

Influence of Sit-to-Stand Task Facilitation, for the Lower Limb Postural Orientation in the Standing Position

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Abstract

One of the most used interventions in post-stroke physiotherapy patients is the facilitation of functional tasks to recovery of normal movement.

Objective: This case report aims to determine the effects of the Sit-to-Sand task facilitation on lower limb postural orientation in the standing position, during stroke rehabilitation.

Case Report: This study presents a 70-year-old patient, with right hemiparesis, somatosensory deficits and global aphasia, resulting from a middle cerebral artery (MCA) stroke. Intervention: After 12 weeks of intervention, based on the facilitation of the normal movement.

Results and Conclusions: It was possible to verify that the sit-to-stand task improves the ability to postural orientation of the hemiplegic lower limb standing.

Keywords: *Sit-to-Stand; Lower Limb; Stroke*

Introduction

Worldwide, stroke is one of the main causes of disability in adults [1,2] and with an aging population, the prevalence also have increased, due to complex metabolic phenomena and high risk factors [2-10]. In Portugal, it is considered one of the main causes of death, with an incidence in 2011 of 251.6/100 000 people / year [3]. The high percentage of ischemic strokes, approximately 80% [4,5], reinforces the importance to understand how the physiotherapy, by using the normal movement facilitation, may be useful in patient recovery.

One of the interventions applied in physiotherapy for the recovery of people with stroke is the use of facilitation of normal movement along with functional tasks. This intervention is based on the neuroplasticity of the nervous system and the influence that a peripheral stimulus has on postural tone, being able to change the function and the structure of the entire system. When using the facilitation of normal movement, it is essential to take into account the multi-dimensional analysis of the functional deficits in a clinical reasoning process, in which the observation, analysis and evaluation allow the interpretation of movement in functional activities and in everyday life [5,10,11]. Based on literature, we consider the activity of sit-to-stand (STS) as a functional task consisting on the ability to change from one stable to a less stable position, with centre of mass change, to avoid losing postural control. This activity can be divided in four moments: flexion phase (sitting for seat-off), the transfer phase (seat-off to maximum dorsiflexion), extension phase (maximum dorsiflexion to the full extension of the hip) and stabilization phase (full extension of the hip until the movement is steady) [12,13].

Postural orientation of the lower limb and its activation capability are key components to the extensor synergies, essential in postural control of the lower limbs in the standing and gait position. Being so, in a pelvis with restriction range, the facilitator movements of stand-

ing and walking positions appear as influencers of voluntary movement and orientation of the feet within the support base and the gait pattern control [14,15].

Case Presentation

Male patient, aged 70, former manager of a laundry, had a controlled hypertension and right visual deficit due to a stroke. A computed tomography (CT) revealed ischemic lesion in deep cortical territory of the left MCA, additionally reaching the head of the caudate nucleus. A second control CT held two weeks after the stroke revealed small foci haemorrhagic on the left frontal and parietal cortical consistent with haemorrhagic transformation. The expectations and goals of the patient are difficult to realize due to the global aphasia. As main symptoms, the patient has pain on the right shoulder, not quantified due to global aphasia, with presence of subluxation. In addition, he also shows signs of pain in the region of the external malleolus of the right foot, which presents a serious oedema.

The patient demonstrated that his concern for help is wife to transfer from wheelchair to the bed and for having independent walking.

Investigation

The patient was subjected to a neuromuscular descriptive evaluation to identify specific disorders of movement. Besides the descriptive evaluation we applied measuring instruments in three different moments throughout the implementation of the intervention program: baseline/ initial evaluation (before program implementation), intermediate evaluation (after six weeks of intervention) and final evaluation (after 12 weeks program application). To evaluate the patient's ability to perform the functional activity of sit-up independently, we used the Barthel Index Modified (BIM) and Postural Assessment Scale for Stroke (PASS). To evaluate the postural orientation, Kinovea software was used.

The use of PASS was applied to evaluate the postural control through tasks related to daily living activities in patients with stroke, in the acute phase and can be used for five years after the stroke. This scale consists of 12 items divided into two subscales: the first is related to the maintenance of a posture (five items) and the second with the ability to change from one posture to another (last seven items), both in the supine position, like sitting and standing [16]. The advantage of using this scale is related to the fact that it is suitable for the pathology of the case presented, and it can be applicable regardless of the severity of brain injury without requiring any collateral (except for the stopwatch) and it can be applied in about ten minutes [16]. The PASS was approved for the Portuguese population, with internal and intra-observer reliability values of 0.999 and 0.992, respectively [17].

The Barthel Index (BI) has been adapted by Granger in 1979 from an original scale, with the aim of refining the evaluation parameters [18]. This Index has been validated for the Portuguese population, being sensitive to patients requiring 3rd assistance, with an 0.72 content validity and inter-rater reliability of 0.98 to 0.80 [19]. The reason for choosing this index relates to its division into two categories (personal autonomy, with nine items, and mobility with six items) and may give emphasis to the global index or individualize the scale, if necessary. Using digital photographs and the Kinovea software 0.8.15 video analysis, has allowed us to see the postural alterations. In this case, photographs were taken in the anterior and posterior profiles, right and left sides in a sitting and standing position, with symmetrical and asymmetrical feet (first with the right foot forward and then with the left foot forward). Despite being a specific video analysis, Kinovea software was chosen due to the fact that it is a free software and it has been used in the course of the Neuromuscular Physiotherapy specialization.

The main problems identified was: (1) the deficit in the proximal postural control by inability to recruit the extensor activity against gravity, particularly when moving from the STS position; (2) Failure in movement dissociation of the left members by hyperactivity and the fixation on trunk to achieve balance; (3) distal reflex activity that does not allow the adaptability of the right foot to the ground.

The intervention goals for this clinical case were established for 12 weeks aiming to conduct the functional activity of STS independently and with good postural control (PASS: grade 3 in field 3, grade 3 in field 10; BI: score 6 in field 11). During this activity, he should be able to STS, and sit down, without support of the left upper limb and highlight. Simultaneous he will be able to adapt the foot to the

base of support with postural orientation of the lower limbs when assumes a standing position (comparison of the images analysed using the Kinovea software).

Procedures

The intervention plan proposed was elaborated by phases, in which all sessions started by preparing the patient for the STS, progressing to a more complex activity in order to integrate the simpler with appropriate motion control. This plan was flexible being performed with a lake of dynamic postural strategies and postural sets, depending on patient's response, for the preparation of the various components essential for functional activity. The program was held 3 times/week frequency, for one hour and 34 sessions and consists in the facilitation of hip extensors activation using initially the supine position, so as to be specific to the area to recruit. Various postures were used with the aim of hip selectivity involving posterior and anterior tilt. To preventing the replacement with the trunk and shoulder girdle, it was important the sensory stimulus stability and the select pelvis activation.

The left hyperactivity control was performed with the right trunk activity facilitation, using the left lateral decubitus position. This activity of the trunk is an important component of postural control that precedes the initiation of walking. The preparation with left trunk stretching, with a large base of support contact, showed that the patient was more ready for the activity and avoided anticipatory recruitment of cervical muscles and compensatory activity of the shoulder girdle. The right shoulder and the upper limb must be able to contribute actively to the task, so the mobility and the specific alignment are crucial to incorporating selective components and optimise the movement strategies.

To facilitate gradually the antigravity position of the trunk, in sitting, with anterior support, we took into account the modulation of the head component due to an overactive response of its extension, replacing the proximal control. Selective extension of the trunk was facilitated in a sitting position and, after the task was completed, serial experiences of muscular structures located in the right lateral neck and the rotation of the head was facilitated, since the head malalignment may interfere with the vestibular information provided by cervical afferents.

For the relation between the right foot and the ground it was essential to facilitate the alignment and postural orientation of the limb in order to remain active for the development of the functional task. Initially, in a sitting position, the foot was prepared for a better contact with the base of support and, in addition, with various length experiences of muscular knee extensors, integrating this movement in the function. With the right lower limb aligned, it was essential to activated concentric and eccentric movements of the plantar flexors in order to enable dynamic stability of the foot and the relationship between agonists and antagonists.

After motor learning of the previous components, it was essential to integrate them into functional activities. The first chosen activity was the STS, since it is fundamental to functional recovery as it serves as a basis for independent mobility [5]. The second task was the sit-to-walk, to be complex and challenging postural control, requiring selective ability to produce movement sequences [10].

Results

After the intervention using the STS, the results obtained in the descriptive evaluation and instruments used, seems to reflect an acquisition of motor and control skills in different aspects as the proximal postural control, in postural orientation of the body and in right foot ground adaptability. After 12 weeks, the patient could get up independently, without posterior support, though still maintaining some asymmetry in the standing position. In table 1 we can see the score changes in the PASS: improvement of the item 10 to score 3, item 3 maintenance in the score 2). In the Barthel Index the results changes in the autonomy level, with a significate improvement (33/53 to 42/53). Regarding postural orientation of the right lower limb and right foot adaptation to support base in the standing position, with symmetrical and asymmetrical feet, there was strong improvement of the right knee extension (15° with symmetrical feet) and in the hip extension (12° to left, foot forward) as seen in table 2. For the right dorsiflexion the gain was 9° in the standing position with symmetrical feet what functionally translates into increased ability to place the heel on the ground (Table 2). These results were considered with reference to a hip alignment 0° of flexion, 0° of knee flexion and 90° of dorsiflexion.

Clinical outcome measures	Initial evaluation (10/11/2014)	Middle evaluation (19/12/2014)	End evaluation (28/01/2015)
PASS	Total Score 26/36 (11/15 e 15/21)	Total Score 28/36 (11/15 e 17/21)	Total Score 31/36 (12/15 e 19/21)
	Item 3 – Score 2 Item 10 – Score 2	Item 3 – Score 2 Item 10 – Score 2	Item 3 - Score 2 Item 10 – Score 3
BI	Score total 71/100 Autonomy: 33/53 Mobility: 38/47	Score total 75/100 Autonomy: 37/53 Mobility: 38/47	Score total 80/100 Autonomy: 42/53 Mobility: 38/47
	Item 11 – Score 3	Item 11 – Score 3	Item 11 – Score 3

Table 1: Results obtained through the clinical outcome measures.

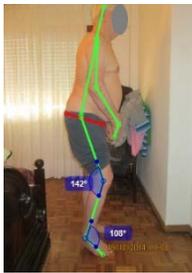
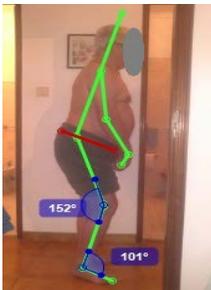
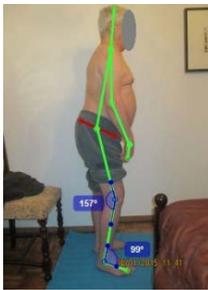
Initial evaluation	Middle evaluation	End evaluation
Standing position with symmetrical feet		
		

Table 2: Results obtained through the image collection using the Kinovea program in the initial.

Discussion

The task of STS was performed with symmetric and asymmetric feet in order to overcome the biomechanical requirements [12]. The same postural analysis was made for the standing position. According to some authors, doing this activity with symmetrical feet allows a greater symmetry between the lower limbs during the course of the task [21], which goes towards the results of this study. However, studies also show the importance of performing the task experiment in different directions and speeds to reach the automation task [22,23]. With the left foot forward, there is a larger displacement of the centre of mass to the right foot, increasing the transfer of weight to the right lower limb, since the left foot has biomechanical disadvantage [23].

Nevertheless, when the patient remains in a standing position with the left foot forward there is a larger flexion of the right knee with a discharge weight to the left lower limb, not supporting the right heel on the ground. According to recent studies [21,23], after stroke the patient presents amplitude restrictions on the hip and knee, and in this case improvements were recorded at the level of the amplitudes of the bi-articular muscles of the hip and knee probably achieved by facilitating movements of antero-posterior tilt when moving from sitting to standing position and from standing to sitting position.

When the activity is performed with the right foot forward, there is further extension of the right knee, with an increased angular displacement of the hip, extending the extension phase [12]. In a standing position with the right foot forward, it was noticed both knees flexion and anterior trunk projection, in order to lower the centre of mass. In addition to the results obtained to support the proposed objective, other results showed possible relations with the intervention plan implemented. The PASS total score showed improvement of five points, being those most frequently observed in the subscale which refers to postural changes. These may have arisen due to the a

better postural orientation of the affected lower limb and a better adaptation of the foot to the support base, conveying a strong sensory input, allowing the lower limb activation during functional activity [12]. Already in 2004, a study mentioned that the repeatedly use of facilitation techniques improves, within two weeks, the voluntary movement in the affected lower limb, in hemiplegic patients [22]. The facilitation from standing to sitting position, improved the ability of the patient to sit, as well as the movement quality of STS because of the biomechanical similarities, allowing these results to remain for over six months [24] after stroke.

In the decision making process for performing a movement, and has a fundamental role in cognitive and emotional processing, since it is rich in projections to the prefrontal cortex [25]. We believe that the motor learning may be influenced by an existing cognitive and emotional lability, recurrent from a brain damage.

It should be noted that most studies using the facilitation of STS, with symmetrical and asymmetrical feet, intended to evaluate essentially the muscle activity, the ground reaction force and the displacement of the centre of mass during the activity, reaching positive results in these parameters [13]. However, it was not founded any one that refers the use of a good postural orientation of the affected lower limb to perform the task and the specific contribute of STS to quality of life or in terms of essential anticipatory activity to the gait [12].

Learning Points/Take Home Messages

- The results allow us to consider that the facilitation of normal movement, using a functional activity have a positive influence on independent performance of the standing
- STS increases the ability to show a better postural orientation and adaptation of the foot to the base of support in a standing position.
- The use of the facilitation of functional activities allows the patient to experience the normal sequence of movement/task by stimulating their active participation in the movement itself and improving the ability to perform more complex activities.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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