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STATIC AND DYNAMIC POSTURAL CONTROL IN LOW-VISION AND NORMAL-VISION ADULTS

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SUMMARY

The aim of this study was to evaluate the influence of reduced visual information on postural control by comparing low-vision and normal-vision adults in static and dynamic conditions. Twenty-five low-vision subjects and twenty-five sighted adults were evaluated for static and dynamic balance using four protocols: 1) the Modified Clinical Test of Sensory Interaction on Balance on firm and foam surfaces with eyes opened and closed; 2) Unilateral Stance with eyes opened and closed; 3) Tandem Walk; and 4) Step Up/Over. The results showed that the low-vision group presented greater body sway compared to the normal vision group during theon a foam surface ($p \leq 0.001$), the Unilateral Stance test for both limbs ($p \leq 0.001$), in the Tandem Walk test, the low-vision group showed greater step width ($p \leq 0.001$) and slower gait speed ($p \leq 0.004$). In the Step Up/Over test, low-vision participants were more cautiousin stepping up (right $p \leq 0.005$ and left $p \leq 0.009$) and executing the movement ($p \leq 0.001$). These findings suggest that visual feedback is crucial for determining balance, especially for dynamic tasks and foam surfaces. Low-vision individuals had worse postural stability than normal-vision adults in relation to dynamic tests and foam surfaces.

INTRODUCTION

The influence of the visual system on postural control has been documented various studies specially in individuals with low vision Patients with visual dysfunctions must place a greater demand on somatosensory and vestibular information to maintain postural stability, establishing and connecting movement patterns and adjusting to positions in space to compensate for low-functioning visual systems [1].

To further understand the balance of low-vision individuals and to provide evidence for future interventions focused on reducing falls in this population, the objective of the present study was to test whether low-vision adults could maintain postural control similar to that of normal-vision adults during stable surface and challenging tasks. To this end, we compared the postural control of low-vision and normal-vision adults in static and dynamic conditions by posturography. Additionally, we investigated the influence of reduced visual information on the postural control systems in both groups.

METHODS

Twenty-five low-vision and twenty-five normal-vision individuals participated in the study. Subjects were tested using the NeuroCom Balance Master System: evaluated for static and dynamic balance using four protocols: 1) the Modified Clinical Test of Sensory Interaction on Balance on firm and foam surfaces with eyes opened and closed; 2) Unilateral Stance with eyes opened and closed; 3) Tandem Walk; and 4) Step Up/Over.

RESULTS AND DISCUSSION

The results showed that the low-vision group presented greater body sway compared to the normal vision group during the on a foam surface ($p \leq 0.001$), the Unilateral Stance test for both limbs ($p \leq 0.001$), in the Tandem Walk test, the low-vision group showed greater step width ($p \leq 0.001$) and slower gait speed ($p \leq 0.004$). In the Step Up/Over test, low-vision participants were more cautious in stepping up (right $p \leq 0.005$ and left $p \leq 0.009$) and executing the movement ($p \leq 0.001$).

In our study, the reduced visual information influenced postural stability in foam surface and dynamic conditions for the low vision group. The eyes open conditions proved to be easier (smaller sway was observed) for the normal-vision group than the low vision group for tasks performed on the foam surface. Additionally, the low vision group was more cautious as compared to normal-vision group when performing Tandem Walk and Step up/over tasks (slower walking velocity, increased step width and smaller lift-up).

Furthermore, the results revealed an interaction between the test's surface and eye condition for the normal-vision group. This group was less stable on a foam surface and in the unilateral stance tests when their eyes were closed.

This finding is corroborated by previous studies in healthy individuals [1,2]

In relation to left leg test, the low vision group had greater difficulty performing when the eyes were closed as compared to open. Very few studies have examined the postural control of low-vision subjects in a single-leg stance under different eye conditions. Maybe, the proprioception inputs could be overload in the left side leg, as previous studies had suggested that unilateral stance tasks might depend on some neuromuscular requirement and muscular strength. Additionally, the ability of the postural control system to select a higher joint configuration variance can contribute to the maintenance of postural stability by correcting lower extremity movements in individuals with vision impairments[3]

The Tandem Walk protocol, the low vision group showed slower speed and greater step width compared to the normal-vision group, in accordance with the literature (29). This suggests that, in walking, visual proprioception normally plays a lead role in postural control system andit can be partially compensated for by improving somatosensory and peripheral vestibular processing [3,4]

In the Step Up/Over test, low vision group was more cautious when stepping up and executing the movement than the normal-vision group, as observed by previous studies that verified these adaptations in order to increase kinaesthetic information and compensate for the unreliable/incomplete visual information Perhaps there is an association with risk or fear of falls Also, dynamic balance can be greatly impaired through the loss of afferent visual information [3,4]

The results provide evidence of the need for interventions focused on reducing falls in this population.

CONCLUSION

This study suggested that visual feedback can influenced the balance during challenging tasks, even during periods of prolonged vision impairment. Low-vision individuals had worse postural stability than normal-vision adults in relation to dynamic tests and foam surfaces.

REFERENCES

1. Anand V, Buckley JG, Scally A, Elliott DB. Postural stability changes in the elderly with cataract simulation and refractive blur. Invest Ophthalmol Vis Sci 44:4670–5;2003

2.Giagazoglou P, Amiridis IG, Zafeiridis A, Thimara M, Kouvelioti V, Kellis E. Static balance control and lower limb strength in blind and sighted women. Eur J Appl Physiol. 107(5):571-9;2009.

3.Krishnamoorthy V, Yang JF, Scholz JP. Joint coordination during quiet stance: effects of vision. Exp Brain Res. Jul;164(1):1-17; 2005

4Friedrich M, Grein HJ, Wicher C, Schuetze J, Mueller A, Lauenroth A, Hottenrott K, Schwesig R. Influence of pathologic and simulated visual dysfunctions on the postural system. Exp Brain Res.186(2):305-14;2008.

Table 1 *Comparison between Low-Vision Group and Normal-Vision Group in terms of dynamic balance protocol.*

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	Eyes Open *M (SD)*	**Eyes Closed** *M (SD)*	***p***
Tandem Walk			
Step width (cm)	11.0 (3.75)	7.36 (1.18)	**≤ 0.001**
Speed (cm/s)	12.2 (3.33)	16.45 (4.21)	**≤ 0.004**
End sway velocity(degrees/s)	4.5(1.45)	3.86(3.21)	.23
Step up / over			
Lift-up Index (% weight)	37.40 (12.48)	46.32 (8.33)	.**005**
Right Leg	34.05(11.72)	41.12 (5.67)	**.009**
Left Leg			
Movement Time (s)	1.89 (.33)	1.49 (.18)	**<0.001**
Right Leg	2.01 (.47)	1.51 (.35)	**<0.001**
Left Leg			
Impact Index (% weight)	42.34(17.22)	44.68(18.61)	.64
Right Leg	42.63(20.76)	44.68(18.61)	.71
Left Leg			

M-mean, SD- standard deviation