194 - EFFECTS OF AUDITORY AND VISUAL CUES ON GAIT IN A SUBJECT WITH PARKINSON DISEASE: A PILOT STUDY

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INTRODUCTION

The Parkinson's disease (PD) is a neurodegenerative disorder, which happen on an elderly population, and compromise the dopaminergic neurons of the substantia nigra, culminating deficit of dopamine in the corpus striatum. These structures which belong to the Central Nervous System, act helping in the mobility, its bad function could cause akinesia, rigidity, tremor, postural instability as well as in some cases the compromise of the cognitive movements , affective and autonomic (MENESES and TEIVE,2003).

Individuals with PD goes through five different stages as per scale proposed by Hoehn and Yahr (1967), based in a serial of symptoms, mainly related to disturbance on the gait, and develops as time goes by. Among these symptoms, the disturbance on the gait gain a place of high light because progressively affects the mobility and independency of the PD patients. (MITONA et al., 2000; REIS, 2006).

The human gait, defined by Perry (2005), as a natural way that the body takes to goes from a place to another, and generally is coordinate by an automatic manner by the Nervous System (CARLETTI et al., 2006), became a conscious matter for PD patients, they need concentration to make their motion, lack of concentration can make them trip and fall. As Freitas et al. (2002) the falls for people on the third age is the most cause of incapacities on the movements and responsible as well for lost of independency on elderly people.

Because the cure of PD has not been found yet, the intervention of pharmacology has been, until this moment, the alternative the most used for the control of the symptoms; although the side affects associated with the use of medication in a long term is a disaster because they can speed up the neuronal degeneration (SCORZA et al., 2001).

That's why the physical exercises, manly the gait training, has been showed an interesting alternative, because it has been causing an improvement in the motion performance, in every day life activities and gait without the side affects caused by medication (POHL et al., 2003). In all, the search for the best therapy of rehabilitation, is important broaden of the know logy about the affects of the pathologies in a model of motion of the march on those who are carrier of PD (PERRY, 2005).

Many studies have been done using visual (AZULAY et al., 1999; JIANG e NORMAN, 2006; LEWIS et al., 2000; SIDAWAY et al., 2006) and auditory cues (ENZERNSBERGER et al., 1997; SUTEERAWATTNANON et al., 2004; SUTEERAWATTANANON et al., 2004) during the training of the gait, aiming to correct the alterations caused by PD, and in general it showing positives results.

However, the studies analyzing the effects of the auditory and visual cues simultaneous are rare (JING and NORMAN, 2006; SUTEERAWATTANANON et al., 2004), as those are limited on diagnose the momentary influence of the cues.

In this sense, the biomechanics became a valuable tool when it comes to evaluate variables related to the motion in the gait of PD patients, because it identify the qualitative form the alterations caused by the clinic state and the efficiency of different intervention based in parameters biologics and mechanics, offering useful information for possible alteration in these evaluation (CIMOLIN et al., 2005).

In light of the need for further research established above, this study has as aim analyse the effects of auditory and visual cues on the gait patterns of PD patient.

METHODS

The subject recruited for this research descriptive of the type case study was a 76-year-old woman who had been diagnosed with PD 2 years ago (HOEHN and YAHR, 1967, classification of disability, stage 2).

All measurements were collected in the Laboratory of Biomechanics of the Sports Center in the Federal University of Santa Catarina after the approval of the Committee of Ethics of Research with Human Beings – UFSC (protocol 035/08). The subject of the study, after has been duly informed signed the terms of agreement.

The laboratory was prepared for the study, where the system of kinemetry 3D, DMAS SPICA Tek™ with four cameras (40fps), was calibrate and adjusted for the collect 3D information of the gait. The environment temperature (25 degrees), the humidity of the air (60 %) and the brightness (112 lux) were controlled to avoid possible interferences in the studied subject's motor behavior and in the perception of the cues.

For the accomplishment of the data collection regarding the kinematic variables of the gait the subject was wearing the least clothes as possible (swimsuit) and barefoot. The reflexives marks of reference that represents the articulate centers, needed for an acquisition of the variables spatial and temporal of the gait, were fixed sob the appropriates places (right and left malleolus lateralis), soon after the subject was instructed to accomplish 5 minutes of gait with free speed, in a determined space for the evaluation (10m of length), to get used to the laboratory.

After, subject completed walking trial in four different conditions: analyses of the gait with free speed without external cues (WC); analyses of the gait with audio cues (AC); analyse of the gait with visual cues (VC); analyses of the gait with audio and visual cues simultaneous (AVC). For each one of the conditions were acquired five videos (5s), being analysed two cycles of the gait in each video.

To generate the visual cues was used a Visual Cues System of the Gait (VCSG), specifically developed for this study, that it consists of a laser device that was attached to the subject's chest projecting a demarcation in the floor. In this condition the subject was instructed to “step up to the line as you walk along the runway”. The device projected a laser line on to the floor 0,64m in front of the subject (following recommendations of SUTEERAWATTANANON et al., 2004), serving as spatial regulation of the subject's steps.

To generate the audio cues was used an digital metronome Seiko SQ50, put in a specific frequency of beats per minute (109bpm) to serve as a regulator of cadence of the gait, the person was oriented to synchronize the frequency of her steps with the beats of the metronome.

For kinematic analyses of the gait, measured of movements of the body segments during the walking's cycle were monitored. In order of a gait cycle is completed a sequence of successive regular events has to occurs (SUTHERLAND et al., 1998). Then, were identified the follow events in each one of the cycles of the gait: initial contact of the foot on the ground (heel touch) (HT); time of left feet leaving the ground (despatch) (LFL); initial touch of the left feet on the ground (TLF); time of the right feet leaving the ground (RFL). Based on the definition of these events, spatiotemporal variables were generated, each one related to one characteristic which define the form of walk in the person who has been studied: TLC (total length of the gait cycle/stride); LRS (length of the right step); LLS (length of the left step); SW (step width); TRS (time of the right step); TLS (time of the left step); TTC (total time of the gait cycle/stride); v (speed of the gait); CAD (cadence of the steps).

The data are presented in average and standard deviation, and for the comparison among the different analyzed situations an ANOVA (one way) was applied ($p \leq 0,05$).

RESULTS AND DISCUSSION

In the Table 1 are showed the spatiotemporal variables of the gait and compared between different situations in analyses.

Table 1 - Results of the analyzed individual's spatiotemporal variables and the comparison among the different external cues.

	WC	VC	AC	AVC
Spatial data				
TCC (m)	0,933 ± 0,022[a]	1,207 ± 0,050[b]	0,933 ± 0,050[a]	1,065 ± 0,044[c]
LRS (m)	0,437 ± 0,023[a]	0,581 ± 0,032[b]	0,436 ± 0,021[a]	0,504 ± 0,024[c]
LLS (m)	0,496 ± 0,015[a]	0,625 ± 0,025[b]	0,497 ± 0,033[a]	0,561 ± 0,021[c]
SW (m)	0,179 ± 0,018	0,176 ± 0,024	0,165 ± 0,029	0,170 ± 0,011
Temporal data				
TRS (s)	0,567 ± 0,026	0,629 ± 0,134	0,567 ± 0,013	0,546 ± 0,010
TLS (s)	0,529 ± 0,019	0,592 ± 0,097	0,546 ± 0,025	0,558 ± 0,013
TTC (s)	1,096 ± 0,043	1,221 ± 0,227	1,113 ± 0,014	1,104 ± 0,019
Spatiotemporal data				
v (m/s)	0,852 ± 0,037[A]	1,011 ± 0,149[B]	0,838 ± 0,043[A]	0,965 ± 0,036[A,B]
CAD (steps/min)	109,6 ± 4,4	100,9 ± 16,8	107,9 ± 1,3	108,7 ± 1,9

[a,b,c] $p<0,01$; [A,B] $p<0,05$; WC: without cues; VC: visual cues; AC: auditory cues; AVC: auditory and visual cues simultaneous.

As showed on the Table 1, for the variable TLC so much in the situation VC as in the situation AVC significant differences were verified ($p<0,01$) if compared with situation WC. In the same way Suteerawattananon et al. (2004) also observed significant enlargement of TLC during the visual stimulation of the gait in PD patients. Although, the visual cues were fixed on the floor. However, in the same study significant difference was observed on the TLC between gait without stimulus and in the same situation with sound cues (metronome). While in the situation with sound and visual cues simultaneous were not found alterations, going against the results of actual study.

Using an equipment of visual stimulation of the gait, similar to the adopted in the present study (Laser), Lewis et al. (2000) amplification of the TLC was as showed in carriers of PD and health elderly people.

In the three situation experimented in this study (WC, AC and AVC) the analyzed subject presented values of CTC inside of the strip (between 0,83m and 1,11m) as said on the literature for PD patients (BLOEN et al., 1997; FERRARIN et al., 2005; KRYSTKOWIAK et al., 2003; LEWIS et al., 2000; SOFUWA et al., 2005). Only during VC analyzed subject showed TLC near of those said on the literature for health elderly (between 1,24m and 1,42m) (FERRARIN et al., 2005; LEWIS et al., 2000; SOFUWA et al., 2005).

In relation to variable LRS and LLS, significant differences were as well showed ($p<0,01$) in situation VC and AVC when compared with WC.

The values of step length observed in the four situation on this study are framed inside of the strip (between 0,43m and 0,63m) as said on the literature for PD patients (DEL OLMO et al., 2006; KRYSTHKOWIAK et al., 2003; FERREIRA, 2005). Analysing health elderly, Del Olmo et al., (2006) showed higher values of LS (0,69m) to those observed in this study.

The majority of the studies showed only the length of one of the steps (do not specify the side) of PD patients, due to restrictions found on the adopted instruments – kinematic 2D and plantar pressure (DEL OLMO et al., 2006; LUBIK et al., 2006) or by methodological delimitation that did not include both variables – kinematic 3D (KRYTHKOWIAK et al., 2003). These studies showed values of step length between 0,43m and 0,63m, then, in all situations tested until now in this study the subject showed values of LRS and LLS in the line expected. Only the studies of Ferreira (2005) and Reis (2006) showed values of LRS (0,57m and 0,60m, respective) and LLS (0,53m and 0,52m, respectively).

The SW in the subject studied here showed is near to the results of the study Mitoma et al. (2000), these observed 0,18m and 0,21m for SW of the PD patients in stage 1-3 and 4 (HOEHN and YAHR, 1967), respectively.

Having as parameter of normality a SW of 0,08m (PERRY, 2005), could be said that the participant in this study showed an enlarged base of sustentation. According to Brian (1997), the fear of falling can provoke the increase of the sustentation base, seeking to increase the dynamic balance.

Studies was not found that analysed the effects of auditory and visual cues in a variable SW on the gait of PD patients, maybe because the SW does not suffer influences of this cues (Table 1).

Studies analysing the PD gait (KRYSTKOWIAK et al., 2003; LUBIK et al., 2006) showed values of very close step time (0,63s and 0,61s, respectively) to the present study, although these studies do not show the differentiation between TRS and TLS. In a analogous study, Ferreira (2005) show 0,57s for TRS and 0,62s TLS, equivalents to the results showed in the present study, although closer of the ones verified in the situation VC, even if wasn't showed differences between the four situations.

The values of TLS observed in the subject of this study are equivalent to the values (1,05s to 1,19s) reported for many different studies with PD suffers (AURIEL et al., 2006; BLOEN et al., 1997; FERREIRA, 2005; KRYSTKOWIAK et al., 2003; YOGEV et al., 2005). These values were near to the values reported by Bloen et al. (1997) and Yogev et al. (2005) for health elderly people (1,18s and 1,07s respectively), although a little above the results found by Barela (2005) (0,99s).

Any of the specialised studies used in this research valued the effects of the auditory and visual cues on the variables of time on the gait of PD patients.

For the variable speed, only the situation VC was significantly different ($p<0,05$) of WC. In other side, Suteerawattananon et al. (2004) was observed a speed up during the AC ($p= 0,01$) and AVC ($p<0,005$), with VC only wasn't observed any difference in the speed.

Sidaway et al. (2006), in a study searching for effects of the visual cues on the steps of PD patients in a long term, was

found a significantly increase on the gait speed, even the affects were noticeable until after a month without stimulus. Lewis et al. (2000) in a study of evaluation of two types of visual cues (fixed lines on the ground and VCSG similar of the used in this study) on the steps of PD patients, was observed a increase on the speed for both of the cases (p=0,003 and p=0,001, respectively).

If compared the speed on the steps of the participate in this study (Table 1) with others PD patients (0,70m/s and 1,18m/s), reported by the literature (AURIEL et al., 2006; DEL OLMO et al., 2006; FERRARIN et al., 2005; KRYSTHKOWIAK et al., 2003; LEWIS et al., 2000; LUBIK et al., 2006; SEKINE et al., 2004; SOFUWA et al., 2005; YOGEV et al., 2005), could be observed that the values are in proportion in both situations. However, if the results of the present study with the results showed in studies with healthy elderly people (DEL OLMO et al., 2000) which is referred to a gait speed varying between 1,25m/s to 1,39m/s, is observed that the PD patient showed gait speed lower than the healthy individuals.

The CAD showed by the subject of this study is agreement with the data of Ferrarin et al., (2005) and Sofuwa et al. (2005) (100 to 109 steps/min), others studies (KRYSTHKOWIAK et al., 2003; LEWIS et al., 2000; SEKINE et al., 2004) showed higher values (114 to 120 steps/min) for CAD on PD patients.

For healthy elderly (DEL OLMO et al., 2006; LEWIS et al., 2000; SEKINE et al., 2004; SOFUWA et al., 2005) were as well found higher values of CAD (113 to 126 steps/min) than the values showed on the present study. However, this is not a result agreed in all studies because many authors (CANNING et al., 2004; FERRARIN et al., 2005; LUBIK et al., 2006) say that there is an increase of the cadence in PD patients, in order to compensate the reduction of the TLC.

In spite of, was not verified alteration in the cadence of the subject in this study, in others studies (SUTEERAWATTANANON et al., 2004, 2006; LEWIS et al., 2000) were reported a significantly alteration on this variable on the gait of PD patients, if they had a stimulation visual as well as auditory stimulation. However, Azulay et al. (1999) do not showed any alteration on CAD either with fixed visual cues or dynamic visual cues (stroboscope).

CONCLUSIONS

With base in the obtained results and in the theoretical referential, was ended that:

a) The total length of the gait cycle (TLC) and the length of the Right Step (LRS) and Length of the left step (LLS), the situation with visual cues as well as the situation with both cues simultaneous, was differed of the situation without external cues;

b) For the variable speed, only the situation with visual cues was differed of situation without external cues.

In general, could be claimed that the visual cues approximated the pattern of the gait of the analyzed individual's of the normal pattern of the gait for healthy elderly.

High light the fact that because of the interventions have been made only once, the individual could have had difficulties in synchronize the gait with both types of cues because of ability lack, specially in situation with the two types of cues simultaneous, possibly causing influence on the results in this study.

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EFFECTS OF AUDITORY AND VISUAL CUES ON GAIT IN A SUBJECT WITH PARKINSON DISEASE: A PILOT STUDY

Parkinson's disease (DP) patients are attacked by many symptoms, mainly motors, that develops as time goes by, and, the disturbance on the gait gain a place of high light because progressively affects the mobility and independency of the PD patients. Many studies have been done using visual and auditory cues during the training of the gait, aiming to correct the alterations caused by PD, and in general it showing positives results, however, the studies analyzing the effects of the auditory and visual cues simultaneous are rare. In light of the need for further research established above, this study has as aim analyse the effects of auditory and visual cues on the gait patterns of PD patient. The subject recruited for this research descriptive of the type case study was a 76-year-old woman who had been diagnosed with PD 2 years ago. The subject completed walking trial in four different conditions: analyses of the gait with free speed without external cues (WC); analyses of the gait with audio cues (AC); analyse of the gait with visual cues (VC); analyses of the gait with audio and visual cues simultaneous (AVC). For the comparison among the different analyzed situations an ANOVA was applied ($p \leq 0,05$). Significant differences were verified ($p<0,01$) if compared WC with situation VC and AVC for the variable TLC, LRS and LLS. Besides, for the variable speed, only the situation VC was significantly different ($p<0,05$) of WC. In general, could be claimed that the visual cues approximated the pattern of the gait of the analyzed individual's of the normal pattern of the gait for healthy elderly. High light the fact that because of the interventions have been made only once, the individual could have had difficulties in synchronize the gait with both types of cues because of ability lack, specially in situation with the two types of cues simultaneous, possibly causing influence on the results in this study.

Keywords: gait, Parkinson's disease, sensorial cues.

EFFETS DE STIMULATIONS VISUELLES ET SONORES DANS LA MARCHE DE PORTEURS DE LA MALADIE DE PARKINSON : UNE ÉTUDE PILOTE

Les porteurs de la maladie de Parkinson (MP) sont attaqués par une série de symptômes, principalement moteurs, qui évoluent avec l'écoulement du temps, en étant que, les émeutes de la marche gagnent place de proéminence, donc ils progressivement vont en toucher la mobilité et l'indépendance. Des diverses études utilisent les stimulations visuelles et sonores pendant l'entraînement de la marche avec l'intention d'essayer de corriger les modifications provoquées par MP, et en général ils présentent des résultats positifs, néanmoins l'insuffisance des études qui analysent les effets de stimulations visuelles et sonores simultanées. De cette manière, cette étude a eu comme objectif analyser les effets de stimulations visuelles et sonores dans le comportement de variables motrices rapportées à la marche d'un transporteur de MP. Il a participé de cette recherche descriptive du type étude de cas un porteur de MP avec 76 ans d'âge, en ayant sa diagnostique depuis 2 ans. La marche de cette personne a été analysée dans quatre situations : sans stimulations externes (SE) ; avec des stimulations sonores (SS) ; avec des stimulations visuelles (SV) ; avec des stimulations sonores et visuelles simultanées (SVS). Pour la comparaison entre les différentes situations analysées il a été appliqué ANOVA ($p \leq 0,05$). Il a été constatées des différences significatives ($p<0,01$) quand comparée la situation SE avec les situations SV et SVS pour les variables longueur totale du cycle et de la longueur du pas droit et gauche. En outre, la variable vitesse a aussi différé significativement ($p<0,05$) entre les situations SE et SV. De façon générale il se peut affirmer que la stimulation visuelle a approché la norme de marche de la personne analysée de la norme normale de marche pour personnes âgées saines. Il faut dire que, dû au fait des interventions avoir été appliquée seulement une

fois, la personne peut avoir eu de la difficulté à synchroniser sa marche avec les différentes stimulations à la disposition dû au manque de pratique, principalement dans la situation avec les deux stimulations simultanées (SVS), qui ont possiblement influencé les résultats trouvés.

Mots-clés: La marche, Maladie de Parkinson, Stimulations sensorielles.

EFECTOS DE ESTÍMULOS VISUALES Y SONOROS EN LA MARCHA DE PORTADORES DE LA ENFERMEDAD DE PARKINSON: UN ESTUDIO PILOTO

Portadores de la enfermedad de Parkinson (EP) son acometidos por una serie de síntomas, principalmente motores, que evolucionan con el decorrer del tiempo, siendo que, los disturbios de la marcha ganan destaque, pues progresivamente van afectando la movilidad y la independencia. diversos estudios han utilizado tanto estímulos visuales como sonoros durante el entrenamiento de la marcha con el objetivo de intentar corregir las alteraciones provocadas por la EP, y de manera general presentan resultados positivos, sin embargo son escasos los estudios analizando los efectos de estímulos visuales y sonoros simultáneos. De esta manera, este estudio tuvo como objetivo analizar los efectos de estímulos visuales y sonoros en el comportamiento de variables motoras relacionadas a la marcha de un portador de la EP. Participaron de esta pesquisa descriptiva del tipo estudio de caso una portadora de la EP con 76 años de edad, diagnosticada la enfermedad hace 2 años. La marcha del sujeto fue analizada en cuatro situaciones: sin estímulos externos (SE); con estímulos sonoros (ES); con estímulos visuales (EV); con estímulos sonoros y visuales simultáneos (EVS). Para la comparación entre las distintas situaciones analizadas se ha aplicado ANOVA ($p \leq 0,05$). Fueron constatadas diferencias significativas ($p<0,01$) cuando comparada la situación SE con las situaciones EV y EVS para las variables largo total del ciclo y largo del paso derecho e izquierdo. Además, la variable velocidad también difirió significativamente ($p<0,05$) entre las situaciones SE y EV. De manera general se puede afirmar que la estimulación visual acercó el patrón de marcha del individuo analizado del patrón normal de marcha para personas mayores saludables. Se destaca que debido al hecho de las intervenciones haber sido aplicadas solamente una vez, el individuo puede haber tenido dificultad en sincronizar su marcha con los distintos estímulos disponibles debido a la falta de práctica, principalmente en la situación con los dos estímulos simultáneos (EVS), posiblemente influenciando en los resultados encontrados.

Palabras-clave: marcha, enfermedad de Parkinson, estímulos sensoriales.

EFEITOS DE ESTÍMULOS VISUAIS E SONOROS NA MARCHA DE PORTADOR DA DOENÇA DE PARKINSON: UM ESTUDO PILOTO

Portadores da doença de Parkinson (DP) são acometidos por uma série de sintomas, principalmente motores, que evoluem com o decorrer do tempo, sendo que, os distúrbios da marcha ganham lugar de destaque, pois progressivamente vão afetando a mobilidade e a independência. Diversos estudos têm utilizado tanto estímulos visuais quanto sonoros durante o treino da marcha com o intuito de tentar corrigir as alterações provocadas pela DP, e de maneira geral apresentam resultados positivos, no entanto são escassos os estudos analisando os efeitos de estímulos visuais e sonoros simultâneos. Desta maneira, este estudo teve como objetivo analisar os efeitos de estímulos visuais e sonoros no comportamento de variáveis motoras relacionadas à marcha de um portador da DP. Participou desta pesquisa descritiva do tipo estudo de caso uma portadora da DP com 76 anos de idade, tendo seu diagnóstico ocorrido há 2 anos. A marcha do sujeito foi analisada em quatro situações: sem estímulos externos (SE); com estímulos sonoros (ES); com estímulos visuais (EV); com estímulos sonoros e visuais simultâneos (EVS). Para a comparação entre as diferentes situações analisadas aplicou-se uma ANOVA ($p \leq 0,05$). Foram constatadas diferenças significativas ($p<0,01$) quando comparada a situação SE com as situações EV e EVS para as variáveis comprimento total do ciclo e comprimento de passo direito e esquerdo. Além disso, a variável velocidade também diferiu significativamente ($p<0,05$) entre as situações SE e EV. De maneira geral pode-se afirmar que a estimulação visual aproximou o padrão de marcha do indivíduo analisado do padrão normal de marcha para idosos saudáveis. Destaca-se que, devido ao fato das intervenções terem sido aplicadas apenas uma vez, o indivíduo pode ter tido dificuldade em sincronizar sua marcha com os diferentes estímulos disponibilizados devido à falta de prática, principalmente na situação com os dois estímulos simultâneos (EVS), possivelmente influenciando nos resultados encontrados.

Palavras-chave: marcha, doença de Parkinson, estímulos sensoriais.