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Posterior Astigmatism: Improving Refractive Outcomes with Toric IOL Implantation

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Abstract

Cataract surgery is not only a rehabilitative surgery, but also a refractive procedure, largely because of the intraocular lens (IOL) improves in latest years. However, recent studies showed a significant residual astigmatism after phacoemulsification with toric IOL implantation. There are several factors that can cause astigmatism refractive errors, such as IOL misalignment, factors related to the incision, incorrect calculation of toric IOL and corneal measurement errors. We believe that overlooking posterior corneal power is one of the most relevant reasons for refractive errors after cataract surgery with toric IOL.

Mini Review

Cataract is one of the leading causes of blindness worldwide, and its extraction is one of the most performed surgical procedures nowadays. The improvement of phacoemulsification techniques contributes for an increasingly less invasive procedure. Advances in IOL (intraocular lens) calculation, as well as the evolution of IOL technology increase patient's expectations for better results and postoperative spectacle independence [1]. Astigmatism is responsible for 13% of refractive errors [2]. Approximately 20 to 30% of patients submitted to cataract surgery had corneal astigmatism of 1.25 diopters (D) or higher, and around 10% of the patients have 2,00D or higher [3]. Recent studies demonstrate that residual astigmatism after toric IOL implantation is frequent [1,4]. Therefore, the correct astigmatism measurement is crucial for better post-operative results and, consequently, the patient's satisfaction. Furthermore, in present days, the 'gold standard' in IOL power calculation is optical coherence biometry associated with keratometry. However, the capacity of this technique to determine the true corneal power is limited [5] because it assumes a fixed posterior-anterior curvature ratio, to estimate the posterior corneal curvature influence in the total corneal power [2]. Ignoring the posterior corneal power was recently highlighted as an important factor that leads to errors in toric IOL [5,6]. Posterior corneal refractive power is low when compared to the anterior surface, but when we take the astigmatic power into account, the posterior cornea surface can represent more than 20% of the total astigmatism power of the cornea [5].

Devices for an accurate measurement of posterior corneal surface have a shorter story when compared to the methods to evaluate the anterior surface. Nevertheless, this data can currently be obtained by several methods such as Scheimplug imaging and optical coherence tomography. This way, total corneal power can be calculated by using ray tracing or Gaussian optics thick-lens formula [2]. Posterior astigmatism has its own clinical importance demonstrated since 1890 by Javal, and recent studies show that posterior astigmatism is usually against the rule and the mean power is around 0.3D (Table 1) [7-10]. When the anterior corneal surface shows with the rule astigmatism, the posterior astigmatism compensates the anterior surface, and consequently reduces the total astigmatism. However, if the anterior surface astigmatism is against the rule, the total astigmatism will increase [9]. Ho et al showed that neglecting posterior astigmatism can cause absolute errors of 0.2±0.16D in astigmatism magnitude and 7.4±10.3 degrees in astigmatism angle [11]. The surgical prognosis related to the reduction of postoperative residual refractive cylinder is influenced by

the correct calculation of the total corneal astigmatism and its axis. In conclusion, the efficacy of toric IOL implantation can be enhanced with the measurement of both anterior and posterior astigmatism.

Table 1: The table shows the values of posterior and anterior astigmatism and the total corneal power from recent important papers.

Author	N	Age (Mean±SD)	Posterior Astigmatism (Mean±SD)	Anterior Astigmatism (Mean±SD)	Total Corneal Power (Mean±SD)
Tonn et al. [7]	3818	47.25±15	0.33±0.18	1.28±1,01	1.13±0.89
Ueno et al. [8]	418	49±23.4	0.31±0.14	1.05±0.68	NR
Koch et al. [9]	715	55±20	0.30±0.15	1.20±0.79	1.07±0.71
Zhang et al. [10]	35	68±11	0.33±0.16	1.61±0.48	1.71±0.63

N: Sample and NR: Not reported

Competing Interest

The authors declare that they have no conflict of interests regarding the publication of this paper.

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