ISB 2013 BRAZIL
XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

COMPARISON OF THE EFFECTS OF THE AEROBIC TRAINING IN THE HEMIPARETIC WALKING IN THE WATER AND AT THE TREADMILL IN CHRONIC HEMIPARETIC STROKE.

[1,2] Patrícia Martins Franciulli, [1,2]Aline Bigongiari, [2]Flávia A. Souza, [2]Juliana V.Francica, [2]Lívia Araújo and [1,3]Luis Mochizuki
[1]Laboratório de Biomecânica da Escola de Educação Física e Esporte da Universidade de São Paulo;
[2]Universidade São Judas Tadeu; [3] Escola de Artes, Ciências e Humanidades da Universidade de São Paulo;
email: franciulli@usp.br

SUMMARY
Walking retraining is a major goal in a rehabilitation program in post stroke. This study aimed to compare the effect of a training program involving both treadmill and aquatic walking to reduce the disability due to poor walking performance in chronic stroke. Twelve participants were randomly assigned to treadmill group and aquatic group for the 9 week (3 days/week) progressive graded, high-intensity aerobic treadmill exercise or aquatic exercise. Data from functional assessments were Fulg-Meyer scale, Berg balance scale and Timed and up & go test. EMG signals were recorded from tibialis anterior, lateral gastrocnemius, rectus femoris, vastus lateralis, biceps femoris and semitendinosus bilaterally during gait. For two groups evaluated, aerobic training have improved the functional variables. The EMG variables showed influence of the training program. These findings suggest that aerobic training programs are beneficial for both groups; however treadmill training group showed increased RMS values compared with aquatic walking training.

INTRODUCTION
Stroke is the leading cause of adult disability in the world. Clearly, walking retraining is a major goal in a rehabilitation program for person with stroke [1]. Our study was designed to evaluate the effect of a training program involving both treadmill and aquatic walking to reduce the disability due to poor walking performance in chronic stroke persons.

METHODS
Twelve participants with stroke (10 female and 2 male) were randomly assigned to treadmill group and aquatic group for the 9 week program (3 days/week) progressive graded, high-intensity aerobic treadmill exercise or aquatic exercise. The inclusion criteria for patients were: (1) a first-ever frontoparietal stroke, (2) chronic stage with more than 12 months of evolution, (3) cognitive status measured with mini-mental state examination (> 21) and (4) have Functional Ambulation Category score of at least 3. The exclusion criteria were: medical conditions that are known to affect walking performance, other than stroke; severe forms of aphasia or cognitive problems that would hinder comprehension or cooperation; severe emotional or behavioral problems, and severe visuospatial neglect.

Data from functional assessments were selected according to levels of the International Classification of Functioning, Disability and Health: Fulg-Meyer scale to body function, Brazilian Berg balance scale, Timed and up & go test activity. Surface electromyogram signals was recorded from tibialis anterior, lateral gastrocnemius, rectus femoris, vastus lateralis, biceps femoris and semitendinosus bilaterally during gait. The skin was cleaned and abraded with alcohol before electrode application. Electrode positioning followed SENIAM recommendations. The EMG signals were collected as analog signals at 2000 Hz, amplified, digitized and stored. The EMG signals were then filtered with a 200 Hz high pass filter, demeaned, rectified and then low pass filtered (20 Hz). Filtering was done with 4th order Butterworth filters in Matlab (MathWorks Inc, Natick,MA, USA). Using the RMS EMG envelope, activity in the muscles could be related to phases in the gait cycle.

RESULTS AND DISCUSSION
The demographic and clinical characteristics of participants in the 2 groups were comparable (table 1). There was no statistical difference between two groups.

Table 1: Characteristics of study participants

Variável	Treadmill training (n=6) Average (SD)	Aquatic Training (n=6) Average (SD)	*p**
Age (years)	54,8 (7,7)	61,67 (10,02)	0,21
Gender	5 female and 1 male	5 female and 1 male	-
Side of lesion	4 right and 2 left	4 left and 2 right	-
Functional Ambulation Category	4 (0,63)	4,17 (075)	0,68
Time post stroke (months)	56,67 (32,93)	67,67 (51,05)	0,66
Mini -Mental State Examination	24,17 (4,17)	24,50 (4,32)	0,89
Fulg-Meyer Scores	144 (38,02)	140 (10,25)	0,80

A two-way ANOVA was performed to test for differences among groups and phases to functional assessments. Table 2 shows the descriptive statistics for each functional variables. Functional variables showed significant differences between phases before training and found no significant differences between the groups. For RMS EMG signals a five-way ANOVA was performed to test for differences among groups, phases, muscles, sides and gait phases (Figure 1). RMS values EMG signal was not different between lateral gastrocnemius and biceps femoris between paretic leg and non-paretic leg. No statistically significant differences in the activation were found for any of the gait phases, either between the paretic and the non-paretic leg. RMS values EMG signal showed a significant improvement post-training. RMS values EMG signal showed significant differences between phases and between two groups before training.

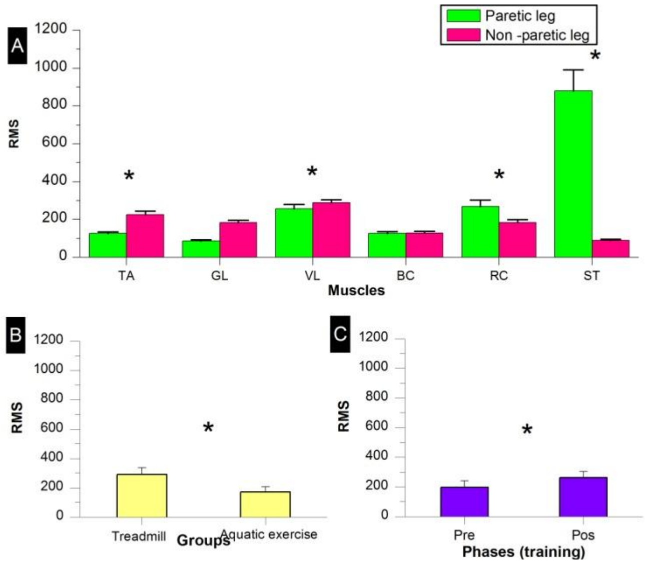

Figure 1: A) Mean (+S.D.) for each muscle of the paretic and non-paretic leg. B) Mean (+S.D.) for each group. C) Mean (+S.D.) for each phases of training. Significant differences are indicated by an asterisk

Data from functional variables suggest that aerobic training improved sensory motor impairment, agility and balance. The functional assessments were used to evaluate and compare the effects of aerobic training for the population studied and can be used in clinical practice of neurorehabilitation.

The RMS patterns were differed between groups. Treadmill training showed increased activation of the paretic muscles after intervention. The inefficiency of muscle contractions of the paretic lower limb is associated with impaired motor performance after stroke. The conventional rehabilitation of persons post-stroke is not enough to improve muscle strength to enable her to perform any activities of daily living [2].

Treadmill training group showed increased RMS values compared with aquatic walking training. Low adaptability that a person has when performing the movement is the result of movement patterns rigid and stereotyped, so the aerobic treadmill training resulted in higher variability in muscle activation for gait performance, making it more flexible adjustments to the front of the movement pattern specificity of exercise [3]. The change in variability of muscle activation results in adaptations differentiated strategies for each lower limb.

CONCLUSIONS

The aquatic walking training and treadmill training program was effective in improving walking in persons after stroke.

The aerobic training improved the functional variables in both groups. The EMG variables showed influence of the training program in both groups. The aerobic training programs in chronic hemiparetic stroke were beneficial and improving functional status in stroke person for both groups.

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Table 2: Performance on the functional assessments from Pre- to Post-Training

	Aquatic walking (n=6)		Treadmill (n=6)		Phase	Group	Interactions
Functional assessments	Pre Median (SD)	Post Median (SD)	Pre Median (SD)	Post Median (SD)	p [1]	p [2]	p [3]
Timed Up & Go test (TUG)	26,67 (14,56)	13,03 (7,52)	19 (2,37)	16,67 (1,86)	**0,02**	0,50	0,11
Berg Balance Scale	41,67 (6,38)	49,17 (4,31)	42,33 (4,55)	48 (4,31)	**0,00**	0,80	0,63
Lower extremity - Fugl-Meyer Scale	10,67 (3,76)	17,83 (4,57)	16,67 (5,01)	19,67 (5,09)	**0,03**	0,09	0,36
Coordination/Speed Lower extremity - Fulg-Meyer Scale	2,17 (1,33)	3,50 (1,05)	3,67 (1,03)	4,0 (1,26)	**0,05**	0,09	0,31