163 - THE USE OF SIGHT FOR THE STATIC BALANCE MAINTENANCE IN YOUNG PEOPLE

CLARISSA STEFANI TEIXEIRA, LUIS FELIPE DIAS LOPES, CARLOS BOLLI MOTA, ANGELA GARCIA ROSSI
Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil
clastefani@gmail.com

Introduction

Many topics have been studied about the postural system. Many authors, through theirs studies, suggest themes related to the balance assessment in order to better clarify its control.

There are many implications for an individual to have the control over his body. In this sense, through the eyes[9] the visual system provides information to the brain regarding the position and the movements of an object in the space, as well as the position and movements of the members related to the environment and to the rest of the body. Through the analysis of the involved systems in the postural control, the sight is the sensorial system that the body most relies in the postural maintenance and movements activities. Moreover, this system, among the sensorial systems, is the most complex[20].For this reason, the influence of the sight in balance maintenance and postural control activities may be the most studied topic in this area. However, some authors assert that despite the visual information are important for the balance control, they are not absolutely necessary. According to Shumway-Cook and Woollacott[32], the visual information, sometimes, are not an accurate source of information for the body orientation, because, as an example, when someone is in movement there is a difficulty in distinguish an object's and the own body's movement.

Actually, the postural system of control intends to keep the dimensions of visual scenery structured in the retina in order to reduce the corporal oscillation. When the individual swings towards front direction, the visual reference that was projected in the retina enlarge its size; that is the reason why postural system of control changes the direction of the oscillation to keep the established reference chart[26]. Thus, it is possible to notice that the sight is one of the important sensorial sources for the postural system of control, since it provides information about the environment, the direction and the speed of the corporal movements in relation to the environment[21]. It also can be used to reduce the corporal oscillation, once the closed eyes causes a rise in the magnitude of that oscillation[25]. According to Freitas Junior and Barela[12], when the static erect posture is kept without visual information there is a rise in the postural oscillation. For Silva et al.[33] these oscillations can be related or to the dependence on visual information or to problems in the visual information processing by the postural control.

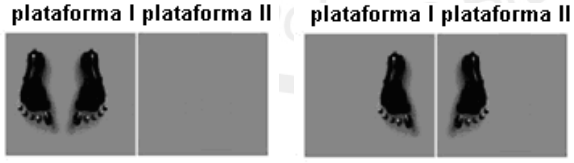
Although the balance is a natural activity of the daily life, we should be attentive to possible unbalances that can damage the execution of daily elementary activities. Many studies about the balance have been done [16, 4, 23, 29, 18, 30, 5, 6, 17, 11, 34]. Some of these studies emphasize the visual information, as according to Hay et al[15], analyzing different age groups, the elderly present higher influence and dependence in the visual information during the postural control. Nevertheless, Freitas Junior and Barela[12] assert that this dependence could be occurring before the senescence period. In view of these facts, we intended to verify the visual information implications over the amplitude of the force center displacement and the force center medium displacement in the anterior-posterior and medium-lateral directions during the static balance.

Materials and Methods

Thirty-four (34) healthy male and female subjects with 20, 33 1, 86 years old of average age, 672, 96 129, 95 N of corporal weight and 1, 76 0, 08 m of stature, participated in this study. They did not have problems in the muscles and skeleton in their historic, neither dizziness historic. For the subjects selection it was intentionally chosen young people that practiced regular activities (three times a week) and that were willing to participate in the study. The activities done by the subjects were swimming, weight-lifting, hydrogimnastics and collective sports.

For the kinetic assessment two OR6-5 *AMTI* (*Advanced Mechanical Technologies, Inc.*) force platforms, distant 5, 5 m one from each other, were used. The data acquisition frequency was 100 Hz.

During the whole collection the participants were barefoot, in bipedal support with the arms along the body. Before the collection, the subjects' stature and the corporal weight were measured. The data were collected in the following conditions: (cond 1) opened and closed eyes with the feet positioned in only one platform; 9cond 2) opened and closed eyes with each foot positioned in one platform, as the figure 1 illustrates:



cond 1 cond 2

Figure1 - Colection Data Condition

It was asked to each participant to keep an erect posture as more stable as possible. In all conditions analysed the subjects kept themselves over the platform with the feet separated one from each other in a distance equivalent to the hip width. So, in the first attempt of each situation and for each subject, the platform was marked with the intention of keeping the subject in the same position in all attempts. In the open-eye situation it was asked for each participant a fixed look on a point marked on the wall a meter distant from the subject in the same height of his/her eyes, following Freitas' and Duarte's recommendations[13]. Twelve attempts of each subject were collected, with five seconds of duration for each attempt, three for each condition.

It was analysed the force center displacement amplitude in the anterior-posterior (COPap) and medium-lateral (DMml) directions, and the averages of each of those variables in the open-eye and closed-eye situation were compared.

The descriptive statistics was used for the data analysis. The data normality was verified through the Shapiro-Wilk test. As the data presented normal distribution, the t test was applied for comparison between the averages of the variables during the condition 1. When the balance was assessed with the memers over the two platforms (condition 2), the *t* test was appliedfor comparison among the averages of the right member with the ones of the left member in all variables studied. As the members did not present statiscally meaningful differences, the mebers were analysed in group through the *t* test. The meaning

used for all the tests was 5%.

Results and Discussion

When the balance was analysed with the inferior memebr over only one force platform in the open-eye and closed-eye conditions of the variables COPap (p=0,007) e DMap (p=0,002), the subjects presented meaningful differences. The values for the COPap, COPml, Dmap and DMml during both situations are illustred in the table 1.

Table 1 - Average (X) and pattern deviation of the values for COPap, COPml, DMap e DMml during the condition 1 with the eyes openend and closed (cm).

	Opened eyes		Closed eyes	
	X	S	X	S
COPap	0,16*	0,04	0,19*	0,06
COPml	0,11	0,04	0,12	0,04
DMap	0,84*	0,19	0,95*	0,24
DMml	0,63	0,17	0,68	0,17

* statiscally meaningful differences (p<0,05).

For the second condition (feet over both platforms) the *t* test did not present statiscally meaningful differences between the members, considering that they were analysed together. The values found for COPap, COPml, DMap e DMml are illustrated in table 2. Through the analysis of the open and closed eye situations, the variable COPml (p=0,12) did not present statistically meaningful differences, but the variables COPap (p=0,3), DMap (p=0,002) and DMml (p=0,04) presented statiscally meaningful differences among them.

Table 2 - Average (X) and desvio padrão (S) of the values for COPap, COPml, DMap and DMml during the condition 2 with the eyes opened and closed (cm).

	Opened eyes		Closed eyes	
	X	S	X	S
COPap	0,21*	0,07	0,24*	0,09
COPml	0,09	0,02	0,09	0,02
DMap	1,18*	0,34	1,29*	0,35
DMml	0,78*	0,18	0,80*	0,20

* statiscally meaningful differences (p<0,05).

Although some studies investigate the importance of physical activity over the corporal balance[7,3,2], the present study shows that even in individuals that practice regular physical exercises, the visual information is a determinant system for the balance maintenance.

According to Freitas junior and Barela[12] , the displacement values are also higher in the anterior-posterior direction. As in the present study, this displacement also raised in the closed-eye condition[12,19]. These results are in agreement with the literature, once many authors point out a raise in the corporal oscillation when some source of sensorial information is taken out[35,22,31,27].

The meaningful differences in the balance change are after the 60 years old[12]. The same authors still affirm that from the 40 years old on there is a linear tendency for the raise of the postural oscillations. However, the present study shows that subjects in the age of 20's likewise elderly people also present meaningful changes in the anterior-posterior direction when the visual information is suppressed.

On the other hand, other studies affirm that with visual information influence it is not observed rise of postural instability in the closed-eye condition[33] . These data are opposite to the results here presented, because in the anterior-posterior direction either the displacement amplitude or the force center medium displacement was different without the presence of visual information. The same was found by Mann et al[19], which analyzed the static balance of students from different semester of the Physical Education course. The authors assert that either the displacement amplitude or the force center medium displacement in the anterior-posterior direction shows a higher oscillation when the visual information cannot be used.

Even if the postural system of control is already developed in adults when the visual information is taken out, both children and adults presented raises in the force center displacement[1] . The authors also explain that in the closed-eyes condition, the task is more complex because it is a rare situation; thus, in order to make the necessary adaptations, the postural control is more required and causes a fall in the performance.

Many studies registered alterations in the anterior-posterior direction36,8,10,28,19 , but the reasons why the differences are in that direction are not well explained in the literature. Some studies affirm that a higher control is necessary in the anterior-posterior direction, because the balance maintenance in this direction depends on a bigger number of joints' flexibility levels when compared to the medium-lateral direction.

Through the values presented, it was possible to notice that when the inferior members were analyzed in different platforms, that is, one member in each force platform, both the displacement amplitude and the force center medium displacement presented differences among their values when the visual information was taken out, except for the variable COPml. Even though, it was possible to verify the similarity to the studies found in the literature, which affirm that with the members analyzed separately, the oscillation is higher in the anterior-posterior axis.

Conclusion

We concluded that the sight is an important information even for normal and young individuals that practice regular physical activities, because its lack significantly interferes in the amplitude of displacement and in the medium displacement, especially in the anterior-posterior direction.

Bibliographical References

1. ALVES, P. A. M.; BARELA, J. A. Mecanismos de controle postural em crianças de 4 a 12 anos de idade e adultos. **In: Anais eletrônicos... XI Congresso Brasileiro de Biomecânica**. Paraíba, 2005

2. AMARAL, R. de L. Do. TEIXEIRA, C. S.; MOTA, C. B. Estudo exploratório do deslocamento do centro de força durante a parada de mãos. **In: Anais eletrônicos... Congresso Internacional de Educação Física**. Porto Alegre, 2005.

3. AVEIRO, M. C.; NAVEGA, M. T.; GANITO, R. N.; DRIUSSO, P. OISHI, J. Efeitos do treinamento de resistência e equilíbrio em mulheres portadoras de osteoporose. **In: Anais eletrônicos... XI Congresso Brasileiro de Biomecânica**. Paraíba, 2005.
4. BARELA, J. A.; POLASTRI, P. F.; GODOI, D. Controle postural em crianças: oscilação corporal e freqüência de oscilação. **Revista Paulista de Educação Física**. v. 14. n. 1. p. 68-77, 2000.
5. BAYAL-BERTOMEU, J. M.; GUILLEM, R. B.; SOLER-GRACIA, C.; MOYA, M. F. P de.; PRAT, J. M.; GUZMÁN, R. B. de. Determinación de los patrones de comportamiento postural en población sana española. **Acta Otorrinolaringol Esp**. n. 55. p. 260-269, 2004.
6. CHOU, L. S.; KAUFMAN, K. R.; HAHN, M. E.; BREY, R. H. Medio-lateral motion of the center of mass during obstacle crossing distinguishes elderly individuals with imbalance. **Gait and Posture**. v. 18. n. 312, p. 125-133, 2003.
7. CAMPOS, C. Efeitos de um programa de treinamento com trampolim acrobático sobre o equilíbrio de crianças surdas. **Revista Sobama**. v. 8. n. 1. p. 21-26, 2003.
8. COLLINS, J.J.; DE LUCA, C.J.; BURROWS, A.; LIPSITZ, L. A. Age-related changes in open-loop and closed-loop postural control mechanisms. **NeuroMuscular Research Center.** Boston University USA. v. 104, p.480-492, 1995.
9. DUARTE, M. **Análise estabilográfica da postura ereta humana quasi-estática**. Tese apresentada à Escola de Educação Física e Esporte da Universidade de São Paulo, como requisito parcial para o Concurso de Livre-Docência na área de Biomecânica, junto ao Departamento de Biodinâmica do Movimento do Corpo Humano. São Paulo, 2000.
10. ERA, P.; HEIKKINEN, E. Postural sway during standing and unexpected disturbance of balance in random samples of men of different ages. **International Journal of Experimental, Clinical and Behavioural Gerontology**. v. 40, n. 3, p. 287-295, 1985.
11. FAQUIN, A.; MELO, S. I. L.; PIRES, R. Comparação do equilíbrio de atletas que treinam com calçado, descalços e não-atletas. **In: Anais eletrônicos... XI Congresso Brasileiro de Biomecânica**. João Pessoa: Sociedade Brasileira de Biomecânica, 2005.
12. FREITAS JÚNIOR , P.B. ; BARELA , J.A.; Analise da postura ereta não perturbada de jovens e adultos.**In: Anais... X Congresso Brasileiro de Biomecânica**. Belo Horizonte. v. 2. p. 36-39, 2003.
13. FREITAS, S. M. S. F.; DUARTE, M. **Métodos de análise do controle postural**. Disponível em http://lob.incubadora.fapesp.br/portal.p. Acessado em 20 de setembro de 2005.
14. HAFSTRÔM, A.; FRANSSON, P.; KARLBERG, M.; LEDIN, T.; MAGNUSSON, M. Visual influence on postural control, with an without visual motion feedback. **Acta-Otolaryngologica**. Stockholm. v. 122. p. 392-397, 2002.
15. HAY, L.; BARD, C.; FLEURY, M.; TEASDALE, N. Availability of visual and propriocepitive afferent messages and postural control in elderly adults. **Exp Brain Res**. v. 108. p. 129-139, 1996.
16. IMBIRIBA, L. A.; RODRIGUES, E. C.; MAYR, G.; MAGALHÃES, J.; VARGAS, C. D. As estratégias de simulação mental modulam o equilíbrio postural: comparação entre videntes e portadores de deficiência visual. **In: Anais... X Congresso Brasileiro de Biomecânica**. Belo Horizonte: Sociedade Brasileira Biomecânica. v. 2. p.78-82, 2003.
17. LAFOND, D. DUARTE, M.; PRINCE, F. Comparasion of three methods to estimate the center of mass during balance assesment. **Journal of Biomechanics**. n. 37. p. 1421-1426, 2004.
18. LÓPEZ, J. R.; FERNÁNDEZ, N. P. Caracterización de la interacción sensorial en posturografía. **Acta Otorrinolaringol Esp**. n. 55. p. 62-66, 2004.
19. MANN, L.; TEIXEIRA, C. S.; LOPES, L. F. D.; MOTA, C. B. Avaliação do centro de força durante o equilíbrio estático em acadêmicos da educação física. **In: Anais eletrônicos... 5ª Mostra de Iniciação Científica, Pós-Graduação, Pesquisa e Extensão**. UCS, Vacaria, 2005.
20. MASSION, J. Movement, posture and equilibrium: interaction and coordination.**Progress in Neurobiology**. Oxford. v. 38. p. 35-56, 1992.
21. NASHNER, L.M. Analysis of stance posture in humans. In: TOWE, A.L.; LUSCHEI, E.S. **Handbook of Behavioral Neurology.** New York: Plenum. v. 5, p. 527-565, 1981
22. ODENRICK, P.; SANDSTEDT, P. Development of postural sway in the normal child. **Human Neurobiology**. v. 3. p. 241-244, 1984.
23. OLIVEIRA, L. F.; IMBIRIBA, L. A.; GARCIA, M. A. C. Índice de Estabilidade para Avaliação do Equilíbrio Postural. **Revista Brasileira de Biomecânica**. n. 1 p.33-38. , 2000.
24. OLIVEIRA, E. M.; ESTRÀZULAS, J. A.; CRUZ, A.; GOMES, R.; PETRY, R.; GUTH, V. J.; ANDRADE, M. C.; MELO, S. I. L. Avaliação biomecânica do equilíbrio do idoso. **In: Anais... V Mercomovimento**. UFSM, Santa Maria. p. 69, 2004.
25. PAULUS, W. M.; STRAUBE, A.; BRANDT, T. Visual stabilization of posture: physiological stimulus characteristics and clinical aspects. **Journal of neurology.** Oxford, v. 107, p. 1143-1163, 1984.
26. PRIOLI, A. C. **Acoplamento entre informação visual discreta e contínua e oscilação corporal em idosos ativos e sedentários.** Trabalho de conclusão de curso. Rio Claro, 2003.
27. RIACH, C. L., STARKES, J. L. Stability limits of quiet standing postural control in children and adults. **Gait and Posture**. v. 1. p. 105-111, 1993.
28. RILEY, M. A.; STOFFEGEN, T. A.; GROCKI, M.J.; TURVEY, M. T. Postural stabilization for the control of touching. **Human Movement Science**. v. 18. p. 795-817, 1999.
29. RONDA, J. M. GALVAÑ, B. MONERRIS, E.; BALLESTER, F. Associación entre sintomas clínicos y resultados de la posturografía computadorizada dinámica. **Acta Otorrinolaringol Esp**. n. 53. p. 252-255, 2002.
30. SANZ, E. M.; GUZMAN, B. De CERVERÓN, C. C.; BAYDAL, J. M. Análisis de la interacción visuo-vestibular y la influencia visual en el control postural. **Acta Otorrinolaringol Esp**. n. 55. p. 9-16, 2004.
31. SHUMWAY-COOK, A.; WOOLLACOTT, M. The growth of stability: postural control from a developmental perspective. **Journal of Motor Behavior**. v. 17. n. 2. p. 131-147, 1985.
32. SHUMMWAY-COOK, A; McCOLLUM, G. **Motor Control: theory and pratical applications**. Baltimore: Williams & Wilkins, 1995.
33. SILVA, J. B.; SOUSA, P. N.; LIMA, E. S. ; TEIXEIRA, L. A.; Comparação do controle postural entre indivíduos adultos e idosos : dependência da tarefa e da informação visual. **In: Anais... V Seminário Internacional sobre atividades físicas para a terceira idade - Educação Física e envelhecimento perspectivas e desafios.** p. 175-178, 2002.
34. SONZA, A.; MACHADO, D. B.; MOCHIZUKI, L. Equilíbrio estático de crianças em diferentes superfícies e

posturas. **In: Anais eletrônicos... XI Congresso Brasileiro de Biomecânica**. João Pessoa: Sociedade Brasileira de Biomecânica, 2005.
35. TAGUCHI, K.; TADA, C. Change of body sway with growth of children. In: AMBLARD, B.; BERTHOZ, A.; CLARAC, F. (Ed) **Posture and Gait: development, adaptation and modulation**. Oxford, Excerpta Medica. p. 59-65, 1998.
36. TEASDALE, N.; STELMACH, G.E.; BREUNING, A. Postural sway characteristics of eldery under normal and altered visual and support surface conditions. **International Journal of Experimental, Clinical and Behavioural Gerontology**. v. 46. n. 6. p.238-244, 1991.

Faixa de Camobi km 9
Bairro Camobi - Cep: 97105-900
Santa Maria - Rio Grande do Sul / Brasil
e-mail: clastefani@gmail.com
Telefones 55 32208271/ 55 32208027/ 55 91317884

THE USE OF SIGHT FOR THE STATIC BALANCE MAINTENANCE IN YOUNG PEOPLE

Abstract

This study was aimed to verify the amplitude of displacement and the antero-posterior as well as the medium-lateral displacement of the force center of 34 subjects of both sexes with average age around 20, 33 ± 1,86 years old during the static balance. It was used two platforms of force, which worked in 100Hz, distant 5,5 mm one from each other. The open-eye and the closed-eye situations were analyzed in two conditions: firstly with the members over one platform; then, with the members over two platforms. The conclusion is that when the visual information was taken out, the individuals presented meaningful differences for both the amplitude of displacement and the force center medium displacement in the conditions analyzed, especially in the anterior-posterior direction.

Keywords: static balance, visual information.

UTILISATION DE LA VISION POUR LA MANUTENTION DE L'ÉQUILIBRE STATIQUE DANS DE JEUNES

Resume

Ce travail a objectivé vérifier l'amplitude du déplacement et le déplacement moyen antéro-postérieur et moyen-latéral du centre de force de 34 sujets des tous les deux sexes avec moyenne d'âges de 20,33 1,86 ans pendant l'équilibre statique. Se sont utilisées deux plateformes de force en opérant à 100 Hz éloignés 5,5 mm un de l'autre.Ont été analysées les situations yeux ouverts et yeux fermés en deux conditions: avec les membres sur un et sur deux plateformes. Il se conclut que quand l'information visuelle a été enlevées les personnes ont présenté des différences significatives de telle façon dans l'amplitude du déplacemnet combien dans le déplacement moyen du centre de force, dans les deux conditions principalement dans la direction antéro-postérieur.

Mots clés: équilibre statique, information visuelle.

EL USO DE LA VISIÓN PARA MANTENER EL EQUILIBRIO ESTÁTICO EN JÓVENES

Resumen

Este trabajo objetivó verificar la amplitud del desplazamiento y el desplazamiento medio anteroposterior y mediolateral del centro de fuerza de 34 sujetos de los dos sexos con edad media de 20,33 ± 1,86 años en equilibrio estático. Fueron utilizadas dos plataformas de fuerza operando a 100 Hz, apartadas 5,5 m una de la otra. Se analisó las situaciones ojos abiertos y ojos cerrados en dos condiciones: con los miembros sobre una y sobre las dos plataformas. Se concluye que, cuando la información visual es retirada los individuos presentan distinciones significativas tanto en la amplitud del desplazamiento cuanto en el desplazamiento medio del centro de fuerza, en las dos condiciones, principalmente en la dirección anteroposterior.

Palabras-clave: equilibrio estático, información visual

UTILIZAÇÃO DA VISÃO PARA A MANUTENÇÃO DO EQUILÍBRIO ESTÁTICO EM JOVENS

Resumo

Este trabalho objetivou verificar a amplitude do deslocamento e o deslocamento médio ântero-posterior e médio-lateral do centro de força de 34 sujeitos de ambos os sexos com média de idades de 20,33 1,86 anos durante o equilíbrio estático. Utilizaram-se duas plataformas de força operando a 100 Hz, distantes 5,5 mm uma da outra. Foram analisadas as situações olhos abertos e olhos fechados em duas condições: com os membros sobre uma e sobre as duas plataformas. Conclui-se que quando a informação visual foi retirada os indivíduos apresentaram diferenças significativas tanto na amplitude do deslocamento quanto no deslocamento médio do centro de força, em ambas condições, principalmente na direção ântero-posterior.

Palavras chave: equilíbrio estático, informação visual.