How to cite this article: Corradini S, Mota RS, Macêdo MC, Brasil MS, Dubois-Mendes SM, Sá KN. Parameters for gait rehabilitation in Tropical Spastic Paraparesis: cross sectional study. J. Physiother. Res. 2019;9(1):18-27. doi: 10.17267/2238-2704rpf.v9i1.2201

Parameters for gait rehabilitation in Tropical Spastic Paraparesis: cross sectional study

Parâmetros para reabilitação da marcha em pessoas com Paraparesia Espástica Tropical: estudo transversal

Sandra Corradini[1], Renata de Sousa Mota[2], Maíra Carvalho Macêdo[3], Marina Silva Brasil[4], Selena Márcia Dubois-Mendes[5], Katia Nunes Sá[6]

[1]Corresponding author. BAHIANA – School of Medicine and Public Health. Salvador, Bahia, Brazil. ORCID: 0000-0003-2101-0091. fisio.scorr@gmail.com
[2]Federal University of Recôncavo of Bahia. Feira de Santana, Bahia, Brazil. ORCID: 0000-0002-5176-3329. renatasmota@gmail.com
[3]Foundation for Neurology and Neurosurgery-Brain Institute. Salvador, Bahia, Brazil. ORCID: 0000-0002-8470-5838. mcarvalhomacedo@gmail.com
[4]BAHIANA – School of Medicine and Public Health. Salvador, Bahia, Brazil. ORCID: 0000-0002-2526-5422. marinabrasil15.2@bahiana.edu.br
[5]BAHIANA – School of Medicine and Public Health. Salvador, Bahia, Brazil. ORCID: 0000-0001-6377-8782. dubois.selena@gmail.com
[6]BAHIANA – School of Medicine and Public Health. Salvador, Bahia, Brazil. ORCID: 0000-0002-0255-4379. katia.sa@gmail.com

RESUMO | INTRODUÇÃO: A marcha de pessoas com Mielopatia Associada ao HTLV-1 ou Paraparesia Espástica Tropical (HAM/TSP) é pouco conhecida. **OBJETIVO:** Avaliar o perfil cinemático da marcha em pessoas com HAM/TSP. **MÉTODOS:** Estudo transversal com 25 pessoas com HAM/TSP e 25 participantes saudáveis. Os dados espaço-temporais e angulares das filmagens da marcha foram submetidos à análise cinemática utilizando o software CVMob®. A marcha dos participantes com HAM/TSP foi analisada quantitativamente através do teste t-student (alfa de 5% e poder de 80%). O projeto foi aprovado pelo comitê de ética da Escola Bahiana de Medicina e Saúde Pública sob o CAAE 13568213.8.0000.5544. **RESULTADOS:** O grupo HAM/TSP apresentou alterações significativas em dois domínios distintos da análise biomecânica da marcha quando comparados aos controles saudáveis. As variáveis angulares apresentaram maior inclinação, flexão e extensão do tronco ($p < 0,05$); aumento da flexão do quadril e diminuição da extensão do quadril ($p < 0,05$); diminuição da flexão e extensão do joelho ($p < 0,05$); diminuição da flexão dorsal e plantar do tornozelo ($p < 0,05$). A amplitude de movimento também foi reduzida em todas essas articulações. As variáveis espaço-temporais mostraram diminuição do comprimento da passada, aumento do tempo da passada e velocidade do ciclo da marcha ($p < 0,001$). Essas mudanças apontam para redução nas amplitudes articulares do quadril, joelho e tornozelo, mudanças na base de apoio e assimetria do tempo do duplo apoio entre os lados direito e esquerdo, redução do tempo do pré-balanço, elevação do quadril no balanço médio e queda do pé ao longo do balanço. **CONCLUSÃO:** As pessoas com HAM/TSP apresentam marcha caracterizada por redução nas amplitudes articulares do quadril, joelho e tornozelo, assimetria do tempo de suporte duplo entre os lados direito e esquerdo, redução do tempo do pré-balanço, elevação do quadril no balanço médio e queda do pé ao longo do balanço.

PALAVRAS-CHAVE: Marcha. Paraparesia Espástica Tropical. Especialista em fisioterapia. Reabilitação. Vírus linfotrópico humano 1.

ABSTRACT | INTRODUCTION: The gait in people with HTLV-1 Associated Myelopathy or Tropical Spastic Paraparesis (HAM / TSP) is little known. **OBJECTIVE:** To evaluate the kinematic profile of gait in people with HAM/TSP. **METHODS:** A cross-sectional study with 25 people with HAM/TSP and 25 healthy participants. Spatiotemporal and angular data from filming of gait were submitted to kinematic analysis using CVMob® software. The gait of partipants with HAM/TSP was analized quantitatively through t Student test (alpha 5% and Power of 80%). The project was approved by Ethical Committee of the Bahiana School of Medicine and Public Health with CAAE 13568213.8.0000.5544. **RESULTS:** The HAM/TSP group showed significant changes in two different domains of biomechanical gait analysis when compared to healthy controls. The angular variables showed increased trunk inclination, flexion and extension ($p<0.05$); increased hip flexion and decreased hip extension ($p<0.05$); decreased knee flexion and extension ($p<0.05$); decreased ankle flexion dorsi and plantar flexion ($p<0.05$). Range of Motion was also reduced in all those joints. The spatiotemporal variables showed decreased stride length, increased stride time and speed gait cycle ($p<0.001$). Those changes point out to reduction in joint amplitudes of hip, knee and ankle, changes in support base and double support time asymmetry between right and left sides, reduction of pre-swing time, hip lift in the mid-swing, and foot drop throughout the swing. **CONCLUSION:** People with HAM/TSP have gait characterized by reduction in joint amplitudes of hip, knee and ankle, asymmetry between right and left sides and reduction of pre-swing time, hip lift in the mid-swing, and foot drop throughout the swing.

KEYWORDS: Gait. Tropical Spastic Paraparesis. Physical therapy specialt. Rehabilitation. Human lymphotropic virus 1.

Submitted 12/10/2018, Accepted 01/11/2019, Published 02/08/2019
J. Physiother. Res., Salvador, 2019 February;9(1):18-27
Doi: 10.17267/2238-2704rpf.v9i1.2201 | ISSN: 2238-2704
Responsible editor: Cristiane Dias

Introduction

HTLV-1 Associated Myelopathy or Tropical Spastic Paraparesis (HAM/TSP) is a neurodegenerative disease that develops from human T-cell lymphotropic virus type 1 infection (HTLV-1)[1]. Viral transmission occurs through the sanguinea, perinatal, sexual route. HTLV-1 has distribution inhomogeneous in the world, estimated at 10 million people infected[2]. Epidemiological studies point Brazil as one of the main endemic areas, presenting the highest absolute number of cases, and Bahia as state of higher prevalence in the country[3]. Salvador is considered the capital with the highest seropositivity, reaching 1.76% of the population[4]. It is estimated that 5% of the infected population develops HAM/TSP[5], whose symptoms are manifested mainly in women in the fourth and fifth decades of life, with low socioeconomic and schooling levels[3].

HAM/TSP is characterized by a chronic and progressive inflammatory process, which mainly affects the thoracic spinal cord, and reduces mobility and functional capacity. Symptomatology includes spasticity, lower limb progressive muscle weakness, sensory disturbances, hyperreflexia, bladder dysfunction, sexual dysfunction, and pain[6,7]. There is a consensus about the evolution of gait incapacity in people with HAM/TSP, which usually leads to the use of assistive technologies including crutches, walkers and wheelchairs[5,8,9] between two and ten years after the first clinical manifestations[6]. Proviral load[6], age[3], time of diagnosis[5], and beginning of the use of auxiliary device before 36 months of the first symptoms[9], were appointed as predictors for greater inability to walk. Muscle weakness[10], pain[7], and spasticity[11] in lower limbs are the main limiting factors for independent walking.

Few researches were developed analyzing gait in HAM/TSP[8,9,11]. In these rare studies, objective and precise quantitative records on kinematic and kinetic gait parameters were not identified. The lack of consistent data on the theme limits the progress of research for a specific and effective physiotherapeutic treatment that promotes improvement in walking in this population. Without this precision, interventions aimed at recovering more functional gait are restricted to professionals and caregivers' subjective interpretations. The translation of knowledge about the efficacy and effectiveness of gait training in other neurological conditions for people with HAM/TSP may not be adequate, and it is necessary to know what the primary objectives should be in specific gait training for this population. Thus, this study aims to describe the kinematic profile of gait in people with HAM/TSP.

Methods

We have followed the STROBE guideline (available in http://www.strobe-statement.org).

Study Design, setting and participants

Cross-sectional study was conducted with people with HAM/TSP (HG) and healthy people (CG) at BAHIANA – School of Medicine and Public Health in Salvador, Bahia, Brazil. Data collection lasted eight months, extending from December 2013 to August 2014. The present study was approved with the CAAE registration number 13568213.8.0000.5544 by the BAHIANA Ethics Committee and followed all the recommendations contained in the Declaration of Helsinki and Resolution of the National Health Council 466/2012 of the Ministry of Health.

Eligibility criteria

Inclusion criteria were the diagnosis of HTLV-1 with ELISA and Western Blot positive, classified as defined or probable for HAM/TSP, assessed by an experienced clinical neurologist. The criteria WHO for the presence of HAM/TSP involves as main neurological manifestations: chronic spastic paraparesis, proximal weakness in the lower limbs, bladder disturbances, constipation and impotence, sensory symptoms, low back and lower limbs pain, low vibratory sense and sometimes also proprioception, hyperreflexia in the lower and upper limbs, besides other less common symptoms. The participants should be the age equal to or greater than 18 years, and had to have the ability to walk without use of auxiliary devices by six meters for the filming of ambulation acquired during the Timed Up and Go test (TUG)[13]. For the comparative group, companions of participants with HTLV-1 with HTLV-1 negative test were included, aged 18 years or older, matched for sex, age and Body Mass Index (BMI). Exclusion criteria were people affected by other concomitant neurological or rheumatological conditions, fractures, deformities and prosthesis in the lower limbs, and not understanding of the commands during the gait recording process, all aspects screened by an open interview and physical examination standardized by an expert neurologist.

Variables, data sources and measurement

To characterize the sample, data of age, sex, weight and height were collected, and the BMI was calculated, defined as weight divided by height squared. In order to describe the kinematic profile of gait, gait images in video were collected according to the Quixadá protocol[14], adapted to a three-meter track, analyzing the following variables: 1) angular: trunk inclination in hip flexion maximum and hip extension maximum, range of motion of trunk inclination, maximum flexion and maximum extension of hip, knee and ankle; and rage of motion of hip, knee and ankle; 2) spatiotemporal: stride length, stride time and gait cycle speed.

The recording of the gait was done during the Timed Up and Go test (TUG), to avoid possible fatigue and to verify that the three meters of track did not interfere in the acceleration and deceleration of the gait in these individuals, due to the typical slowness for its execution. A GoPro HERO 3 (GoPro, HERO 3, Black Edition, Inc., USA and other countries) camera was placed three meters away from the center of the track outlined for the TUG, focused on the center of the track, i.e., at the intermediate point between the chair and the cone, and set at 50% of the height of the subject. Participants were filmed in the right and left side views. The analyzes prioritized the timing of the cycle in which subjects passed in front of the camera to minimize possible distortions in the image. After collection, the images were transferred to the computer, treated in the GoPro Studio software (available in www.techtudo.com.br/tudo-sobre/gopro-studio.html) to eliminate the effect of "fisheye" due to the curvature of the lens, and analyzed with software CvMob® (available in https://sites.google.com/site/cvmobufba/; Salvador, Bahia, Brazil).

CvMob® is a software for dynamic analysis of motion, two-dimensional (Pena et al. 2013), validated to analyze human gait in healthy individuals[16]. In this study, version 3.4 was used, available at https://sites.google.com/site/cvmobufba/. In addition to the quantitative analysis, a qualitative analysis was realized, based on the kinematic parameters defined for normal gait[15].

Sample size

The sample size was calculated with the Lee Dante calculator (http://www.lee.dante.br/pesquisa/amostragem/qua_2_medias.html), using as primary outcome the differences in the standard deviation of ankle plantar flexion of people with multiple sclerosis compared to healthy controls. Data from multiple sclerosis were acquired from Kelleher et al., 2010[16]. For healthy controls we used as reference data from Perry[15]. An alpha value of 5% and study power of 80%, and difference between groups of 0.26 (HG standard deviation: 0.86, CG standard deviation: 0.60) were assumed, totalizing a minimum sample size of 50 individuals (HG: 25; CG: 25). This study involved the baseline assessment of a bigger study with the aim to assess the impact of home exercises for HAM/TSP participants with a sample size of 60 participants.

Statistical methods

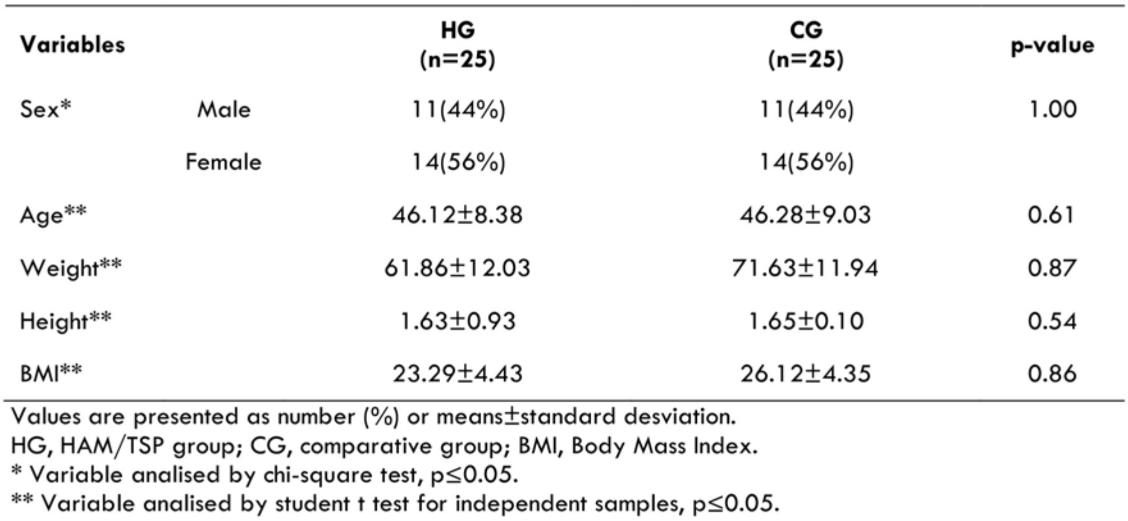
Group matching was tested for similarity of gender, age, weight, height and BMI, by the t-student tests for independent samples in the case of numerical variables and the chi-square test for categorical variables ($p>0.05$). The data were tabulated and statistically analyzed by the Social Package Statistical Science (SPSS) version 14.0, using the t-student test for independent samples. Quantitative variables were expressed as mean, standard deviation and standart error, and categorical variables were expressed in proportion and frequency. The differences between the values obtained were considered statistically significant for alpha of 5% and statistical power of 80%. The clinical meanings of the quantitative parameters were analyzed based on classical biomechanical studies[15].

Results

Characteristics of the sample

The sample consisted of 50 participants, 25 of them with HAM/TSP (HG) and 25 healthy (CG). Anthropometric and sociodemographic data on gender, age, weight, height and BMI were compared to verify the homogeneity of the sample. There was no difference between the groups (Table 1).

Table 1. Sociodemographic and anthropometric data of the sample of people with and without HAM/TSP



Variables		**HG (n=25)**	**CG (n=25)**	**p-value**
Sex*	Male	11(44%)	11(44%)	1.00
	Female	14(56%)	14(56%)	
Age**		46.12±8.38	46.28±9.03	0.61
Weight**		61.86±12.03	71.63±11.94	0.87
Height**		1.63±0.93	1.65±0.10	0.54
BMI**		23.29±4.43	26.12±4.35	0.86

Values are presented as number (%) or means±standard desviation.
HG, HAM/TSP group; CG, comparative group; BMI, Body Mass Index.
* Variable analised by chi-square test, $p \leq 0.05$.
** Variable analised by student t test for independent samples, $p \leq 0.05$.

Quantitative kinematic findings

Regarding the angular kinematic, no significant reduction was observed between groups for the variables maximum inclination of the trunk at the moment of maximal flexion of the right hip, maximum inclination of the trunk at the moment of maximum extension of the right and left hip, maximum range of motion of trunk inclination in the left lateral view, and maximum right hip extension. The results of the analysis of the angular variables are presented in Table 2.

Table 2. Comparison of angular variables between HAM/TSP and comparative groups

		HG (n=25)		CG (n=25)		
Angular variables		**X±SD**	**X±SE**	**X±SD**	**X±SE SE**	**p-value**
Trunk inclination in hip	R	2.068±4.165	2.068±0.833	-3.260±3.390	-3.260±0.678	0.40
Maximum flexion	L	2.621±6.692	2.621±1.338	2.374±3.593	2.374±0.719	0.03*
Trunk inclination in hip	R	6.077±5.472	2.621±1.094	-2.608±3.104	-2.608±0.621	0.06
Maximum extent	L	3.471±4.669	3.471±0.934	2.012±3.253	2.012±0.650	0.11
Trunk inclination ROM	R	4.813±3.987	4.813±0.797	3.380±2.830	3.380±0.566	0.04*
	L	3.578±3.323	3.578±0.665	3.087±2.830	3.087±0.407	0.06
Maximum hip flexion	R	67.429±6.899	67.429±1.380	66.020±3.405	66.020±0.681	0.002*
	L	68.808±6.248	68.808±1.250	66.487±2.932	66.487±0.586	0.005*
Maximum hip	R	96.387±5.637	96.387±1.127	105.583±3.541	105.583±0.723	0.08
	L	95.011±6.224	95.011±1.245	105.778±3.613	105.778±0.723	0.02*
Hip ROM	R	28.514±8.406	28.514±1.681	39.203±3.613	39.203±0.671	p<0.001*
	L	26.198±7.367	26.198±1.473	38.891±3.009	38.891±0.602	p<0.001*
Maximum Knee	R	36.915±14.858	36.915±2.972	58.609±4.481	58.609±0.976	p<0.001*
	L	37.413±12.780	37.413±2.556	58.374±6.492	58.374±1.298	0.03*
Knee extension	R	171.637±9.438	171.637±1.887	177.870±2.776	177.870±0.555	p<0.001*
	L	171.552±7.444	171.552±1.489	178.438±2.168	178.438±0.434	p<0.001*
Knee ROM	R	27.518±14.489	27.518±2.898	60.739±6.177	60.739±1.235	p<0.001*
	L	28.936±11.489	28.936±2.345	60.125±7.220	60.125±1.444	0.009*
Ankle dorsal flexion	R	18.985±6.339	18.985±1.268	21.593±2.996	21.593±0.599	0.004*
	L	19.518±6.290	19.518±1.258	21.515±3.483	21.515±0.697	0.05*
Ankle plantar flexion	R	13.072±7.640	13.072±1.528	16.585±3.701	16.585±0.740	0.01*
	L	10.926±6.590	10.926±1.318	17.413±2.816	17.413±0.563	0.007*
Ankle ROM	R	31.697±11.302	31.697±2.260	38.178±5.510	38.178±1.102	0.007*
	L	30.445±11.447	30.445±2.289	38.502±4.895	38.502±0.979	p<0.001*

Values are presented as means±standard deviations and stardard error.
X±SD, means±standard deviation; SE: standard error; HG, HAM/TSP group; CG, comparative group; R, right; L, left; ROM, range of motion.
*p≤0.05 by student t-test for independent samples, significant difference between groups.

Significant reduction was observed for all spatiotemporal kinematic variables (Table 3).

Table 3. Comparison of spatiotemporal variables between HAM/TSP and comparative groups

		HG (n=25)		CG (n=25)		
Spatiotemporal variables		**X±SD**	**X±SE**	**X±SD**	**X±SE**	**p-value**
Stride length	R	0.846±0.231	0.846±0.046	1.103±0.113	1.103±0.025	p<0.001*
	L	0.832±0.229	0.832±0.046	1.105±0.125	1.105±0.025	0.01*
Stride time	R	1.728±0.784	1.728±0.157	1.167±0.142	1.167±0.028	p<0.001*
	L	1.625±0.559	1.625±0.112	1.190±0.185	1.190±0.037	p<0.001*
Speed gait cycle	R	0.584±0.269	0.584±0.054	0.958±0.144	0.958±0.028	p<0.001*
	L	0.591±0.271	0.591±0.054	0.943±0.157	0.943±0.031	p<0.001*

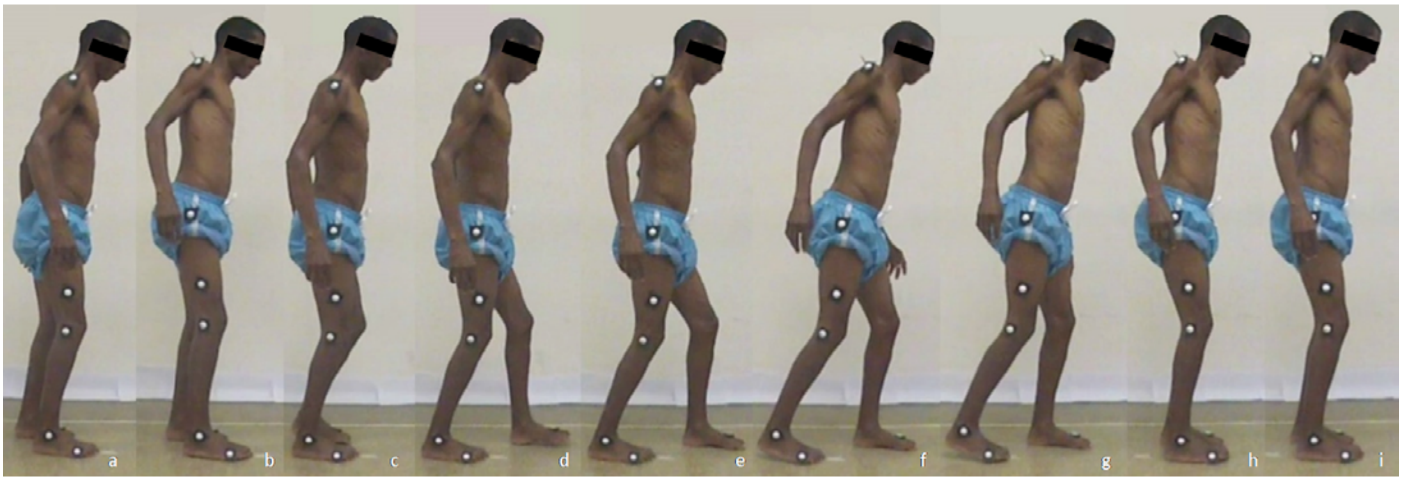
Values are presented as means±standard deviations and standard error.
HG, HAM/TSP group; CG, comparative group; X±SD, maeans±standard deviation; X±SE, means±standard error; R, right; L, left.
*p≤0.05 by student t-test for independent samples, significant difference between groups.

Qualitative kinematic findings of the gait in individuals with HAM/TSP

The gait kinematics of people with HAM/TSP were also analyzed qualitatively in the right and left lateral views of the sagittal plane. Right-to-left asymmetry was observed, more extended stay in double support, reduction in length, time and speed of step and the stride, reduction of flexion, extension and range of motion of hip, knee and ankle, and increase of anterior inclination of the trunk and support base throughout the gait cycle.

In HG, knee flexion was observed throughout the gait cycle in 13 (52%) participants, with minimal angular variation. On the other hand, 5 (20%) of the analyzed ones remained in extension in the contralateral knee during the whole gait cycle. Normal gait was viewed in 4 (16%) participants, but the angular variation of the knee was minimal in 3 (12%) and did not reach the expected range of flexion. It was possible to observe two critical moments related to the sub phases of gait. The first moment involved the passage of the double support to the single support, with temporal reduction of the initial contact and the response to the load associated with decreased hip and knee flexion and ankle extension. There was a tendency for the confluence of these sub phases at the beginning of the midstance. Soon after the initial contact, a rapid transfer of body weight over the tibia at 90 degrees was observed. The second critical moment was in the terminal stance, pre-swing and initial swing. At the moment of transition from the single support to the double support, the decomposition of the terminal stance was observed at three distinct moments (load on the limb positioned posteriorly, weight distributed on both limbs, and load on the anterior limb). In the third subphase, there was an increase in the anterior trunk inclination, hip elevation of advancing limb, and minimal or no ipsilateral heel elevation. Figure 1 shows the gait phases as described above.

Figure 1. Gait stages in people with HAM/TSP, sagittal view. (a) Initial contact. (b) Loading response. (c) Midstance. (d) Double initial stance. (e) Double intermediate stance. (f) Double final stance. (g) Initial swing. (h) Midswing. (i) Terminal swing



Source: The authors (2019).
Available in (Video 1): https://youtu.be/VOK5_bOY_IE

The gait in people with HAM/TSP shows, at midswing, greater hip elevation of advancing limb, associated with a accentuated lateral displacement of the center of gravity, ipsilateral to the support member, as well as hip and knee flexions of the advancing limb significantly reduced.

Discussion

The angular parameters of people with HAM/TSP are characterized by reduction of joint amplitude of hip, knee and ankle. The maximum range of posterior and anterior trunk inclination was increased. The spatiotemporal parameters revealed short stride realized in increased time, which reduces the gait speed. There was also an increase in the support base and in the time of double support. The evident asymmetry between the movements of the right and left sides was observed. There was also a tendency for the confluence of the initial contact with the loading response in the support phase. Reduction in pre-swing time, hip elevation during mid-swing and foot drop throughout the swing phase, were observed.

These parameters are original and serve as bases to guide clinical practice for gait training in people with HAM/TSP. Previous studies have evaluated only spatiotemporal parameters[8, 9, 10, 12], which are excellent markers for monitoring clinical evolution and responses to interventions. Spatiotemporal gait data in the HAM/TSP of the previous studies[9,17] are concordant with the results found in the present study, but contribute little to the understanding of the functional alterations that support the exercises and other resources of the neurofunctional physiotherapy. The question remained about how to train the march in this specific population.

The group of patients that has been most frequently compared to people with HAM/TSP involves people with Multiple Sclerosis (MS)[6,18,19]. However, the ambulation in MS is quite different from that found in the present study, although both are consequent to spinal cord injuries[20]. People with MS have a higher incidence of plantar ascending response, increased knee reflex, decreased ankle reflex, and paresthesia in upper limbs[21]. In addition, they develop coordination dysfunctions and tremor due to cerebellar involvement[6,22,23]. These signs were not observed in the group with HAM/TSP. Cognitive impairment is associated with the severity of cortical involvement in both pathologies[21], can be intensified by depression and fatigue in HAM/TSP[24] and in MS[23]. The intensity of spasticity, hypertonia, weakness in lower limbs, paresthesia in the lower limbs and sensory deficits are usually more predominant in HAM/TSP than in MS[19].

Although no scale has been used to evaluate spasticity, clinical signs of its presence were observed in the sample analyzed. Some studies propose comparisons with people with Parkinson's Disease (PD) due to the more rigid pattern of movements. However, people with HAM/TSP presented a slower and more rigid gait, and with little fluidity compared to people with PD. In PD, signs of limited fluency on gait, with disturbance of the rhythmic regularity, can be seen in the freezing and initial hesitation, more notable in more advanced stages of the disease[24], but not in the course of ambulation, as observed in HAM/TSP.

The reduced joint amplitude of the lower limb joints, especially the hip, knee and ankle joints in compare to the health individuals, may partially explain the gait limitations. The kinetic chain of the entire limb is also compromised from the biomechanical point of view[15]. Chronic spasticity, in the presence of adequate strength, rarely prevents ambulation, although it may make it precarious due to the predominance of anti-gravitational muscles[8]. Therefore, muscle weakness and joint limitation in the lower limbs may be added for the genesis of this gait pattern.

Spasticity and weakness in lower limbs may also be related to increased instability and body imbalance, and consequent increase in the support base and the time of double support of gait. They may still be related to the proprioceptive and sensorimotor changes described in HAM/TSP[6]. Anterior and posterior inclinations increased in the trunk may also express facilitation compensatory strategies for reaching the movement in the step and the balance[19]. In any case, these attitudes seem to be a reaction to avoid the frequent falls that affect this population[17]. Seniors with loss of balance also tend to increase the time of double support to compensate for dynamic postural instability[25].

Studies of gait in both PD[24] and MS[19] have observed that altered spatiotemporal parameters do not differ much in different neurological diseases. Although there are few differences among different groups of patients, HAM/TSP presents worse values than those observed in PD, MS and stroke[25]. Particularly in HAM/TSP, the reduction of gait speed of two seconds per 10 meters per year has been considered the expected rate in the continuous progression of the disease in people who do not require walking assistance[12]. Therefore, this parameter may be interesting only to compare the individual with himself in the cohorts and to evaluate the prognosis. For rehabilitation, however, a specific training is required that tells how and what to stimulate in the different phases of the gait cycle.

In any case, it can be stated that clinically the findings of the present study provide the bases for the development of treatment protocols for movement in this specific population. The strengthening of the abdominopelvic muscles and lower limbs is fundamental. Similarly, flexibility and trunk control should be developed to ensure stability and balance. It is also important to preserve joint mobility in the major joints of the lower limbs including pelvis, hip, knee, ankle and foot.The protocols to be developed must consider the general needs, but the most effective treatment is always that directed to the conditions of the individual, the preferences of the patient, the available resources and the experience of the physiotherapist, as recommended by the World Health Organization.

Yamano and Sato[6] point out that impairment to ambulation may present a variable course between patient groups. The researchers point to four subgroups in which motor incapacity may progress: 1) slowly, 2) milder and less progressive 3) less progressive and 4) fast. However, the present study did not verify the association between disease time and gait kinematic parameters. The high standard deviations from the means found, with variations of up to approximately 50%, may reflect the participation of people from the various subgroups in the present study. Because it is a rare disease, stratification of subgroups in analyzes is difficult. Therefore, caution is advised in the translation of knowledge to the clinical practice, requiring the observance of individual capacities.

The main limitation of this study refers to the adopted reduced gait route of three meters. This research protocol prevents the guarantee of the elimination of acceleration and deceleration of the gait as in the conventional runway of seven meters. The TUG application was used to film the participants due to the great difficulty of ambulation of this sample and intending to provide a simple evaluation protocol to be adopted in clinics of the small dimensions and with the use of cellular cameras. This bias, however, was circumvented with the comparative group that presented a reduction of less than 5% in relation to the standardized values of 1m/sec in healthy people. New studies must be carried out in order to expand the spatiotemporal and angular parameters associated with different variables, such as spasticity, disease time and device use.

Conclusions

Reduction of angular joint of hip, knee and ankle; increased of trunk inclination; increased of time of spatiotemporal parameters; asymmetry; reduction in pre-swing and hip elevation were related to lower limb functional deficits and compensated by additional trunk movements and increased support base and double support time.

Author contributions

Corradini S and Mota RS participated in the drafting of the study design, data collection, data analysis, manuscript writing and approved the final version. Macêdo MC and Dubois-Mendes SM participated in the preparation of the project, the data collection and approved the final version. Brazil MS participated in the data analysis, the correction and translation of the manuscript and approved the final version. Sá KN participated in the design of the study, supervised the collection and analysis of the data, participated in the writing of the manuscript and approved the final version.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

References

1. Romanelli LCF, Caramelli P, Proietti ABFC. (2010) O vírus linfotrópico de células t humanos tipo 1 (HTLV-1): quando suspeitar da infecção? Rev Ass Med Bras. 2010;56(3):340-347. doi: 10.1590/S0104-42302010000300021

2. Gessain A, Cassar O. (2012) Epidemiological aspects and world distribution of HTLV-1 infection. Front Microbiol. 2012;3:388. doi: 10.3389/fmicb.2012.00388

3. Glória LM, Damasceno SA, Rodrigues LR, Santos MSB, Medeiros R, Dias GAS et al. Perfil clínico-epidemiológico de pacientes infectados pelo HTLV-1 em Belém/Pará. Cad Saúde Colet. 2015;23(2):157-162. doi: 10.1590/1414-462X201400050087

4. Dourado I, Alcantara LCJ, Barreto ML, Teixeira MG, Galvão-Castro B. HTLV- I in the General Population of Salvador, Brazil: a city with African ethnic and sociodemographic characteristics. Acquir Immune Defic Syndr. 2003;34(5):527-531. doi: 10.1097/00126334-200312150-00013

5. Olindo S, Cabre P, Lézin A, Merle H, Saint-Vil M, Signate A et al. Natural History of Human T-Lymphotropic Virus 1–Associated Myelopathy: A 14-Year Follow-up Study. Arch Neurol. 2006;63(11):1560-1566. doi: 10.1001/archneur.63.11.1560

6. Yamano Y, Sato T. Clinical pathophysiology of humanT-lymphotropic virus-type 1-associated myelopathy/tropical spastic paraparesis. Front Microbiol. 2012;3:1-10. doi: 10.3389/fmicb.2012.00389

7. San-Martin DL, Santos DN, Baptista AF. Pain prevalence, characteristics and associated factors in human T-cell lymphotropic virus type 1 infected patients: a systematic review of the literature. Braz J Infect Dis. 2016;20(6):592-598. doi: 10.1016/j.bjid.2016.08.013

8. Franzói AC, Araújo AQC. Disability and determinants of gait performance in tropical spastic paraparesis/HTLV-I associated myelopathy (HAM/TSP). Spinal Cord. 45(1):64-68. doi: 10.1038/sj.sc.3101919

9. Champs APS. Mielopatia pelo HTLV-1: perfil clínico, epidemiológico e fatores prognósticos de incapacidade para marcha [dissertação]. Belo Horizonte: Universidade Federal de Minas Gerais – UFMG; 2010.

10. Cafaia RC, Orsini M, Felicio LR, Puccioni-Sohler M. Muscular weakness represenys yhe main limiting fator of walk, funcional independence and independenve and quality of life os mielopathy patients associated to HTLV-1. Arq Neuro-Psiquiatr. 2016;74(4):280-286. doi: 10.1590/0004-282X20160019

11. Tauil CB. Ensaio clínico controlado randomizado aberto com metil-prednisolona em portadores de mielopatia associada ao HTLV-1 paraparesia espástica tropical [dissertação]. São Paulo: Universidade de São Paulo, Faculdade de Medicina; 2003. doi: 10.11606/D.5.2004.tde-13092006-121302

12. Martin F, Fedina A, Youshya S, Taylor GP. A 15 year prospective longitudinal study of disease progression in patients with HTLV-1 associated myelopathy in the UK. J Neurol Neuosurg Pschiatry. 2010;81:1336-1340. doi: 10.1136/jnnp.2009.191239

13. Dutra MC, Cabral ALL, Carvalho GA. Tradução para o português e validação do Teste Timed Up And Go. Interfaces. 2016;3(9):81-88. doi: 10.16891/2317-434X.430

14. Quixadá AP, Onodera NA, Peña N, Miranda JGV, Sá KN. Validit and reliability of free software for bidimentional gait analysis. J Physio Research. 2017;7(4):548-557. doi: 10.17267/2238-2704rpf.v7i4.1648

15. Perry J, Burnfield JM. Normal and Pathological Function. 2.ed. London: Slack Incorporated; 2010.

16. Kelleher KJ, Spence W, Solomonidis S, Apatsidis D. The characterisation of gait patterns of people with multiple sclerosis. Disabil Rehabil. 2010;32(15):1242-1250. doi: 10.3109/09638280903464497

17. Facchinetti LD, Araújo AQ, Chequer GL, Azevedo MF, Oliveira RVC, Lima MA. Falls in patientes with HTLV-1 associated myelopathy/tropical spastic paraparesis (HAM/TSP). Spinal Cord. 2013;51(3):222-225. doi: 10.1038/sc.2012.134

18. Lannes P, Neves MAO, Machado DCD, Miana LC, Silva JG, Bastos VHV. Paraparesia Espástica Tropical – Mielopatia associada ao vírus HTLV-I: possíveis estratégias cinesioterapêuticas para a melhora dos padrões de marcha em portadores sintomáticos. Rev Neurocienc. 2006;14(3):153-160.

19. Mañago MM, Glick S, Hebert JR, Coote S, Schenkman M. Strength Training to Improve Gait in People with Multiple Sclerosis: A Critical Review of Exercise Parameters and Intervention Approaches. Inter J MS Care In-Press. 2018;1-33. doi: 10.7224/1537-2073.2017-079

20. Howard AK, Li DK, Oger J. MRI Contributes to the Differentiation Between MS and HTLV-I Associated Myelopathy in British Columbian Coastal Natives. Can J Neurol Sci. 2003;30(1):41-48. doi: 10.1017/S0317167100002420

21. Socie MJ, Motl RW, Pula JH, Sandroff BM, Sosnoff JJ. Gait variability and disability in multiple sclerosis. Gait Posture. 2013;38(1):51-55. doi: 10.1016/j.gaitpost.2012.10.012

22. Morris ME, Cantwell C, Vowels I, Dodd K. Changes in gait and fatigue from morning to afternoon in people with multiple sclerosis. J Neurol Neurosurg Psychiatry. 2002;72(3):361-365. doi: 10.1136/jnnp.72.3.361

23. Cistia AD, Silva ACSM, Torriani C, Cyrillo FN, Fernandes S, Nova IC. Velocidade de marcha, força muscular e atividade mioelétrica em portadores de esclerose múltipla. Rev Neurocienc. 2007;15(2):102-107.

24. Ebersbach G, Sojer M, Vallderiola F, Wissel J, Müller J, Tolosa E et al. Comparative analysis of gait in Parkinson's disease, cerebellar ataxia and subcortical arteriosclerotic encephalopathy. Brain. 1999;122(7):1349-1355. doi: 10.1093/brain/122.7.1349

25. Gabell A, Naak US. The effect of age on variability of gait. J Gerontol. 1984;39(6):662-666.