Dysarthria in patients with Parkinson's Disease :A Comparative Study of Early and Advanced Stages.

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Abstract:

This study aimed to examine statistically significant differences in dysarthria between patients with early-stage and advanced-stage Parkinson's disease. The sample consisted of six patients aged between 70 and 80 years, including three patients diagnosed with early-stage Parkinson's disease and three with advanced-stage Parkinson's disease. A comparative descriptive design was adopted. The oral expression subtests of the MTA Test (2000), including syllable repetition, word repetition, sentence repetition, and naming tasks, were administered because no standardized dysarthria assessment adapted to the Algerian context was available. Data were analyzed using SPSS Version 27. The findings revealed clear differences between the two groups across all assessed speech-production tasks. Patients in the advanced stage demonstrated greater impairment in articulation and verbal performance than those in the early stage, confirming the progressive impact of Parkinson's disease on speech motor functions.

Keywords: dysarthria; Parkinson's Disease .

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1- Introduction

Language is a fundamental human capacity and the primary means of communication ,and the expression of needs and emotions. It is a cornerstone in social adaptation and knowledge development. In this regard, language is not limited to words; rather, it covers signs, face expressions, and tones, making it an integrated behavioral neurological system. Thus, any hereditary or acquired deficit in the nervous system may negatively affect language and pronunciation, and cause dysarthria. The latter is a motor speech disorder causing problems in issuing voice and coordinating the muscular movements needed for speech production, without a deficit in language centers or cognitive abilities. Dysarthria manifests in unclear, slow, and difficult pronunciation due to lack of motor coordination of lips, tongue, throat, and palate. These difficulties clearly aggravate due to some nervous problems, including Parkinson's Disease .

Parkinson's Disease is a chronic neurodegenerative disorder characterized by progressive motor and speech impairments resulting from the degeneration of dopaminergic neurons. This directly affects the ability to control the exact movements, including pronunciation, leading to dysarthria, which takes different aspects based on the stage of the disease. In this context, some early stage patients may face slight difficulties in pronunciation while those who suffer the advanced stage face big difficulties, as their speech becomes unclear, intoned, and impossible sometime.

1.1 Problem of the study:

Articulatory and phonetic impairments caused by neurodegenerative conditions—such as Parkinson's disease and Lewy Body Dementia—result from progressive neurological deterioration. These deficits compromise motor and linguistic skills, inducing profound alterations in communication and leading to dysarthria .Dysarthria is defined as an organic speech disorder characterized by intermittent, strained speech and hypernasality due to weakness and incoordination of the speech musculature (al-Farmawi, 2010, p. 133). It is highly prevalent in Parkinson's disease, which clinically presents with resting tremors, muscle rigidity, bradykinesia, loss of facial expression (hypomimia), dysphagia, and speech disorders.

This motor system impairment progressively induces neuronal atrophy and axonal degeneration over time (Kaddour, 2019, p. 13). Approximately 1 in 500 adults over the age of 50 is affected by Parkinson's disease, with the prevalence rising sharply with age (Bakyoun, 2013, p. 120). Early symptoms are frequently overlooked or misattributed to normal aging; consequently, actual epidemiological figures may exceed official diagnostic statistics (Chabira, 2014, p. 13). Postural instability, gait disturbances, and dysarthria represent primary clinical features that deteriorate into significant speech impairments in advanced stages (Kaddour, 2019). Numerous empirical studies have investigated the impact of Parkinson's disease on speech performance:

The study of J.C Vasquez_correa and J.R Orozco_Arroyave aimed at designing an automatic scale to evaluate dysarthria in Parkinson patients. In so doing, the authors assessed the suitability of the adjusted version of Frichai scale for evaluating dysarthria using signal analysis and Machine Learning. Besides, they designed speech tapes covering correct pronunciation, clarity, and prosody, using regression models to exactly estimate dysarthria level. Findings showed strong correlation between the automatic evaluations and those of the experts, mainly when using specific tasks, such as rapid repetition of syllables and text reading. Besides, combining diverse tasks and features confirmed the efficiency of the evaluation, showing its validity in providing exact results to improve therapy decisions.

Besides, the study of Hamdan Asia & Saidani Nadjat assessed dysarthria in 04 Parkinson patients aged 37 to 75 from the Department of Neurology in Khalil Omran Hospital in Bejaia using three tests. Findings showed that Parkinson patients suffer dysarthria, mainly troubles in voice and expression. Besides, there was a relation between Parkinson's Disease and speech troubles, proving that dysarthria is a symptom of Parkinson. In addition, the study of Dianna Van Lancker Daniel Kempler found out that Parkinson patients who suffer

dysarthria show unclear speech. Besides, it evaluated spontaneous speech, repetition, reading, recurrent singing, and spontaneous singing using the same statements in all tasks, except in spontaneous singing.

Moreover, the study of Gemma Moya-Galé & Erika Slvy, "Parkinson's Disease and dysarthria: spread, effect, and therapeutic strategies", showed that dysarthria is a motor trouble resulting from a neural deficit that hinders the execution of the movements needed for producing speech. Statistics show that 90% of Parkinson patients suffer speech problems, including voice loudness, monotony, restricted fundamental frequency range, weak pronunciation of consonants and vowels, breathing difficulties, and irregular stops. These problems negatively affect the ability to understand and communicate verbally. The study aimed at describing the nature of the trouble and its effect on communication, and discussed the medical methods to improve speech and the patients' life quality, the behavioral therapy techniques, and tele-medication, mainly for those suffering motor difficulties. In addition, the study shed light on the management of dysarthria through languages, which is a modern underexamined point in motor speech troubles.

As for our study, we decided to focus on dysarthria in Parkinson's Disease early and advanced stages patients because dysarthria is one of the main clinical indicators since the early stage, and may aggravate with the progression of Parkinson. The topic is important because this trouble directly affects the patient's ability to communicate. Besides, distinction of dysarthria features at each stage may improve diagnosis, limit the gradual deterioration of language skills, and foster therapy based on the specificity of each stage. Based on what was said, we raise the following question, "Are there statistically significant differences in dysarthria between early stage and advanced stage Parkinson patients?"

Sub-questions:

- Are there statistically significant differences in syllables repetition between early stage and advanced stage Parkinson patients?
- Are there statistically significant differences in words repetition between early stage and advanced stage Parkinson patients?
- Are there statistically significant differences in sentence repetition between early stage and advanced stage Parkinson patients?
- Are there statistically significant differences in naming between early stage and advanced stage Parkinson patients?

1.2 The study hypothesis

The main hypothesis:

- There are statistically significant differences in dysarthria between early stage and advanced stage Parkinson patients

Sub-hypotheses:

- There are statistically significant differences in syllables repetition between early stage and advanced stage Parkinson patients.
- There are statistically significant differences in words repetition between early stage and advanced stage Parkinson patients.
- There are statistically significant differences in sentence repetition between early stage and advanced stage Parkinson patients.
- There are statistically significant differences in naming between early stage and advanced stage Parkinson patients.

1.3 Aims of the study:

This study aims at shedding light on Parkinson, which is one of the main neurodegenerative disorders, and at making a comparison between early stage and advanced stage Parkinson patients regarding dysarthria.

1.4 Importance of the study:

- It sheds light on dysarthria in Parkinson patients.
- It enriches the theoretical balance with information and studies on Parkinson and dysarthria.
- It develops the therapeutic interventions and helps design efficient therapeutic programs.
- It fosters the neurological researches through a deep understanding of the neural troubles and pronunciation deficits.

1.5 The study concepts:

Dysarthria:

It is a linguistic and vocal trouble that affects the ability to correctly and clearly pronounce words, form sounds, and order words during speech due to nervous system problems (Chahata, 2014, p. 25). Procedurally speaking, it is a trouble in pronunciation that hinders people from issuing sounds correctly and leads to deficits in speech and communication; it may result from organic or neural problems.

Parkinson's Disease:

It is a neurodegenerative disorder, characterized with shaking, freezing, rigidity, and loss of balance. In this regard, 20% to 60% of the patients lose letters with the disease progression (Delatour, 1998, p. 15). Procedurally speaking, it is neurodegenerative disorder that primarily affects movement. It happens due to the devastation of the brain cells that produce dopamine and causes shaking, rigidity, slow movement, and imbalance.

2. Method and tools:

2.1 Method of the study:

We used the comparative descriptive method to analyze and describe the cases and compare the information and data. The method allows for a comprehensive and detailed vision of the study phenomenon for a better understanding of the different variables and factors.

2.2 The study limitations:

The study took place at the Department of Functional Reeducation of Ben Aknoun Hospital, and at the Blue Beach Hospital in Staouali from 05/01/2025 to 15/06/2025. It covered 06 cases diagnosed with Parkinson's Disease.

Although the study sample size was relatively small (N = 6), this number is considered sufficient and justified given the nature of clinical research that relies on the "case study approach." This limited number of participants is primarily due to the strict criteria established for sample selection; it was mandatory for each patient to have a confirmed medical diagnosis of Parkinson's disease accompanied simultaneously by dysarthria. Furthermore, identifying and accessing patients who precisely and consistently met all these specific clinical characteristics presented a significant challenge. Therefore, the findings of this study should be interpreted and understood within the scope of this particular methodological context.

2.3The study sample:

The sample covered 06 Parkinson patients who were chosen at random and divided into two groups; the first includes 03 early stage patients while the 02 includes 03 advanced stage patients.

Table (1) The early stage of Parkinson's Disease

	Name	Age	Gender	Address	Education	Language used	Disease	symptoms
The early stage of Parkinson	N. Noureddine	77	Male	Sidi Abdellah	University	French/ Arabic	Parkinson with dysarthria	- Loss of balance - Heaviness on the right side of the body - Speech difficulty
	M. Abd al Madjid	75	Male	Ain allah	University	French/ Arabic	Parkinson with dysarthria	-Shaking -Severe fatigue - Voice disorders
	H. Dhahbia	72	Female	Draria	Middle school	French/ Arabic	Parkinson with dysarthria	- Loss of balance - difficulty turning -Articulation disorders

Source: By the author based on clinical interviews and medical records.

Table (2) The advanced stage of Parkinson's Disease

	Name	Age	Gender	Address	Education	Language used	Disease	symptoms
The advanced stage of Parkinson	S. Omar	74	Male	Sidi Abdellah	Middle school	Arabic	Parkinson with dysarthria	Excessive shaking - Inability to stand and walk - articulation disorders
	B. Kamal	78	Male	Staouali	Middle School	French/ Arabic	Parkinson with dysarthria	-Akinesia - Vocal disorders - Linguistic disorders
	A. Slimane	80	Male	Bach Djerrah	Primary school	French/ Arabic	Parkinson with dysarthria	-Inability to move - Vocal disorders - Articulation disorders

Source: By the author based on clinical interviews and medical records .

2.4 The study tools:

2.4.1 The interview:

We used the semi-structured interview for collecting deep qualitative data and getting in direct interaction with Parkinson patients to make sure they provide enough information since they face difficulties in verbal communication. Besides, we interviewed speech therapists and physicians to find out more about their health and functional history in order to build a primary perception on the cases and choose the sample members that meet the study criteria. Thus, we gained a deeper understanding of the communicative and motor troubles the patients suffer.

2.4.2 Observation:

We used the direct and indirect observations to collect exact and objective data on the informants.

The direct observation: We attended different therapeutic sessions inside the hospital to monitor the patients' linguistic behaviors and interactions, and find out the aspects that reflect the difficulties they face during therapy sessions or test application.

The indirect observation: We accessed the medical files of the patients to find out more about the clinical diagnoses, MRI results, and speech therapy reports. Thus, we built a comprehensive image of the neural, motor, and communicative state of each informant.

2.4.3 MTA 2000 test:

It is a neuro-psychological test designed to evaluate language and communication troubles for aphasia patients. It was developed in 1986 by Montreal-Toulouse team, and is widely used in neurology and speech therapy. Under the agreement between the University of Algiers and the University of Toulouse, the test was adapted to the Algerian linguistic cultural milieu to assess the different aspects of oral and written language after strike, neurodegenerative diseases, and traumatic brain injuries. The test evaluates oral comprehension, oral production (repetition, naming, and spontaneous speech), reading and writing, and grammatical and semantic procession. In our study, we use the item of syllables repetition, words repetition, sentence repetition, and naming.

Scoring:

- Repetition of syllables: Grade 01 is given to the correct answer that shows no omission or substitution while 00 is given to the wrong answer, or the answer that shows omission, addition, or substitution.
- Repetition of words: Grade 01 is given to the correct answer while 00 is given to the wrong.
- Repetition of sentences: Grade 01 is given to the correct answer while 00 is given to the wrong answer, or the answer that includes omission or substitution.
- Naming: Grade 01 is given to the correct answer while 00 is given to the wrong.

2.4.4 The statistical methods:

We used percentages, arithmetic means, and standard deviations. Besides, we relied on SPSS 27 to analyze data after reviewing, quantifying, and coding them to facilitate their tabulation.

3. Results and discussion:

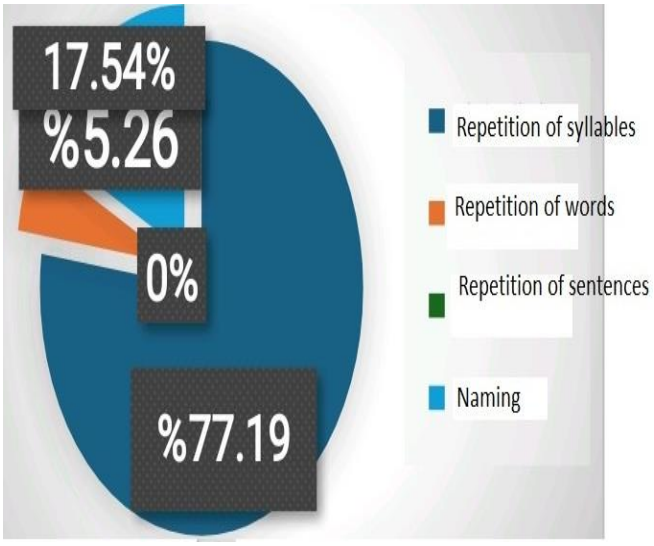
3.1 Presentation and analysis of the results of MTA test for group 01 (early stage patients)

Case 01:

Table (3) The results of MTA test for case 01:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**44**	57	**77.19%**	100%
Repetition of words	**3**		**5.26%**	
Repetition of sentences	**0**		**0%**	
Naming	**10**		**17.54%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

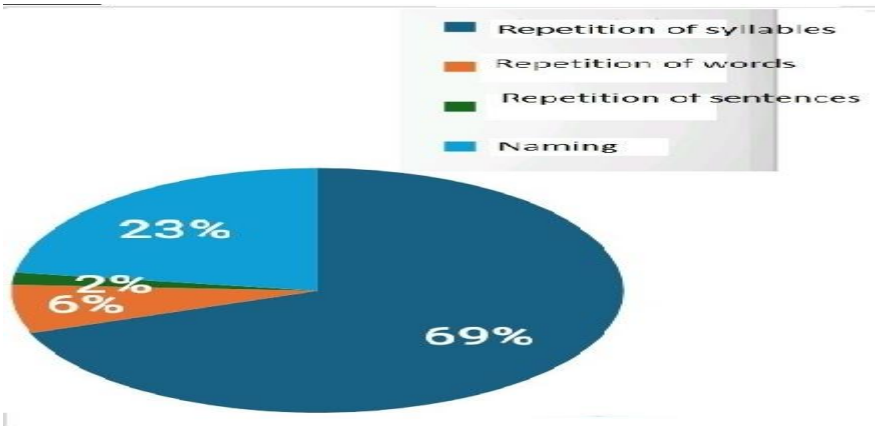
Figure (1) The distribution of levels according to case 01:

Case 02:

Table (4) The results of MTA test for case 02:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**43**	62	**69.35%**	100%
Repetition of words	**4**		**6.45%**	
Repetition of sentences	**1**		**1.61%**	
Naming	**14**		**22.58%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

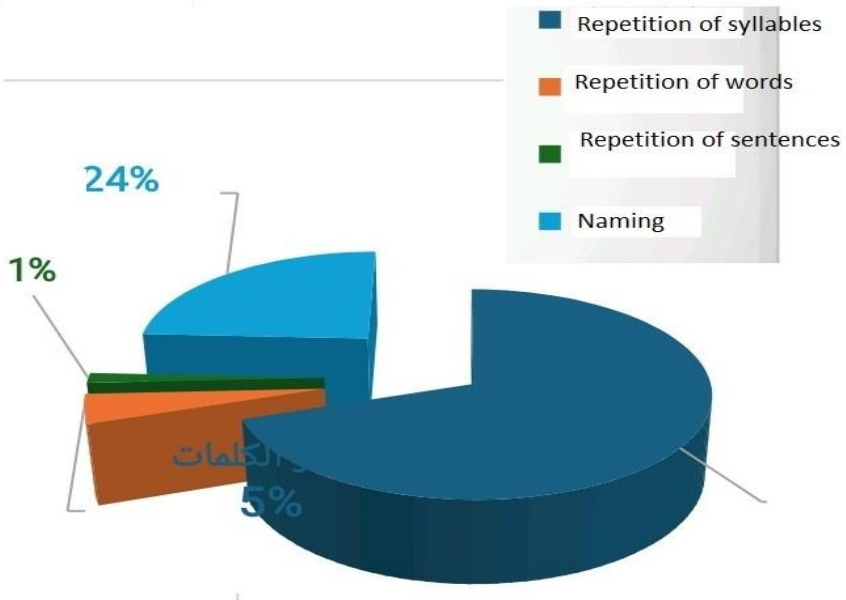
Figure (2) The distribution of levels according to case 02:

Case 03:

Table (5) The results of MTA test for case 03:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**46**	66	**69.70%**	100%
Repetition of words	**3**		**4.55%**	
Repetition of sentences	**1**		**1.52%**	
Naming	**16**		**24.24%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

Figure (3) The distribution of levels according to case (03):

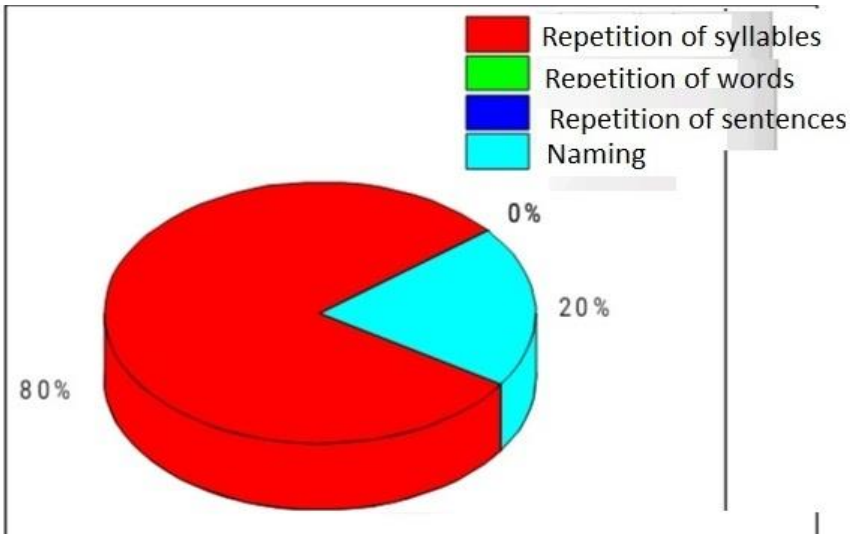
3.2 Presentation and analysis of the results of MTA test for group 02 (advanced stage patients)

Case 01:

Table (6) The results of MTA test for case 01:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**8**	10	**80%**	100%
Repetition of words	**0**		**0%**	
Repetition of sentences	**0**		**0%**	
Naming	**2**		**20%**	

Source: By the author based on the outputs of SPSS27 using Origin



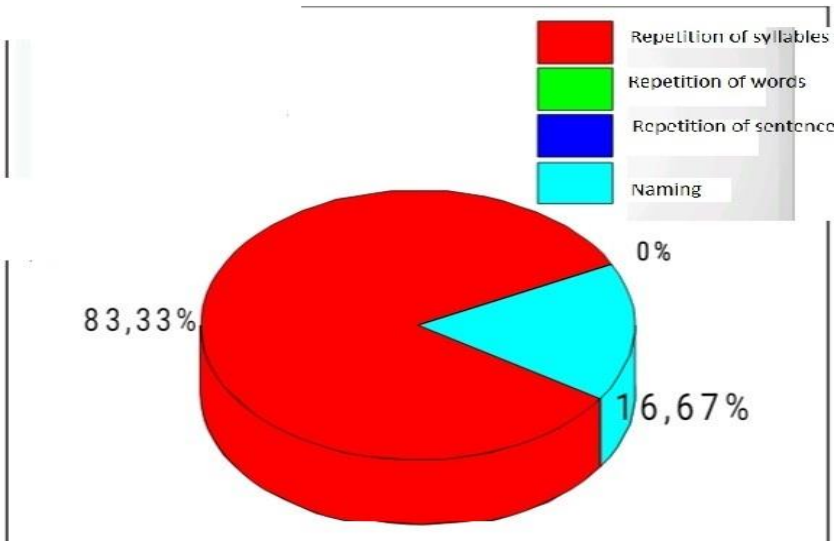
Source: By the author based on the outputs of SPSS27 using Origin

Case 02: Figure (4) The distribution of levels according to case (1)

Table (7) The results of MTA test for case 02:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**6**	10	**83.33%**	100%
Repetition of words	**0**		**0%**	
Repetition of sentences	**0**		**0%**	
Naming	**1**		**16.67%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

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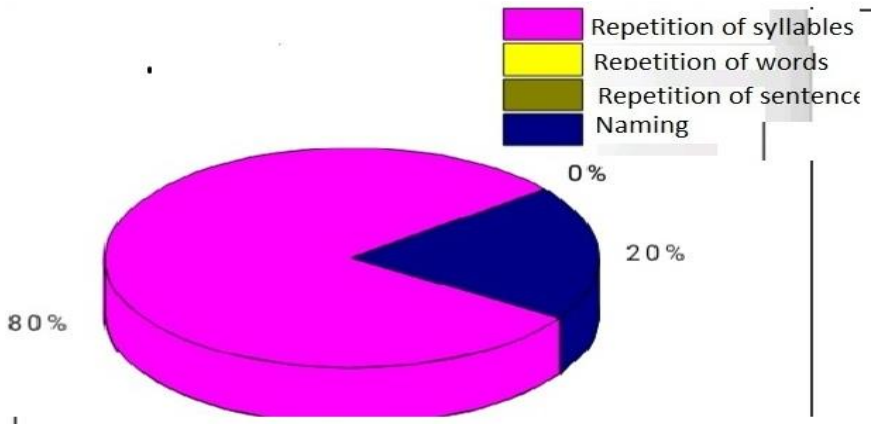
Figure (5) The distribution of levels according to case 02:

Case 03:

Table (8) The results of MTA test for case 02:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**8**	10	**80%**	100%
Repetition of words	**0**		**0%**	
Repetition of sentences	**0**		**0%**	
Naming	**2**		**20%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

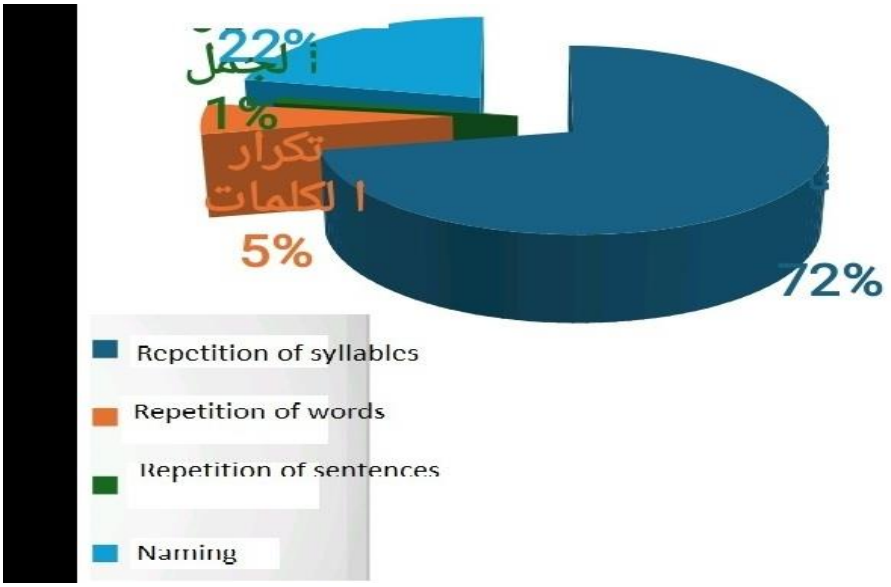
Figure (6) The distribution of levels according to case (03):

The overall levels of the early stage:

Table (9) The overall levels of the early stage cases:

Items	Total	Total degree	Percentage of each level	Total percentage
Repetition of syllables	**133**	185	**71.89%**	100%
Repetition of words	**10**		**5.41%**	
Repetition of sentences	**2**		**1.08%**	
Naming	**40**		**21.62%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

Figure (7) The distribution of levels in the early stage:

The overall levels of the advanced stage:

Table (10) The overall levels of the advanced stage cases:

Items	Total	Total degree	Percentage of each level	Total percentage
21	**133**	26	**80.77%**	100%
00	**10**		**0%**	
00	**2**		**0%**	
5	**40**		**19.23%**	

Source: By the author based on the outputs of SPSS27 using Origin



Source: By the author based on the outputs of SPSS27 using Origin

Figure (8) The distribution of levels in the advanced stage:

Table (11) The statistically significant differences in dysarthria for early and advance Parkinson patients

Variables	Early stage N= 3		Advanced stage N= 3		Df	F	T test	Sig.
	Mean	Standard deviation	Mean	Standard deviation				
Aspects of dysarthria for Parkinson patients	15.4167	18.18320	2.1667	3.09936	22	17.211	2.488	0.00

Source: By the authors based on the outputs of SPSS 27

Comment on the table:

The table shows that the arithmetic mean of dysarthria for the early stage patients is 15.42 with a standard deviation of 18.18, showing variance in the severity of dysarthria for the patients. In this regard, some maintain acceptable speech ability while others suffer slight to moderate troubles. On the other hand, the arithmetic mean for the advanced stage patients is 2.17 with a standard deviation of 3.10, reflecting big common deterioration in pronunciation, and that most of the patients suffer severe troubles that affect the ability to produce speech.

Besides, the value of T test is 2.488 at degree of freedom 22. It is a statistically significant value at significance level 0.00; i.e., much less than the usual significance level, estimated at 0.05. Thus, the can confirm that differences between the two groups are due not random, and that they appear with the progression of the disease. Besides, the value of F (17.211) is high and shows a clear variance between the two stages. Thus, our findings confirm that dysarthria aspects increase with the progression of Parkinson, as confirmed by previous works, which found out that the motor and vocal disabilities in the advanced stage directly affect the patient's pronunciation.

3.3 Presentation and analysis of the results of sub-hypothesis 01:

It states that: "there are statistically significant differences in syllables repetition between early stage and advanced stage Parkinson patients". Seemingly, the neuro-motor deterioration that accompanies Parkinson directly affects pronunciation, mainly in the tasks that require exact coordination and speed, such as in the repetition of syllables. In this regard, our findings showed that the mean of syllables repetition in the early stage is 44.33 compared to 7.00 in the advanced, reflecting big decrease in the ability to pronounce syllables with the progression of the disease, and the negative effect on the speech motor system due to the neurological symptoms, mainly those related to breathing, muscle coordination, and control of the exact movements. This big variance in the means is a clear indicator that Parkinson patients face increasing difficulties in pronunciation with the progression of the disease, confirming the sub-hypothesis.

Literature review shows that J.C Vasquez-Correa & J.R Orozco-Arroyave proved the efficiency of using syllable repetition drills to highly detect dysarthria, and that combination of the multiple pronunciation tasks fosters the evaluation. Besides, Dianna Van Lancker & Daniel Kempler showed that Parkinson patients who suffer dysarthria produce unclear speech, mainly in the spontaneous situations and when repeating syllables. These findings agree with those of Gemma Moya Galé & Erikas Levy, which showed that 90% of patients suffer pronunciation troubles, mainly the restriction of the frequency range and difficulties in pronouncing letters and making stops; this affects the efficiency of communication. Based on what was said, our findings agree with those of other scholars and foster the hypothesis that states: "there are statistically significant differences in syllables repetition between early stage and advanced stage Parkinson patients". In addition, they show the importance of adopting this indicator in the clinical evaluation of dysarthria to decide the suitable therapeutic interventions.

3.4 Presentation and analysis of the results of sub-hypothesis 02:

It states that: "there are statistically significant differences in words repetition between early stage and advanced stage Parkinson patients". Findings show that the mean of repeating words in the early stage is 3.33, with a standard deviation of 0.57. As for the advanced stage, the mean decreases to 0.00 with a full absence of the standard deviation, showing a severe deterioration in the skill for all patients, and reflecting a clear inability to recall and pronounce words due to the disease's effect on the neuro-motor system and the lexical procession. This confirms that word repetition requires integrated linguistic and pronunciation abilities, and confirms the previous studies, such as that of Van Lancker & Kempler, which found out unclear speech in spontaneous situations, and the study of Moya Galé & Levy that revealed common deep pronunciation troubles for 90% of Parkinson patients. Thus, we confirm the sub-hypothesis and that word repetition is a vital clinical criterion to detect and monitor dysarthria in Parkinson patients, and to build up therapeutic programs.

3.5 Presentation and analysis of the results of sub-hypothesis 03:

It states that: "there are statistically significant differences in sentence repetition between early stage and advanced stage Parkinson patients". The mean of repetition of sentences is 0.66 in the early stage and 0.00 in the advanced, while the standard deviation is 0.57 in the early stage and is fully absent in the advanced stage. This shows a complete disability in repeating sentences, which raises big challenge for the patients because it requires an exact coordination of breathing, voice production, and muscles coordination. Thus, we confirm the sub-hypothesis, as despite some difficulties, the early stage patients still maintain a minimum ability to execute this complicated task, unlike the advanced stage patients.

These findings are in line with those of Van Lancker & Kempler, which showed that speech clarity decreases in the tasks that require a complex production, such as spontaneous speech and sentence repetition, unlike the less complicated tasks, such as repetition of syllables and words. Besides, they agree with the study of Gemma Moya Galé & Erika Levy, which confirmed that weak breathing and lack of control on sound and monotony are the main factors that affect dysarthria, mainly in the advanced stage. Thus, the weak repetition of sentences is a good indicator of dysarthria progression and the low motor linguistic abilities, and a good clinical tool to direct therapy.

3.6 Presentation and analysis of the results of sub-hypothesis 04:

It states that: "there are statistically significant differences in naming between early stage and advanced stage Parkinson patients". The arithmetic mean in the early stage is 13.33 and the standard deviation is 3.05, reflecting a relative ability to recall words, with some differences. As for the advanced stage, the mean decreases to 1.66 and the standard deviation to 0.57, indicating severe deterioration in the skill. These differences show that naming is a linguistic task that requires full integration of the higher cognitive abilities, such as recalling, and the motor skills. Hence, the decrease of the ability to name things reflects deficits in lexical memory and articulatory motor execution, mainly with the disease progression. These results agree with those of Gemma Moya Galé & Erika Levy, which showed that Parkinson patients suffer unclear speech, restricted vocal frequency range, and weak sounds production, which negatively affect their lexical tasks, including naming. Moreover, these findings agree with those of Hamdan Assia & Saidani Nadjat, who noticed that Parkinson patients show troubles in voice and verbal expression, confirming that naming deficits are not cognitive; rather, they are a combination of perceptional and speech muscle weaknesses. Thus, naming is an exact indicator to monitor the effect of Parkinson on the linguistic performance, mainly in the advanced stage, and is vital for evaluating the efficiency of therapy and linguistic education.

3.7 Presentation and analysis of the results of the general hypothesis:

It states that "There are statistically significant differences in dysarthria between early stage and advanced stage Parkinson patients". To test it, we statistically processed a set of linguistic tasks, namely repetition of syllables, repetition of words, repetition of sentences, and naming in the two stages. Findings showed clear statistically significant differences between the two stages regarding the general performance and internal dispersion of data, as the early stage patients had relatively high means in most of the tasks, reflecting good pronunciation and cognitive abilities, while the advanced stage patients showed sharp weakness in all the tasks, reflecting a complex disability in the motor system and the lexical system. Besides, T test results confirm the hypothesis, as its value is 2.488, with a significance level of 0.000, indicating that the differences between the two groups are due to the disease progression and to its effect on speech mechanisms.

In this context, the study of Vasquez-Correa & Orozco-Arroyave confirmed the efficiency of automatic assessment of dysarthria in monitoring the exact changes in pronunciation, and that the complex tasks, such as repetition of sentences and reading texts, are most sensitive to disease changes. Besides, the study of Gemma Moya-Galé & Erika Levy confirmed that dysarthria that accompanies Parkinson develops from simple troubles, such as monotony and low voice, into more complicated troubles, such as breathing problems and irregular stops that affect the clarity of speech and communication. Based on what was said, we confirm the hypothesis, as dysarthria does not have the same symptoms for all patients; rather, it differs according to its stage. Thus, it is necessary to make an exact diagnosis to direct the vocal and linguistic therapy. In addition, therapy should start in the early stage before reaching the advanced where symptoms cannot be handled. Thus, our findings confirm the need to adopt exact periodical assessment protocols and early flexible therapy.

4. Conclusion:

This study focused on dysarthria in Parkinson patients by applying MTA (2000) test, which examines the repetition of syllables, the repetition of words, the repetition of sentences, and naming. Findings show clear differences between the early stage and advanced stage of the disease. In this regard, the early stage patients showed better performance in all the study tasks and that they maintain relative linguistic and articulatory abilities, showing that the motor articulatory system is not much affected at the early stage. However, these abilities highly decrease in the advanced stage, indicating the gradual deterioration with the disease progression. Therefore, Parkinson does not only affect speech muscles; rather, it affects the linguistic and cognitive aspects with time. These results confirm the need to use exact tests, such as MTA (2000), to evaluate the linguistic and articulatory performance, and the role of early intervention in limiting the deterioration of the communicative skills.

Based on what was said, dysarthria is one of the prominent symptoms of Parkinson that requires an integrated intervention since the early stage to reduce the effect on the patient's daily life. Such study is a good reference in developing therapeutic plans taking into account the differences between the two stages and the needs of each patient. In the end, we recommend:

- Encouraging early diagnosis and regular evaluation of dysarthria since the early stage of Parkinson to limit the symptoms.
- Designing specialized therapeutic programs based on the needs and differences between the two stages, with a focus on the psychological and vocal support in the start, and on pronunciation clarity and substitution abilities later.
- Integrating the digital and clinical evaluations through exact vocal analysis tools that help objectively monitor the disease and take efficient therapeutic decisions.
- Fostering the multidisciplinary care by integrating speech therapists, neurologists, psychologists, and physicians to deal with the motor, linguistic, and psychological symptoms.
- Raising family awareness and integrating it in reeducation.

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