European Journal of Preventive Medicine
2023; 11(1): 6-10
http://www.sciencepublishinggroup.com/j/ejpm
doi: 10.11648/j.ejpm.20231101.12
ISSN: 2330-8222 (Print); ISSN: 2330-8230 (Online)

Study of Induced Astigmatism After Cataract Surgery by Phacoalternative

Koman Chiatse Ellalie[1, *], Agli Thierry[2], N'da Hermine Cynthia[1], N'diaye Madoune Robert[2], Fofana Ibrahima[2], Saley Ali[2], Barry Mamadou Oury[2], Konan Manmi Sienou Marguerite Pascaline[1], Agbohoun Reine Prisca[1], Appia Gilles Beda[1], Kouadio Kouao Cédric Romaric[1]

[1]Faculty of Medical Sciences, Felix Houphouet Boigny University, Abidjan, Ivory Coast

[2]Faculty of Medical Science, Gamal Abdel Nasser University, Conakry, Guinea

Email address:

kellalie@outlook.com (Koman Chiatse Ellalie)

[*]Corresponding author

To cite this article:

Koman Chiatse Ellalie, Agli Thierry, N'da Hermine Cynthia, N'diaye Madoune Robert, Fofana Ibrahima, Saley Ali, Barry Mamadou Oury, Konan Manmi Sienou Marguerite Pascaline, Agbohoun Reine Prisca, Appia Gilles Beda, Kouadio Kouao Cédric Romaric. Study of Induced Astigmatism After Cataract Surgery by Phacoalternative. *European Journal of Preventive Medicine*. Vol. 11, No. 1, 2023, pp. 6-10.
doi: 10.11648/j.ejpm.20231101.12

Received: December 18, 2022; **Accepted**: January 9, 2023; **Published**: January 31, 2023

Abstract: The objective is to study the astigmatism induced after phacoalternative surgery in order to improve the quality of the surgery. This was a prospective and descriptive cross-sectional study carried out at the Donka University Hospital in Conakry from july 2021 to january 2022, i.e. a duration of 7 months, on 100 operated eyes. It involved 100 eyes, operated by phacoalternative with an upper limbal incision of at least 6 mm and implantation in the lens bag. Automatic refraction was performed pre-operatively and post-operatively at 45[e] day. The mean age was 62 years. Visual acuity was reduced to light perception in 58% of cases preoperatively. The mean implant power after biometry was 19±2.38 Dioptres (D); 50% of patients received the calculated implant. Corneal oedema was the most frequent early complication. Regarding the functional outcome, 82% of the eyes had an uncorrected visual acuity greater than 3/10 at D45 and 92% with correction. 95% of preoperative astigmatism was less than 2D and 57% according to the rule. The average postoperative astigmatism induced was 3.15D against the rule. In conclusion, phacoalternative surgery with a linear superior incision induces an astigmatism against the rule of 3.15 dioptres on average.

Keywords: Phacoalternative, Astigmatism with the Rule, Astigmatism Against the Rule, Induced Astigmatism, Cataract

1. Introduction

Phacoalternative or small-incision cataract surgery (SICS) is a surgical technique described for the management of cataracts. Cataract is a complete or partial opacification of the lens. It is the leading cause of blindness of all ages in the world [1, 2]. It is diagnosed clinically by slit lamp examination and treated exclusively surgically by removal of the opacified lens and correction of the aphakia. Over the years, surgical techniques have progressively evolved towards less invasive surgical methods with concomitant modulations of post-operative complications. More recent techniques such as phacoemulsification [3] or femtosecond laser surgery [4, 5] are commonly performed in developed countries. In developing countries, these methods are struggling to spread due to the cost of the equipment to be used. The SICS method is similar to phacoemulsification with broadly similar results [6-8]. However, due to the manipulation of the ocular surface, morphological changes are often observed in the cornea.

The aim of this work is to evaluate the astigmatism induced after cataract surgery by SICS.

2. Methods

A prospective descriptive study was conducted at the

CADESSO of the CHU Donka. The study period spanned 7 months from July 2016 to January 2017.

Over the study period, 100 eyes of 96 patients were operated on by three surgical teams. These included 48 males and 48 females with an age range of 23-90 years and an average age of 62±12.18 years.

2.1. Surgical Technique

After retrobulbar anaesthesia with 2% lidocaine, asepsis with dermal betadine and blepharostat placement, an upper conjunctival disinsertion of approximately 1 cm with electrical cautery was performed. Then, a scleral incision was made superiorly (at noon), of a linear type approximately 6 mm long, which could be enlarged in case of a large nucleus. The incision is made approximately 2.5 mm from the limbus. A scleral-corneal tunnel of approximately 3.5 mm was then made allowing an anterior chamber opening through the clear cornea. A capsulotomy was then performed with a can opener and hydrodissection under viscoelastic and the nucleus was expelled en bloc. The cortex was then washed manually with the dual stream cannula, followed by placement of a posterior chamber implant and washing of the masses.

2.2. Method and Follow-up

The preoperative and postoperative astigmatism of our patients was determined using an auto-refracto-keratometer.

The axis of the astigmatism was classified as follows: astigmatism according to the rule or "direct" (negative cylinder at 180 ± 20°), astigmatism against the rule or "indirect" (negative cylinder at 90 ± 20°) and oblique astigmatism (negative cylinder at 20 - 70° or 110 - 160°). The surgically induced astigmatism is determined by subtracting the postoperative cylinder power in each case from the preoperative cylinder power. If the preoperative astigmatism is with the ruler, its cylinder power is added to the postoperative astigmatism against the ruler to determine the value of the induced astigmatism.

The postoperative astigmatism was measured at D45.

3. Results

The mean age of the patients was 62±12.18 years with extremes ranging from 23 to 90 years.

Preoperative visual acuity was ≤ 1/20 in 99% of patients.

The mean power obtained after biometry and implant calculation was 19±2.38 Diopters (D).

Ninety-two percent (92%) of the procedures were uneventful. The incidents were mainly capsular ruptures with vitreous exit in 8 cases.

Half of the operated eyes (50 eyes) received the implant corresponding to the result of the implant calculations.

Ninety-seven (97%) of the eyes were implanted in the posterior chamber and 3% in the anterior chamber.

Early postoperative complications (<15 days) were dominated by corneal oedema in 65% of cases (Table 1). Late postoperative complications (>30 days) were dominated by secondary cataract in 3% of cases. One eye presented with late postoperative hypertonia.

Functionally, at D45, 92% of patients had a visual acuity without correction greater than 3/10, rising to 92% with correction (figure 1).

The diopter values of the preoperative astigmatism were between 0 and 1D in 75% of the eyes, between 2D and 3D in 22%, between 4D and 5D in 1% and greater than 5.00 D in 2%. Only one eye had no astigmatism (figure 2). The mean preoperative astigmatism was 1D with a standard deviation of 1.19. Also preoperatively, according to the axis of astigmatism, 57% of the eyes had astigmatism with the ruler, 31% had astigmatism against the ruler and 11% had oblique astigmatism (figure 3). The cylindrical power of the astigmatism assessed at D45 postoperatively was between 0 and 1D in 1%, between 2 and 3D in 61%, between 4 and 5D in 29% and greater than 5D in 9 (figure 2). The average postoperative astigmatism power was 3.15D (Table 2). The axis of the astigmatism was direct in 10%, indirect in 82% and oblique in 11% of cases postoperatively (figure 3). The majority of the astigmatism induced postoperatively was inverse.

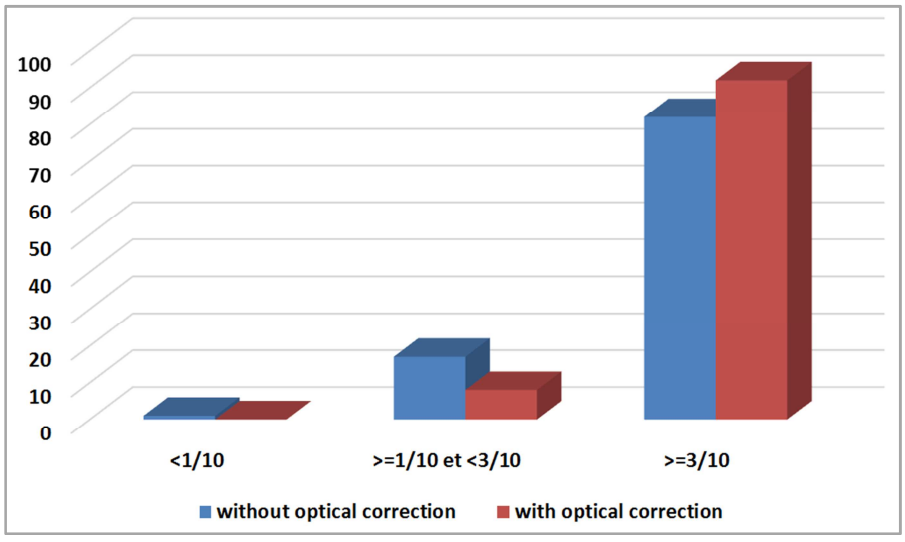

Figure 1. *Distribution of patients according to postoperative distance visual acuity.*

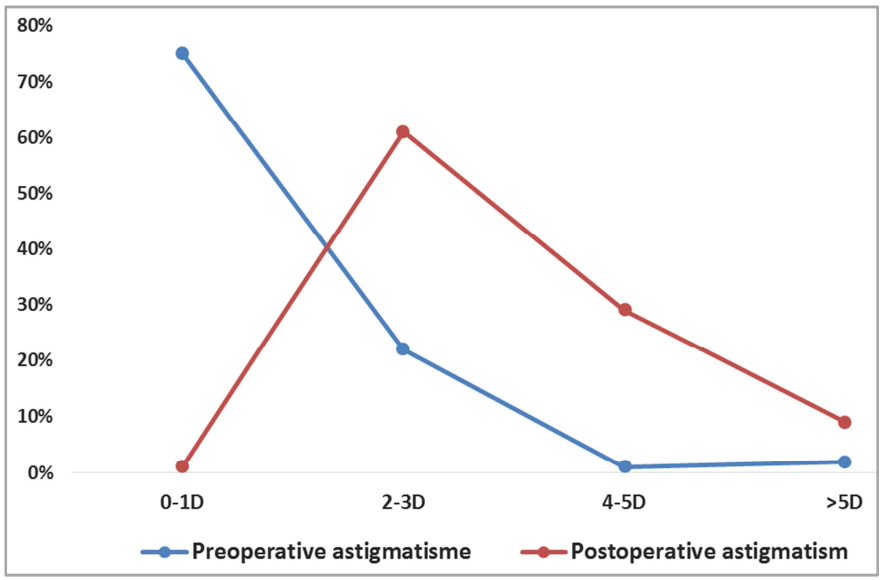

Figure 2. *Comparison curve between preoperative and postoperative astigmatism power.*

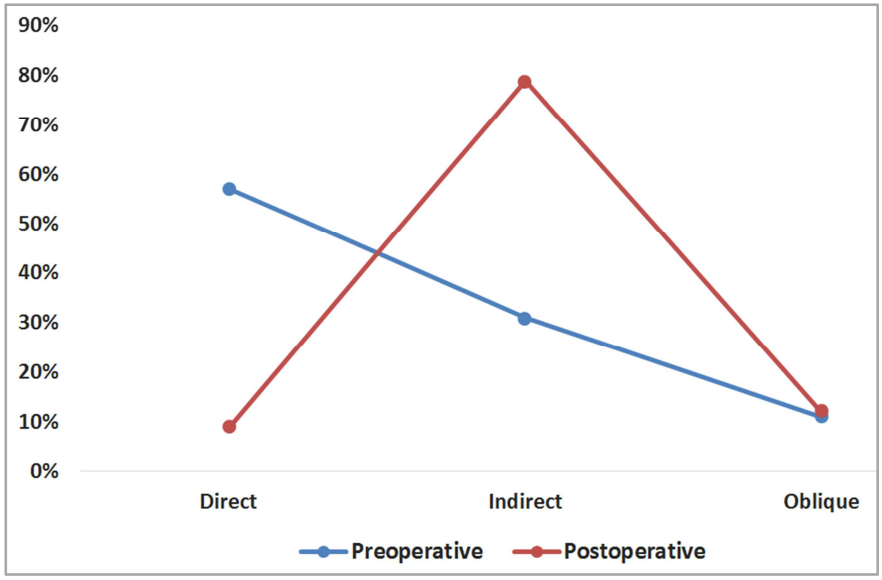

Figure 3. *Comparison curve between the axis of the preoperative and postoperative astigmatism.*

Table 1. *Early postoperative complications.*

Complications	Number of employees (n)	Percentage (%)
Corneal edema	28	65
Keratitis	6	14
Hyphaema	5	12
Tyndall of the anterior chamber	2	4.5
Fibrin	2	4.5
Total	100	100

Table 2. *Distribution of eyes according to the power of postoperative astigmatism at D45.*

Astigmatism strenght (D)	Percentage (%)
-1	1
]1;3]	61
]3;5]	29
> 5	9
Total	100

The average postoperative astigmatism was reverse astigmatism or against the rule of minus 3.15D.

4. Discussion

In our study, the mean preoperative astigmatism was 1D with a standard deviation of 1.19. Its values were close to those of Billong in Togo [9]; Sounouvou in Benin [10] and Diallo [11] in Burkina-Faso with respectively 1.27D, 0.9D and 0.87D.

The number of astigmatisms against the rule increased postoperatively from 31% preoperatively to 79% postoperatively. This observation could be explained by the fact that the astigmatisms against the ruler existing in preoperative are aggravated by the surgery. The value of the postoperative astigmatism then becomes an addition of the pre-existing preoperative astigmatism to that induced by the

surgery. In this study, the surgery itself induced an average astigmatism against the 3.15D rule.

The astigmatism with the ruler decreased postoperatively from 57% preoperatively to 11% postoperatively. This could be explained by the fact that phacoalternative surgery with superior incision induces astigmatism against the ruler.

Oblique astigmatism did not vary. This could be explained by the fact that induced astigmatism is horizontal or against the rule, and does not aggravate or correct a pre-existing oblique astigmatism.

Billong in Togo [11] made the same observation with astigmatism with the ruler decreasing from 38% preoperatively to 28% postoperatively, as well as astigmatism against the ruler increasing postoperatively from 48% preoperatively to 56% postoperatively. We obtained the same observations because we worked under similar conditions. Billong, like us, made a superior incision with the same type of material as we did. These results corroborate those of Magdun et al [12] who found that the superior surgical approach induces astigmatism against the rule.

However, we obtained more astigmatism than Billong, 3.15D on average in our study compared to less than 2D in Billong's, because we performed a linear incision. In Billong's study in Togo, he made a parabolic or eyebrow incision. We can therefore say that the linear incision was more astigmatogenic than the eyebrow incision. The type of incision would be the only difference between Billong's study and ours.

Malik et al [13] reported that the further away from the visual axis one was, the less astigmatism one induced. This would explain why the temporal approach is the best site to minimise induced astigmatism.

Furthermore, Burgansky et al [14] studied the relationship between the size of the incision and the average value of induced astigmatism. A size of 6 mm induced an astigmatism of 0.6 ± 0.3 D. Our results were far from this value. Indeed, the incision size in our case often exceeded the initial 6 mm, as many patients had overly large cores, and their passage through the tunnel required enlargement of the tunnel and the incision.

Diallo [11] in Burkina-Faso found, on the contrary, a more negligible astigmatism with the phacoalternative than in our study and that of Billong [9] with an average induced astigmatism of 1.31D. This could be justified by the choice of incision sites. While in our study and Billong's study we performed a superior incision, Diallo [11] performed a superior incision when the preoperative astigmatism was within the rule, and temporal when it was against the rule. He had therefore already predictively reduced the induced astigmatism by choosing the incision site to correct the preoperative astigmatism. Indeed, any incision, e.g. superior, will cause relaxation and flattening of the vertical meridian concerned here and a bulging of the perpendicular (horizontal) meridian, proportional to the length of the incision and inversely proportional to the distance from the centre of the cornea.

For Gokhale et al [15], the upper incision induced approximately 1.28D of astigmatism. This figure was lower than our results. This could be justified, on the one hand, by the size of the incision in our study, 6 mm and more, which is larger than the incision in Gokhale's study and, on the other hand, by the location of the incision in relation to the limbus, 1.5 mm, which is closer to the limbus than in Gokhale's study, which was at 2.5 mm.

5. Conclusion

Our study confirms other previous studies showing that upper incision phacoalternative surgery induces reverse astigmatism, and that the linear incision is more astigmatogenic than the brow incision. The smaller the incision and the further away from the limbus, the less astigmatogenic it is.

Phacoalternative surgery after a 45-day setback induces twice as much astigmatism as the pre-existing astigmatism. The astigmatism induced postoperatively is mostly against the rule. Factors could explain the increase in cylindrical power and the axial change following the topographical changes of the cornea. These include the size, greater than 6 mm, and the incision site. The choice of incision site could therefore be part of the refractive surgery coupled with cataract surgery in order to minimise pre-existing astigmatism.

References

[1] Renouvin A, Fournié P, Soler V. Les évolutions dans le traitement de la cataracte. NPG Neurol - Psychiatr - Gériatrie. 2016; 16 (92): 64-72.

[2] Berthélémy S. La cataracte. Actual Pharm. 2016; 55 (558): 39-42.

[3] Milazzo S, Laurans P, Turut P. Phacoémulsification. EMC - Ophtalmol. 2005; 2 (2): 77-102.

[4] Donaldson KE, Braga-Mele R, Cabot F, Davidson R, Dhaliwal DK, Hamilton R, et al. Femtosecond laser–assisted cataract surgery. J Cataract Refract Surg. 1 nov 2013; 39 (11): 1753-1763.

[5] He L, Sheehy K, Culbertson W. Femtosecond laser-assisted cataract surgery. Curr Opin Ophthalmol. 2011; 22 (1): 43-52.

[6] Fry LL. The phacosandwich technique. Cataract Surg Altern Small Incision Tech Thorofare NJ Slack Inc. 1990; 110.

[7] Venkatesh R, Tan CS, Sengupta S, Ravindran RD, Krishnan KT, Chang DF. Phacoemulsification versus manual small-incision cataract surgery for white cataract. J Cataract Refract Surg. 2010; 36 (11): 1849-1854.

[8] Ruit S, Tabin G, Chang D, Bajracharya L, Kline DC, Richheimer W, et al. A Prospective Randomized Clinical Trial of Phacoemulsification vs Manual Sutureless Small-Incision Extracapsular Cataract Surgery in Nepal. Am J Ophthalmol. 2007; 143 (1): 32-38.e2.

[9] Billong J. Quelle modification apporte la CCPISS sur l'astigmatisme au centre hospitalier adventiste d'ophtalmologie de Glei au Togo. Mémoire d'ophtalmologie. [FSS (Faculté des sciences de la santé)]: Université de Lomé; 2014.

[10] Souvounou I, Tchabi S, Agbahoungba L, Yehouessi L, Doutetien C. Astigmatisme après extraction extracapsulaire manuelle de cataracte par incision cornéenne pure. Rev CAMES. 2009; 09: 37-39.

[11] Diallo JW, Ahnoux-Zabsonre A, Yameogo C, Dolo M, Sanou J, Daboue A. Résultats fonctionnels de la chirurgie de la cataracte par phacoalternative avec implantation en chambre postérieure: à propos de 300 cas à Bobo Dioulasso (Burkina Faso). Pan Afr Med J. 2015; 20 (1).

[12] Magdum RM, Gahlot A, Maheshgauri RD, Patel K. A comparative study of surgically induced astigmatism in superior and temporal scleral incision in manual small incision cataract surgery. Natl J Med Res. 2012; 2 (04): 497-500.

[13] Malik VK, Kumar S, Kamboj R, Jain C, Jain K, Kumar S. Comparison of astigmatism following manual small incision cataract surgery: superior versus temporal approach. Nepal J Ophthalmol. 2012; 4 (1): 54-58.

[14] Burgansky Z, Isakov I, Avizemer H, Bartov E. Minimal astigmatism after sutureless planned extracapsular cataract extraction. J Cataract Refract Surg. 2002; 28 (3): 499-503.

[15] Gokhale NS, Sawhney S. Reduction in astigmatism in manual small incision cataract surgery through change of incision site. Indian J Ophthalmol. 2005; 53 (3): 201-203.