

INFLUENCE OF FOOT POSITION IN THE PERFORMANCE OF SIT TO STAND IN POST STROKE HEMIPARETIC PATIENTS

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Abstract

Background: Sit to stand is one of the functional tasks that may have been altered in post stroke hemiparetic patients. This transfer may have been altered affected by various extrinsic conditions, among them the position of the feet. Objective: systematize the knowledge about the influence of foot placement in the performance of standing up in post stroke hemiparetic patients. Method: a non systematic review in the period of March to September 2014 was performed, including original articles published from January 2002 to September 2014. Results: 35 articles were found, 8 met the inclusion criteria and were included, 6 of them of observational feature, 1 controlled biomechanical experiment and 1 randomized clinical trial. Conclusion: the findings suggest that the choice of foot position interferes in the standing up performance. This aspect should be considered for the evaluation and treatment, allowing the control of variables that interferes on the performance of this task.

Keywords: Stroke; Foot position; Sit- to- stand.

INTRODUCTION

The Stroke is considered as a common cause for mobility reduction and deficit in the execution of daily activities.⁽¹⁾ Hemiparesis is

the most clear dysfunction after stroke (2) and it is characterized by sensorial changes, muscle weakness, postural control impairment and

weight bearing distribution asymmetry.^(3,4) All of these changes converge for the development of functional incapacity and gait and raise impairment, are the main aggravating factors of the incapacity.^(3,5)

The task of sit to stand from a chair can be altered in hemiparetic patients. They frequently use the pattern of asymmetrical weight bearing during this movement and it takes more time to do so^(3,4) and this transfer can be affected by various extrinsic conditions, among them the foot position.^(6,8) Previous studies show that training of rising with the paretic foot posterior to the non paretic (non stricken) induced the gain in performance efficiency, functional mobility and balance when compared to the symmetric foot position.⁽⁹⁾

Considering the importance on the motion of standing up as pre requisite to functional independence of people,⁽⁷⁾ the identification of movement determinants that influence in the performance of this task is primordial when choosing appropriate strategies to proper facilitation of this transfer. The purpose of this paper is to systematize the knowledge about the influence of foot position in the performance of standing up in hemiparetic patients post stroke.

METHOD

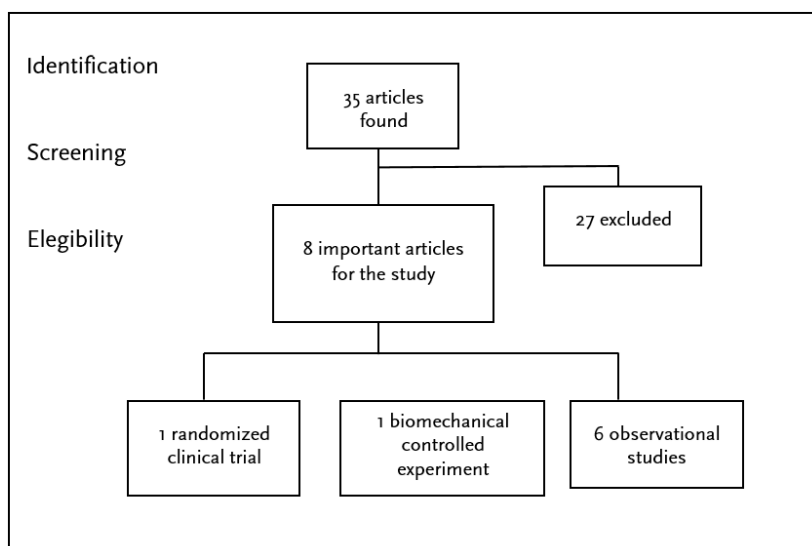
It is a non systematic review, which search was performed using Scielo and Medline database by Pubmed and virtual library Capes. The data gathering was realized in the period of March to September 2014. The key words used were stroke, foot position and sit-to-stand and their correlates in Portuguese/English.

Original articles published from January 2002 to September 2014 were included, and they addressed the influence of foot position in the performance of sit-to-stand transfer in hemiparetic post stroke individuals. The articles that only addressed the sit-to-stand transfer in stroke patients and those that correlated the raising only with the seat height or knee angle were excluded.

RESULTS

Thirty five articles that addressed the standing up motion in hemiparetic patients post stroke were found, 27 were excluded for they didn't address the foot position relation with the performance of standing up in hemiparetic patients after stroke. Eight articles were included, 6 of them observational, 1 controlled biomechanical experiment and 1 randomized clinical trial (Image 01).

Image 1 - Flowchart



Three studies used spontaneous positions (without instructions about the initial position of the feet), symmetric (with 15 degrees of feet dorsiflexion) and asymmetric (with the paretic foot behind the non affected and the unaffected foot behind the paretic).^(8,10,11) Another author performed a study on the same positions, but used the asymmetric moment only with the paretic foot behind the unaffected.⁽¹²⁾

Some studies were performed only with two positions: spontaneous and asymmetric (with the paretic foot behind the uninvolved),⁽¹³⁾ symmetric and asymmetric,⁽⁹⁾ and normal (knee at 90 degrees

and neutral ankle) and posterior (both heels 10 cm behind the normal position).⁽¹⁴⁾ Only one study considered the member position in the normal condition (both members were positioned so that the knee flexion were 100 degrees), in the extended condition (non-affected member was positioned so that the knee stayed 75 degrees of flexion and the paretic limb remained at 100 degrees of flexion) and in a elevated condition (the unaffected limb was positioned in a dense foam while the paretic was flat on the floor with the knee flexion to 100 degrees). These conditions determined the foot position (15). (Table 01)

Table 1 - Relation of foot position and variables of the performance on the transfer from a sit-to-stand position.

Performance on the transfer from a sit-to-stand position

AUTHOR	METHOD/ INSTRUMENTS OF MEASUREMENT	FEET POSITION	L	Ass	J.M.A	E.M.G	D.T	B.M	N.R
Roy et al(2006)	Force platform and Optotrak 3020 System	Spontaneous symmetric Asymmetric I / II	X	X					
Roy et al (2007)	Force platform and Optotrak 3020 System	Spontaneous symmetric Asymmetric I / II			X				
Lecours et al (2008)	Force platform and Optotrak 3020 System	spontaneous Symmetric Asymmetric		X	X			X	
Kwong et al (2014)	Five times sit-to-stand test time	Normal Posterior	X						
Camargos et al (2009)	EMG (MPI50wsw) Balance Master System Triaxial accelerometer	Spontaneous Symmetric Asymmetric I /II	X	X		X			
Farqalt et al (2013)	Repetition counting	Symmetric Asymmetric							X
Duclos et al (2008)	Force platform and Optotrak 3020 System	Spontaneous Asymmetric					X		
Brunt et al (2002)	Electromyography Force platform	Normal condition Extended condition Elevated condition	X			X			

L = Length of the raise; Ass = Asymmetry; J.M.A = Joint moment asymmetry; E.M.G = electromyography; D = displacement; B.M = Body movement; N.R = number of repetitions of the raise.

Source: research data

DISCUSSION

Through this review it was found that there was an influence among the different positions of the feet on the performance of the standing up in hemiparetic subjects after stroke. Three studies using the positioning foot strategies, found shorter time in the performance of standing up from spontaneous position when compared to the symmetric and asymmetric in hemiparetic patients.^(8,11,13) The duration to complete the task on the spontaneous position of feet on the above studies was shorter (2,6; 2,7 and 1,93 s) than reported by Chou e outros,⁽⁵⁾ 2003, in his study about hemiparetic subjects (4,5s).

A recent study examining the position of feet and arms during the five times sit-to-stand test showed that posterior position of feet compared to the normal position, exhibited shorter duration and therefore a better performance, regardless the position of the arms.⁽¹⁴⁾ Corroborating with these findings, a study showed the posterior positioning of foot allows a more efficient movement of standing up with reduction of anterior displacement of body gravity center.⁽¹⁶⁾ Furthermore Brunt e outros,⁽¹⁵⁾ 2002 reported an increase in this time when the paretic limb was behind the uninvolved and even more when the uninvolved was in a more elevated position than the paretic.

Hemiparetic individuals showed differences in vertical reaction forces and knee joint moment between the sides, the spontaneous, symmetrical and asymmetrical positions of the feet, but was less marked in the asymmetric position.⁽¹²⁾ The asymmetric position of the feet, with the paretic foot positioned behind the uninvolved, largely reduced the difference in the distribution of the vertical reaction force.⁽⁸⁾ This fact was also observed by Roy e outros,⁽¹⁰⁾ 2007, decrease in the net joint moment asymmetry between sides, especially in the transition phase and loss of contact with the seat. On the other hand, recent studies shown a reduction in weight distribution and knee joint moment symmetry measure between the sides in healthy young subjects in the asymmetric position

when compared with the symmetric,⁽¹⁹⁾ but this results divergence is attributed to the different characteristics of population between studies, as hemiparetic and healthy young people were studied, respectively.

Other authors found that hemiparetic subjects showed no difference in simetric weight distribution, regardless of foot position used, concluding that the foot position on the motion of standing up from a seated position should not be a relevant factor for functional performance of these individuals.⁽¹¹⁾ The divergence of results can be explained by the sample of chronic hemiparetic subjects, using different motor control strategies promoting the performance.

Another aspect associated with the difference in weight bearing and the failure in the perception of this distribution in hemiparetic subjects, was the strength of the knee extensors.⁽¹⁸⁾ Evidence suggests that muscle strength (especially the concentric activity of the knee extensors and ankle extensor and flexor eccentric plantar) and the weight distribution skill in the paretic side are important factors in the ability of standing up.⁽³⁾ The distribution of weight to the paretic foot may favor more tactile and proprioceptive stimulation optimizing the sensory information about joint moment, which would allow member position adjustment.

According to Duclos e outros,⁽¹³⁾ 2008, standing up with the asymmetrical position of feet (paretic foot behind the unaffected one), compared to the spontaneous positioning, enabled reduction of lateral deviation of the center of pressure and shoulders for the unaffected side and oscillation of the body in the frontal plane during the first 25% of the task. There was no significant change in the displacement of the pelvis when compared to the two positions of the feet. Studies using the same asymmetric positioning of the feet, confirmed these findings.^(8,12)

After stroke automatic program to get up may be compromised by muscle weakness in the paretic side.⁽⁵⁾ Study investigated the relationship of muscle strength with the transfer from sitting to

standing identified the association of paretic knee extensors and ankle extensors with the performance of standing up in subjects after stroke.⁽³⁾ The biomechanical experiment of Brunt e outros,⁽¹⁵⁾ 2002, showed higher electromyographic activity of the anterior tibial and quadriceps in the paretic limb, with this limb behind the uninvolved and the unaffected one in a higher position in relation to paretic.

Lower electromyographic activity of the hamstrings in symmetric position and higher in the asymmetric and spontaneous position, were found in an observational study that evaluated the effect of foot position on the performance of standing up in hemiparetic subjects. It was not found significant differences between the position of feet and quadriceps and anterior tibial.⁽¹¹⁾ The same study reports that lower activity of the hamstrings is indicative that the posterior positioning of both feet, in other words, in the symmetrical position, reduced the need of joint stabilization. In addition the authors found that the onset of soleus activation was delayed in the asymmetric position (unaffected foot behind the paretic) compared with the spontaneous and that it was activated before the loss of contact with the seat.

Corroborating with this study another author found that in healthy individuals the anterior tibial muscle was the first one to be activated, followed by the quadriceps, hamstrings and finally the soleus. However in hemiparetic subjects, this muscle group was activated almost simultaneously, considering that this pattern of activation of the muscles is due to extensor synergy in these patients, involving the hamstrings, quadriceps and soleus, acting on the hip, knee and ankle, respectively.⁽¹⁹⁾

A randomized clinical trial demonstrated that the training of standing up for four weeks in a group with their feet in the asymmetric position resulted in an increase in the number of repetitions of the task, when compared with the group that trained with the symmetrical position of the feet.⁽⁹⁾ This study reported an increased number of repetitions of a three minute break so to perform more repetitions

within this range it is assumed that the individual has increased the speed of the transfer from a sit-to-stand position. The completion of standing up with the asymmetric foot position provides a greater degree of anteroposterior stability, thereby allowing the movement to be performed at a higher speed.⁽²⁰⁾

CONCLUSION

The findings suggest that the choice of the foot position affects the performance of the task of sit to stand. This should be considered in the evaluation and treatment, enabling to control the variables that affect the performance of this task. One limitation of this study is that we highlight the lack of methodological standardization among studies to establish more insightful conclusions.

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