EFFECTS OF EYE MOVEMENTS ON BALANCE IN CHILDREN
EFFECTUL MIŞCĂRILOR OCULARE ASUPRA ECHILIBRULUI LA COPII

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Key words: children, balance, eye movement

Cuvinte cheie: copii, echilibru, mişcări oculare

Abstract

Introduction: Balance is the state of human body to maintain equilibrium with respect to environment. Children learn to maintain equilibrium as age progresses. There are many factors that contribute in balance. Out of many factors vision and eye movement is one of the factors.

Aim. The purpose of this study was to determine whether the balance is affected by various types of eye movements. The study examined the effects of eye movements on balance in normal children.

Method: Participants were assessed for dynamic balance with respect to different tasks related to eye movements. The data was analysed for type of eye movement, gender and age.

Results: During dynamic balance the duration was more (10.44 sec) during static fixation than saccadic eye movements (7.42sec) and smooth pursuit eye movements (6.12sec). In static fixation, while comparing dynamic balance between both the genders, balance component was more in girls (11.7sec) than boys (9.4sec). In comparison of dynamic balance in the age groups, children between 9 years could balance effectively (13sec) than other age group.

Conclusion: Eye movements can determine the efficacy of visual postural control.

Rezumat

Introducere: Echilibrul este o stare a corpului uman în relaţie cu mediul înconjurător. Copiii învaţă să îşi menţină echilibrul pe măsură ce înaintează în vârstă. Sunt mulţi factori care contribuie la menţinerea echilibrului. Alături de mulţi factori, ochii şi mişcările oculare au un rol important.

Scop. Scopul acestui studiu este de a determina dacă echilibrul este influenţat de diverse mişcări oculare. Studiul a examinat efectul mişcărilor oculare asupra echilibrului la copii.

Metodă: Participanţilor li s-a evaluat echilibrul dinamic în relaţie cu diferite sarcini referitore la mişcările oculare. Datele s-au analizat din punctul de vedere al tipurilor de mişcări oculare, gen şi vârstă.

Rezultate: Durata echilibrului dinamic a fost mai mare (10.44 sec) la fixarea oculară statică decât la mişcarea sacadică a ochilor (7.42 sec) şi la urmărirea cu privirea (6.12sec). La fixarea statică, la compararea rezultatelor echilibrului dinamic între băieţi şi fete, acesta a fost mai bun la fete (11.7 sec) decât la băieţi (9.4 sec). La compararea echilibrului dinamic în funcţie de vârstă, copiii de 9 ani au avut un echilibru mai bun (13sec) comparativ cu alte grupe de vârstă.

Concluzii: Mişcările oculare pot determina eficienţa controlului vizual postural.

Introduction

As it is rightly said by Albert Einstein that "Life is like riding a bicycle in order to keep your balance, you must keep moving." Balance can be defined as "a state of bodily equilibrium". It is the condition in which all the forces acting on the body are balanced such that the centre of mass (COM) is within the stability limits, the boundaries of the base of support (BOS). [1] Good balance helps the child to know how he/she fits into space, stay still when sitting, standing & lying and develop eye movement and vision. [2]

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There are two types of balance i.e. static balance and dynamic balance. Static balance is the ability to maintain the postural stability and orientation with the COM over the BOS and the body at rest. [1] Dynamic balance is the ability to maintain postural stability and orientation with the COM over the BOS while parts of the body are in motion. [2] The body, unless it is fully supported and relaxed, is in constant state of adjustment to maintain its posture and its equilibrium. The forces tending to upset this balance may vary in strength also the body's reactions to maintain its equilibrium will vary in degree. [3]

Vision has a primary role in governing spatial orientation and balance. A vast amount of evidences show that equilibrium responses are highly dependent on vision in adults. [4] As a person shifts position, the object appears to move in the direction opposite to the head movement.

The thalamus and basal ganglia perceive this object motion as resulting from self- motion. It executes appropriate postural adjustments. For object to be perceived accurately, the eye first must have viewed the object as stationary.

Individuals have three visuomotor options given a stationary surrounding. 1) Static fixation is when the target object is kept stationary at a particular place. 2) Saccadic eye movements are fast, voluntary eye movements from a fixation point to another. They are used to scan a stationary environment or to read. 3) Smooth pursuit eye movements allow the eyes to closely follow a moving object. Smooth pursuit is mostly asymmetric and most humans tend to be better at horizontal than vertical smooth pursuit. [5]

Movement perception differs depending on the type of eye movement. During both saccades and visual fixations, the visual surround appears to be fixed absolutely despite eye movement. [6] During SPEMs, however, the eyes register the perceived movement of the visual field caused by the movement of the eyes. [7] The image of the moving object remains stationary on the fovea, whereas the static background, the peripheral visual field, appears to move.

A wobble board is a device used for recreation, balance training, athletic training and brain development therapy. Thus this board stimulates and exercises the parts of the body and brain and also creates the sense of balance. Edwards [8] reported that postural sway was increased when subjects visually tracked a swinging pendulum as compared with when they fixated, but did not examine the effects of saccadic eye movement. Iwase et al [9] and Uchida et al [4] demonstrated that saccades reduced static postural sway when compared with visual fixations and passive eye rotation. Because saccadic eye movements and visual fixations preserve the stable image of the environment, we hypothesized that they would promote postural stability during standing.

Matherial and Methods

50 children were selected for the study purpose. The procedure to be carried out for the study was explained to the parents and the consent was taken for the same. Thereafter the procedure was explained to participants. Shoulder width, or the distance between the acromion processes, was measured by measuring tape and the distance was marked on the testing platform.

Then the participants were instructed to place their feet over the marks and to keep the platform evenly balanced. They then balanced the platform for 45 seconds once to get orientation. After that the testing procedure was explained. Participants were instructed not to move their heads and not to anticipate the movement of the object.

To practice the eye movements, participants stood still on the platform and received verbal feedback about both eye and head movements. The instructions were given as 1) To focus at a fixed target. 2) To focus at alternating fixed target. 3) To focus at the moving target.

A total of nine experimental trials recording were made. Each trial was of 45 seconds duration. If the participants moved their heads, they were reminded to keep still. Occasionally, the participants' eyes would make a saccadic movement away from the stimulus. If more than three of these deviations occurred, the trial was excluded from data analysis. After all the trials were completed, the participants indicated which condition they found most difficult to perform.

At the end all the data was collected, tabulated for statistical analysis

Result

During dynamic balance the duration for which the children balanced while static fixation was 10.44sec., saccadic eye movements was 7.42sec. and smooth pursuit eye movements was 6.12sec. In static fixation, while comparing dynamic balance between both the gender, the girls balanced for 11.7sec. and the boys for 9.4sec.In static fixation, while comparing dynamic balance in the age groups, children with 5 years balanced for 7.5sec., 6 years for 7.4sec., 7 years for 6.7sec., 8 years for 12sec., 9 years for 13sec. and 10 years for 11.4sec.

TABLE NO. 1: COMPARISON OF VARIOUS EYE MOVEMENTS DURING DYNAMIC BALANCE

Sr.no	Eye Movements	Mean (Time in sec.)
1	Static Fixation	10.44
2	Saccadic Eye Movements	7.42
3	Smooth Pursuit Eye Movements	6.12

TABLE NO. 2: COMPARISON OF DYNAMIC BALANCE DURING STATIC FIXATION BETWEEN GIRLS AND BOYS

Sr. no	Gender	Mean (Time in sec.)
1	Boys	9.4
2	Girls	11.7

TABLE NO. 3: AGE WISE COMPARISON OF DYNAMIC BALANCE DURING STATIC FIXATION

Sr. no	Age Group (yrs)	Mean (Time in sec.)
1	5	7.5
2	6	7.4
3	7	6.7
4	8	12
5	9	13
6	10	11.4

Discussion

The data analysis interprets that there is a difference in the duration of dynamic balance during various eye movements. The effect of static fixation on dynamic equilibrium strengthens the dynamic equilibrium control.

An explanation for the strong relationship between eye movements and balance is that the visual control of balance depends on visual perception of a still object. [10] When compared the dynamic balance during static fixation between both genders, the girls showed greater postural stability than boys. As the females have wider pelvis so the base of support is large and hence the balance is maintained.

When studied the age wise comparison of dynamic balance during static fixation children less than 8 years of age displayed significantly greater sway than the older children. For maintaining proper balance, the body's center of mass should be within the base of support. The center of mass when standing is gradually and progressively rising as humans grow older. Therefore, as the age increases the postural stability is maintained. [11]

Conclusion

The results of this study concluded that eye movements can determine the efficacy of visual postural control. Static fixation has a positive effect on balance i.e. it improves the postural

stability thereby supporting the alternate hypothesis. When the postural stability was challenged, the boys showed greater postural sway than the girls and from the study we can also conclude that as the age increases above 8 years the postural stability goes on improving.

Limitations

The study was conducted in the small group.

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