Evaluating Visuomotor Coordination in Children with Amblyopia

Sabrina Hou¹, Yan Zhang¹, Lisa Christian², Ewa Niechwiej-Szwedo³, Deborah Giaschi¹

¹ Department of Ophthalmology and Visual Sciences, University of British Columbia
² School of Optometry and Vision Science, University of Waterloo
³ Department of Kinesiology, University of Waterloo

Background

Amblyopia
- Visual developmental disorder characterized by poor visual acuity in one eye that cannot be immediately corrected with lenses.
- Caused by conditions during childhood that deprive an eye of normal visual experience for a prolonged period of time, such as strabismus or anisometropia.
- Clinical diagnosis depends mainly on interocular visual acuity differences, but many patients show additional deficits that might be related to vulnerability in the dorsal visual stream, including depth perception, motion perception, visuomotor coordination and reading.

Stereoscopic Depth Perception and Visuomotor Coordination
- Many children with amblyopia show reduced or absent stereopsis¹.
- Adults with amblyopia show deficits on reaching and grasping tasks², but less is known about visuomotor deficits in children.
- Stereopsis was previously found to be significantly correlated to average peak velocity and deceleration interval in healthy children using the same bead-threading task described below³.

Purpose

Identify the hand movement kinematic parameters that are most characteristic of the disrupted visuomotor mechanisms in children with amblyopia or strabismus.

Methods

Participants
- Children with amblyopia (strabismic \( n = 10 \), anisometric \( n = 4 \), mixed \( n = 3 \)) or strabismus only \( n = 4 \) and control participants \( n = 236 \) aged 5-14 were recruited.
- Each participant completed assessments of distance visual acuity (logMAR) and stereoacuity (Randot Preschool Test).

Bead-threading Task
- Each trial of the bead-threading task involved grasping a small bead with two fingers and threading the bead onto a vertical needle.
- Participants completed 10 trials of the task under binocular viewing.

Data Analysis

Each trial was broken down into a sequence of movement intervals:

- The patient group showed significantly longer durations than the control group on the grasp, thread, and total movement parameters (* \( p < .05 \)).
- Grasp duration was longer in both mature (ages 10-14) and immature patient groups (ages 5-9); thread and total movement durations were longer in the mature patient group only.
- Stereoacuity, but not interocular acuity difference, was significantly correlated with grasp, average reach, acceleration and total movement durations for the patient group (all \( r 's \geq 0.5 \)).

Conclusions

- Grasp duration is the most disrupted kinematic parameter in children with amblyopia or strabismus, regardless of age.
- Binocular vision rather than depth of amblyopia may determine the severity of visuomotor deficits.

References

² Grant et al. (2007) IOVS 48(3):1139-1148
⁴ Niechwiej-Szewdeo et al. (2020) Hmn Mvmt Science 72:102652

Funding provided by the Natural Science and Engineering Research Council of Canada, BC Children's Hospital Research Institute: Brain, Behaviour and Development Theme, and BC Children's Hospital Foundation.