• Brief Report •

Comparison of surgically induced astigmatism among different surgeons performing the same incision

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Abstract

• To compare surgically induced astigmatism (SIA) of different surgeons, who perform the same main incision. Two hundred and seventy eyes underwent cataract surgery with phacoemulsification by four different surgeons (A, B, C, and D). A 3-step, 3.0 mm, superotemporal for the right eye and superonasal for the left eye clear corneal incision was performed. A comparison in SIA among A, B, C and D surgeon was made. No significant difference was found in SIA at both first and sixth postoperative month between different surgeons (*P*>0.05). SIA is more dependent on incisional characteristics and preoperative astigmatism and less on the surgeon.

• KEYWORDS: surgically induced astigmatism; cataract; incision
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INTRODUCTION

As for astigmatism in cataract surgery, factors affecting postoperative corneal refractive status are under research. Incision size (width and length) and configuration (1-, 2-, 3-step), incision location relative to the limbus and axis on which the main incision is performed[1] are parameters upon which a surgeon can impact in order to change or not preoperative astigmatism. A small incision temporally positioned is thought to be by most surgeons "astigmatically neutral" compared with a superotemporal, superonasal or superior incision[2]. Factors such as the eye, left or right[3-4] corneal pachymetry[5], the magnitude of preoperative astigmatism[6] and the type of astigmatism (with the rule-WTR, against the rule-ATR)[7] are parameters that we take into account when planning cataract surgery, but we cannot affect in order to change corneal astigmatism.

Every surgeon is considered to induce standard astigmatism (surgically induced astigmatism-SIA). The purpose of this study is to determine which factor, "surgeon" or incisions' characteristics actually matter in changing corneal curvature.

METHODS

This observational retrospective study was performed in General Hospital of Piraeus "Tzaneio", Attiki, Greece from February 2011 to October 2013. The study was approved by the hospital's Ethics Committee and performed in accordance with the thical principles of the Declaration of Helsinki. Written informed consent was obtained from each patient.

All eyes presented ≤1.5 diopters (D) corneal astigmatism. Preoperative exclusion criteria were previous anterior segment surgery, dry eye syndrome, chronic use of eye drops and corneal pathology, horizontal corneal diameter <11.5 mm and >12.5 mm. Moreover, all cases of unrecordable corneal topography or big differences between serial measurements, dilated pupil diameter smaller than 5.5 mm and cataract grading according to Lens Opacity Classification System (LOCS) III system of NC5NO5, NC6NO6 as factors delaying cataract surgery and further stressing the main incision were excluded. Postoperative exclusion criteria were suturing of the incisions, complicated surgery necessitating enlargement of the tunnel incision, bad incisions leading to ballooning, wound burn, unstable anterior chamber or tight fit around phaco probe, iris prolapse and corneal distortion.

Preoperatively all patients underwent a full ophthalmologic examination. Biometry was performed with A-scan U/S. Keratometric data were obtained by corneal topography EyeSys Vista 2000. Three serial measurements were performed and compared with the measurements obtained with automated refractometer NIDEK ARK-510A, and when not consistent (threshold: difference between autorefractometer and topography >0.5 D and/or >20°), patients were excluded. Furthermore, NIDEK ARK-510A was used to measure white-to-white distance. Preoperatively the location of tunnel and sideport incision were marked on the slit lamp, in seated position.

Table 1 SIA in right and left eyes and in cases of ATR and WTR astigmatism for each surgeon at first and sixth postoperative month

Parameters	Surgeon A	Surgeon B	Surgeon C	Surgeon D
SIA (SD)				
Left eyes				
1st postoperative month	0.67 (0.48)[a]	0.64 (0.36)[a]	0.77 (0.38)[a]	0.80 (0.48)[a]
6th postoperative month	0.64 (0.49)[a]	0.58 (0.36)[a]	0.75 (0.35)[a]	0.71 (0.49)[a]
Right eyes				
1st postoperative month	0.76 (0.36)[a]	0.85 (0.57)[a]	0.67 (0.43)[a]	0.64 (0.38)[a]
6th postoperative month	0.78 (0.41)[a]	0.78 (0.56)[a]	0.61 (0.37)[a]	0.63 (0.36)[a]
Astigmatism				
WTR	Surgeon A (*n*=36)	Surgeon B (*n*=30)	Surgeon C (*n*=27)	Surgeon D (*n*=25)
1st postoperative month	0.68 (0.56)	0.71 (0.39)	0.72 (0.47)	0.81 (0.44)
6th postoperative month	0.73 (0.56)	0.63 (0.38)	0.63 (0.38)	0.76 (0.44)
ATR	Surgeon A (*n*=45)	Surgeon B (*n*=40)	Surgeon C (*n*=35)	Surgeon D (*n*=32)
1st postoperative month	0.73 (0.29)	0.74 (0.52)	0.71 (0.37)	0.64 (0.43)
6th postoperative month	0.68 (0.36)	0.69 (0.51)	0.70 (0.36)	0.58 (0.4)

[a]*P*>0.05.

Postoperative follow up was scheduled at the 1st day, 1st month and 6th month after surgery. Biomicroscopy at the slit lamp, where the axis of tunnel incision was reported by turning the light beam coaxially to the tunnel incision, was performed.

Also best corrected visual acuity using Snellen optotype, corneal topography and auto-keratometry were performed. SIA was calculated by vector analysis using the Alpin's method. A 0-25° and 155°-180° was considered as ATR astigmatism and 65°-115° was WTR astigmatism. Eyes with oblique astigmatism were excluded because of their small number.

All patients underwent phacoemulsification by four different experienced (>1000 cataract surgeries) surgeons (A, B, C, D). All surgeons were right-handed and performed the same main 3-step clear corneal incision, 3.0 mm, superotemporal for the right and superonasal for the left eye (at 100°-130°). A stab sideport incision 1.0 mm was made in predetermined distance. Nucleus removal was followed by injection of a foldable hydrophilic acrylic 3-pieces intraocular lens (Mediconsult A85UV). All eyes were under medication therapy with a combination of tobramycin-dexamethasone and nepafenac ophthalmic drops 4 times a day for 1mo.

RESULTS AND DISCUSSION

This was a retrospective study conducted on 270 eyes, of which 138 left and 132 right eyes, 118 presented WTR and 152 ATR astigmatism. Of all patients 141 were females and 129 males, aged 72.65±9y (SD). Analysis of variance (ANOVA) was used to compare SIA in right and left eyes and WTR and ATR astigmatism between different surgeons (Table 1). No significant difference was found in SIA at both first and sixth postoperative month among different surgeons (*P*>0.05). Furthermore, SIA presented statistically significant reduction between 1st and 6th month (*P*=0.003).

Our purpose was to evaluate how the factor "surgeon" affects SIA, while eliminating other confounding factors. Since our main incision was oblique (always at 100°-130°) we separated left from right eyes in order to eliminate factors such as corneal thickness and proximity of the main incision to the optical center of the eye, which influence postoperative astigmatism. The superomedial quadrant of the cornea is considered thicker than the superolateral[8].

A thin cornea is more vulnerable to a bending force and causes more deformation (or SIA) in the central cornea[5]. On the other hand it is a fact that superomedial location of the main incision for the left eyes affects more postoperative astigmatism, due to the closer location of the main incision relative to the optical center and the bigger wound stress caused by the phacoprobe as a result of the difficult handling in the presence of the nose and the eyebrow[3-4].

According to the above, both superomedial and superolateral incisions affect postoperative astigmatism but for a different reason. It is a fact that the relative change in diopters caused in each case cannot be easily quantified. SIA is multifactorial and each factor affects each eye in a different way. Our results show no statistical difference in SIA between left and right eyes, consistent with other publications (Table 2). However other authors reported a predominance of superonasal incisions in left eyes in SIA[4,9].

Özyol and Özyol[7] supported the fact that superior incisions affected more ATR astigmatism than WTR astigmatism. In our study superolateral/medial incisions affect equally SIA in both WTR and ATR cases. This may be related to the oblique location of the incision. Oblique incisions affect less SIA but lead to greater torque in the axis of astigmatism.

Table 2 SIA in cases of different width and location of the main incision

Superolateral/superomedial			On-axis			Temporal			Nasal		
Incision width (mm)	SIA (D)	Authors	Incision width (mm)	SIA (D)	Authors	Incision width	SIA (D)	Authors	Incision width (mm)	SIA (D)	Authors
4.0	OD-0.78 OS-1.19	Özkurt Y *et al*[4] (2008)	3.2	0.92	Borasio E. *et al*[1] (2006)	3.0	0.71	Rainer G *et al*[2] (1999)	3.5	1.65	Barequet IS *et al*[13] (2004)
3.0	Superotemporal OD-0.85 Superotemporal OS-0.77	Rainer G *et al*[2] (1999)	3.2	0.85	Khokhar S *et al*[11] (2006)	3.5	0.74	Barequet IS *et al*[13] (2004)	3.6	1.55	Kohnen S *et al*[14] (2002)
3.2	Superotemporal 0.75 Superonasal 0.71	Ermis S *et al*[3] (2004)	3.2	1.0	Ben Simon G and Desatnik H[12] (2005)	3.6	0.62	Kohnen S *et al*[14] (2002)			
3.5	Superotemporal 0.68 Superonasal 0.66	Beltrame G *et al*[10] (2001)				3.2	0.68	Borasio E *et al*[1] (2006)			
3.0	WTR-1.03 ATR-0.52 Oblique-0.88	Özyol E and Özyol P[7] (2012)				3.5	0.83	Wei YH *et al*[15] (2012)			
4.0	Superotemporal 1.08 Superonasal 1.36	Altan-Yaycioglu R *et al*[9] (2007)				2.5	0.60	Wei YH *et al*[15] (2012)			
						2.8	0.46	Can I *et al*[16] (2010)			
						2.2	0.24	Can I *et al*[16] (2010)			
						1.8	0.42	Wilczynski M *et al*[17] (2009)			

In our study, incision characteristics were the same as for size, configuration and location in all cases. The only variable was the surgeon. Our data show no statistical difference in SIA between A, B, C, and D surgeons. SIA appears to be more related to the preoperative keratometric data, the location and width of the main incision. As it is shown in Table 2 superotemporal, superonasal, superior incisions of 3.0-3.5 mm width present SIA of 0.70-0.80 D, on-axis incisions 0.80-1.0 D, temporal incisions 0.60-0.70 D, while nasal incisions introduce more SIA, thus 1.5 D. In all the above studies SIA was calculated using vector analysis as was in our study.

Our study shows that incisions with the same characteristics of width and location, calculated by the same method, result in similar SIA. It is of note that "surgeon's" effect is limited in comparison with other incisional characteristics.

Further studies comparing incisions in other locations and surgeons with different experience would shed more light on surgeon's influence in SIA. It is our belief, that studies can safely include eyes operated by different surgeons as long as they present same incision characteristics and SIA, without fear of inconsistensy. Thus, larger studies may be performed and safer conclusions could be drawn.

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REFERENCES

1 Borasio E, Mehta JS, Maurino V. Torque and flattening effects of clear corneal temporal and on-axis incisions for phacoemulsification. *J Cataract Refract Surg* 2006;32(12):2030-2038.

2 Rainer G, Menapace R, Vass C, Annen D, Findl O, Schmetterer K. Corneal shape changes after temporal and superolateral 3.0 mm clear corneal incisions. *J Cataract Refract Surg* 1999;25(8):1121-1126.

3 Ermiş SS, Inan UU, Oztürk F. Surgically induced astigmatism after superotemporal and superonasal clear corneal incisions in phacoemulsification. *J Cataract Refract Surg* 2004;30(6):1316-1319.

4 Özkurt Y, Erdoğan G, Güveli AK, Oral Y, Ozbaş M, Cömez AT, Doğan OK. Astigmatism after superonasal and superotemporal clear corneal incisions in phacoemulsification. *Int Ophthalmol* 2008;28(5):329-332.

5 Woo SJ, Lee JH. Effect of central corneal thickness on surgically induced astigmatism in cataract surgery. *J Cataract Refract Surg* 2003;29(12):2401-2406.

6 Tejedor J, Murube J. Choosing the location of corneal incision based on preexisting astigmatism in phacoemulsification. *Am J Ophthalmol* 2005;139(5):767-776.

7 Özyol E, Özyol P. The relation between superior phacoemulsification incision and steep axis on astigmatic outcomes. *Int Ophthalmol* 2012; 32(6):565-570.

8 Jonuscheit S, Doughty MJ, Martin R, Río-Cristóbal A, Cruikshank V, Lang S. Peripheral nasal-temporal corneal asymmetry in relation to corneal thickness: a Scheimpflug imaging study. *Ophthalmic Physiol Opt* 2015;35(1):45-51.

9 Altan-Yaycioglu R, Pelit A, Evyapan O, Akova YA. Astigmatism induced by oblique clear corneal incision: right vs. left eyes. *Can J Ophthalmol* 2007;42(4):557-561.

10 Beltrame G, Salvetat ML, Chizzolini M, Driussi G. Corneal topographic changes induced by different oblique cataract incisions. *Refract Surg* 2001;27(5):720-727.

11 Khokhar S, Lohiya P, Murugiesan V, Panda A. Corneal astigmatism correction with opposite clear corneal incisions or single clear corneal incision: comparative analysis. *J Cataract Refract Surg* 2006;32(9): 1432-1437.

12 Ben Simon GJ, Desatnik H. Correction of pre-existing astigmatism during cataract surgery: comparison between the effects of opposite clear corneal incisions and a single clear corneal incision. *Graefe's Arch Clin Exp Ophthalmol* 2005;243(4):321-326.

13 Barequet IS, Yu E, Vitale S, Cassard S, Azar DT, Stark WJ. Astigmatism outcomes of horizontal temporal versus nasal clear corneal incision cataract surgery. *J Cataract Refract Surg* 2004;30(2):418-423.

14 Kohnen S, Neuber R, Kohnen T. Effect of temporal and nasal unsutured limbal tunnel incisions on induced astigmatism after phacoemulsification. *J Cataract Refract Surg* 2002;28(5):821-825.

15 Wei YH, Chen WL, Su PY, Shen EP, Hu FR. The influence of corneal wound size on surgically induced corneal astigmatism after phacoemulsification. *J Formos Med Assoc* 2012;111(5):284-289.

16 Can I, Takmaz T, Yildiz Y, Bayhan HA, Soyugelen G, Bostanci B. Coaxial microcoaxial and biaxial microincision cataract surgery. *J Cataract Refract Surg* 2010;36(5):740-746.

17 Wilczynski M, Supady E, Piotr L, Synder A, Palenga-Pydyn D, Omulecki W. Comparison of surgically induced astigmatism after coaxial phacoemulsification through 1.8 mm microincision and bimanual phacoemulsification through 1.7 mm microincision. *J Cataract Refract Surg* 2009;35(9):1563-1569.