The effect of amblyopia on balance and gait

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Upholding postural stability is of central importance for daily living.[1,2] Vision, along with vestibular and somatosensory inputs, supplies sensory information regarding the position of the body with respect to the environment to warrant upright balance and forward movement in the course of gait.[1,2] Therefore, the incorporation between these elements is a key determinant factor for control of postural stability.[1,2] However, the role of vision is critical in postural control.[1] Once normal binocular vision is undesirably disturbed in childhood due to some reason, especially in patients with amblyopia, balance may also be affected.[1]

Amblyopia is known as reduced best-corrected visual acuity in the absence of a structural ocular defect or visual pathway anomaly.[1,3,4] However, this definition has recently been questioned through the concept that although the central feature of amblyopia is reduced best-corrected visual acuity, it is mainly due to binocular vision anomalies.[1,5] Considering this concept, postural instability should be consistent with the loss of binocular vision in its most general form.[1,5] This is confirmed by the findings that optimal binocular vision provides more information for keeping balance than monocular vision in both normal healthy controls and patients with amblyopia.[1,2,6–8]

Postural stability can be evaluated under progressively tough situations, such as minimized base of support (i.e., standing on one leg) or diminished sensory cues (i.e., standing with eyes closed or on a soft surface).[1,2] Similarly, obstacles have been tried to evaluate walking in a more demanding situation (i.e., walking on an icy surface or walking on a treadmill when vision is denied).[1,2] In this context, reduced postural stability has been demonstrated in patients with amblyopia.[1,2,6,8] Since postural stability is a critical aspect in standing or navigating through the environment, the presence of reduced postural stability in amblyopic patients can affect their everyday function.[1,2]

Remarkably, these results put forward that children with abnormal vision still rely on the visual sensory input to uphold their balance regardless of the abnormality in this element.[1,2] This is in contrast to visually impaired people or blind people who deploy other sensory inputs (i.e., relying more on the vestibular or somatosensory input) and use compensatory mechanisms and adaptations.[9] Another important finding is the point that no substantial correlation between balance scores and patient features, such as visual acuity or stereoacuity, has been found.[1,2,8]

Outstandingly, the scarcity of resources about the effect of amblyopia on balance and gait presents a gap in the understanding of how reduced postural stability may affect daily living of children and adults with amblyopia.[1,2]

In addition, it is important to highlight the role of collective factors in amblyopia. In this view, referring to Skeffington's four circles model, vision is the product of the interaction of four components, namely, anti-gravity, centring, identification, and the speech–auditory process.[10,11] The anti-gravity system is responsible for balance and posture.[10,11] The centring system is defined as an attentional and orienting system for selecting where the body, head, and eyes are directed.[10,11] For example, convergence is the overt oculomotor element of the centring process.[10,11] The identification system derives meaning from those areas of space that are selected for attention by the centring system, and accommodation is the overt oculomotor element of this process.[10,11] Eventually, the speech–auditory process is accountable for inspecting and communicating what is seen.[10,11] In this four circles model, the four circles are mutually overlapping and vision is represented by the region where all four circles intersect.[10–12] Therefore, vision is not considered in isolation,[12] and from this perspective, several components including balance should be pointed out and managed while treating amblyopia.[1] In this regard, case reports have reported that even adult patients with amblyopia can regain binocular vision with improved body and head posture after active vision therapy.[13] As a result, the author suggests that balance and gait should be considered as essential elements in amblyopia evaluation and treatment.

Furthermore, amblyopic patients tend to suffer from a wide range of neurodevelopmental deficits, such as eye movement disorders, fixational instability, inaccurate accommodative responses, perceptual errors, positional uncertainties of images, and the perception of moving or flickering patterns.[14,15] Once more, this shows the importance of comprehensive approaches in amblyopia management.[1] Therefore, in addition to the improvement of visual acuity in amblyopia with traditional procedures, such as optical treatment of refractive error and patching as the first lines of treatment in amblyopia, other features of amblyopia should also be considered.[1] This brings the initial point raised by this article to attention again where the underlying binocular vision deficit and other issues associated with amblyopia, such as balancing, eye–hand coordination, and visual perceptual skills, should also be included in the proposal plan of amblyopia management.

In conclusion, the existence of reduced postural stability in amblyopia should encourage enough motivation in all eye professionals to devote clinical tests related to balance in patients with amblyopia or refer their patients to relevant specialists, especially behavioural optometrists, to do so as these tests are not presently performed in routine clinical eye examinations. As a result, the author proposes employing clinical tests related to balance on all patients with amblyopia and then treating them accordingly.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable

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Ali Nouraeinejad: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.

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