## VOICE QUALITY IN NEUROLOGICAL DISORDERS: PATHOPHYSIOLOGICAL CORRELATES

Thesis Submitted for the Partial Fulfillment of the

M.D. Degree in Phoniatrics

Nervana Gamal El-Din Hafez

M.B., B.Ch. M.Sc. (Phoniatrics)

Supervised by

Prof. Dr. Mohamed Nasser Kotby

Professor and Head of the Phoniatric Unit and Head of E.N.T. Dept. Faculty of Medicine-Ain Shams University

Prof. Dr. Mahmoud Moustafa 57427

Professor of Neurology Faculty of Medicine-Ain Shams University

Prof. Dr. Mahmoud Youssef Abou El-Ella

Professor of Phoniatrics Faculty of Medicine-Ain Shams University

Dr. Taha Kamel Alloush

Assistant Professor of Neurology Faculty of Medicine-Ain Shams University

> Faculty of Medicine Ain Shams University 1998



بسدالله الرحن الرحيد

قالوا سبحانكلا علم لنا إلا ما علمتنا، إنكأنت العليم المكيم

صدق الله العظيم

سورة البقرة-الآية:٣٢

### Acknowledgment

I am greatly honored that I have worked under the supervision of Prof. Dr. Mohamed Nasser Kotby, Professor of Phoniatrics and the Head of E.N.T. Department, Faculty of Medicine, Ain Shams University, without his guidance, kind help and constructive criticism, the accomplishment of this work could not be a fact.

I am also deeply grateful to Prof. Dr. Mahmoud Mostafa, Professor of Neurology, Faculty of Medicine, Ain Shams University for his guidance and generous help.

I am also deeply indebted to Prof. Dr. Mahmoud Youssef, Professor of Phoniatrics, Faculty of Medicine, Ain Shams University, for his good advice, help and creative suggestions.

Also, my thanks to Dr. Taha Kamel, Assistant Professor of Neurology, Faculty of Medicine, Ain Shams University for his support all through the work.

I would like to express my sincere gratitude to all professors and staff members, especially Dr. Aliaa Khidr.

Nervana Gamal

# List of contents

	Page
Abstract	
Introduction	1
Aim of the work	2
Review of literature	
Neuromotor aspect of speech	3
Acoustics of speech	9
Motor speech disorders	23
• Dysarthrophonia	30
Diagnostic procedures in dysarthrophonia	51
Material and Methods	68
Results	82
Discussion	155
Conclusion	171
Summary	174
Appendix I	176
Appendix II	185
Appendix III	190
References	192
Arabic summary	

# List of Tables

		Page
•	Table (1): Difference between apraxia of speech and dysarthrophonia	26
•	Table (2): Types of aphasia according to the site of lesion	27
•	Table (3): Types of dysarthrophonia according to the site of lesion	30
•	Table (4): Proportion of positivity for the different dysarthrophonic	
	groups	93
•	Table (5-a): Group I: Parkinson's disease dysarthrophonia	95
•	Table (5-b): Group II: Cerebellar dysarthrophonia	96
•	Table (5-c): Group III: Suprabulbar dysarthrophonia	9 <b>7</b>
	Table (5-d): Group IV: Bulbar dysarthrophonia	98
•	Table (5-e): Group V: Dyskinetic dysarthrophonia	99
•	Table (5-f): Group VI: Vocal fold immobility (paralysis)	100
•	Table (6): Positions of the V.F. from the midline	101
•	Table (7): Aetiological categorization in different groups	102
	of dysarthrophonia	
•	Table (8-a): Parkinson's disease dysarthrophonia	115
•	Table (8-b): Cerebellar dysarthrophonia	115
•	Table (8-c): Suprabulbar dysarthrophonia	116
•	Table (8-d): Bulbar dysarthrophonia	117
•	Table (8-e): Dyskinetic dysarthrophnia	117
•	Table (8-f): Vocal fold immobility (paralysis)	118

# List of Agures

	Pag
Fig. (1): Idealized laryngeal spectrum	13
Fig. (2): Acoustic events in the production of stop consonants	15
Fig. (3): Spectrogram of: A. Aspirated stop; B. Unaspirated stop;	16
Fig. (4): Spectrogram with highlighted formant transitions for the syllables	18
/ba/-/da/-/ga/	
Fig. (5): Normal C.T. findings of the velopharyngeal port area during	72
rest and phonation	
Fig. (6): Normal oral sentence " ali ra:h jel b kor∂"	74
Fig. (7): Normal nasal sentence /Mama betnajm manal/	74
Fig. (8): [A] Normal spectrographic analysis of a female patient 32 years	75
[B] Spectrographic analysis for /tami/	
Fig. (9): Group (I); Parkinson's disease dysarthrophonia. Proportion	103
of positivity (n=16)	
Fig. (10): Group (I); Parkinson's disease dysarthrophonia	104
(Significance graph)	
Fig. (11): Group (II); Cerebellar dysarthrophonia. Proportion of positivity	105
Fig. (12): Group (II); Cerebellar dysarthrophonia (Significance graph)	106
Fig. (13): Group (III); Suprabulbardysarthrophonia. Proportion of positivity	y 10 <b>7</b>
Fig. (14): Group (III); Suprabulbar dysarthrophonia (Significance graph)	108
Fig. (15): Group (IV); Bulbar dysarthrophonia. Proportion of positivity	109
Fig. (16): Group (IV); Bulbar dysarthrophonia (Significance graph)	110
Fig. (17): Group (V); Dyskinetic dysarthrophonia. Proportion of positivity	111
Fig. (18): Group (V); Dyskinetic dysarthrophonia (Significance graph)	112
Fig. (19): Group (VI); Vocal Fold Immobility (Paralysis).	113
Proportion of positivity	
Fig. (20): Group (VI); Vocal fold immobility (Significance graph)	114
Fig. (21a): C.T. findings in Parkinson's disease dysarthrophonia	119
Fig. (21b): C.T. findings in cerebellar dysarthrophonia	120
Fig. (21c): C.T. findings in suprabulbar dysarthrophonia	121
Fig. (21d): C.T. findings in bulbar dysarthrophonia	122
Fig. (22): Auditory Perceptual Assessment analysis sheet of a male	123
patient 58 years old with Parkinson's disease dysarthrophonia	
Fig. (23): Auditory Perceptual Assessment analysis sheet of a male	124
patient 23 years old with cerebellar disease dysarthrophonia	

Fig. (24): Auditory Perceptual Assessment analysis sheet of a male	125
patient 72 years old with suprabulbar dysarthrophonia	
Fig. (25): Auditory Perceptual Assessment analysis sheet of a male	126
patient 57 years old with bulbar dysarthrophonia	
Fig. (26): Auditory Perceptual Assessment analysis sheet of a male	127
patient 13 years old with dyskinetic dysarthrophonia	
Fig. (27): Auditory Perceptual Assessment analysis sheet of a female	128
patient 32 years old with bilateral vocal fold immobility (paralysi	s)
Fig. (28): CSL voicing analysis in a case of Parkinson's disease	129
dysarthrophonia showed perturbation values	
Fig. (29): CSL voicing analysis in a case of cerebellar dysarthrophonia	130
Fig. (30): CSL voicing analysis in a case of suprabulbar dysarthrophonia	131
Fig. (31): CSL voicing analysis in a case of bulbar dysarthrophonia	132
Fig. (32): CSL voicing analysis in a case of dyskinetic dysarthrophonia	133
Fig. (33): CSL voicing analysis in a case of left vocal fold immobility	134
Fig. (34): (A) Spectrographic analysis in a male patient with Parkinson's	135
disease dysarthrophonia. (B) Spectrographic analysis of /tami/	
Fig. (35): (A) Spectrographic analysis in a male patient with cerebellar	136
dysarthrophonia. (B) Spectrographic analysis for /kora/	
Fig. (36): (A) Spectrographic analysis of a male patient with suprabulbar	137
dysarthrophonia (B) Spectrographic analysis of /tami/	
Fig. (37): (A) Spectrographic analysis of a male patient with	138
bulbar dysarthrophonia (B) Spectrographic analysis for /tami/	
Fig. (38): (A) Spectrographic analysis of a female patient with dyskinetic	139
dysarthrophonia (B) Spectrographic analysis of /tami/	
Fig. (39): Spectrographic analysis of a female patient with right vocal fold	140
immobility (paralysis)	
Fig. (40): Oral sentence showed mild increase in nasalance score of	141
Parkinson's disease dysarthrophonia patient	
Fig. (41): Oral sentence showed normal findings in a case of cerebellar	142
dysarthrophonia patient	
Fig. (42): Oral sentence displayed by nasometer with increase in nasalanace	e 143
seen in a case of suprabulbar dysarthrophonia	
Fig. (43): Marked increase in nasality of oral sentence displayed by nasome	eter
in a case of bulbar dysarthrophonia	144
Fig. (44): Nasometer findings in a case of dyskinetic dysarthrophonia	145
Fig. (45): Visipitch findings in a case of cerebellar dysarthrophonia	
showed increased intensity and uncoordinated pattern of speech	146

Fig. (46): Visipitch findings in a case of bulbar dysarthrophonia	
showed monotonous pattern of speech	146
Fig. (47): Visipitch findings in a case of dyskinetic dysarthrophonia	
showed variable intensity with variable pattern of speech	147
Fig. (48a): Nasofibroscopic findings in a case of Parkinson's	
disease dysarthrophonia	148
Fig. (48b): Nasofibroscopic findings in a case of cerebellar	
dysarthrophonia	149
Fig. (48c): Nasofibroscopic findings in a case of suprabulbar dysarthropho	nia 150
Fig. (48d): Nasofibroscopic findings in a case of bulbar dysarthrophonia	151
Fig. (48e): Nasofibroscopic findings in a case of dyskinetic dysarthrophon	ia152
Fig. (48f): Nasofibroscopic findings in case of vocal fold immobility	153
(A) A case of left vocal fold immobility	
(B) A case of bilateral vocal fold immobility	
Fig. (49): Increased subglottal pressure in case of vocal fold immobility	
(paralysis as a compensatory mechanism	154

#### ABSTRACT

The speech of 103 individuals with different types of dysarthrophonia and peripheral nerve lesion were studied with Auditory Perceptual Assessment (APA), acoustic spectrographic analysis, nasometer, aerodynamics, Visipitch, neurological examination and nasofibroscopic examination. The abnormalities documented by APA analysis were able to differentiate between dysarthrophonia groups. The spectrographic analysis results were alteration in the time pattern, disturbed vowel duration, VOT and formant transition duration as well as frequency value disturbances reflecting various dysprosodic features.

Nasometer showed hypernasality associating most of the dysarthrophonia groups. In addition, aerodynamic studies were influenced by the type of breakdown in every group. Visipitch gave only significant results with bulbar and dyskinetic groups. A correlative study between APA parameters and other variables explained the breakdown and pathology that affect voice quality

Key words: Dysarthrophonia-Acoustic analysis-Voice quality