Commentary: Automated strabismus measurement – Orthoptics with an edge!

Binocular single vision (BSV) is one of the many virtues of humankind that make us the sovereign species of the animal kingdom. In order to maintain BSV, the visual axes must meet at the point of regard, that is, the eyes should be aligned. When this fails, the condition of squint or strabismus results. When squint manifests at all times, it is termed as heterotropia. When controlled by fusional vergences and not manifesting, it is termed as latent squint or heterophoria. When present at times and controlled at other times, it is termed as intermittent squint. If untreated for long, strabismus can result in amblyopia, faulty stereopsis and adverse psychosocial consequences.

The assessment and correction of ocular deviations depend on the ophthalmologist's skill and experience. Some of the traditional squint diagnostic methods include Hirschberg test, Krimsky test, cover–uncover test (CUT) and prism bar cover test (PBCT). The latter may be a simultaneous or alternate prism cover test to measure manifest deviation or total deviation, respectively. These manual methods, although they have stood the test of time, are time consuming and subjective. They are also difficult to carry out in communities, such as schools. In view of this, the authors have used a novel eye-tracking system based on detection of infrared light reflected from the corneal surface.[1]

The eye tracker is a commercially available device, consisting of a tablet PC that displays targets to patients, an eye tracker equipped with a sensor to record eye position, an infrared emitter, and a pair of specially calibrated shutter glasses that can alternately cover and uncover each eye similar to manual CUT. The pupillary center is the reference point, and the deviation of the corneal reflection from the pupillary center is converted into a vector. This is converted by mathematical algorithms into the amount of deviation in terms of prism diopter.

The authors have initially measured the deviation using the conventional CUT and PBCT methods. Subsequently, the eye tracker performed the automated CUT and automated alternate cover test and displayed the result. The automated and the manual results were then compared statistically and a good agreement between the two was found. The range of variability between the two methods was found to be 1–16.5D. It should be noted that some interobserver variability of 6.9–12.5D exists even in manual methods.[2]

Economides *et al*.[3] used a video eye tracker to quantify the stability of eye position in strabismus and to measure variability in the ocular deviation in 25 patients of alternating exotropia versus controls. They found that variability of misalignment is greater for horizontal eye positions than for vertical eye positions, with ocular saccades contributing to this variability. Instability of the fixating eye has also been reported in children with reduced or absent stereopsis.[4] This principle could be used for mass strabismus screening.

There have been several attempts at utilizing eye-tracking technology for strabismic evaluation in the past. Some of these were based on television cameras.[5,6] More advanced methods were later developed by Pulido[7] and Model and Enzmann.[8] Pulido used the Tobii eye tracker, whereas Model and Enzmann used an automated Hirschberg test (also based on eye-tracking technology). However, there was little strabismic data to test these methods.

In a similar study, Yehezkel *et al*.[9] compared the performance of an eye-tracking-based test to that of the manual CUT and PBCT methods and found a good agreement between the two. However, they also measured the vertical deviation unlike the present study. The eye-tracking-based automated system does have limitations. It is difficult to use in paralytic strabismus, large-angle nystagmus, measurements of torsion, and requires a certain degree of cooperation by the patient to be able to fixate on a screen target for a minute or so.

Despite these factors, the automated system is portable, quick, and allows for repeated testing. It provides automated results and may not necessarily need the help of a strabismus specialist or orthoptist; this may be very useful in a remote clinical setting. With further advancements, the system may be able to measure deviations that are larger, deviations for distances, and in all nine positions of gaze. The eye-tracker system can be used for not just strabismus measurement but also a comprehensive visual evaluation including the visual acuity (using Teller visual acuity cards and DigiTAC), contrast sensitivity, stereoacuity, colour vision, and so on. This would help save time and energy of both the patient and clinician.

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Conflicts of interest

There are no conflicts of interest.

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