

## Peer Review File

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### Reviewer Comments

(1) “There was a similar report (PLoS One. 2016 Sep 7; 11(9):e0162012) about corneal astigmatism in patients with high myopia in the PubMed. What is the novel idea in the paper? Please elaborate in the introduction.”

**Reply:** Thank you very much for the significant suggestion. In the previous study (PLoS One. 2016 Sep 7;11(9):e0162012), the authors mainly evaluated the characteristics of the posterior corneal astigmatism in high myopia patients before cataract surgery and found that posterior corneal astigmatism decreased with age and remained as “against-the-rule” (ATR) astigmatism in most patients of high myopia; there was no significant difference in posterior corneal astigmatism between patients with high myopia and those without high myopia. However, the authors did not evaluate the anterior corneal astigmatism systemically; the prevalence or distribution of anterior corneal astigmatism in cataract patients with high myopia was not reported in the previous study. To the best of our knowledge, in cataract patients with high myopia, few reports have systematically evaluated anterior corneal astigmatism (referred to as “corneal astigmatism” in previous studies in patients with age-related cataracts) (J Cataract Refract Surg. 2013 Feb;39(2):188-92; J Cataract Refract Surg. 2011 Mar;37(3):613-5; Br J Ophthalmol. 2019 Jul;103(7):993-1000). Until now, the prevalence and distribution of corneal astigmatism in patients with high myopia before cataract surgery have remained unclear. Our study is the first study to evaluate the distribution of preoperative corneal astigmatism in cataract surgery candidates with high myopia. Moreover, in the previous study (PLoS One. 2016 Sep 7;11(9):e0162012), small sample sizes (167 eyes of 98 patients), a narrow age range (41–82 years, age ≤ 50 years only in 27 patients) and a small time width (4 months, between September 1 and December 31, 2014) may have affected the results reported. Additionally, in the

previous study (PLoS One. 2016 Sep 7;11(9):e0162012), two eyes in most patients with high myopia were enrolled for statistical analyses. It will also affect the results because two eyes in one patient are considered to be inter-connected instead of independent. Compared to the previous study, our study was conducted in large sample sizes (1921 eyes of 1921 patients), a wide age range (20–95 years) and a large time width (18 months, between August 2018 and January 2020). As suggested by the reviewer, we have supplemented the details in the introduction.

**Changes in the text:** Page 6, Lines 106-110, 114-118.

**(2)** “In the introduction, please enrich the roles of corneal astigmatism in cataract. Corneal astigmatism and myopia was the major subject in the paper. What was the association between corneal astigmatism and high myopia? Please supplement in the introduction.”

**Reply:** Thank you very much. Due to advances in phacoemulsification techniques, intraocular lens (IOL) power calculations and IOL design, cataract surgery is routinely performed in patients with high myopia; although cataract surgery is significantly more challenging in highly myopic eyes than in eyes with normal axial lengths, with significantly higher incidences of unpredictable refractive errors and perioperative complications (Curr Opin Ophthalmol. 2016 Jan;27(1):45-50). In particular, those who suffer from both cataracts and corneal astigmatism can now undergo implantation of a toric IOL, which corrects corneal astigmatism to improve postoperative visual acuity and increase spectacle independence (Exp Ther Med. 2018 Jun;15(6):5288-5294; J Cataract Refract Surg. 2016 Oct;42(10):1431-1440; Ophthalmology. 2016 Feb;123(2):275-286). Findings in several studies (J Cataract Refract Surg. 2012 Jul;38(7):1181-6; Clin Ophthalmol. 2012;6:333-8; Ophthalmology. 2016 Feb;123(2):275-286; Graefes Arch Clin Exp Ophthalmol. 2020 Feb;258(2):451-458) have suggested that corneal astigmatism is a major contributor to uncorrected poor vision after cataract surgery and that correcting residual astigmatism can greatly improve visual acuity both at a distance and up close. As suggested by the reviewer, we have supplemented the details in the introduction.

In myopia patients without cataracts, a previous study (Optom Vis Sci. 2005 Apr;82(4):244-7) on total astigmatism (including corneal astigmatism and internal astigmatism) found that there was a negative correlation between myopic severity and cylinder power; younger age (< 16 years) was associated with higher cylinder power. Another previous study on total astigmatism by Chan et al. (Jpn J Ophthalmol. 2018 May;62(3):321-326) found that the clinical significant astigmatism ( $\geq 1.00$  D) was not associated with myopia progression in Chinese primary school children. However, the association between corneal astigmatism and myopia was not evaluated in the two previous studies. To the best of our knowledge, the association between corneal astigmatism and high myopia remains unclear. Our study is the first study to analyze the association between corneal astigmatism and high myopia in cataract patients with high myopia. In the high myopia patients, corneal astigmatism was not statistically correlated with axial length ( $r = 0.044$ ,  $P = 0.054$ ); corneal astigmatism was negatively correlated with age before the age of 50 ( $r = -0.129$ ,  $P = 0.006$ ), but positively correlated with age ( $r = 0.134$ ,  $P < 0.001$ ) after the age of 50, as shown in the results in our study. As suggested by the reviewer, we have supplemented the details in the introduction.

**Changes in the text:** Page 5, Lines 93-101; Page 6, Lines 110-114.

(3) “Please add a title each section in the part of result. So that it is easy to understand for reader.”

**Reply:** Thanks for your helpful suggestion. As suggested by the reviewer, we have added a title for each section in the part of result.

**Changes in the text:** Pages 10-13, Lines 195, 207, 237-238, 250, 259-260.

(4) “The figure 3 was not clearly enough. Please replace it with a new.”

**Response:** Thank you very much for the kind reminding. As suggested by the reviewer, we have replaced it with a new figure.

**Changes in the text:** Figure 3 in the revised manuscript (version).

(5) “In the discussion, please supplement the analysis about the causes leading to high

myopia.”

**Reply:** Thank you very much for the significant suggestion. With the myopia boom that has occurred over the past few decades, the prevalence of myopia in teenagers and young adults has increased to 80–90% in East and Southeast Asia, accompanied by a high prevalence of high myopia (10–20%) (Prog Retin Eye Res. 2018 Jan;62:134-149). It is widely considered that the increasing prevalence of myopia is driven by environmental and genetic factors, both of which promote progression from mild myopia to high myopia, and the major environmental risk factors that have been identified are less time spent outdoors and higher educational pressures (Ophthalmology. 2016 May;123(5):1036-42; Invest Ophthalmol Vis Sci. 2019 Feb 1;60(2):488-499). In our study, the high ratio of high myopia (12.8%) in Chinese cataract surgery candidates may be largely due to genetic susceptibility in this racial group, and may not be due to limited time spent outdoors or high educational pressures because the older generation in China were not subjected to the same high educational pressures during their childhood as the present generation of young adults (Invest Ophthalmol Vis Sci. 2019 Feb 1;60(2):488-499; Ann Acad Med Singap. 2017 Jun;46(6):229-236). As suggested by the reviewer, we have supplemented the analysis in the discussion.

**Changes in the text:** Pages 14, 15, Lines 294-300, 304-308.

(6) “How about the distribution of corneal astigmatism in common people with myopia? Please supplement in the discussion.”

**Reply:** Many thanks for your constructive suggestion. To the best of our knowledge, no study has reported the distribution of corneal astigmatism in common people (general population) with myopia. In a previous study (Cont Lens Anterior Eye. 2016 Feb;39(1):20-5), 376 eyes of 188 myopic patients (mean age,  $27.8 \pm 5.7$  years) scheduled for refractive surgery were included. The mean corneal astigmatism was  $1.85 \pm 1.01$  D, higher than that in the high myopia patients (mean age,  $59.8 \pm 12.6$  years) scheduled for cataract surgery in our study ( $1.20 \pm 0.83$  D). It was consistent with our results that corneal astigmatism was negatively correlated with age before the age of 50

( $r = -0.129$ ,  $P = 0.006$ ) and positively correlated with age after the age of 50 ( $r = 0.134$ ,  $P < 0.001$ ). There is no related content of the distribution of corneal astigmatism in common people with myopia supplemented in the discussion. As suggested by the reviewer, we will evaluate the distribution of corneal astigmatism in Chinese general population with myopia in a next study.

**Changes in the text:** No change in the discussion.

(7) “Whether corneal astigmatism could be occurred following cataract surgery? It is more interesting to investigate the association between postoperative corneal astigmatism.”

**Reply:** Thank you very much for the kind reminding. Corneal astigmatism can be occurred following cataract surgery. It named surgically induced astigmatism (SIA) caused by the incision after cataract surgery (J Optom. Oct-Dec 2017;10(4):252-257). SIA is significantly associated with the cataract surgeons and surgical approaches (Curr Opin Ophthalmol. 2016 Jan;27(1):58-64; J Cataract Refract Surg. 2015 Oct;41(10):2075-80). In this study, we did not analysis the distribution of postoperative corneal astigmatism in cataract patients with high myopia because the purpose of our study was to evaluate the distribution of preoperative corneal astigmatism in cataract surgery candidates with high myopia, as shown both in the abstract and in the introduction. As reminded by the reviewer, the postoperative corneal astigmatism in high myopia patients will be evaluated in a next study.

**Changes in the text:** No change in the discussion.

(8) “This research is a simple statistical analysis about corneal astigmatism in high myopia. And the conclusion was high corneal astigmatism was more common in highly myopic eyes. What is the most point in the paper? Or what is the scientific problem was resolved in the paper? Please supplement in the discussion.”

**Reply:** Thank you very much for the significant suggestion. To the best of our knowledge, the preoperative corneal astigmatism in cataract patients with high myopia has not yet been investigated systemically, and until now, the prevalence and

distribution of preoperative corneal astigmatism in cataract surgery candidates with high myopia have remained unclear. The information will assist IOL manufacturers in the design and manufacture of suitable astigmatism-correcting IOLs and surgeons in selecting therapeutic strategies because today's patients have increasing demand for better visual quality and spectacle independence after cataract surgery. To the best of our knowledge, our study is the first study in large scale to evaluate the distribution of preoperative corneal astigmatism in cataract surgery candidates with high myopia. The scientific problem resolved in this paper is what is the pattern of corneal astigmatism distribution in Chinese patients with high myopia before cataract surgery?, and what is the differences in preoperative corneal astigmatism between patients with high myopia and those with normal axial lengths? As suggested by the reviewer, we have supplemented the details in the discussion.

**Changes in the text:** Page 13, 14, Lines 268-272, 279; Page 18, Lines 369-371.