

# Induced astigmatism after cataract surgery - a retrospective analysis of cases from the University of Port Harcourt Teaching Hospital, Nigeria

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## Abstract

Visual rehabilitation after cataract surgery may often be disappointing due to induction of corneal astigmatism following issues in realigning, point to point, the corneal wound margin in the process of surgery despite biometry and use of the appropriate intraocular lens. The purpose of this study is to determine the amount of surgically induced astigmatism after sutured cataract extraction-extracapsular cataract extraction (ECCE) and intracapsular cataract extraction (ICCE) and intraocular lens (IOL) implantation in the University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria. Records of all cataract patients operated on in the eye theatre of the aforementioned tertiary facility between 2002 and 2006 were considered. Relevant patient details and intraoperative and postoperative management were examined and reported upon. One hundred and fourteen eyes (114) of one hundred patients who had cataract surgeries done within the five-year period of this study were examined. ECCE + IOL implantation were examined in the period under review. The post-operative refraction objectively and subjectively was retrieved from the records of each patient. The post-operative cylinder power (total astigmatism) was recorded.

Of 114 eyes, only 83 eyes (72.8%) had refraction results postoperatively due to loss of follow-up. The total number with astigmatism was 57(68.7%). Forty-two had against-the-rule (73.7%), twelve (21.1%) with-the-rule, while five (0.09%) were oblique. The mean post-operative astigmatism was 1.85 D. The surgically induced corneal astigmatism was highest with ECCE with PCIOL. Astigmatism less than 2 D was highest in this group (ECCE with IOL) while ICCE with ACIOL had the highest number with astigmatism in the range between 2 D and 4 D. The total astigmatism which was mainly with-the-rule (vertical plus cylinder) did not seem to impair severely the post-operative visual acuity of the patients. In conclusion, surgically induced astigmatism affected almost 75% of the patients operated and refracted within the period under review. This can be reduced with better operating skills using small incision suture-less techniques. Existing postoperative astigmatism can be reduced by suture cutting at specific periods particularly if there is follow-up at the critical periods. (*S Afr Optom* 2011 70(2) 75-80)

**Key words:** Astigmatism, post cataract extraction, suturing, intraocular lens, refraction

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## Introduction

The visual acuity (VA) of most patients following cataract extraction has been shown to be significantly better than preoperative vision in every age group<sup>1, 2</sup>. However, even with modern techniques, particularly with incisions larger than 3 mm, poor vision can result from astigmatism<sup>1, 3</sup>. This is largely because of wound closures which for large incisions still require sutures which can inadvertently create tension in certain meridians of the cornea. The location of the incision is also important as certain loci can induce astigmatism more than others<sup>4-6</sup>. Suture placement and whether sutures are removed postoperatively are also important in the development of astigmatism<sup>7, 8</sup>. All these factors can lead to astigmatism which is difficult to correct and this has been the difficulty with these surgeries. Astigmatism means unequal curvature of the refractive surfaces of the eye. Thus a point source of light cannot be brought to a focus on the retina but is spread over a more or less diffuse area. This results from the radius of curvature in one plane being longer or shorter than the radius at right angles to it<sup>9</sup>. There are basically two types of astigmatism that are based on axis of the principal meridians and on the focus of the principal meridians. On the axis basis, the different types are regular astigmatism in which the principal meridians are perpendicular and irregular astigmatism where the principal meridians are not perpendicular. This is also called Murdoch syndrome<sup>9</sup>. In the axis basis, the subtypes are as follows, with-the-rule astigmatism where the axis is between 0 and 30 or 150 and 180 degrees. Against-the-rule astigmatism has the axis between 60 and 120 degrees. Oblique astigmatism has an axis between 30 and 60 or 129 and 150 degrees<sup>10</sup>.

In the postoperative management of these patients, an over-refraction is often needed to enable the patient to have clear vision at different distances<sup>2, 11</sup>. Clear vision may however still elude some patients. Thus, there may be a need for a high corrective astigmatic spectacle or contact lens in many of the patients with, in some instances, poor tolerability of the optical prescription by the patient<sup>8</sup>.

A clinical study has highlighted factors that may result in induced astigmatism<sup>2</sup>. The advent of sutureless small incision surgery<sup>1, 3, 5, 12</sup> will doubtless significantly reduce induced astigmatism. However a lot of centers are still performing extra capsular cataract extraction with the implantation of an intraocular lens

(ECCE and PC IOL)<sup>3, 13-15</sup>. Even intracapsular cataract extraction (ICCE)<sup>16</sup> is still widely performed in certain places. The center at the period in which this study was carried out was still performing ICCE for some patients, with sometimes incisions of up to 6-8 mm.

This study is aimed at assessing the magnitude of the induced astigmatism and if significant to find solutions to the problem, looking at the various options in our hospital.

## Methods

Folders of all adult patients attending the University of Port Harcourt Teaching Hospital Eye Clinic, who had cataract extraction carried out consecutively on them between the years 2002 and 2006 were analyzed year by year using the following information: the age, gender, the past medical history, the type of cataract surgery, the power of the intraocular lens (IOL) that was inserted and the position of the IOL. Other information retrieved include the following: the pre and postoperative visual acuity at 12 weeks, whether or not intraoperative or postoperative complications occurred and what type, the refraction in those who were still on follow up at the end of 12 weeks with emphasis on the astigmatic errors. All information was analyzed using *Epi Info* version 6 with the assistance of a statistician.

## Results

The folders of 114 eyes of 100 people operated upon at the University of Port Harcourt Teaching Hospital within the five year period under review were analyzed in this study. Some had bilateral surgery. The ages ranged from 10 years to 94 years (Mean 61.06 years, SD  $\pm$ 15.99). There were 45 males and 55 females. Coexisting medical conditions which could affect the visual outcome of surgery were seen in the following: Twenty three had hypertension while six of them had diabetes mellitus. Two each had peptic ulcer disease and arthritis, one had asthma and one patient had coexisting glaucoma.

The preoperative acuity ranged between Counting Fingers (CF) and Light Perception (LP). Intra capsular cataract extraction (ICCE) was carried out in 29 eyes (25.4%). ICCE and Anterior Chamber Intra Ocular Lens (ACIOL) was carried out on one eye (0.9%),



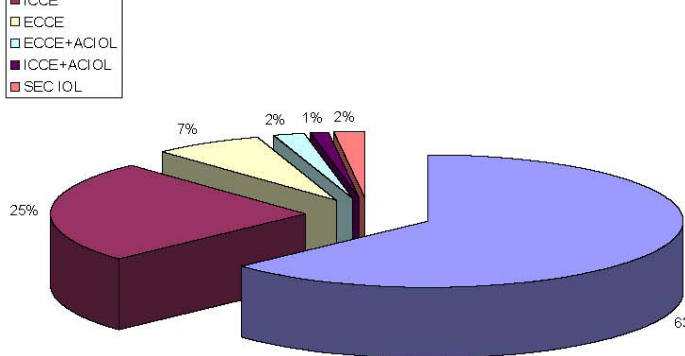
Extra Capsular Cataract Extraction (ECCE) only was performed on eight eyes (7.0%), ECCE and ACIOL was on two eyes (1.8%), ECCE with Posterior Chamber Intra Ocular Lens (PCIOL) was performed on seventy-two eyes (63.2%). Two eyes had secondary IOL inserted into the anterior chamber (1.75%). See Figure 1 for these results.

The power of the IOL used was generally between 17 and 22 D with 21 D used in about 60% of cases. Of those with lenses inserted, over 90% had them inserted in the posterior chamber. Intraoperative complications were mainly vitreous loss in seven cases (6.1 %) ruptured posterior capsule which precluded IOL insertion in two cases (1.75%) retained soft lens matter in two cases (1.75 %). Zonular dialyses or hyphema were noticed in one patient each and positive pressure in one other during surgery. Postoperatively, corneal opacity and iridodialysis was observed in one patient each.

Of the 114 eyes seen, refraction was not done on 31 eyes (27.2%) due to lack of patient attendance after surgery. Of these, four of the eyes had no useful retinoscopic reflex and no improvement with lenses possibly due to the post operative complications. The objective refraction 12 weeks postoperatively gave corrected visual acuities ranging between 6/6 and 6/60. Of the 83 eyes refracted, 57 (68.7%) had astigmatism. The astigmatic errors using the spherical equivalent ranged from -0.5 D to -4.00 D with a mean of 1.85 D. (SD ±1.07).

**KEY**

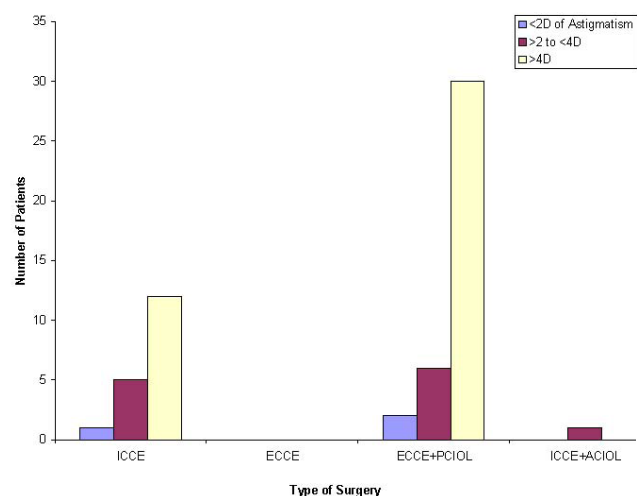
- ECCE+PCIOL EXTRACAPSULAR CATARACT EXTRACTION WITH POSTERIOR CHAMBER INTRAOCULAR LENS
- ICCE INTRACAPSULAR CATARACT EXTRACTION
- ECCE EXTRACAPSULAR CATARACT EXTRACTION
- ECCE+ACIOL EXTRACAPSULAR CATARACT EXTRACTION WITH ANTERIOR CHAMBER INTRAOCULAR LENS
- ICCE+ACIOL INTRACAPSULAR CATARACT EXTRACTION WITH ANTERIOR CHAMBER INTRAOCULAR LENS
- SEC IOL SECONDARY IMPLANTATION OF INTRAOCULAR LENS



**Figure 1** Types of surgery carries out between 2002 and 2006 at the University of Port Harcourt Teaching Hospital, Rivers State, Nigeria

**Discussion**

In this study, about seventy percent (68.7%) of patients within the period under review had some level of astigmatism demonstrable following cataract surgery. The majority ranged from between -0.50 D and -4 D with an average of 1.85 D using the spherical equivalent. Corneal astigmatism after cataract surgery is a well documented finding in adults<sup>17-19</sup>. The degree of astigmatism present depends on various factors, such as the type and location of the surgical incision, the amount of scleral cauterization performed, the suture material and the placement of the sutures. The immediate post operative astigmatism and its subsequent changes are affected by the surgical technique and the experience of the surgeon<sup>3, 5, 20, 21</sup>. The majority of patients (63.2 %) studied in the period under review had extra capsular cataract extraction performed, the gold standard for many years<sup>22</sup>, particularly in the developing world. Prior to this, the situation had been different. Cataract surgery has evolved over the years from being performed through a large incision to give adequate access to the entire lens to enable it to be delivered safely and easily. The methods then were a bit crude with the instruments rather large and making larger incisions<sup>23</sup>.



**Figure 2** Number of patients with different degrees of astigmatism in the different surgeries

With the advent of smaller incision surgeries for cataract like small incision cataract surgery (SICS) and phacoemulsification, and microsurgical equipment, it is expected that the incidence of surgically induced astigmatism will be reduced to the barest minimum<sup>6, 23</sup>.

In this study, relatively large incisions were made





of up to 120 degrees or 8 mm in some cases. Attempts were made to suture the openings back with no visible tension in every meridian; it was observed from the postoperative refractions carried out that some level of astigmatism had been induced thereby optimal visual results were not obtained despite good biometry (see Figures 2 and 4). Some studies<sup>3, 14</sup> have not shown any significant level of astigmatism doing similar types of cataract surgeries.

A study<sup>16</sup> of post ICCE surgery patients showed even higher figures than ours of 4 D with ranges of up to 8 D. In our series, the type of cataract extraction that caused the greatest amount of astigmatism was ECCE with PCIOL as can be seen in Figure 2. This could be because of sheer numbers (as it was the most commonly performed surgery in our center), not necessarily that the surgery itself has a higher rate of inducing astigmatism.

Astigmatism less than 2 D was highest in this group (ECCE with PCIOL) while ICCE with ACIOL had the highest number with astigmatism in the range between 2 D and 4 D. The level of astigmatism of up to 4 D in our series was also observed in Nepal<sup>16</sup>. Against-the-rule astigmatism was also observed in a high number of our patients (40 of 57 (70.2%)) as shown in Figure 3. This high number was corroborated by other workers<sup>15, 24</sup>.

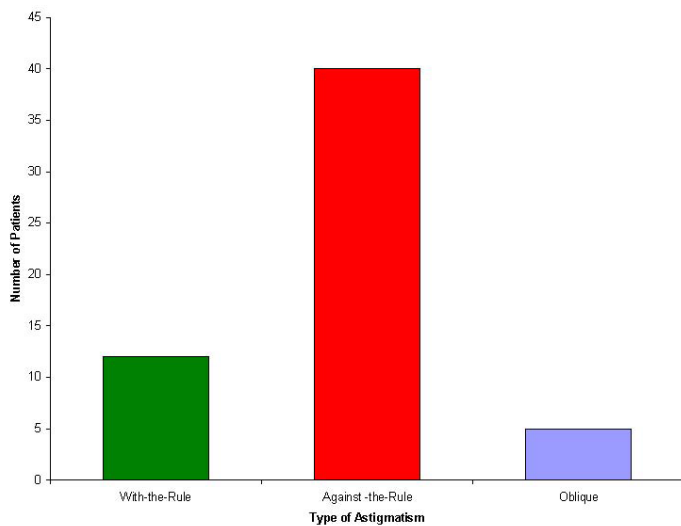


Figure 3 Number of patients with types of astigmatism

Surgically induced astigmatism is a dynamic feature showing changes in size and axis even up to three years postoperative. Releasing the sutures early by the 6th week<sup>25</sup> has however been found helpful particularly if done in conjunction with careful retinoscopy

and keratometry in decreasing induced astigmatism and accelerating the shift in astigmatic axis, turning astigmatism against-the-rule when compared with eyes with intact sutures<sup>17, 18</sup>. Astigmatism reduced significantly in eyes that had their sutures cut<sup>26</sup>.

Eyes with pre-existing astigmatism however have higher chances of being or remaining astigmatic after the surgery<sup>6</sup>. Though a study stated that pre-operative astigmatism did not affect astigmatic change in their series of ECCE surgeries<sup>3</sup>. Also studies have shown that the size of the incision and the location can affect postoperative astigmatism<sup>3, 12</sup>.

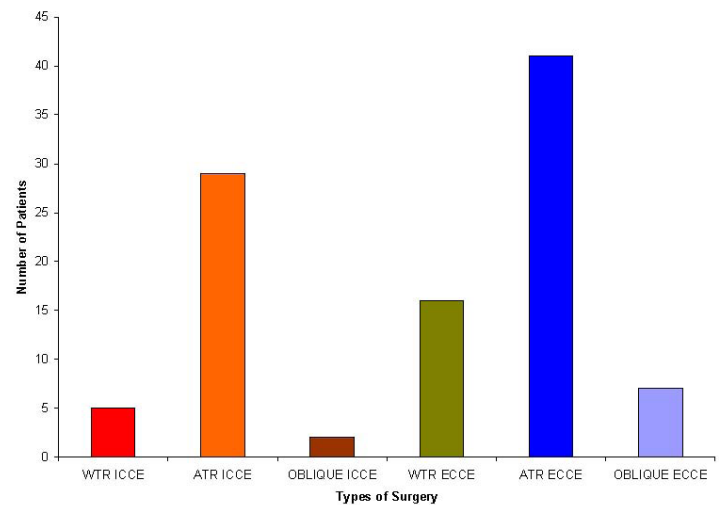


Figure 4 The different types of Astigmatism in various surgeries

Incisions larger than 3.2 mm are more likely to induce astigmatism no matter the location<sup>3, 4, 14</sup>. Making the incision temporally can also ameliorate the surgically induced astigmatism<sup>3, 5</sup>. In our series, most of the surgeries were performed using the superior location. Making the incision temporally is also important and causes minimum astigmatism<sup>27</sup>. If the incision is made in clear cornea, it is more advantageous, particularly if it is 2.8 mm long<sup>5, 12</sup>. This has greater effect, no matter the location; if there was low preoperative corneal cylinder<sup>28</sup>. Most of the temporal incisions carried out in our series were 6-7 mm long. If sutureless, also, it is more advantageous<sup>6, 14</sup>. However in our series, about a third of the patients (27.2%) were lost to follow-up. It could be that they were satisfied with their vision. This may have favorably altered the outcome of these results as in reducing the overall level of the astigmatism, particularly if they had milder levels of induced astigmatism. Follow-up has been a great challenge in this part of the world



as traceable addresses are few and far between and an erratic communication network precludes effective follow-up. This can also be made worse by the various bureaucratic bottlenecks, in hospitals, that the patients are made to go through. Therefore immediately a patient begins to feel better, he may stop coming for check ups. This may also adversely affect early detection of the induced astigmatism for which suture cutting can be used at the appropriate meridian. This will allow remodeling and thereby prevent intractable astigmatism<sup>7, 8</sup> which in our series has been observed to be as high as 4 D.

Our average of 1.85 D is however lower than a study that reported up to 3.47 D as the mean induced cylinder<sup>3</sup>. Astigmatism however changes over time with the eye still remodeling months to years after the surgery<sup>3, 8, 15, 24</sup>. Pre-existing astigmatism can be treated during surgery as shown in some studies<sup>6, 29</sup>. However carrying out suture-less small incision surgery, may reduce astigmatism almost completely as the amount of induced astigmatism is almost negligible when carried out carefully<sup>6</sup>. This will mean better and more satisfied patients as the quality of vision they have will be superior<sup>11</sup>. This type of surgery is what is advocated for now in developing countries due to loss in follow-up, a perennial occurrence. The morbidity is much less also and the patient will be able to return to work a much happier person than before.

A limitation of this study is the lack of recorded preoperative refraction as it is possible that some or even most of these patients had preexisting astigmatism. An assumption was therefore made that the astigmatism seen postoperatively was mainly induced by the cataract surgery. Future studies are therefore needed which will be prospective in nature to allow for refraction to be recorded preoperatively and thus separate its effect or impact on postoperative astigmatism which was difficult to do in this study.

## Conclusion

It is advocated that a complete change in surgical technique (unless otherwise indicated) should be made in our center and others to suture-less small incision surgery as the level of astigmatism induced from the traditional extracapsular could be crippling and unbearable for some patients due to the larger incisions made whether temporal or superior<sup>3</sup>. This is what should be taught to all ophthalmology residents.

Intracapsular techniques should be discontinued completely as even inserting an IOL can increase the risk of developing astigmatism postoperatively<sup>16</sup>.

The best surgery to avoid astigmatism is however to use temporal incisions that are less than 3 mm long. This can only be used with techniques however, which are still not as widespread in the developing world possibly due to expensive equipment<sup>4</sup>.

As most patients find it difficult to come for follow-up, less than 3 mm clear cornea incision surgery or at the very minimum SICS, may be a better option as surgically induced astigmatism can be treated only if the patients present themselves for periodic refraction so that it can be picked up on time and suture cutting carried out in a timely manner<sup>8</sup>. This change is in keeping with international recommendations for the developing world and it is desirable for it to be adopted in our center and elsewhere around the world.

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