

## Assessment of macular vascular plexus density using optical coherence tomography angiography in cases of strabismic amblyopia

Amar Pujari, Rohan Chawla, Ritika Mukhija, Hameed Obedulla, Swati Phuljhele, Rohit Saxena, Pradeep Sharma, Atul Kumar

**Purpose:** To evaluate the superficial retinal vascular plexus density using optical coherence tomography angiography (OCTA) in cases of strabismic amblyopia. **Methods:** Ten eyes of 10 patients with purely strabismic amblyopia underwent detailed ocular evaluation followed by the assessment of the superficial retinal plexus vascular density using OCTA (Topcon DRI OCT Triton, Swept Source OCT, Topcon, Japan). Ten contralateral normal eyes of the same patients were considered as control. All these 20 eyes underwent a 4.5 × 4.5 mm cube scan OCTA centered at the fovea. Using the Topcon propriety software all 20 eyes were assessed for the capillary plexus density of the superficial retinal vascular plexus along the superior, inferior, nasal, and temporal quadrants centered at the fovea. The numerical values were statistically assessed using a paired *t*-test with respect to each quadrant between the normal and the pathological eyes. **Results:** The average age of patients was 16 years and eight patients were males. The mean superficial retinal vascular plexus density along the superior, inferior, nasal, and temporal quadrants in normal and pathological eyes were 49.25 ± 30.34 and 48.93 ± 2.85, 47.22 ± 4.11 and 47.37 ± 4.8, 45.54 ± 1.55 and 43.81 ± 4.21, and 46.26 ± 4.63 and 46.38 ± 5.40, respectively. Similarly, the capillary densities along the central were 17.84 ± 3.49 and 17.24 ± 2.44 in normal and pathological eyes. The differences among all these four quadrants and central area were not statistically significant (*P*-values > 0.05 for all four quadrants and central area) as compared with the normal eyes. **Conclusion:** The superficial retinal vascular plexus density of a 4.5 × 4.5 mm cube centered at the fovea of eyes of cases of strabismic amblyopia is similar to that of normal eyes.

**Key words:** Optical coherence tomography angiography, strabismic amblyopia, superficial retinal plexus density

Amblyopia is a common ocular disorder of pediatric patients. Cases of amblyopia (except form vision deprivation amblyopia) lack any pathology of the ocular media or visual pathway. Ocular examination in such cases is within normal limits. Few studies have evaluated these eyes using optical coherence tomography and have noted variable findings along the retino-choroidal layers.<sup>[1-4]</sup> One study has also shown a statistically significant decrease in the vascular plexus density in eyes with amblyopia.<sup>[5]</sup> In this report, we intend to analyze the changes in vascular plexus density along the superficial vascular network in cases of strabismic amblyopia using a noninvasive modality that is optical coherence tomography angiography (OCTA) only. We did not select other types of amblyopia such as ametropic and anisometropic as this would have led to a mismatch of refractive error between the cases and controls and thus the two groups would not have been ideally comparable. Extremes of refractive error *per se* could affect the vascular density.

### Methods

A total of 10 patients with unilateral strabismic amblyopia were included in this observation. All patients were explained

Dr. Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi, India

**Correspondence to:** Dr. Amar Pujari, Dr. Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, Room No 212, Second Floor, RPC-1, New Delhi, India. E-mail: dramarpujari@gmail.com.

Manuscript received: 12.07.18; Revision accepted: 05.12.18

about the procedure and a written informed consent was obtained from each patient. This observational study adhered to the Declaration of Helsinki. The patients were noted for the age, sex, laterality followed by detailed anterior and posterior segment evaluation to rule out other confounding pathologies responsible for low vision. All these patients subsequently underwent swept source optical coherence tomography of the macula followed by OCTA (4.5 × 4.5 mm scan) (OCTA, Topcon DRI OCT Triton Swept source OCT, Topcon, Japan) by a single observer. All these 10 patients had strabismic amblyopia in one eye. The other eye having 20/20 vision in absence of any significant refractive error was considered as a control. Patients with poor fixation, nystagmus, uncooperative, and not consenting for the observation were excluded from the study. Using an inbuilt proprietary software, the vascular plexus density was measured along the superficial retinal plexus. The density values along the superior, inferior, nasal, and temporal quadrants as well as central areas were measured and the results were compared using a paired *t*-test. The deeper

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

**Cite this article as:** Pujari A, Chawla R, Mukhija R, Obedulla H, Phuljhele S, Saxena R, *et al.* Assessment of macular vascular plexus density using optical coherence tomography angiography in cases of strabismic amblyopia. Indian J Ophthalmol 2019;67:520-2.

#### Access this article online

##### Website:

www.ijo.in

##### DOI:

10.4103/ijo.IJO\_1069\_18

#### Quick Response Code:

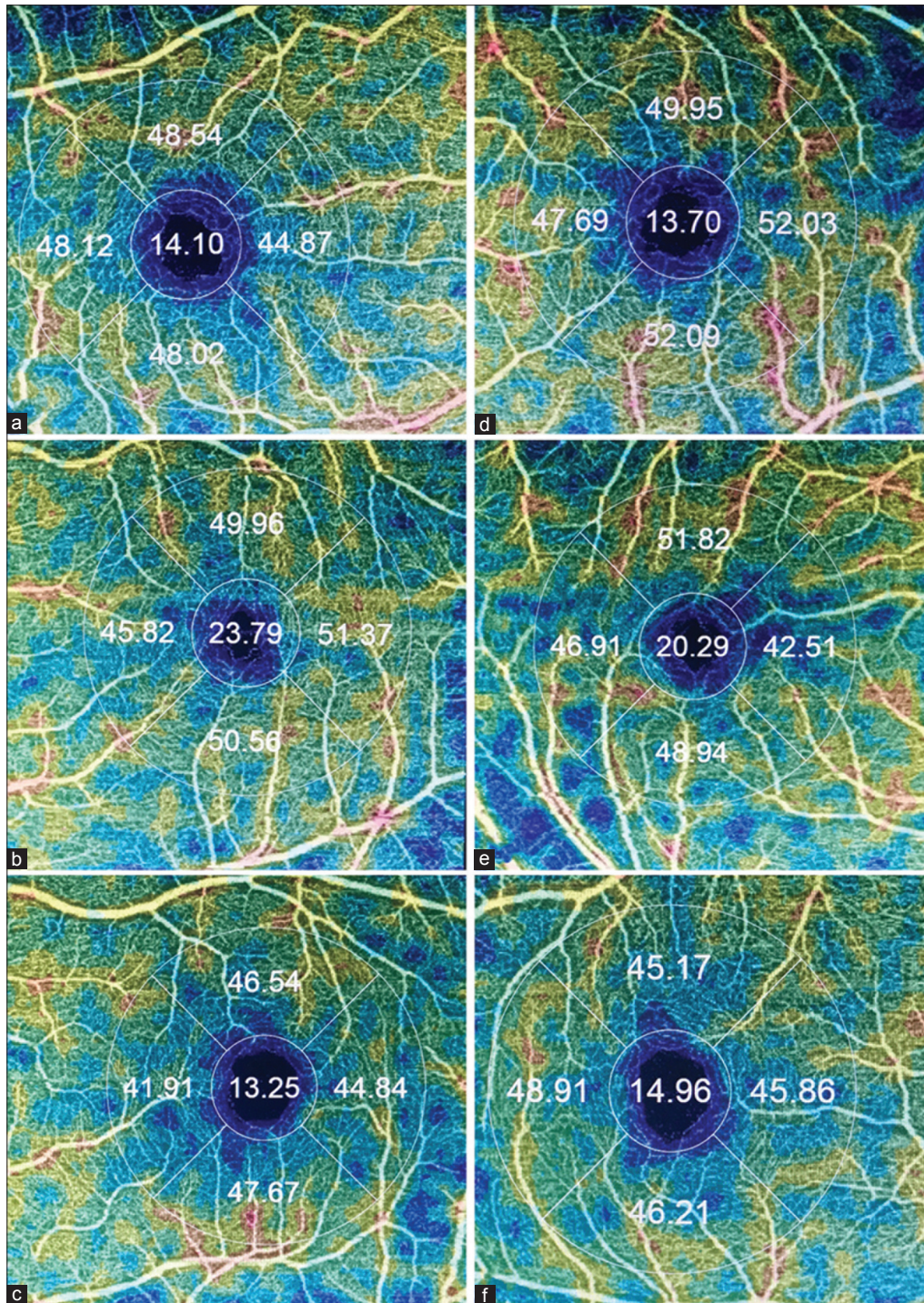


plexus density was not compared as there is no provision of quantifying this plexus in the current generation SS-OCTA used by us.

### Results

The average age of 10 patients was 16 years ( $\pm 4.5$ ), eight patients were males, and the right eye was the strabismic eye in six patients. The values for mean superficial retinal vascular

plexus density along the superior, inferior, nasal, and temporal quadrants in normal and pathological eyes were  $49.25 \pm 3.34$  and  $48.93 \pm 2.85$ ,  $47.22 \pm 4.11$  and  $47.37 \pm 4.8$ ,  $45.54 \pm 1.55$  and  $43.81 \pm 4.21$ , and  $46.26 \pm 4.63$  and  $46.38 \pm 5.40$ , respectively [Fig. 1]. Similarly, the capillary densities along the central zone were  $17.84 \pm 3.49$  and  $17.24 \pm 2.44$  in normal and pathological eyes. On comparing respective zones between cases and control the *P* values obtained along the superior, inferior, nasal, and



**Figure 1:** (a-c) On the left side of the panel are the values of normal eyes displayed along the respective quadrants and central area. (d-f) On the right side of the panel are the values of amblyopic eyes displayed along the respective quadrants and the central area

temporal quadrant and central area were 0.7, 0.9, 0.2, 0.9, and 0.2, respectively. Thus there was no statistically significant difference seen in the superficial retinal vascular plexus density between the cases and controls.

## Discussion

Clinical retinal examination of eyes of purely strabismic amblyopia is within the normal limits. Some OCT studies have suggested few changes on OCT in these eyes.<sup>[1-3]</sup> Some observers have analyzed the changes in the macular thickness in different types of amblyopia at different distances from the center of the fovea with variable conclusions. Few studies have shown an increase in the foveolar thickness and decrease in the macular thickness away from the center in the amblyopic eyes as compared with normal/control eyes.<sup>[1,3]</sup> Few authors have demonstrated a reduction in macular thickness after patching therapy.<sup>[4]</sup> Similarly, the retinal nerve fiber layer (RNFL) thickness around the peripapillary region in amblyopia has been studied with variable conclusions.<sup>[2,6]</sup> Few studies document an increased thickness<sup>[2]</sup> and some show no RNFL thickness changes.<sup>[6]</sup> Similarly, the subfoveal choroidal layer thickness of amblyopic eyes has been found to be increased without any definable cause.<sup>[3]</sup> The pediatric eye disease investigative group study states that there is no significant change in the RNFL thickness (globally or quadrant wise) in amblyopia.<sup>[6]</sup>

We investigated the superficial retinal capillary plexus density of purely strabismic eyes and compared it with the contralateral normal eyes of the same patient. We did not find any statistically significant difference in the superficial retinal capillary plexus density between these groups. We did not include other types of amblyopia to avoid confounding factors such as refractive error which may affect the vascular density. Also all our patients were within  $16 \pm 4.5$  age group. A younger and smaller range age group was selected to avoid age-related vascular changes affecting the mean values of our study.

In a recent study by Lonngi *et al.*, the authors observed a statistically significant decrease in the capillary plexus density along the superficial and deeper retinal vascular plexus using a spectral domain OCTA. The amblyopic patients in that study had higher spherical, cylindrical and spherical equivalent refractive error as compared with the control group, though not significant statistically. After adjusting for age and refractive error the authors felt that there was a definite decrease in retinal vascular plexus density along the superficial and deeper retinal plexus. The authors hypothesized that this abnormal development of retinal vasculature may be related to

lack of a normal visual experience in the early developmental period.<sup>[5]</sup>

In our study we avoided confounding factors such as refractive error, axial length, poor fixation, media opacity, and large age range. All current generation commercial OCTA machines only provide software for analyzing the superficial retinal plexus. Thus a comparison of the deep plexus was avoided.

Limitations of our study include a small sample size, inability to assess the deeper retinal plexus, single observer study, lack of a blinding protocol, and inclusion of contralateral eye of the same patient for comparison.

## Conclusion

To conclude, we found no statistically significant difference in the vascular plexus density along the superficial retinal plexus in patients with purely strabismic amblyopia. This is in concert with the assumption that purely strabismic amblyopic eyes *per se* do not have significant anatomical developmental pathology. In view of certain limitations, further studies with a larger sample size are necessary to reaffirm the findings related to the vascular plexus changes in various types of amblyopia using OCTA.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Rajavi Z, Moghadasifar H, Feizi M, Haftabadi N, Hadavand R, Yaseri M, *et al.* Macular thickness and amblyopia. *J Ophthalmic Vis Res* 2014;9:478.
2. Alotaibi AG, Al Enazi B. Unilateral amblyopia: Optical coherence tomography findings. *Saudi J Ophthalmol* 2011;25:405-9.
3. Avram E. CAN optical coherence tomography redefine amblyopia? *Romanian J Ophthalmol* 2017;61:95-100.
4. Pang Y, Frantz KA, Block S, Goodfellow GW, Allison C. Effect of amblyopia treatment on macular thickness in eyes with myopic anisometropic amblyopia. *Investig Ophthalmol Vis Sci* 2015;56:2677.
5. Lonngi M, Velez FG, Tsui I, Davila JP, Rahimi M, Chan C, *et al.* Spectral-domain optical coherence tomographic angiography in children with amblyopia. *JAMA Ophthalmol* 2017;135:1086-91.
6. Repka MX, Kraker RT, Tamkins SM, Suh DW, Sala NA, Beck RW, *et al.* Retinal nerve fiber layer thickness in amblyopic eyes. *Am J Ophthalmol* 2009;148:143-7.