Original Article

The subjectivity of objective evaluation of torsion on fundus photographs by practicing strabismologists

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Purpose: To assess the variability of assessing the ocular torsion on fundus photographs among strabismus surgeons. **Methods:** This was a prospective, noninterventional, clinical trial involving 16 trained and experienced squint surgeons participated in the study. Two videos were prepared of a total of 10 fundus pictures with or without lines for disc foveal angle. The first video had a 4 s viewing time for each fundus image. The second video had the disc foveal lines drawn and a similar 4 s viewing time for each image. The participants were asked to grade the torsion. The primary outcome measure was to assess the agreement between the raters for ocular torsion measurement. Difference in the response of observers from the standard response was the secondary outcome measure. **Results:** A 4 s viewing time was given to mimic the exposure time in the clinic while assessing torsion in a patient. Large variability was found among the responses. The kappa test was done for comparing the agreement between various observers which ranged from slight to fair (<0.40). There was no difference in torsion grading in 30.6% and 26.3% responses in the first and second video from the standard response, respectively. When a limit of ±1 grade was taken as acceptable for the responses, 66.2% for the first and 68.7% for the second video respectively were similar to standard response. **Conclusion:** There is wide variability in assessing ocular torsion by fundus photography. The level of accuracy does increase with marking the line on photographs but still remains unreliable.

Key words: Disc foveal angle, indirect ophthalmoscopy, torsion

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Ocular torsion can be measured by various techniques including indirect ophthalmoscopy, slit lamp biomicroscopy, fundus photography and disc foveal angle, retinal vasculature orientation and now recently using infrared imaging.[1-8] The commonly used objective techniques of assessing ocular torsion include the indirect ophthalmoscopy and fundus photography. There have been studies on the reliability of fundus photography,[9] reliability of slit lamp biomicroscopy,[10] and agreement of between double Maddox rod and Spierer's technique.[4,11]

Since Guyton *et al*.[1] suggested the grading of torsion based on the indirect ophthalmoscopy, there has been little literature on the interobserver variability of this technique. It is difficult to simulate the variability on actual patients. The Guyton's grading of ocular torsion with the use of indirect ophthalmoscope suggests that the normal range of fovea is within the upper third (upside down view) of the optic disc. It is important to know the variability in the assessment of ocular torsion since an excyclotorsion for one observer should not be normal or intorsion for another. The grading shows that severity of excyclotorsion which in turn shows the severity of for example a superior oblique paresis and therefore would change the management of the said disorder. Hence, we prepared a question-based response survey to assess the grading the grading of ocular torsion on fundus pictures. The responders were told about the fundus photographs and were asked to grade excyclotorsion or incyclotorsion on the scale of +1 to +4 and −1 to −4, respectively. They were informed that this should be similar to what they do in clinical practice and if they feel that there is no torsion, they should grade it as 0.

Methods

The study was done at a tertiary care institute, and informed consent was taken from the patients regarding their fundus picture and approval was taken from Institutional Review Board and Institutional Ethics Committee.

The mean age of patients was 22.54 ± 4.8 years. All the patients have 20/20 best corrected visual acuity in each eye and had clear media and good fixation and understanding. All the patients were stable with no latent or manifest nystagmus.

Each video was prepared using 10 fundus images [Videos 1 and 2]. Fundus photographs were taken keeping the eyes still, and the patient was asked to fix on a target. The head was straight, and there was no tilting of the head, and the illumination level was constant. Both the videos had a 4 s exposure time for each image, and the fundus image was a standard 50° image with a well-demarcated foveal reflex [Fig. 1]. The second video also had 10 images with lines drawn

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for disc foveal angle [Fig. 2]. The method of marking the lines has been previously described in the literature.[8]

The video was sent to 16 experienced strabismus surgeons who were fellowship trained and had a mean experience of 10.3 ± 2.1 years and used indirect ophthalmoscopy or fundus photography in their practice to assess torsion regularly. The strabismus surgeons were asked to grade the torsion as +1, +2, +3, +4 for extorsion depending upon the severity and as −1, −2, −3, −4 for intorsion based on the classification proposed by Guyton *et al*. for indirect ophthalmoscopy.[1] The patient with no abnormal ocular cyclotorsion or normal was to be graded as 0. The responses were collected and recorded in an Excel sheet. A standard response was already made for all the fundus images, and they were graded.[1]

Statistical analysis

Descriptive and inferential statistics were performed using STATA version 12 for Windows (StataCorp LP, College Station, Texas). Kappa values were calculated to estimate the agreement between the graders. The agreement was graded as slight (0.00–0.20), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80), or almost perfect (0.81–1.00). A Chi-square test was done to find out the difference in the grading responses for the first and the second videos.

Results

A total of 16 strabismologists were sent videos and the responses recorded. A total of 160 responses were recorded, 80 for the right eye and 80 for the left eye. The difference in the grading of the response from the standard response was calculated. For a no difference between the standard response and the received response, there were 49 (30.6%) responses for the first and 42 (26.3%) responses for the second video [Tables 1 and 2]. When a margin of ±1 grade was taken as acceptable, the acceptable responses increased to 106 (66.2%) for the first and 110 (68.7%) for the second video. There was no difference in the grader's response for the first and the second set of videos (P = 0.48). The marking of lines did not increase the accuracy of the correct responses. Both the videos had similar responses. This suggests that objective viewing (assessment) of ocular torsion is accurate amongst individual graders and it could be that the interpretation of Guyton's technique of grading is variable for different strabismologists.

Discussion

A variety of techniques for measurement of ocular torsion are available. Variability in ocular torsion could be up to 18° due to the variability in the position of the fovea with respect to the disc. [1,7,12] Apart from this, the measurement taken in monocular conditions may vary, and the variation may also occur when viewed with either eye fixing.[1,3,5,6] The limitation of assessing

Table 1: The difference in grading response from the standard response and the percentage of such responses for first video

Difference in grading	Number of responses (%)
0	49 (30.6)
±1	57 (35.6)
±2	27 (16.9)
±3	20 (12.5)
±4	7 (4.4)
Total	160 (100)

Table 2: The difference in grading response from the standard response and the percentage of such responses for second video with lines drawn for disc foveal angle

Difference in grading	Number of responses (%)
0	42 (26.2)
±1	68 (42.5)
±2	25 (15.6)
±3	20 (12.5)
±4	5 (3.1)
Total	160 (100)

Figure 1: A 4 s exposure time was given to grade the torsion. A set of 5 picture of right eye and 5 picture of left eye were included. The right eye fundus pictures were named R1, R2 etc. The left eye fundus pictures were named L1, L2 etc. The video showed the pictures in that order alternating right and left eye

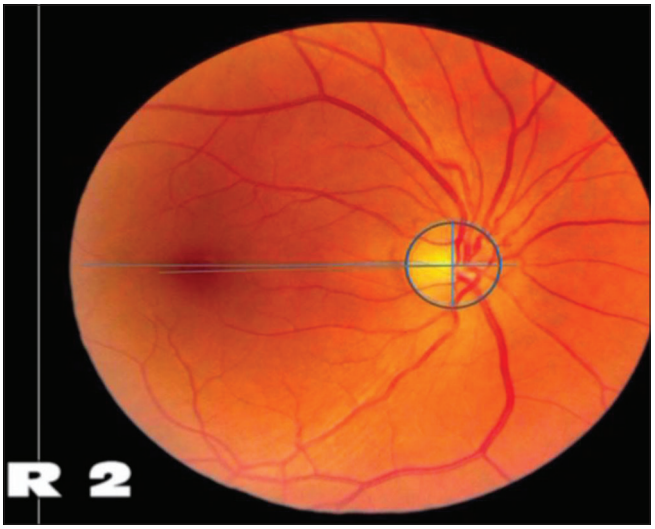

Figure 2: A 4 s exposure time was again given to grade the torsion. The lines were drawn to show the disc foveal angle. The right eye fundus pictures were named R1, R2 etc. The left eye fundus pictures were named L1, L2 etc. The video showed the pictures in alternating right and left eye but not in the same order as in first video

ocular torsion using indirect ophthalmoscopy include the position of the examiner, position of the patient, tilting of the head, usage of bright light, and continuous ocular movement. However, in uncooperative patients and young children, this method is commonly used.[1,4,5,8] An important aspect where literature is lacking is in the variability and agreement in the grading of torsion by indirect ophthalmoscopy. The examiner is the most important variable even when the other factors are kept constant. Examiner A may call a particular amount of torsion as Grade + 1, and another may call it Grade + 2 or even normal. The reliability of assessing ocular torsion by fundus photography method has been studied well and has been found to be excellent with or without the measurement of actual angle.[7-9,13]

Kothari *et al*.[10] found a poor correlation (0.5) between the measurement of the angle by slit lamp biomicroscope and fundus photography (objective versus objective) whereas Freedman *et al*.[11] found a good correlation between the disc foveal angle and double Maddox rod (objective vs. objective).

Our study was designed to look at interobserver variability for the method of objective testing of ocular torsion by fundus viewing. It is difficult to subject the same patient to indirect ophthalmoscopy by multiple observers and record their assessment. We took fundus pictures and incorporated it in a video and recorded the observations of various strabismologists. A similar study for Hirschberg's and Krimsky's test was done by Choi and Kushner.[14]

Our study clearly shows that the variability is large and the agreement for any particular picture is fair at best among the 16 strabismologists. The marking of disc foveal angle lines[8] improves the agreement from slight (kappa 0.00–0.20) to fair (kappa 0.21–0.40) but is still not significant. This indicates that viewing of ocular torsion is an objective test with large subjective variability. It is important to keep this in mind while grading the torsion through indirect ophthalmoscopy. Each surgeon has to look for his own patient, and a better indicator should be available to help the strabismologist. The marking of lines did not increase the accuracy. The first and second videos had a similar response which suggests that the individual strabismologist may have a certain interpretation of Guyton's grading system; and hence, his response remains similar in the presence of absence of the marking of lines.

The secondary outcome measure of assessing the difference in the response of observers from the standard response showed that almost 60% of responses were within ± 1 grade of torsion. This suggests that clinically torsion can be assessed with fair amount of accuracy and hence patients can be measured and managed with such a method of clinical assessment without any marking of lines for disc foveal angle (which evidently does not increase the accurate responses). However, it is important to note that despite calculating for ± 1 grade of inaccuracy, almost 40% of responses were still off the mark. Therefore, for research purposes or repeatable measurements of torsion, disc foveal angle should be used and may be a better indicator as suggested by one of our previous studies regarding its variability both intra- and inter-observer.[8]

The study has important limitations

a. The study used fundus photographs and compared the subjectivity for the indirect ophthalmoscopy. The explanation is that it is impossible to have multiple observers for indirect ophthalmoscopy in the same patient except for an indirect ophthalmoscope recordings
b. Although it has used fundus pictures, the variability is present. With an indirect ophthalmoscope, the patient and the observer are moving with no control over the tilt or movement of eyes. If this shows variability, it is obvious that indirect ophthalmoscopy would show larger variability
c. The time given to each image was 4 s and in real practice, the observers may get more time for each patient
d. Although intraobserver variability has not been looked into, the fact that the responses between the two videos are not very different suggests that intraobserver variability is not high although it was not assessed specifically. Our main aim was to see if the grading done by one ophthalmologist compares to the same done by another or not.

Conclusion

Indirect ophthalmoscopy for assessing torsion may have large variability from one strabismologist to another. The grading system used to grade torsion varies from surgeon to surgeon and cannot be used interchangeably among them. The marking of disc and fovea may not help increase the reliability.

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Conflicts of interest

There are no conflicts of interest.

References

1. Guyton DL. Clinical assessment of ocular torsion. Am Orthopt J 1983;33:7-15.
2. Madigan WP Jr., Katz NN. Ocular torsion-direct measurement with indirect ophthalmoscope and protractor. J Pediatr Ophthalmol Strabismus 1992;29:171-4.
3. Bixenman WW, von Noorden GK. Apparent foveal displacement in normal subjects and in cyclotropia. Ophthalmology 1982;89:58-62.
4. Spierer A. Measurement of cyclotorsion. Am J Ophthalmol 1996;122:911-2.
5. Brodsky MC, Klaehn L, Goddard SM, Link TP. Heidelberg spectralis infrared video imaging: A clinical tool for diagnosing ocular torsional instability. J AAPOS 2014;18:306-7.
6. Jethani J, Seethapathy G, Purohit J, Shah D. Measuring normal ocular torsion and its variation by fundus photography in children between 5-15 years of age. Indian J Ophthalmol 2010;58:417-9.
7. Parsa CF, Kumar AB. Cyclodeviation of the retinal vascular arcades: An accessory sign of ocular torsion. Br J Ophthalmol 2013;97:126-9.
8. Jethani J, Dave P. A technique for standardizing disk foveal angle measurement. J AAPOS 2015;19:77-8.
9. Morton GV, Lucchese N, Kushner BJ. The role of funduscopy and fundus photography in strabismus diagnosis. Ophthalmology 1983;90:1186-91.
10. Kothari MT, Venkatesan G, Shah JP, Kothari K, Nirmalan PK. Can ocular torsion be measured using the slitlamp biomicroscope? Indian J Ophthalmol 2005;53:43-7.
11. Freedman SF, Gearinger MD, Enyedi LB, Holgado S, Toth CA. Measurement of ocular torsion after macular translocation: Disc fovea angle and Maddox rod. J AAPOS 2003;7:103-7.
12. Williams TD, Wilkinson JM. Position of the fovea centralis with respect to the optic nerve head. Optom Vis Sci 1992;69:369-77.
13. Piedrahita-Alonso E, Valverde-Megias A, Gomez-de-Liano R. Rotation of retinal vascular arcades and comparison with disc-fovea angle in the assessment of cycloposition. Br J Ophthalmol 2014;98:115-9.
14. Choi RY, Kushner BJ. The accuracy of experienced strabismologists using the Hirschberg and Krimsky tests. Ophthalmology 1998;105:1301-6.