Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 6 Issue 4 April 2022

Research Article

Kinematic Analysis of Gait of Patients with Amyotrophic Lateral Sclerosis (Longitudinal Study)

Paloma Nepomuceno Araujo[1]*, Paulo Fernando Lôbo Correa[2], Denise Sisterolli Diniz[3] and Jakeline Ferreira de Araújo Lôbo[4]

[1]Academic of the 8th Period of the Physiotherapy Course of Alfredo Nasser College, in the 2nd Semester of 2021, Brazil

[2]PhD Student of the Health Sciences Program of the Faculty of Medicine and Advisor of this Project, Brazil

[3]Neurologist at Hospital das Clínicas and Advisor of this Project, Brazil

[4]Professor of the Physiotherapy course at Alfredo Nasser College, PhD Student in Health Science and Advisor of the Present Work, Brazil

***Corresponding Author:** Paloma Nepomuceno Araujo, Academic of the 8th Period of the Physiotherapy Course of Alfredo Nasser College, in the 2nd Semester of 2021, Brazil.

Received: February 17, 2022

Published: March 15, 2022

Abstract

Introduction: Amyotrophic Lateral Sclerosis (ALS) is a terminal neurodegenerative, progressive and paralytic disease that occurs due to the degeneration of the upper and lower motor neurons. Survival is 3 to 5 years and the peak of the disease occurs between 65 and 75 years, being more prevalent in Caucasian men. The quality of life of affected individuals is mainly compromised by reduced mobility and ability to perform daily life activities, such as gait.

Objective: The objective of this stucco was to evaluate the gait performance of individuals with ASS, without the use of aid devices, through the analysis of kinematic parameters.

Methodology: This is a cross-sectional, descriptive and laboratory study, in which we analyzed the kinematic gait parameters of patients with ALS, such as inclination, oblinetity and pelvis rotation; flexion, extension, abduction, adduction and hip rotation; flexion, extension, abduction and knee adduction; and plantar flexion, dorsal flexion and bearings ankle. The study included adult patients with confirmed diagnosis of ASS, both genders, ages 18 to 80 years, living in the state of Goiás and who were able to march independently without the use of auxiliary devices. For each patient, five gait captures were performed and the mean of the five collections was used for analysis. The kinematic parameters were evaluated by 10 infrared cameras and 2 video cameras.

Results and Discussion: In kinematic analysis, there was changes in all joints, with greater frequency in the ankle and pelvis component. The scarcity of materials that analyzed the kinematics of EDS made it difficult to discuss a comparative discussion.

Conclusion: The presence of kinematic gait alterations of patients with ALS with great heterogeneity in the kinematic components was observed.

Keywords: Amyotrophic Lateral Sclerosis; March; Kinematics

Introduction

Amyotrophic Lateral Sclerosis (ALS), also known as Motor Neuron Disease, Lou Gehrig's disease or Charcot disease is a terminal neurodegenerative, progressive and paralytic disease that occurs by the degeneration of the upper and lower motor neurons [1-3]. The overall gross prevalence of ALS is 4.42 per 100,000 people-years, with a ratio of 1.4:1 for males with a peak between 65 and 75 years [4,5]. Disease progression occurs rapidly and survival ranges from 3 to 5 years, respiratory failure is the leading cause of death [6].

ALS can be subdivided in its etiological classification of sporadic ALS that has no defined cause (90%) and family-related ALS of genetic and hereditary character, usually dominant (10%) (WHITE; SREEDHARAN, 2016). It can also be classified as to the origin of symptoms, onset in the limbs (70%), bulbar onset (25% to 30%) or respiratory onset (3%) that usually has a worse prognosis [7].

The quality of life of affected individuals is greatly affected mainly in the motor aspect by the reduction of mobility and capacity to perform daily life activities, which includes activities such as eating, dressing, sanitizing and transferring [8].

The functional evaluation of individuals affected by neurological diseases is important because of the diagnostic and prognostic analysis of these diseases, especially gait analysis [9], which can be performed by five measurement systems in which three of them are specific for analysis of walking, analysis of movement by ci nematic, kinetics and electromyography, and both evaluate the biomechanics of gait and its effects; characteristics of the stride by time and spatial parameters; and energy expenditure measurement [10].

In the literature there is little description of the gait analysis of ALS in particular, especially that directly evaluates and correlates kinematic parameters. This study, therefore, aims to evaluate the gait performance of patients with ASD through kinematics.

Methodology

This is a cross-sectional, descriptive and laboratory study in which the kinematic gait parameters of patients with ALS were analyzed, such as: inclination, oblinetity and pelvis rotation; flexion, extension, abduction, adduction and hip rotation; knee extension, abduction and adduction; and plantar flexion, dorsal flexion and ankle bearings.

The recruitment and screening of patients was performed at the neurology service of the Hospital das Clínicas of the Federal University of Goiás (HC-UFG), in the city of Goiânia-Goiás. Data collection was performed at the Movement Analysis Laboratory of the Rehabilitation Center Dr.º Henrique Santillo (CRER), in the city of Goiânia-Goiás.

For the analysis of kinematic parameters, 10 VICON® Motion Systems Ltd. cameras were used for the analysis of the film parameters and 2 more video cameras of the VICON® (Vicon Motion Systems Ltd.) model Bonita 720C.

The sample consisted of 36 adult patients with confirmed diagnosis of ALS, for inclusion in the study, patients of both genders were considered, regardless of ethnic or social group, aged between 18 and 80 years, living in the state of Goiás, who were able to perform gait independently, who accepted participar of the study and, with a confirmed diagnosis of ALS according to the criteria of [11].

The calibration and configuration of the entire camera system were performed, and later, all complementary materials were checked for data collection (measuring tape, manual caliper, double-sided adhesive tape, reflective markers and data control sheet). Subsequently, the height and weight, length of the lower limbs (LLLL), width of the knees and ankles of the individuals were measured. To perform these procedures, the patient was previously instructed to wear clothing that exposed his lower limbs.

After the preparation of the patient, he walked through the collection track with selected self-speed and in the comfortable way possible, in an attempt to reproduce his usual gait, in an air-conditioned environment. For each patient, five gait captures were performed and for data analysis the mean of the five collections.

The collected data were processed after VICON NEXUS 1.8.5 software and® later the results related to those were analyzed and presented in a report generated by vicon polygon 4.1® software. These data were exported to Excel spreadsheets for statistical analysis, which had descriptive analysis of the total sample and age group, as well as demographic characterization variables, and time and spatial data that were compared.

For statistical analysis, an inferential analysis of the sciatic characteristics presented was performed, with mean, standard deviation, confidence interval, frequency, percentage and interquartile interval. The Statistical Package for Social Sciences version 22.0 software was used for analysis.

Results and Discussion

The kinematic parameters of the lower limbs of the gait of 36 patients with ASS who did not use auxiliary devices for ambulation were analyzed. Table 1 shows the main changes considered those with frequency greater than or equal to 10%.

Changes more frequently				Gait phase	
				MID	MIE
Pelvis	Inclination	Support	-	-	-
		Balance sheet	-	-	-
	Obliquidade	Support	Down	19,63%	22,13%
		Balance sheet	Up	15,57%	17,21%
	Rotation	Support	Internal Rotation	15,57%	11,48%
		Balance sheet	External Rotation	13,93%	16,39%
Hip	Flexo/Extension	Support	-	-	-
		Balance sheet	-	-	-
	Adu/Abdução	Support	Abduction	-	12,3%
		Balance sheet	-	-	-
	Rotation	Support	-	-	-
		Balance sheet	-	-	-
Knee	Flexo/Extension	Support	Extension	10,66%	-
		Balance sheet	Delays bending	16,39%	16,39%
			Lower bending	-	12,3%
	Adu/Abdução	Support	-	-	-
		Balance sheet	-	-	-
Ankle	Dorsi/Planti	Support	-	-	-
		Balance sheet	-	-	-
	Bearings	Support	Does not perform 1st bearing	20,49%	20,49%
			Delays 3rd bearing	13,93%	13,93%

Table 1: Frequency of changes in the kinematic gait parameters of 36 patients diagnosed with ALS through the analysis of inclination, obliqueand rotation of the pelvis; flexion, extension, abduction, adduction and hip rotation; flexion, extension, abduction and knee adduction; and plantar flexion, dorsal flexion and ankle bearings.

MID: Right Lower Limb; MIE: Left Lower Limb; changes with frequency less than 10%.

It was observed in this study that the involvement of kinematics in ASS is higher in the ankle component, especially during the first em bearing that was not performed by 20.49% of the individuals and the third bearing that occurred late in 13.93% of the patients. According to Eisen., *et al.* (2017) the predominance of the initial involvement of dorsiflexors under the plantiflexor muscles can be explained in two ways, the first is by assigning the effect of gravity, since they are antigravitational muscles, the second concerns the cortical impulse that for dorsiflexors is greater than for plantiflexors [12].

In the frontal plane there was greater abduction left hip in 12.3% of the individuals, with no significant alterations in the right limb. Regarding knee movements, there was a greater extension during the support phase for the right limb in 10.66% of the individuals. In the balance line, there was a delay in knee flexion to 16.39% in both limbs, which indicates that the patient performs the effective flexion of the knee, but it occurs at a moment after the physiological, which may lead to the drag of the tip of the foot in the durante soil the beginning of the balance. There is also a lower flexion for 12.3% of the individuals in the left limb, which can also lead to foot drag on the ground, but now throughout the swing period.

In pelvic oblinety, during the support period 19.67% of the individuals presented a fall in the right pelvis and 22.13% to the left. In the movement of obliletity of the pelvis, in which there is a high frequency of fall of the pelvis during support, the physiological should be a maximum elevation at the time of medium support. In the balloon, 15.57% showed high right pelvis and 17.21% with elevated left pelvis. Pelvic elevation during the swing can be associated as a compensatory movement for flexion delay and lower knee flexion during the swing phase and absence of the first bearing [13].

During the pelvic rotation movement, the internal rotation was present in the support, in 15.57% in the right limb and 17.21% in the left limb, while in the balance there was a prevalence of external rotation in 13.93% in the right limb and 16.39% in the left limb.

In general, despite the movements with frequent alterations, a great heterogeneity was observed in the kinematics of the gait of these individuals. The weakness of the lower limbs presented in THE SI leads to less efficient gait patterns that consome more energy [14]. Due to this, it is necessary that, in clinical practice, gait training is performed along the progression of the disease, since compensatory gait patterns can trigger musculoskeletal pain, such as low back pain, and can worsen fatigue. However, moderate exercise should be performed, as high intensity activities are associated with muscle damage, and may lead to a worse prognosis [15,16].

Conclusion

The presence of several kinematic changes in gait of patients with ALS was analyzed in the study, especially for ankle bearing movements and pelvic obliquede.

Therefore, it is not an efficient gait, because there are many compensations of movement and que, although ASL is a progressive disease, it is necessary, in clinical practice, a treatment with training of a gait so that it becomes as efficient as possible.

Limitations

There is, in the literature, a scarcity of studies that performed analysis of the score of patients with ASD, especially their kinematic description, thus making it impossible to discuss a comparative discussion. More research needs to be carried out in this area.

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