Article • Objectively Measuring Acquired Ocular Torsion Secondary to Trochlear Nerve Palsy with Zeiss Cirrus Optical Coherence Tomography

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ABSTRACT

Background: Optical coherence tomography (OCT) allows the identification of key fundus landmarks (fovea and center of optic disc) to help calculate estimated ocular torsion amounts in acquired ocular torsion disorders. A case of chronic trochlear nerve (CN IV) palsy secondary to stroke, in which objective ocular torsion was measured with OCT software and basic trigonometric calculations, follows in this report.

Case Report: A 68-year-old female patient with a history of brainstem stroke from five years earlier showed a right-eye hyper deviation of 2^{Δ}. Resultant Parks-Bielschowsky three-step testing, as well as ocular torsion testing with OCT software measurements, helped determine that the patient's hyper deviation was secondary to a right CN IV palsy. Her objective ocular torsion was calculated using measurement tools and trigonometric functions derived from her OCT scans.

Conclusions: OCT technology can provide objective methods for measuring ocular torsion in acquired ocular torsion disorders. Potential OCT software development and future study regarding the use of OCT in these ocular torsion disorders is needed.

Keywords: ocular torsion, optical coherence tomography, trochlear nerve palsy

Introduction

Abnormal cyclotorsion has been known to occur with acquired ocular torsion disorders such as trochlear nerve palsies and skew deviations.[1-5] Historically, the most common way to measure ocular torsion objectively has been with fundus photography.[2-5] Newer reports document OCT as another tool to measure objective ocular torsion in acquired cases.[1,6-8] This case expands on previous OCT ocular torsion reports using Spectralis OCT (Heidelberg Engineering, Heidelberg, Germany)[1,6,8] to include Cirrus OCT (Carl Zeiss Meditec, Dublin, California, USA) as a potential way to assess acquired ocular torsion disorders.

Case Report

A 68-year-old female presented for routine eye examination, with a chronic vertical diplopia complaint for five years since she suffered a brainstem stroke secondary to her history of hypertension and diabetes mellitus. Her diplopia disappeared when covering either eye, suggesting binocular vision dysfunction. She was able to alleviate her diplopia fully in primary gaze with a small left head tilt. Her medical history included hypertension and osteoporosis. Visual acuity was 20/20 OD and 20/25 OS. Pupils, extraocular motilities, and confrontation visual fields were normal OU. Cover test revealed a 2^{Δ} hyper deviation OD. With the Parks-Bielschowsky three-step test, the hyper deviation worsened with right head tilt and in left gaze, suggesting right superior oblique weakness.[1,2,4] External examination was unremarkable OU. Retinal examination was unremarkable except for mild macular drusen OU. Increased excyclotorsion (-11°) of the right eye and normal torsion (-4°) of the left eye were noted objectively with fundus photography, consistent with a mild trochlear nerve palsy OD (Figure 1). Cirrus OCT macular thickness scans were also performed on the patient OU. Using the linear measuring tool embedded within the Cirrus OCT software, two linear micron measurements were drawn: one from the center of the optic nerve to the fovea, and the second to estimate the horizontal meridian. Using these linear OCT measurements, the disc-to-fovea angle was calculated to estimate the amount of ocular torsion present in each eye (-11.4° OD, -6.6° OS; Figure 2). This shows a

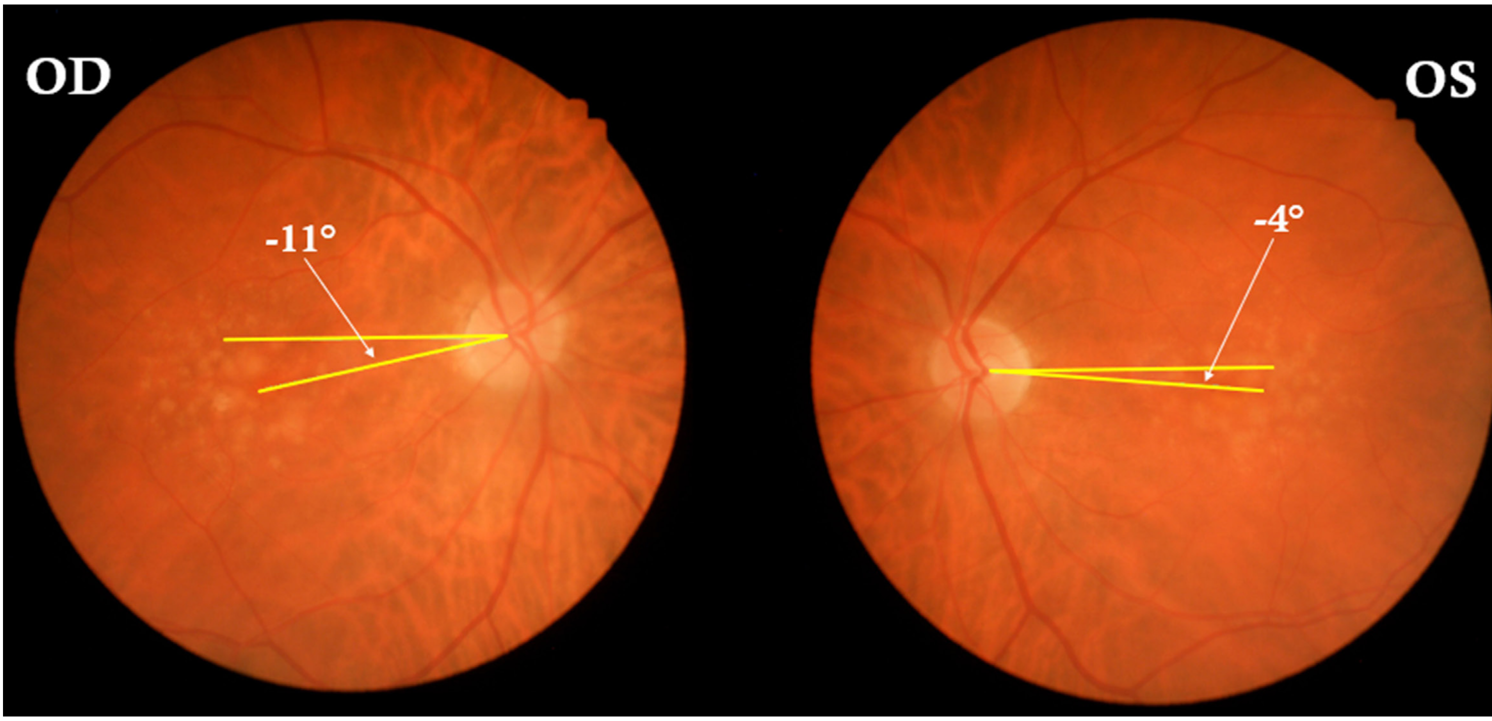

Figure 1. Standard fundus photography of the right eye (OD) and left eye (OS). Note the increased excyclotorsion OD (-11.0°) compared to the normal ocular torsion OS (-4.0°). This is consistent with a right trochlear nerve palsy.

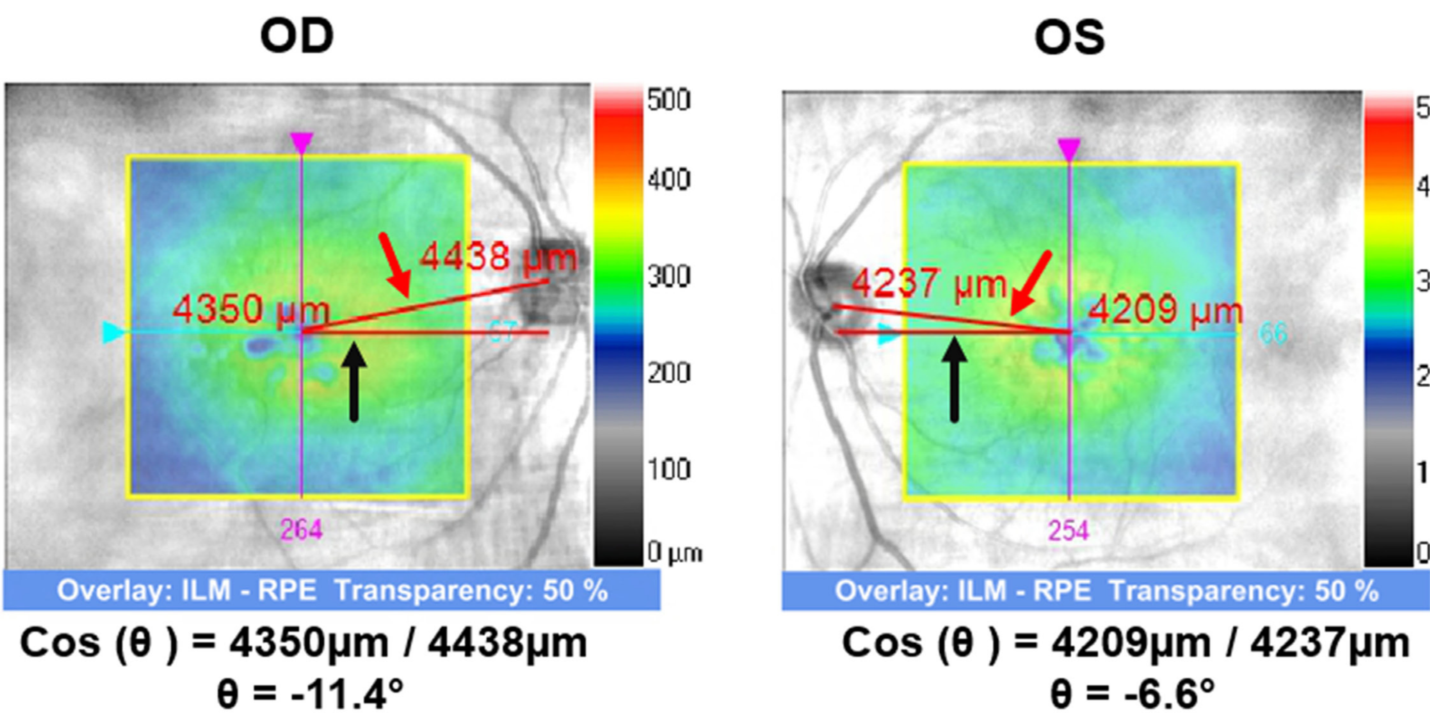

Figure 2. Optical coherence tomography (OCT) of the patient in this case using Cirrus OCT (Cirrus 5000, Carl Zeiss Meditec, Dublin, California, USA) macular thickness scans of the right eye (OD) and left eye (OS). The standard measuring tool on the Cirrus OCT was used to measure the linear distance (microns) from the center of the optic nerves to the fovea (red line with red arrow) and the horizontal meridian (red line with black arrow). These two distances were used to estimate the disc-to-fovea angle with the cosine trigonometric calculations below each respective photo (-11.4° OD, -6.6° OS). The excessive excyclotorsion of the OD is consistent with a right trochlear nerve palsy.

nice correlation between the objective measures of ocular torsion in this case, as obtained from fundus photography and OCT.

Discussion

The ability of OCT to measure ocular torsion is based upon its ability to estimate the angle between a line drawn from the optic nerve center to the fovea and the true horizontal plane, called the "disc-fovea angle."[5,9] Previously documented mean normal ranges of cyclotorsion with Spectralis OCT have been reported to be -6.6° ± 2.8°.[5] A recent study compared cyclotorsion with Spectralis OCT in normal versus trochlear nerve palsy patients.[9] This study reported average cyclotorsion in trochlear nerve palsies of -11.3° (range: -7.7° to 14.9°).[9] However, to the author's knowledge, studies of other OCT platforms to measure cyclotorsion specifically, such as the Cirrus OCT used in this case, do not exist. The Cirrus OCT has a measuring tool within its standard software capable of measuring linear distances (microns). Using this tool to measure the distance from the fovea to the center of the optic nerve, and then measuring a second distance from the fovea along the horizontal meridian to form a right triangle, a clinician could perform a simple trigonometric cosine calculation to estimate the disc-fovea angle. This would then allow the clinician to document the degree of ocular torsion, as in this case (Figure 2). Additionally, the true foveal center can be easily identified on standard OCT macular thickness scans, allowing more accurate ocular torsion measurements.

Since the patient was able to alleviate her vertical diplopia with a small head tilt, she declined further treatment beyond monitoring in this case. The patient is being followed on a yearly basis due to the chronicity and stability of her vertical deviation. The patient's systemic risk factors (i.e., hypertension and diabetes mellitus) account for her stroke history and subsequent trochlear nerve palsy in this case. Given the known anatomy of the trochlear nerves, the likely lesion location in this case is either the inferior dorsal midbrain (at the level of the inferior colliculus) or further along the trochlear nerve's course towards the superior oblique muscle, involving the nerve's vasa-nervorum blood supply.[10]

Conclusion

Cirrus OCT platforms, along with some basic trigonometric calculations, can provide an objective means to estimate degrees of cyclotorsion in acquired ocular torsion disorders, such as this case of trochlear nerve (CN IV) palsy. This is important since some patients are subjectively poor responders to classic tests that measure ocular torsion, such as the double Maddox rod. OCT has the potential to provide objective measures of ocular torsion that do not depend on patients' subjective responses. Potential OCT software development and future study regarding the use of OCT in these ocular torsion disorders is needed and should be encouraged.

References

1. Borgman CJ, Haynes JA. Measuring acquired ocular torsion with optical coherence tomography. Clin Exp Optom 2021;104:132-4.
2. Roh YR, Hwang JM. Comparison of subjective and objective torsion in patients with acquired unilateral superior oblique muscle palsy. Br J Ophthalmol 2011;95:1583-7.
3. Sharpe JA, Kumar S, Sundaram AN. Ocular torsion and vertical misalignment. Curr Opinion Neurol 2011;24:18-24.
4. Lee JJ, Chun KI, Baek SH, Kim US. Relationship of hypertropia and excyclotorsion in superior oblique palsy. Korean J Ophthalmol 2013;27:39-43.
5. Lengwiler F, Rappoport D, Jaggi GP, Landau JK, et al. Reliability of cyclotorsion measurements using scanning laser ophthalmoscopy imaging in healthy subjects: The CySLO study. Br J Ophthalmol 2018;102:535-8.
6. Borgman CJ, Follansbee CJ. Degree of excyclotorsion in an acquired trochlear nerve palsy. Clin Exp Optom 2020;103:550-1.
7. Sophocleous S. Use of optical coherence topography for objective assessment of fundus torsion. BMJ Case Rep 2017:bcr2016216867.
8. Kanku MS, Sele S, Held U, et al. Cyclotorsion measurement on scanning laser ophthalmoscopy imaging compared with fundus photography in patient with fourth nerve palsy and healthy controls: CySLO-IV study. J Neuroophthalmol 2021;41(4):e612-e618.
9. Amini N, Nowroozizadeh S, Cirineo N, Henry S, et al. Influence of the disc-fovea angle on limits of RNFL variability and glaucoma discrimination. Invest Ophthalmol Vis Sci 2014;55:7332-42.
10. Morillon P, Bremner F. Trochlear nerve palsy. Br J Hosp Med 2017;78:C38-C-40.

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