Postural balance in elderly evaluated in a force platform: the vestibular system and its importance in the aging process

7th EFSMA-European Sports Medicine Congress
3rd Central European Congress of Physical Medicine and Rehabilitation
Annual Assembly of the German and the Austrian Society of Physical Medicine and Rehabilitation

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Keywords: vestibular system; direct evaluation; force platform || andre@ipb.pt

Objective

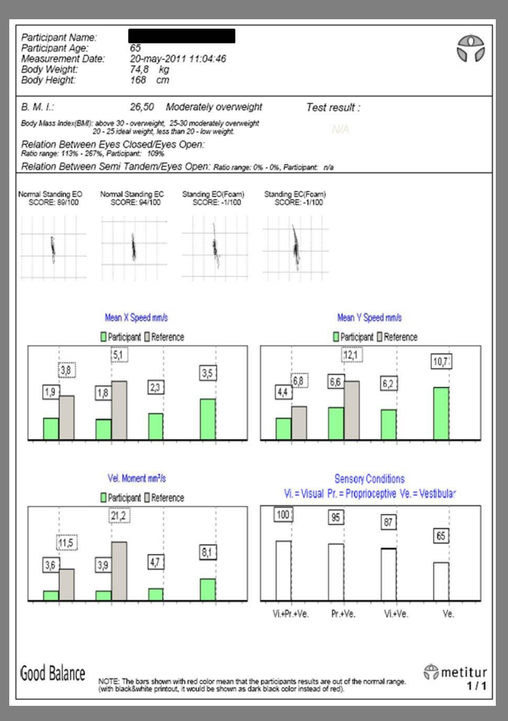
Balance dysfunction remains a significant factor for disability in the elderly (Melzer et al., 2004). Several mechanisms have been proposed to explain the changes in balance during aging. Balance disorders represent a growing public health problem due to the association with falls and fall related injuries (Kalisch et al., 2011). The complexity of the balance system, however, often requires a thorough, multidisciplinary approach to the evaluation and successful treatment of balance impairment (Matsumura et al., 2006). The vestibular system detects head movement in space and in turn generates reflexes that are crucial for daily activities, such as stabilizing the visual axis and maintaining head and body posture (Sturnieks et al., 2008). To measure postural balance an accurate and reliable instrument is needed that can numerically reflect the importance of the different variables involved in human balance (Era et al., 2006).
With this study it's our aim to directly determine the balance of older people and to establish the importance of the vestibular system in aging.

Material/Methods

The static postural balance was evaluated in a Metitur® force platform in four different tests, with 30 seconds each:
1. – normal standing eyes open;
2. – normal standing eyes closed;
3. – foam standing eyes open;
4. – foam standing eyes closed.

Three variables were calculated:
1. – Antero-posterior oscillation velocity (x axis);
2. – Medium-lateral oscillation velocity (y axis);
3. – Moment velocity.

Height was measured with a Seca® stadiometer: subjects were asked to stand with back, buttocks and heels against the stadiometer. Subject's feet were together and flat on the floor and their heads in the Frankfort plane.



Results

We evaluated 49 elderly (42 woman and 7 men) with a mean age of 68,73±9,39 years and with a BMI of 28,63±4,77.
Establishing correlations, we observed that the age is positively correlated to different types of evaluations in foam: mean x-axis speed in foam standing with eyes open (0,358*; p=0,011), mean y-axis speed in foam standing with eyes open (0,419**, p=0,002), mean x-axis speed in foam standing with eyes closed (0,331*, p=0,02) and mean y-axis speed in foam standing with eyes closed.
Comparing the subjects studied with reference values of same age and sex (Era et al., 2006), we can observe that our subjects achieve better results (less velocity) in both "x" and "y" axis (subjects versus references values):

- Mean x-axis speed in normal standing with eyes open – 3,56±1,39 mm/s vs. 4,18±081 mm/s;
- Mean y-axis speed in normal standing with eyes open – 6,82±2,5 mm/s vs. 7,27±1,84 mm/s;
- Mean x-axis speed in normal standing with eyes closed – 4,51±2,35 mm/s vs. 5,68±1,44 mm/s;
- Mean y-axis speed in normal standing with eyes closed – 10,96±4,75 mm/s vs. 12,20±3,01 mm/s.

Table 1 - postural balance data values

Mean X speed (mm/s) - normal standing with eyes open (mm/s)	3,56 ± 1,39
Mean y speed (mm/s) - normal standing with eyes open (mm/s)	6,82 ± 2,50
Mean moment velocity - normal standing with eyes open (mm^2/s)	9,84 ± 7,06
Mean X speed (mm/s) - normal standing with eyes closed (mm/s)	4,51 ± 2,35
Mean y speed (mm/s) - normal standing with eyes closed (mm/s)	10,96 ± 4,75
Mean moment velocity - normal standing with eyes closed (mm2/s)	17,21 ± 14,66
Mean X speed (mm/s) - foam standing with eyes open (mm/s)	4,37 ± 1,67
Mean y speed (mm/s) - foam standing with eyes open (mm/s)	9,29 ± 2,86
Mean moment velocity - foam standing with eyes open (mm2/s)	20,56 ± 12,38
Mean X speed (mm/s) - foam standing with eyes closed (mm/s)	5,59 ± 2,62
Mean y speed (mm/s) - foam standing with eyes closed (mm/s)	15,09 ± 4,29
Mean moment velocity - normal standing with eyes closed (mm2/s)	32,04 ± 19,13

Taking into account the results in the different tests, the platform software assigns a classification to the importance of the different systems involved in balance. The vestibular system is itself responsible for 55,19% of the total balance of the studied subjects.

Conclusion

Comparing with the reference values for same age and sex, the evaluated subjects had better results. They also present greater oscillation with the aging process in the tests "foam eyes open" and "foam eyes closed" (in the x and y axis). This means that the vestibular system has an important role in the balance of the elderly evaluated.

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