

Astigmatism after Cataract Alternative Phaco Surgery

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Abstract

Purpose: The present authors studied astigmatism in alternative phaco cataract surgery at the University Hospital HKM of Cotonou.

Patients and Methods: The study is a cross-sectional and retrospective one which covered a 7-year period from January 1st, 2010 to December 31st, 2016. It involved all patients who had cataract surgery without suturing during the study period. A total of 129 eyes from 129 patients were retained.

Results: 129 eyes of 129 patients were selected from 203 patients operated for cataract without suture, a percentage of 51%. The mean age of the patients was 59 ± 15 years. 53.5% were male and 46.5% female, a sex ratio of 1.15%. In the preoperative period, 64.4% of patients had significant astigmatism. In the postoperative period, 31% of patients have significant astigmatism. The higher astigmatism increased progressively from 68.2% to 55% from postoperative day 15 to day 45. The mean of astigmatism decreased gradually from day 15 to day 45 (2.8 ± 1.6 D at 2.3 ± 1.4 D). 56.6% of the patients had indirect astigmatism during the preoperative period. Indirect astigmatism accounted for 69% of cases at postoperative day 45. The average axis varied around 85 and 100°. Indirect astigmatism accounted for 89% of cases at postoperative day 45.

Conclusion: Corneal astigmatism remains a concern after cataract surgery, hence the need to improve the phacoalternative to reduce induced astigmatism.

Keywords: Astigmatism; Cataract Surgery; Phacoalternative

Introduction

Astigmatism is a variety of non-spherical ametropia, usually characterized by an absence of sphericity of the anterior surface of the cornea. This inequality of the corneal radii of curvature makes that the image of a point is not a point but a surface [1]. It can be congenital or acquired during surgery of the anterior segment. The removal of the opacified lens by a sclero-corneal tunnel without suture (phacoalternative) can cause astigmatism postoperatively.

It leads the subject to a fuzzy or double perception of objects.

Nowadays, phacoemulsification is the most used technique in developed countries. In sub-Saharan Africa, the phacoalternative is being popularized because of its simplicity, cost, reduced material and good functional result.

The management of postoperative astigmatism on the one hand is a widely studied topic, particularly with regard to the choice of site and incision architecture [2]. On the other hand, in the literature, few studies deal with astigmatism in the phacoalternative, therefore this study purpose at the National University Hospital HKM of Cotonou, was to determine astigmatism in cataract surgery without suturing in cataract surgery in order to calculate the regularity of postoperative astigmatism cases, to evaluate the average dioptric value and the average axis of induced astigmatism.

Patients and Methods

The study is a retrospective, descriptive and analytical cross-sectional one. It covered a 7-year period from January 1, 2010 to December 31, 2016, and included all patients who had cataract surgery without suturing during the study period.

Included were subjects over 15 years who had benefited from the removal of the lens by the suture-free scleral-corneal tunnel performed by an ophthalmologist with posterior chamber implantation. The surgeon had used an automatic refractometer before and after surgery on the Topcon KP-8800 refractometer, having performed post-operative controls up to the 45th day and having undergone an examination that recorded the appearance of the cornea (edema or not), the appearance of the anterior chamber, the presence and position of the intraocular implant, the ocular tone and the assessment of visual acuity.

Subjects who had undergone stitching during the procedure, those who had not been followed-up or who did not at least respond to post-operative controls day 15, day 30 and day 45, those who had undergone other ocular surgery, and those who had undergone surgery whose astigmatism is not in the scope of cataract surgery.

According to WHO, cataract surgery's postoperative results with posterior chamber implantation are classified into three groups: good, average and bad [3].

Result	AVL	AVSC	AVAC
Good	3/10 - 10/10	> 80%+	> 90%+
Average	< 3/10 - 1/10	< 15%	< 5%
Bad	< 1/10	5%	< 5%

(Table)

The astigmatism data were classified according to the HOLMSTRÖM gradient [4].

The astigmatism induced by surgery is calculated by simple subtraction between the power of the postoperative cylinder in each case and that of the preoperative cylinder [5].

The variables studied were socio-demographic characteristics (age, sex, occupation, origin), laterality of the operated eye, pre-scleral incision, pre- and postoperative visual acuity, pre- and postoperative astigmatism and the astigmatism made by surgery.

Data entry was done in the Epi-Data version 3.1 software. Data analysis was performed in Epi-Data Analysis 2.2.2.182, R 3.2.2 and Open Epi (Open Source Epidemiological Statistics for Public Health) 3.01.

The central tendency and dispersion parameters were used to describe the quantitative variables and the proportions for the qualitative variables. Averages were presented with their standard deviation. The occurrence was compared using the Pearson Chi2 or Yates test as appropriate with a significance level of 0.05. The difference was statistically significant for a p value less than 0.05.

Results

A total of 398 patients underwent cataract surgery, 203 operated cataract surgery without suture or 51%. Of the 203 patients, 129 eyes of 129 patients were selected for having been conform with the inclusion criteria of 63.5%.

Sociodemographic characteristics

53.5% were male and 46.5% female, a sex ratio of 1.15%. The mean age of the patients was 59 ± 15 years (range: 18 - 92 years). The most represented age groups were 60 - 80 years old. 53.5% were civil servants and 74.4% came from Cotonou.

Preoperative ophthalmological examination

Operated eye

Both eyes were operated in almost identical proportions with a slight predominance for the right eye (50.4%).

Preoperative visual acuity

Figure 1 summarizes the distribution of the eyes according to preoperative visual acuity.

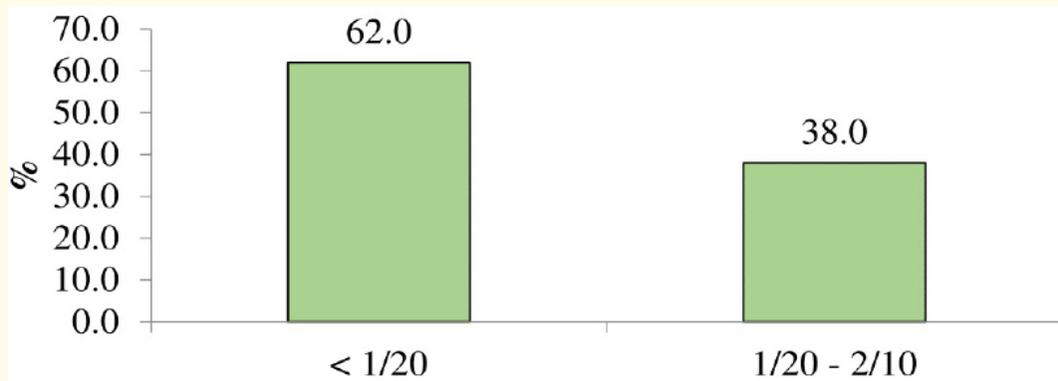


Figure 1: Distribution of eyes according to preoperative visual acuity (CNHU-HKM, 2017)
Preoperative visual acuity was less than 1/20 in 62% of cases.

Surgical intervention

Pre scleral incision

The pre-scleral incision was curvilinear in 62.8% of cases and rectilinear in 37.2%.

Functional result of the operated eye

Table 1 represents the visual acuity of the eye operated at day 45.

	Without correction		With correction	
	N	%	N	%
1/20 - 2/10	67	51,8	10	7,7
3/10 - 7/10	58	45	46	35,7
8/10 - 10/10	4	3,2	73	56,6
Total	129	100	129	100

Table 1: Distribution of visual acuity of the operated eye at day 45 (2017, CNHU-HKM).

On day 45, after correction, 92.3% of patients had a visual acuity greater than or equal to 3/10, of which 56.6% had a visual acuity greater than 7/10.

Preoperative and postoperative astigmatism

Power

Table 2 illustrates preoperative value and postoperative astigmatism.

	Pre op	Day 15	Day 30	Day 45
	N (%)	N (%)	N (%)	N (%)
< 0,25	13 (10,0)	1 (0,8)	1 (0,8)	2 (1,6)
[0,25 - 1]	33 (25,6)	9 (7,0)	10 (7,8)	16 (12,4)
[1 - 2]	49 (38,0)	31 (24,0)	39 (30,2)	40 (31,0)
≥ 2	34 (26,4)	88 (68,2)	79 (61,2)	71 (55,0)
Average	1,7±1,6	2,8±1,6	2,6±1,4	2,3±1,4

Table 2: Distribution of astigmatism value in diopters (2017, CNHU-HKM).

$$p < 0,0001$$

In the preoperative period, 64.4% of patients had significant and elevated astigmatism.

In the postoperative period, 31% of patients have significant astigmatism. As for higher astigmatism, it progressively decreased from 68.2% to 55% from day 15 to day 45 postoperatively.

The average astigmatism decreased gradually from day 15 to day 45 (2.8 ± 1.6 D at 2.3 ± 1.4 D).

Axis

Table 3 shows the axis of preoperative and postoperative astigmatism

	Pre op	Day 15	Day 30	Day 45
	N (%)	N (%)	N (%)	N (%)
Direct astigmatism	24 (18,6)	12 (9,3)	9 (7,0)	5 (3,9)
Indirect astigmatism	73 (56,6)	72 (55,8)	81 (62,8)	89 (69,0)
Oblique astigmatism	32 (24,8)	45 (34,9)	39 (30,2)	35 (27,1)
Average (Degree)	85,3 ± 48,5	91,6 ± 41,9	100,9 ± 109,5	84,6 ± 33,5
P = 0,0018				

Table 3: Distribution of the axis of astigmatism in degrees.

More than half of the patients (56.6%) had indirect astigmatism during the preoperative period.

Indirect astigmatism accounted for 69% of cases at postoperative day 45. The average axis varied around 85 and 100 °.

Astigmatism induced

Power

Table 4 summarizes the value of induced astigmatism

	Day 15	Day 30	Day 45
< 0,25	2 (1,6)	2 (1,6)	5 (3,9)
[0,25 - 1]	11 (8,5)	17 (13,2)	23 (17,8)
[1 - 2]	35 (27,1)	39 (30,2)	37 (28,7)
2	81 (62,8)	71 (55,0)	64 (49,6)
Average (D)	2,59 ± 1,58	2,41 ± 1,48	2,14 ± 1,50

Table 4: Distribution of the value of induced astigmatism in diopters (2017, CNHU-HKM).

Insignificant astigmatism nearly doubled from day 15 to day 45, while higher astigmatism decreased from 62.8% to 49.6%.

Axis

Table 5 shows the axis of induced astigmatism.

	Day 15	Day 30	Day 45
Direct astigmatism	20 (15,5)	15 (11,6)	10 (7,8)
Indirect astigmatism	72 (55,8)	84 (65,1)	89 (69,0)
Oblique astigmatism	37 (28,7)	30 (23,3)	30 (23,3)
Total	129 (100,0)	129 (100,0)	129 (100,0)

Table 5: Breakdown of induced astigmatism axis in degrees ((2017, CNHU-HKM).

Indirect astigmatism accounted for 89% of cases at postoperative day 45.

Discussion

Sociodemographic characteristics

The average age of our patients was 59 years old with extremes of 18 to 92. These results are almost similar with those of Sounouvou., *et al.* [5] and Ayena., *et al.* [6] who reported an average age of 60 to 64 years. This average age is that of the senile cataract which represents the majority of the cases. These results confirm the thesis that cataract appears early in Africa [7].

Men accounted for more than half (53.5%) of our sample with a sex ratio of 1.15. These results are in line with those of Sounouvou., *et al.* in which they found 58,7%. On the other hand, Ayena., *et al.* [6] in Togo found a female predominance of 51%. The officials prevailed in our study. This predominance could be explained by the fact that they receive administrative support, which relieves their expenses and motivates their choice of consultation at the public hospital.

Operated eye

In our study, there is no big difference between the two eyes (50.4% at OD and 49.6% at OG). This result is in line with that of Ayena, *et al.* in Togo [6] with 51% of right eye operated and 49% for the left eye. The senile cataract is usually bilateral but asymmetrical.

Visual acuity

Preoperative visual acuity

Overall, preoperative visual acuity in our patients was less than 1/20 in 62% of cases. This result is almost similar to that of Ayena, *et al.* [6] in Togo, which found 64% but less than those observed by Sounouvou, *et al.* [6] (80.4%) in cataract surgery by pure corneal incision.

This finding clearly demonstrates that cataract is operated at the blinding stage in developing countries because of difficulties related to accessibility to care.

Post-operative visual acuity

At day 45 postoperative visual acuity without correction was greater than or equal to 3/10 in 48.5% of cases. These results are inferior to those of Ayena, *et al.* [6] 73%.

In contrast, visual acuity after correction was greater than 3/10 in 92.3% of cases, a result consistent with WHO recommendations [3].

Astigmatism

Although astigmatism results from the difference in corneal meridians on the one hand and the crystalline lens on the other hand, ablation of the lens by the scleral route should not induce significant astigmatism.

In the preoperative period, 25.6% of the eyes had insignificant astigmatism while 38% had significant astigmatism according to Holmström gradation [4]. After the intervention, the sclerocorneal tunnel, the architectural modifications of the cornea (corneal edema) would be the source of astigmatism postoperatively.

Considering preoperative astigmatism, 64.4% had significant astigmatism between 1 and 3.50 diopters. This percentage is similar to that observed by Ayena, *et al.* [6] in Togo (64%) because the countries are close, the peoples have similar socio-demographic characteristics. In a study done in Burkina Faso in 2015, Diallo, *et al.* [7] found a preoperative mean astigmatism of 0.87 diopters lower than that found in our study of 1.7 diopters, probably due to the morphology of different populations.

In the postoperative period, we noted a mean astigmatism of 2.6 +/- 1.4 diopter at the 30th postoperative day. This mean astigmatism increased to 2.3 ± 1.4 diopters at day 45 postoperatively, much higher than those found by Ayena, *et al.* [6] in Togo 1,00 ± 0,60D. In general, corneal astigmatism according to Drews [8] undergoes a continuous change of years after surgery.

In our study, astigmatism was indirect in 56.6% of cases during the preoperative period. This high percentage of indirect astigmatism has been reported by other authors [6,9,10] who think that senile cataract carriers have indirect astigmatism.

For Ayena, *et al.* [6], in the postoperative period, at three months 56% of the eyes have indirect astigmatism, lower than the 69% found in our study. These results confirm the thesis of Magdun [11] who believes that the superior surgical approach induces indirect astigmatism.

However, the size of the scleral incision (6 mm) and the distance to the limb (2.5 mm) could play a role because for Malick, *et al.* [12], the more the incision is far from the visual axis, the less it induces astigmatism and the temporal approach also induces less astigmatism [11,12].

A study on the correlation of incision size, core extraction, tunnel quality, incision site and cataract type may confirm these theories.

As for the average astigmatism induced, it went from $2.59 \pm 1.58D$ to 2.14 ± 1.50 diopters in our study. These values are higher than those of Ayena, *et al.* [6] ($0.57 \pm 0.52D$). Sounouvou, *et al.* [5] in his study of astigmatism after extra capsular extraction by pure corneal incision, found a mean induced astigmatism of $1.4D$ after total removal of the wires at 3 months. Our result could be explained by the quality of the tunnel, a recent introduction of the technique, the surgeons' experience and the quality of the crescent knife for the sclero-corneal tunnel.

This higher percentage of induced astigmatism does not negatively affect the functional result because 92.3% had good results after optical correction.

Conclusion

We noted that 57% of the patients were operated by the phacoalternative technique. The average age was around 59 years old with male predominance. The preoperative astigmatism was on average 1.7 diopters and that induced around 2.14 diopters with an axis around 90° is an indirect astigmatism. The phacoemulsification technique popular in developed countries reduces the induced astigmatism. In our countries the phacoalternative, although giving good functional results remains astigmatogenic. Better control of the technique with adapted equipment should make it competitive especially since it remains less expensive than phacoemulsification. It deserves to be better studied as to the characteristics of the sclerocorneal tunnel in order to make it competitive and especially for its popularization.

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