

Astigmatism and visual recovery after phacoemulsification and conventional extracapsular cataract extraction

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Abstract. In this study we wanted to investigate the post-operative astigmatism and visual acuity after phacoemulsification and conventional extracapsular cataract surgery. Patients operated between April and June 1993 ($n=150$) were retrospectively analyzed. The patients were examined prior to surgery and at day 1, at day 10, and in week 6 post-operatively. The difference between the post-operative log mean visual acuity in the Phaco group and in the CECCE group was significant after 1 and 10 days, however it was not significant ($p=0.191$) after 6 weeks. The mean astigmatism was significantly less in the Phaco group than in the CECCE group during the whole post-operative check-up period. This study suggests that Phaco results in a lower post-operative astigmatism and an earlier visual rehabilitation compared to the CECCE technique.

Abbreviations: Phaco – Phacoemulsification; CECCE – Conventional extracapsular cataract extraction.

Introduction

With the introduction of small-incision cataract extraction with phacoemulsification, it was suggested that patients had a shorter post-operative recovery of the visual acuity and post-operative astigmatism using this technique [1, 2].

In this study, the described advantage of the small incision cataract extraction with the phacoemulsification was assessed by comparing the visual rehabilitation and post-operative astigmatism in a group of cataract patients operated with the CECCE technique with a group of patients operated with Phaco.

Secondly, with the use of echographic biometry of the operated eye, an emmetropizing intraocular lens can be planned [3, 4]. Analysis of systematic errors in ultrasonic biometry results in a 25 to 30% post-operative refractive

error of more than 1 D. In about 5% of the cases it results in more than 2 D refractive error [3].

In this investigation, we studied the effects on the refractive errors resulting from our biometrical calculations for the emmetropizing intraocular lenses.

Patients and methods

Patients. In a retrospective study, cataract patients operated between April and June 1993 (n=150) were analyzed. The cataract extractions were performed by experienced surgeons as well as residents in training. Furthermore patients with both complicated and uncomplicated cataract extractions were included in this study. The cataract extractions with intraocular lens implantation were done with the conventional extracapsular technique (CECCE group) or with the phacoemulsification technique (Phaco group) depending on the experience of the surgeon.

Surgical procedures. A standard phacoemulsification procedure was used through a 3.2 mm bevelled two-step tunnel-incision about 1 mm posterior to the superior corneoscleral limbus. Following phacoemulsification of the nucleus, aspiration of the residual cortex, and the implantation of an intraocular lens with an optic of 5.5 mm or 6.5 mm, the wound was closed with an uninterrupted 10.0 monofilament nylon suture (Alcon Surgical, Fort Worth, Texas). For the standard extracapsular technique a bevelled corneoscleral incision of 12 to 13 mm in length was made, a 6.5 mm intraocular lens was implanted in the bag and the wound was closed by an uninterrupted suture of 10.0 nylon.

Post-operative astigmatism and visual acuity. Pre-operatively, the visual acuity and refraction were measured for all patients. On day 1, day 10 and after 6 weeks the post-operative astigmatism, refraction and visual acuity were examined when these data were available. These parameters were studied for the CECCE and the Phaco group.

Refractive error. The effect on the refractive error from the emmetropizing power of the intraocular lenses were studied by comparing the predicted refractive power with the post-operatively resulting refractive power. The average difference between the predicted and resulting refractive power were subdivided by axial length.

Table 1. The (log) mean pre- and post-operative visual acuity in the Phaco and CECCE group

	Phaco (n)	CECCE (n)	<i>p</i> -value
Pre-operative	0.210 (116)	0.087 (33)	0.006
Day 1	0.401 (94)	0.244 (29)	0.013
Day 10	0.544 (107)	0.343 (30)	0.001
Week 6	0.629 (82)	0.382 (27)	0.022

Table 2. The (log) mean pre- and post-operative visual acuity in the Phaco and CECCE group after selection of patients with a pre-operative visual acuity > 0.1

	Phaco (n)	CECCE (n)	<i>p</i> -value
Pre-operative	0.320 (99)	0.283 (19)	0.271
Day 1	0.489 (79)	0.310 (18)	0.020
Day 10	0.628 (92)	0.378 (17)	0.015
Week 6	0.736 (70)	0.520 (13)	0.191

Statistical analysis. The student's two sample t-test was used to assess the statistical significance of the differences between the CECCE and the Phaco group in astigmatism and log mean visual acuity [5] at various post-operative time intervals.

Results

Phaco and CECCE. One hundred and fifty patients (eyes) were included in this study of whom 116 had undergone Phaco and 34 CECCE. The data of pre- and post-operative ophthalmic examination were not always complete. The numbers of patients can be deduced from Tables 1, 2 and 3.

Pre- and post operative vision. The pre-operative visual acuity was significantly lower in the CECCE group than in the Phaco group ($p=0.006$) (Fig. 1, Table 1). The difference in visual acuity between both groups could be explained by the fact that patients with mature and hypermature cataracts were in general operated with the CECCE technique. To reduce the difference in preoperative visual acuity in both groups, patients were selected with

Table 3. The mean post-operative astigmatism on day 1, day 10 and week 6 in the Phaco and CECCE group

	PHACO (n)	CECCE (n)	p-value
Day 1	1.836 (96)	3.607 (21)	0.001
Day 10	1.636 (81)	3.575 (20)	0.004
Week 6	1.117 (47)	2.382 (19)	0.009

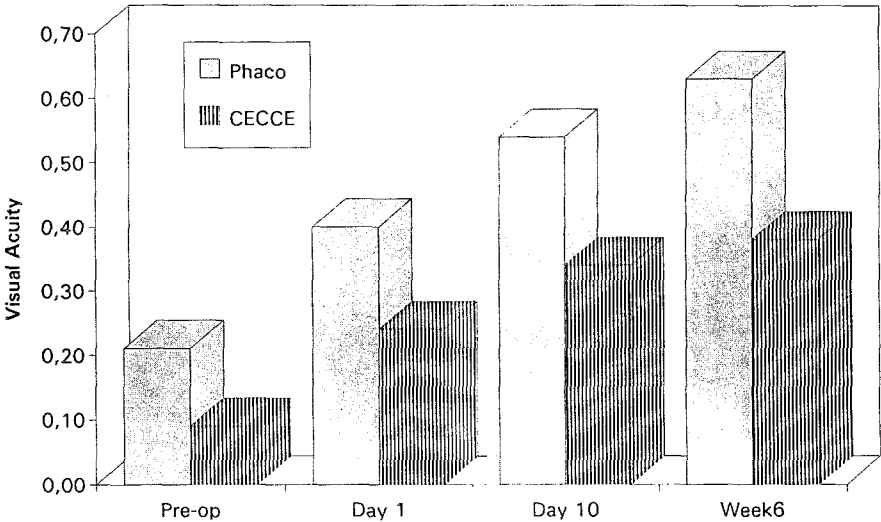


Fig. 1. The (log) mean pre- and post-operative visual acuity in the Phaco and CECCE group.

a visual acuity >0.1. With this selection no significant difference existed in the pre-operative visual acuity between the Phaco group and the CECCE group (Fig. 2). The post-operative mean visual acuities after 1 day and after 10 days, were better in the Phaco group than in the CECCE group ($p=0.02$ and $p=0.015$). However, after 6 weeks post-operatively, the difference was reduced ($p=0.191$) (Fig. 2, Table 2).

Post-operative astigmatism. The keratometry values were significantly lower at day 1, day 10 and in week 6 using Phaco than using CECCE (Fig. 3, Table 3).

IOL calculation. The average emmetropizing power of the lens was 21 D, which should give a predicted refractive power of -0.5 D. However at 6

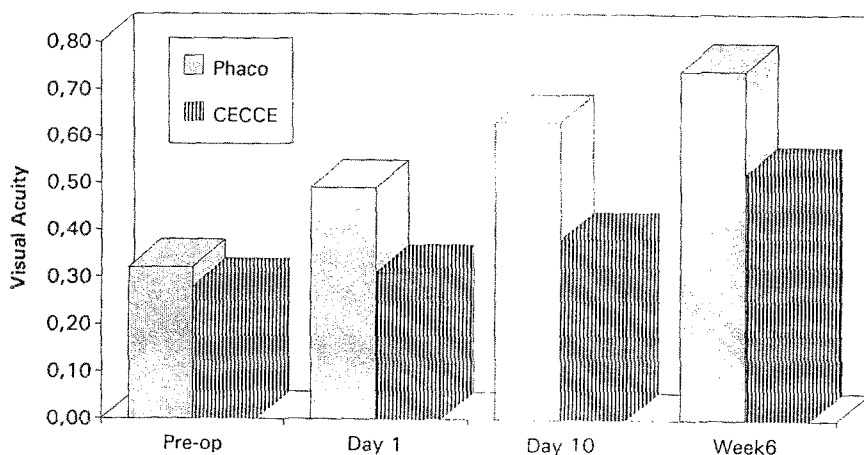


Fig. 2. The (log) mean pre- and post-operative visual acuity in the Phaco and CECCE group after selection of patients with a better visual acuity pre-operatively than 0.1.

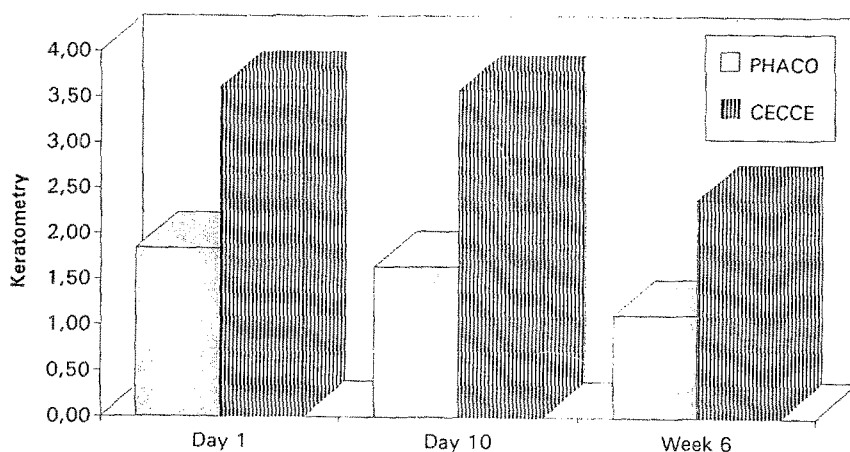


Fig. 3. The mean post-operative astigmatism on day 1, day 10 and week 6 in the Phaco and CECCE group.

weeks post-operatively the resulting refractive power was -0.88 D, thus giving a refractive error of -0.31 (Table 4). The refractive errors according to axial length are summarized in Table 5. The refractive error was inversely proportional with the axial length.

Table 4. Predicted and resulting refractive error

	Average	Min	Max
1. Pre-operative refraction (SE):	-1.2987	+6.0	-22.9
2. Average lens power:	21 D	2 D	32 D
3. Predicted refraction (SE): (n=143)	-0.521	+3.7	-6.23
4. Resulting refraction (SE): (n=118)	-0.884	+3.0	-7.8
5. Resulting - predicted refraction (n=117)	-0.309	+1.21	-2.96

Table 5. Post-operative refractive error by axial length

Axial Length (mm)	n	Refractive error	>2 D	>1 D
< 20	0			
20 - 21	3	-1.893	1/3	3/3
>21 - 22	13	-0.878	1/13 (7.7%)	5/13 (38.4%)
>22 - 24.5	80	-0.307	2/80 (2.5%)	18/80 (22.5%)
> 24.5	21	-0.058	0/21	2/21 (9.5%)
total	117	-0.309	4/117 (3.4%)	28/117 (23.9%)

Discussion

The patients operated with Phaco in this study had less post-operative corneal astigmatism than those with CECCE during at least the first six weeks post-operatively. The lower post-operative corneal astigmatism observed in the Phaco group was most probably due to the smaller incision [1, 2].

Furthermore it was found that for patients operated with Phaco, the visual acuity recovered faster than for patients operated with CECCE. However, the difference between Phaco and CECCE is not significant at 6 weeks. We expect the visual acuity probably to be similar in course of time. A prolonged follow-up is necessary to assess the long-term effects of Phaco.

Interpretation of the results of the post-operative visual acuity and astigmatism at 6 weeks is difficult due to loss to follow-up, especially in the Phaco group, probably caused by the fact that patients with a good vision at 6 weeks may not respond to the 6 weeks examination. Inclusion of these data would probably result in a better mean log visual acuity and lower astigmatism at 6 weeks in the Phaco group. This would make the significance even more stronger.

The difference between the predicted refractive error and the ultimate result lies within the accepted standard which is 5% >2 D and 25–30% >1 D [3, 4]. The calculation of IOL power using the Colenbrander formula results in refractive errors, predominantly in eyes with shorter axial lengths. The standard anterior chamber depth, which is used in the Colenbrander formula, is 4.7 mm. Therefore in short eyes, the intraocular lens is implanted relatively nearer to the cornea than in long eyes and this results in myopia. This problem could be solved by correcting the predicted post-operative refraction for the depth of the anterior chamber with a regression curve by axial length and post-operative refraction error for a large group of cataract patients.

This study indicates that Phacoemulsification results in lower corneal astigmatism following intraocular lens implantation and earlier recovery of visual function than extracapsular cataract surgery.

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