnormalities in movement rate, precision, coordination, and strength. Measures of impairment are instrumental, physiological measures and through perceptual judgments of vocal quality' (Yorkston et al, 1987: 9).
Dysarthria can also be defined as a disability. The measurements for this include 'speech intelligibility and rate, perceptual judgements of overall articulatory adequacy, and prosody' (Yorkston et al, 1987:11).

'The handicap resulting from a motor speech disability involves the reduced ability to function in communication situations that require understandable, efficient, and natural sounding speech, and involves the reactions of persons who impact the social educational and vocational opportunities and experiences of the dysarthric individual' (Yorkston et al, 1987: 11).

Dysarthria results from damage to the central and/or peripheral nervous system that impairs the transmission of neural messages to the muscles involved in speech. The site of the lesions includes the Upper Motor Neuron, the Lower Motor Neuron, the Basal Ganglia, and the Cerebellum etc.

The dysarthrias may be either congenital or acquired. Yorkston et al (1987: 2) stated that 'the course of dysarthria may follow a number of patterns, including developmental (as in cerebral palsy in children), recovering (as in early post onset traumatic head injury and stroke), stable (as in cerebral palsy in adults), degenerative (as in amyotrophic lateral sclerosis.'
Dysarthria is commonly caused by different neurological conditions such as,

- Stroke
- Brain injury
- Tumors
- Parkinson's disease, a disorder of the brain characterized by shaking (tremor) and difficulty with walking, movement and coordination. It is caused by progressive deterioration of the nerve cells of the part of the brain that controls muscle movement (the basal ganglia and the extrapyramidal area)
- Wilson's disease, a genetic metabolic disorder caused by inadequate processing of the dietary intake of copper
- Amyotrophic lateral sclerosis, a disease of the motor nerve cells in the brain and spinal cord, causing progressive loss of motor control
- Multiple sclerosis, a disease of the central nervous system characterized by the destruction of the myelin sheath surrounding neurons, and
- Cerebral Palsy, a nonprogressive disorder of motor impairment/motion and posture due to brain injury.
- It may also occur after head trauma or infection.
Yorkston et al (1987: 3) further mentioned that the term dysarthria does not encompass the developmental disorders of articulation and resonance due to structural deformities such as missing teeth, cleft palate, developmental articulatory disorders such as dyslalia, stuttering, failures of voice change at puberty and psychogenic aphonia or dysphonias. Dysarthria is "restricted to neurogenic speech dysfunctions, those resulting from the impairment of the central or peripheral nervous system."

Following Darley et al (1975), there are six different types of dysarthria depending on the area of lesion.

These are as follows:

1) Spastic dysarthria
2) Flaccid dysarthria
3) Hypokinetic dysarthria
4) Hyperkinetic dysarthria
5) Ataxic dysarthria
6) Mixed dysarthria

Now each of these six types is described below one after the other.
2.7.1 SPASTIC DYSARTHRIA

It is a relatively common type of dysarthria. The individuals suffering from this dysarthria 'have increased muscle tone of spasticity in various muscles of the vocal tract. It is accompanied by weakness and reduced range of motion, and decreased fine motor control in many of these same muscles' (Freed, 2000:135).

According to Freed (2000: 136), 'Specifically, spastic dysarthria is caused by bilateral damage to both the pyramidal and extrapyramidal neural pathways that serve the speech mechanism... Speech is one of the discreet skilled movements that rely on the proper functioning of the pyramidal system. Damage to the parts of the pyramidal system serving the speech mechanism will result in weakness and slowness in the speech musculature. In other words, when the pyramidal system is damaged, the tongue, lips, velum, and other speech structures will demonstrate weak and slow movements'. In case of damage to the motor neurons of the extrapyramidal system there would be weakness and increased muscle tone and abnormal muscle reflexes.

A number of disorders can cause spastic dysarthria. These include,
• Stroke
• Degenerative diseases such as Amyotrophic lateral Sclerosis, a
disease of unknown etiology that results in the progressive
degeneration of the lower and upper motor neurons; infections of
the brain tissue,
• Traumatic head injury
• Tumors, and
• Others

2.7.2 FLACCID DYSARTHRIA

Flaccid Dysarthria is caused by anything that disrupts the flow of motor
impulses along the cranial or spinal nerves that innervate the muscles
of respiration, phonation, articulation, prosody or resonance. It is
caused by the damage to the lower motor neurons or final common
pathway of the PNS.
According to Darley et al (1975:109-110), 'Damage to lower motor
neurons that innervate the respiratory musculature or to the cranial
nerves that innervate the speech musculature results in speech
changes collectively designated flaccid dysarthria. The specific acoustic
features depend upon which nerves are affected and the relative degree
of weakness that results from damage to them.'
The several conditions that damage the lower motor neurons are,

- Physical trauma,
- Brainstem stroke commonly known as cerebrovascular accident (CVA),
- Myasthenia gravis, a disease that damage parts of the muscle tissue (Freed, 2000: 110),
- Guillain Barre Syndrome, a disease where 'the progressive inflammatory loss of the myelin sheath around axons (demyelination)' (Freed, 2000: 110),
- Polio, an infectious viral disease that attacks the cell bodies of lower motor neurons' (Freed, 2000:111), and
- Others

Speech of the patients with flaccid dysarthria is characterized by slow and laboured articulation, hoarse-breathy phonation and hypernasal resonance. These are caused by the paralysis, weakness, hypotonicity, atrophy and hypoactive reflexes of involved speech musculature owing to damage to their cranial nerve supply or to inherent muscular disease.
2.7.3 HYPOKINETIC DYSARTHRIA

According to Freed (2000: 201), hypokinetic dysarthria is caused by the 'damage to the basal ganglia’s neural connections to other parts of the CNS. Literally hypokinetic means "less motion".' It results in muscle rigidity, reduced range of motion etc.

The major causes of hypokinetic dysarthria are,

- Parkinson’s disease, a degenerative disease caused by the dysfunction in basal ganglia,
- Traumatic head injury,
- Stroke,
- Toxic metal poisoning, and
- Others

2.7.4. HYPERKINETIC DYSARTHRIA

According to Nicolosi et al (1983:80), 'A dysarthria in which involuntary movements are present, muscle tone is abnormal, ranging from hypotonic to hypertonic, and in some cases fluctuating between the two.'
According to Freed (2000: 230). 'Hyperkinetic means too much movement...characterized by excessive involuntary movements of various body parts...Hyperkinetic movement disorders include many different involuntary motions, ranging from subtle movements of the lips, hands, or vocal folds.'

This type of dysarthria is associated to the damage to the extrapyramidal system, more specifically, lesions in the basal ganglia and their major pathways, which are important in the planning and programming of learned movements.

The various disorders that lead to hyperkinetic dysarthria are,

- **Chorea,** 'a movement disorder distinguished by random involuntary movements of the limbs, trunk, head and neck' (Freed, 2000: 234);
- **Myoclonus,** a 'movement disorder distinguished by involuntary and brief contractions of part of a muscle, a whole muscle, or a group of muscles in the same area of the body' (Freed, 2000: 242);
- **Huntington's disease,** 'a progressive disorder that is caused by the gradual degeneration of neurons in the basal ganglia and cerebral cortex' (Freed, 2000: 236);
• Tics, a disorder characterized by a rapid movement that can be controlled voluntarily for a certain period, but nevertheless is performed frequently because of a compulsive desire to do so (Freed, 2000: 243);
• Essential tremor, a disorder that cause tremulous movements in affected body parts (Freed, 2000: 244); and
• Dystonia, a hyperkinetic movement disorder of muscle tone...causes involuntary, prolonged muscle contractions that interfere with normal movement or posture (Freed, 2000: 245), and
• Others

2.7.5. ATAXIC DYSARTHRIA

Ataxic dysarthria is caused by the ' damage to different parts of the cerebellum or its control circuits' (Freed, 2000: 182). The cerebellum plays an important role in coordinating the many intricate muscular contractions needed to produce intelligible speech. Movement coordination implies the timing of onsets and offsets of individual muscle activities and for the cerebellum to perform this task, an internal time-keeping process appears to be a prerequisite.
Ataxic dysarthria often occurs when there is generalized or bilateral damage to the cerebellum. Speech coordination might be especially dependent on a part of the cerebellum at the midpoint between the cerebellar hemispheres called the vermis. Recent research has suggested that focal lesions also can cause ataxic dysarthria (Freed, 2000: 182). According to the study of Darley, et al. (1975), ataxic dysarthria is characterized by articulatory inaccuracy, prosodic excess and phonatory-prosodic insufficiency.

There are a number of progressive cerebellar dysfunctions that cause ataxic dysarthria, such as,

- Cerebellar ataxia,
- Stroke

and a number of different toxic and metabolic conditions that can also cause ataxic dysarthria, such as,

- Mercury poisoning,
- Traumatic head injury
- Tumors, and
- Others
2.7.6 MIXED DYSARTHRIA

A mixed dysarthria is 'a combination of two or more of the pure dysarthria types' (Duffy, 1995: 234). Mixed dysarthria occurs because of the damage, which may occur to a combination of any two or more of the following structures: upper motor neurons (UMNs), lower motor neurons (LMNs), cerebellum, basal ganglia control circuit. Many of the etiologies can cross over anatomical boundaries, thus affecting various components of the motor system simultaneously.

Many disorders can cause mixed dysarthria, for example,

- Single or multiple stroke,
- Traumatic head injuries,
- Infectious disease,
- Brain tumors,
- Degenerative diseases like multiple sclerosis, 'a progressive disease in which the myelin covering of axons degenerates' (Freed, 2000: 261), and
- Others.

REFERENCES


