Original Article

The Effect of Intraocular Pressure on Corneal Topographic Findings of Donor Cornea

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Abstract

Purpose: To evaluate the effect of intraocular pressure on topographic findings of donor corneas.

Materials and Methods: In the present study 37 intact enucleated globes were included. Desirable intraocular pressure was provided by fluid flowing into the globe using a needle inserted via the optic nerve connected to a balanced salt serum bottle. The Sim K and corneal astigmatism in different IOPs (0, 10, 20, 30, 40 and 50 mmHg) were measured using a topography cone (Zeiss - Humphery System, Atlas Version 10.1).

Results: Out of 37 globes studied, 26 globes (70.3 %) were from male and 11 globes (29.7 %) were from female donors. Donors were aged 25 to 45 years at time of death with the mean age of 37 years. The mean Sim K was not significantly different in different IOP levels (0 to 50 mmHg). The mean corneal astigmatism had a significant relation with IOP ($P < 0.001$) and decreased (IOP 0 mmHg to IOP 30 mmHg) then increased (IOP 30 mmHg to IOP 50 mmHg) when the IOP was changed. The minimum astigmatism was detected at IOP 30 mmHg (1.56 D) and the maximum was detected at IOP 0 mmHg (2.76 ± 1.73).

Conclusion: The mean Sim K of donor cornea does not significantly change in different IOP levels of enucleated globe, while the corneal astigmatism changes significantly. It seems that keratometric readings from donor cornea might be used without caution about the IOP in enucleated globe.

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Introduction

Penetrating keratoplasty (PKP) is performed to restore corneal transparency using a donor graft [1]. Previous refractive surgery on donor cornea and also neglected donor keratoconus may compromise the optical success of an otherwise straightforward PKP operation. Refractive errors after keratoplasty may be related to surgical factors and recurrence of primary corneal pathology in the graft, but they may also be related to preoperative keratometry of the donor cornea [1,2]. For example in penetrating keratoplasty combined with cataract surgery and IOL implantation (triple procedure), post operative refraction success partially depends on a correct keratometry reading of the donor cornea [1-5].

The present study was performed to evaluate the effect of intraocular pressure on corneal topographic findings including Sim K and astigmatism of donor cornea.

Materials and Methods

This study was approved by the ethics committee of Tehran University of Medical Sciences, Tehran, Iran. Thirty seven enucleated globes were used in the present study. Globes were fixed by muscle stubs placed in a simple eye holder consisting of a small plastic cup on a plastic block in the correct anatomical orientation (cornea pointing forward). A 25 gauge needle was inserted into the vitreous via the optic nerve end and intraocular pressure control was achieved by altering the height of a balanced salt serum bottle connected to the needle. The needle and serum set were free of air bubbles to eliminate the chance of resistance against serum flow. The needle was fixed by a holder to the plastic block (Figure 1).

The collection of the eye, inserted needle, eye holder, and plastic block were placed in a distance of 6 to 8 cm in front of a topography cone (Zeiss-Humphery System, Atlas Version 10.1). The position of the eye was adjusted to align the topography axis perpendicular to the center of the cornea. The cornea was moistened using balanced salt solution and then topography was performed at IOP 0 mmHg (serum reservoir at the level of the globe). The same procedure was repeated at IOPs of 10, 20, 30, 40 and 50 mmHg (serum reservoir height at 13.6, 27.2, 40.8, 54.4 and 68 cm of midpoint of vertical diameter of the globe, respectively). In all cases, three readings were taken and the Sim K as well as astigmatism was calculated by averaging these three readings.

Data were analyzed using SPSS software version 20 (Armonk, NY: IBM Corp). T-test was used for the comparing quantitative data, and P values of less than 0.05 were considered statistically significant.

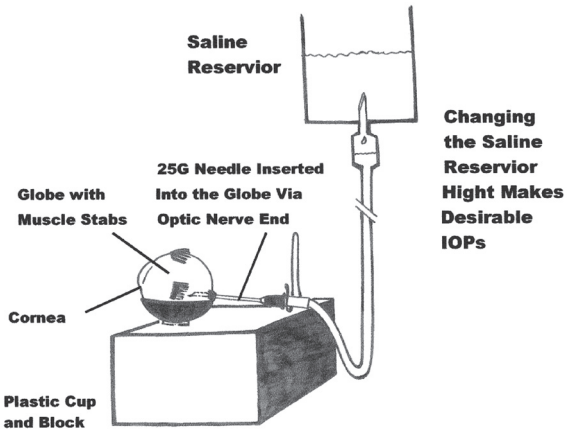

Figure 1: Schematic view of the eye holder setting in front of the topography unit.

Results

Thirty seven globs including 26 globs (70.3 %) from male subjects and 11 globs (29.7 %) from female subjects were used in the present study. The mean age of donors at the

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Table 1: Mean Sim K and corneal astigmatism changes according to IOP changes

IOP(mmHg)	Sim K (D)			Astigmatism (D)
	Minimum	Maximum	Mean ± SD	Mean ± SD
0	36.49	46.25	41.2912 ± 2.4985	2.7635 ± 1.7387
10	37.49	47.56	41.5649 ± 2.0640	2.4243 ± 1.7448
20	38.90	45.50	41.7765 ± 1.8696	1.7876 ± 1.2168
30	38.50	46.44	41.8622 ± 1.9249	1.5676 ± 0.9802
40	38.37	45.38	41.9401 ± 1.8626	1.6284 ± 1.2995
50	37.69	45.94	41.8037 ± 2.0084	2.1851 ± 1.5307

time of their death was 37 years (range 25 to 45 years) and the maximum time from donor death until evaluating the eye was 96 hours.

The mean Sim K and corneal astigmatism measured in different IOPs are shown in table 1. The mean Sim K was not significantly different in different IOP levels (0 to 50 mmHg). The mean corneal astigmatism had a significant relation with IOP ($P < 0.001$) and decreased (IOP 0 mmHg to IOP 30 mmHg) then increased (IOP 30 mmHg to IOP 50 mmHg) when the IOP was changed. The minimum astigmatism was detected at IOP 30 mmHg (1.56 D) and the maximum was detected at IOP 0 mmHg (2.76 ± 1.73) (Figure 2).

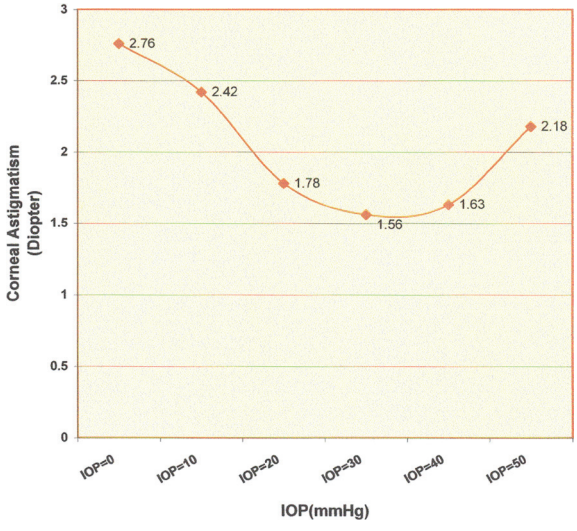

Figure 2: Corneal astigmatic changes in different IOPs.

Discussion

PKP might result in less than ideal refractive outcomes, such as myopia, hyperopia and irregular astigmatism. The presence of these refractive errors may significantly compromise visual outcomes after PKP despite the presence of a clear graft. Keratometric studies suggest some correlation between donor power and graft power at least shortly after keratoplasty [2,6]. Jasper et al., [2] reported that corneal donor power influenced the corneal power of the graft after keratoplasty, especially during the first months after performing the surgery, however the dependency seemed to be weak and so the authors proposed that in the presence of other known determinants of post surgical corneal power, keratometric "power typing" of donor corneas appears to be of limited clinical significance [2].

The influence of intraocular pressure on donor cornea topography has been investigated in previous experiments with some studies proposing that it may be valuable to measure the topography of the donor cornea in normal IOP [1,7,8]. In the present study we found that the Sim K of donor cornea was not significantly different in different IOPs (0-50 mmHg), so we suggest that the measured Sim K in different IOPs (0-50 mmHg) can be used without using extra instruments to induce a

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particular IOP in the donor globe, decreasing the manipulation of the enucleated globe and its endothelium as well as lowering the risk of iatrogenic contamination. This would allow the surgeon to use the donor keratometry in IOL power calculations rather than using a surgeon-specific average keratometric value, which occasionally results in an unacceptable post operative refractive errors. This finding is in line with other in vivo and in vitro studies indicating well preserved corneal stability in the presence of intraocular pressure fluctuations [2,7,9]. Similar to our findings Ajay et al., [10] reported that donor keratometric readings were not significantly different at different IOPs. Also Brenman et al., [11] studied eight cadaveric eyes using a method similar to the present study. The IOP was altered as necessary by adjusting the height of a ringer serum bottle and the corneal power was assessed at pressure levels of hypotony (2-4 mmHG), normal physiologic IOP (12-20 mmHg) and hypertony (135-142 mmHg) [11]. They concluded that corneal deformation was minimal in the range of 2 to 140 mmHg and also the variation in corneal shape was not uniformly parallel to IOP variation [11].

In our study the astigmatism values of the donor cornea were different in different IOPs. Jesper et al., [2] reported that the astigmatism of donor grafts was not significantly correlated with post keratoplasty corneal astigmatism and surgical factors associated with trephination and suturing are often responsible for postoperative astigmatism. Further studies to better evaluate the effect of IOP on donor cornea astigmatism and the effect of this astigmatism on post keratoplasty astigmatism is suggested.

Conclusion

The mean Sim K of donor cornea does not significantly change in different IOP levels of enucleated globe, while the corneal astigmatism changes significantly. It seems that keratometric readings from donor cornea might be used without caution about the IOP in enucleated globe.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present study.

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