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Astigmatism surgically induced after manual surgery of the cataract by small incision realized on the axis of astigmatism

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Abstract
Background: Phacoemulsification is based on in situ fragmentation prior to extracapsular aspiration of the opacified lens through a small limbal or corneal incision. This low invasiveness allows surgery.
Objective: to evaluate the importance of the AIT by the CMCPP on the strategy of opposition to pre-existing astigmatism. Methods: prospective study carried out from January 1st to August 31st, 2017 in the ophthalmology department of the Brazzaville University Hospital in 213 patients (240 eyes) presenting a cataract. The patient underwent cataract surgery using the CMCPP technique with incision on the axis of astigmatism, the astigmatism being evaluated as a positive cylinder.
Results: The mean preoperative astigmatism was 1.49D, while the mean postoperative astigmatism was 1.83D. The group of patients with preoperative astigmatism greater than or equal to 1.5D was distinguished by an average of surgically induced astigmatism of -0.27 ± 1.62D. The group of patients with preoperative astigmatism less than 1.5 had a mean of surgically induced astigmatism of 0.88 ± 1.17D. In total, 63.6% of patients with preoperative astigmatism greater than 1.5D experienced a significant ($p < 0.05$) decrease in postoperative astigmatism compared to only 23.3% of patients with preoperative astigmatism less than 1.5D. With respect to the variations in postoperative astigmatism according to the power of preoperative astigmatism, the reduction of astigmatism was found more in 77.8% of patients with inverse astigmatism ($p = 0.03$) compared to 11 , 1% of patients with direct astigmatism.
Conclusion: The neutralization of this strategy in the CMCPP is more evident with preoperative astigmatisms greater than 1.5D.

Keywords: cataract, phacoemulsification, scleral manual incision, astigmatism

Introduction

The small incision manual technique of cataract surgery is considered an alternative to phacoemulsification, also called Phaco A [1, 2]. This is the case of cataract surgical technique, as recommended in developing countries because of these results similar to those of phacoemulsification, its low cost and its non-requirement of a large technology [2, 3]. However, this technique, which is based on its usual practice on a superior incision, generates astigmatism or significantly aggravates preexisting astigmatism [4, 5]. This contributes to reducing the expected functional benefit. To minimize this surgically induced astigmatism (ACI), many authors advocate incisions on the axis of astigmatism. This strategy has already been proven in phacoemulsification [6, 7, 8], thus justifying its practice in manual surgery for cataract by small incision (CMCPP) [9, 10, 11]. The purpose of this study is to evaluate the importance of the AIT by the CMCPP on the strategy of opposition to pre-existing astigmatism through our experience

Methods

Patients

A prospective study was conducted from 1 January to 31 August 2017 in the ophthalmology department of the Brazzaville University Hospital in patients with cataracts. Included in the study were subjects over 18 years of age with uncomplicated cataract. The main exclusion criterion was the refusal to participate in the study. A total of 240 eyes from 213 patients were operated on the ward. The informed consent of the patients was obtained.

Methods

Preoperative evaluation of keratometry was performed at Nidek Tonoref II for each patient. Subsequently, the patient underwent cataract surgery using the CMCPP technique with incision on the axis of astigmatism, the astigmatism being assessed as a positive cylinder.

A 6 to 7 mm sclero-corneal tunnel is constructed through a rectilinear scleral incision made 2 mm from the limb. A service incision is made in the peripheral cornea for easy handling. A capsulotomy in rexcis is performed and the nucleus dislocated in anterior chamber. The viscoelastic product is injected all around the nucleus. The nucleus is then expelled in whole or in part through the sclero-corneal tunnel. Residual cortex is extracted by manual irrigation-aspiration; a PMMA implant of 5.5 or 6 mm is introduced into the capsular bag. An injection of solution by the service incision ensures the tightness of the tunnel.

The patient was then followed 6 weeks after the operation. After six weeks, control keratometry was performed to determine postoperative astigmatism. The value of the

postoperative astigmatism is that obtained after the operation, even if there is a reversal of the axis. Surgically induced astigmatism was determined by simple subtraction.

After entering the data on the Epi Info 7.0 software, their processing was performed on the SPSS software, version 16.0. The comparison of the values of pre- and postoperative astigmatism was based on the Mann-Withney U-test, the distribution of non-Gaussian law-derived values. The influence of the degree of astigmatism on the presence of surgically induced astigmatism was examined using the Pearson Khi 2 test. Moreover, the comparison of more than two percentages (case of the variations of the postoperative astigmatism) was carried out starting from the S test of Sokal. The threshold of statistical significance of the tests was set at $p < 0.05$.

Results

The mean age of the patients was 63.5 years (range: 19-83 years). Table 1 reports changes in astigmatism after surgery (diopter, D), taking into account incision sites.

Table 1: Variation of astigmatism after diopter surgery (D) according to the incision site

Type of astigmatism	Effective	Astigmatism preoperative	Astigmatism postoperative	Astigmatism surgically armature
Direct astigmatism	36	1.50 ± 1.52	2.08 ± 1.31	0.58 ± 1.73
Inverse astigmatism	156	1.49 ±0.82	1.63 ± 0.93	0.14 ± 1.24
Oblique Astigmatism	48	1.17 ± 0.93	2.29 ± 1.39	1.12 ± 1.77
Total	240	1.42 ± 1.03	1.83 ± 1.18	0.40 ± 1.48

The mean preoperative astigmatism was 1.49D, while the mean postoperative astigmatism was 1.83D.

The mean surgically induced astigmatism in patients with inverse preoperative astigmatism was 0.14 ± 1.24D compared to 1.12D for patients with oblique preoperative astigmatism.

Table 2 shows the variations of preoperative, postoperative and surgically induced astigmatism.

Table 2: Variations in astigmatism according to preoperative optical power

	Effective	Astigmatism preoperative	Astigmatism postoperative	Astigmatism Surgically Induced
Astigmatism<1.5D	141	0.79 ± 0.36	1.67 ± 1,03	0.88 ± 1.17
Astigmatism ≥1.5	99	2.33 ± 1.00	2.06 ± 1,21	-0.27 ± 1.62
Total	240	1.42 ± 1.03	1.83 ± 1.18	0.40 ± 1.48

The group of patients with preoperative astigmatism greater than or equal to 1.5D was distinguished by an average of surgically induced astigmatism of -0.27 ± 1.62D. The group of patients with preoperative astigmatism less than 1.5 had a mean of surgically induced astigmatism of 0.88 ± 1.17D.

The variations in postoperative astigmatism according to the power of preoperative astigmatism are presented in Table 3. In total, 63.6% of patients with preoperative astigmatism greater than 1.5D experienced a significant decrease ($p < 0.05$) of the power of postoperative astigmatism against only 23.3% of patients with preoperative astigmatism below 1.5D. In the latter, a significant increase ($p < 0.05$) in the power of astigmatism was noted.

Table 3: Variation of postoperative astigmatism taking into account the power of preoperative astigmatism

Type of postoperative variation	Increase n(%)	Decrease n(%)	Stabilization n(%)	Total n(%)
Preoperative astigmatism< 1.5D	57 (63.3)*	21 (23.3)	12 (13.3)	90 (57.7)
Preoperative astigmatism≥ 1.5D	18 (27.3)	42 (63.6)*	6 (9.1)	66 (42.3)
Total	75	63	18	156

Abbreviation: *, $p<0.05$

With respect to the variations in postoperative astigmatism according to the power of preoperative astigmatism (Table 4), the reduction of astigmatism was found more in 77.8% of patients with inverse astigmatism ($p = 0.03$) versus 11.1% of patients with direct astigmatism.

Table 4: Variations in astigmatism by Incision site

Type of variation	Direct n(%)	Reverse n(%)	Oblique n(%)	Total n(%)
Increase	24(17.8)	75(55.5)	36 (26.7)	135(56.2)
Decrease	9 (11.1)	63(77.8)*	9(11.1)	81(33.7)
Stable	3(12.5)	18(75.0)*	3(12.5)	24(10.0)
Total	36	156	48	240

Abbreviation: *, $p<0.05$

Similarly, between the inverse astigmatism and the oblique astigmatism, the difference in the rates of patients who saw their postoperative astigmatism decreased or remained unchanged was statistically significant.

Discussion

The mean age of our patients, 63.5 years, is the average age of

cataract studies, which is around 60 years old. It is 55.4 years for Gokhale [9] and 66.98 years for Arthur [4]. The mean surgically induced astigmatism was 0.40 ± 1.48D. Taking into account the incision axes, the ACI was 0.58 ± 1.73D for the upper incisions, 0.14 ± 1.24D for the temporal incisions and 1.12 ± 1.77D for the oblique incisions. Ghokale [9] reported mean values of 1.36 ± 1.03D for the upper incisions, 0.40 ± 0.40D for the temporal incisions and 0.51 ± 0.49 for the oblique incisions. In contrast, Malik [10] noted an ACI of 1.45 ± 0.73 for the upper incisions and 0.75 ± 0.40 for temporal incisions. Reddy [12], meanwhile, found values of 1.92 ± 0.53 D for the upper incisions versus 1.57 ± 0.24 D for the temporal incisions. Although the temporal incision shows better results in terms of AIT in all studies, our results show an even lower ICA on this site. Taking into account the mean preoperative astigmatism of our patients that was 1.42 ± 1.03D, we separated our patients into two groups, according to whether they had preoperative astigmatism below 1.50D or greater than or equal to 1.5D. ACI in patients with preoperative astigmatism less than 1.5 was 0.88 ± 1.17D versus -0.27 ± 1.62D with mean postoperative astigmatism lower than preoperative mean astigmatism in the latter group.

The strategy of opposing astigmatism pre-existing by the incision on the axis of astigmatism is based on the fact that the incision flattens the axis, thus reducing astigmatism on the axis concerned [13] . This reduction depends on the size of the incision. For example, Kumar [5], by comparing two specifically higher incision phasememulsification techniques of 1.8 and 3.2 mm incision with CMCPP of 5.5 mm, found ACIs at the 90th postoperative day. 0.68D and 1.17D in phacoemulsification against 2.35D in CMCPP. While phacoemulsification is likely to neutralize weak astigmatism, the CMCPP appears to be more effective on astigmatisms greater than 1.5D, because of its larger incision that results in a greater IFA [14, 15].

This is illustrated by our results, the cases of reduction of postoperative astigmatism was more numerous in patients with preoperative astigmatism greater than or equal to 1.5D or 53.6%, compared to only 27.3% in patients with preoperative astigmatism less than 1.5D. These postoperative reductions in patients with more than 1.5D preoperative astigmatism, lower the average postoperative astigmatism; this explains the significant reduction in ACI noted in our patients with a temporal incision. Note also that Gokhale [9] found an ACI of 0.40 against 0.14 in our study; however, this author in his series recruited only patients with preoperative astigmatism less than 1.5D. Our group of temporally incised patients had lower mean postoperative astigmatism than the mean preoperative astigmatism.

Some authors have found an average ICA of patients with oblique incisions lower than the average ICA of patients with a superior incision [9, 13]. However, our observation is the opposite. Usually, authors perform these oblique incisions in upper temporal [9]. In our logic of incision on the most positive axis, we realized these oblique incisions as well in superior temporal superior nasal. The upper nasal incisions are more difficult to perform because of the spine of the nose which reduces the field of work. This anatomical variant of the incision site may explain the inversion of the results of these two incision sites.

Conclusion

The strategy of the incision opposed to the pre-existing astigmatism allowed to have good postoperative results. The high efficiency at the temporal incision site was confirmed with surgically induced astigmatism near zero. The neutralization of this strategy in the CMCPP is more evident with preoperative astigmatisms greater than 1.5D.

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