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Comparison of Preoperative and Postoperative Astigmatism after Superotemporal or Superonasal Clear Corneal Incision in Phacoemulsification

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A B S T R A C T

The aim of this work was comparison of preoperative and postoperative astigmatism after superotemporal or superonasal clear corneal incision. Twenty eight eyes of 28 patients treated with phacoemulsification through superotemporal or superonasal 3 mm clear corneal incision were examined by kerato-refractometer preoperatively and six months postoperatively. Adequate score was assigned to each preoperative and postoperative K-value with associated axis of astigmatism to enable comparison. Wilcoxon paired samples test was used for statistical analysis. Postoperative uncorrected Snellen visual acuity was 0.5 or better in 26 patients. In one patient visual acuity was 0.3 because of diabetic maculopathy. Postoperative astigmatism was less or equal than preoperative in 18 and greater in 10 patients. There was no statistical difference between the preoperative and postoperative astigmatism (Wilcoxon paired samples test, p=0.966) and therefore the conclusion can be made that the superotemporal or superonasal clear corneal incision has minimal effect on corneal astigmatism.

***Key words**: astigmatism, phacoemulsification, clear corneal incision*

Introduction

The aim of cataract surgery today is rapid visual rehabilitation, the best possible uncorrected visual acuity and minimal postoperative astigmatism[1]. One of the possible complications of all types of cataract surgery is induced astigmatism which is a major cause of functional disturbance and insufficient uncorrected visual acuity.

Phacoemulsification procedure results in less surgically induced astigmatism than extracapsular cataract extraction, in which the incision is much larger[2–5].

Clear corneal incision (CCI) in phacoemulsification surgery can be placed at *superior*, oblique or *temporal* locations[6]. The location of the CCI affects the degree of postoperative astigmatism. Temporal CCI induces regular astigmatism 90 degrees away from the incision (with the rule astigmatism) thus minimizing the postoperative astigmatism[7–9]. Oblique scleral tunnel incision predictably reduces astigmatism by simultaneously producing corneal flattening and steepening[10]. Only few authors have studied the astigmatic effect of an oblique CCI[11].

The aim of this study was to analyse whether *superotemporal* or *superonasal* located CCI has significant effect on postoperative astigmatism.

Patients and Methods

This prospective study included 28 eyes of 28 patients with senile cataracts. Patients were scheduled to undergo a routine phacoemulsification and an intraocular lens (IOL) implantation. All eyes were examined by keratorefractometer RT-6000 (Tomey, Nagoya, Japan) preoperatively and six months postoperatively. Written informed consent was obtained from each patient. All operations were performed by the same surgeon. The surgical technique was as follows:

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Xylocaine gel 2% was applied in the lower fornix of the eye to be operated before the procedure. The surgeon sat in the superior position. *Superotemporal* or *superonasal* CCI was made with a 3.0 mm keratome. A viscoelastic material was instilled in the anterior chamber. Endocapsular phacoemulsification was performed in an identical manner in all eyes with Universal II (Alcon, Forth Worth, Tx, USA).

After phacoemulsification and cortex removal by a bimanual technique, the capsular bag was filled with viscoelastic material and acrylic IOL was then placed in the capsular bag (Acrysof MA 60 BM IOL, Alcon, Forth Worth, Tx, USA). The viscoelastic material was removed, and the incisions were hydrated.

K-values and axis of astigmatism obtained preoperatively and six months postoperatively were used to calculate the magnitude of preoperative and postoperative astigmatism (Table 2). For that purpose we used the modified table for manual scoring the astigmatism as described by Morlet et al. This method is manually assigning a score to each patient's refraction or astigmatism. This method assumes that a lower magnitude of astigmatism with the rule is most desirable and that a higher magnitude of oblique astigmatism is the least desirable outcome[12].

Statistics

Patients' age was expressed as median and range. Preoperative and postoperative values of astigmatism were expressed as median and 95%CI, and were compared using the Wilcoxon paired samples test. The level of statistical significance was set at $p<0.050$. The analysis was performed using MedCalc for Windows v. 8.2.1.0 (2006, Frank Schoonjans, Belgium).

Results

The median patient's age was 66 years (range 44–78 years). There were 19 female and 9 male patients.

None of the patients had a history of previous ocular surgery or disease that affected corneal refraction. Coexisting eye disease was present in 10 patients including *glaucoma* (3), macular degeneration (2), diabetic retinopathy (4) and other (1).

Preoperative uncorrected Snellen visual acuity was 0.1 or worse in 9 patients. Postoperative uncorrected visual acuity of 0.5 or better was achieved in 27 patients. In one patient postoperative uncorrected visual acuity was 0.3 due to diabetic maculopathy both of which couldn't be recognized before the surgery. Postoperative complications included only posterior capsule rupture which occurred in 2 patients.

The median preoperative astigmatism score was 2 (95%CI = 1–3, range 1 to 12), while the postoperative median score was 2.5 (95%CI = 1–3, range 1 to 11). There was no statistically significant difference between preoperative and postoperative astigmatism (Wilcoxon paired samples test, $p=0.966$). In 10 patients postoperative astigmatism was equal, in 8 patients it was smaller and in 10 patients it was greater than preoperative astigmatism (Table 2).

TABLE 1
MANUALLY SCORING THE ASTIGMATISM TO PRODUCE A SUMMARY MEASURE FOR STATISTICAL ANALYSIS

Magnitude (D)	WTR (axis 60–120°)	ATR (axis 0–30°, and 150–180°)	OBL (axis 31–59°, and 121–149°)
>6.00	20	21	22
5.25–6.00	17	18	19
4.25–5.00	14	15	16
3.25–4.00	11	12	13
2.25–3.00	8	9	10
1.25–2.00	5	6	7
0.50–1.00	2	3	4
<0.50	1	1	1

WTR – with the rule astigmatism, ATR – against the rule astigmatism, OBL – oblique astigmatism

Discussion

Many studies investigated the influence of different factors such as the type of a surgery, type and length of incision, location and width of incision, presence or absence of a suture and the suturing method on postoperative astigmatism[2,3,10,13]. Clear corneal incision is the most used type of incision in phacoemulsification surgery because it is less time-consuming and doesn't require cauterization or wound suturing[1,14]. The location as well as the width of the incision affects the degree of postoperative astigmatism. Clear corneal incision can be placed at *superior,* oblique or *temporal* location[6]. *Temporal* CCI is known to induce the least postoperative astigmatism. Also the smaller the CCI, the lesser the induced astigmatism.

Similar studies have shown that a small *superior* CCI induces greater postoperative astigmatism than a small *supero-oblique* CCI, and a small *supero-oblique* CCI induces higher postoperative astigmatism than a small *temporal* CCI[1,3,15].

Ermis et al reported that although *temporal* CCI is reported to result in the least induced astigmatism, locating the incision *superotemporally* or *superonasally* may ease surgical manipulations during the phacoemulsification cataract surgery for a right-handed surgeon who works from the 12 o'clock position relative to the patient. Performing the procedure from the patient's *temporal* side may not be possible with the most operating tables, and locating the CCI *temporally* in left eye may be difficult for a right-handed surgeon who sits at the 12 o'clock position. For a watertight wound stability, the appropriate corneal incision should be 3.0 to 3.5 mm wide and 1.7 to 2.0 mm long[16,17]. Oshima and co-authors reported that the allowable limit of keratometric shift for refraction

TABLE 2
PREOPERATIVE AND POSTOPERATIVE ASTIGMATISM WITH CORRESPONDING SCORES*

Patient number	Preoperative astigmatism	Postoperative astigmatism	Preoperative score	Postoperative score
1	0.25 × 90	0.50 × 180	1	3
2	0.88 × 90	0.75 × 25	2	3
3	0.50 × 180	0.63 × 10	3	3
4	1.75 × 180	1.37 × 180	6	6
5	1.00 × 180	0.37 × 90	3	1
6	4.00 × 0	2.75 × 90	12	8
7	4.00 × 80	3.63 × 95	11	11
8	0.13 × 90	0.37 × 90	1	1
9	0.87 × 180	0.62 × 120	3	2
10	1.62 × 180	1.00 × 91	6	2
11	0.50 × 180	0.38 × 59	3	1
12	0.75 × 90	0.87 × 90	2	2
13	1.00 × 90	1.13 × 20	2	3
14	0.38 × 180	0.75 × 180	1	3
15	0.37 × 180	0.00 × 10	1	1
16	0.12 × 90	0.63 × 139	1	4
17	0.13 × 90	0.50 × 0	1	3
18	0.12 × 180	0.25 × 180	1	1
19	0.37 × 180	0.75 × 90	1	2
20	0.50 × 180	0.13 × 90	3	1
21	1.00 × 90	0.50 × 90	2	2
22	0.25 × 90	1.25 × 110	1	5
23	0.38 × 90	0.25 × 90	1	1
24	1.00 × 180	0.12 × 180	3	1
25	0.37 × 180	0.50 × 180	1	3
26	0.12 × 180	0.85 × 0	1	3
27	1.25 × 180	0.50 × 180	6	3
28	0.25 × 180	0.12 × 90	1	1

* p=0.966

and visual rehabilitation is approximately 0.50 diopters, and this can be achieved with a 3.0 mm incision size[18].

Until now only few authors have studied the astigmatic effect of the *supero-oblique* clear corneal incision[11].

Jacobs and al. analysed refractive astigmatism in 52 eyes of 52 patients who had phacoemulsification cataract surgery performed by the oblique clear corneal incision. They provided evidence similar to ours that the *supero--oblique* clear corneal incision does not induce the clinically significant amount of oblique astigmatism. Our results showed that 9 patients had smaller postoperative astigmatism, 9 greater, and in 10 patients postoperative astigmatism was equal to preoperative. In cases where postoperative astigmatism differed from preoperative, changes were minimal. Our results show that the *superotemporal* or *superonasal* CCI, which is the most convenient CCI location for a right-handed surgeon sitting at the 12 o'clock position, has minimal effect on corneal astigmatism.

Further studies on more patients should provide definitive conclusions about the influence of the *superotemporal* or *superonasal* clear corneal incision on postoperative astigmatism.

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USPOREDBA PREOPERATIVNOG I POSTOPERATIVNOG ASTIGMATIZMA NAKON GORNJEG TEMPORALNOG ILI GORNJEG NAZALNOG REZA KROZ ROŽNICU KOD FAKOEMULZIFIKACIJE

S A Ž E T A K

Cilj ovog rada je usporedba preoperativnog i postoperativnog astigmatizma nakon gornjeg *temporalnog* ili gornjeg *nazalnog* pristupa kroz rožnicu. Dvadeset osam očiju u 28 pacijenata tretiranih fakoemulzifikacijom, kroz gornji t*emporalni* ili gornji *nazalni* rožnični 3 mm-arski rez, je ispitano keratorefraktometrom preoperativno i šest mjeseci postoperativno. K- konstante i osi astigmatizma su uspoređivane preoperativno i šest mjeseci nakon operativnog zahvata, a Wilcoxon test je upotrebljen za statističku analizu. Postoperativna nekorigirana vidna oštrina je bila veća ili jednaka 0.5 u 26 pacijenata dok je kod jednog pacijenta vidna oštrina iznosila 0.3 zbog dijabetičke makulopatije. Postoperativni astigmatizam je bio manji ili jednak u odnosu na preoperativni u 18, a veći u 10 pacijenata. Nije bilo statistički značajne razlike u preoperativnom i postoperativnom astigmatizmu (Wilcoxon test, p=0.966) stoga se može zaključiti da gornji *temporalni* ili gornji *nazalni* pristup kroz rožnicu ima minimalni učinak na kornealni astigmatizam.