COMPARATIVE FUNCTIONAL RESULTS BETWEEN THE FOLDABLE ARTIFICIAL AND RIGID CRYSTALLINES IN THE CATARACT SURGERY THROUGH PHACOEMULSIFICATION

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Abstract: *Introduction: In this study, we aimed at examining whether the functional outcome after cataract surgery by phacoemulsification depends or not on the type of artificial lens implanted. Material and method: Prospective clinical trial, that took place between 2001-2009; we divided the patients into 4 study groups, were we implanted artificial crystallines made of polymethyl-meta-acrylate (PMMA) - group 1 (a corneal incision of 6 mm) and group 2 (5.5 mm incision), or hydrophilic or hydrophobic acrylic lens –group 3 (the incision of 2.8 mm) and group 4 (2.2 mm). The analysis of the induced postoperative astigmatism was achieved using the SIAC_104 freeware. Results: Surgically induced astigmatism when incisions exceed 5.5 mm is statistically significant, being higher than that induced by the smaller incision of less than 3 mm. There is also a statistically significant difference of the induced astigmatism when analyzing the 2.8 mm versus the 2.2 mm incisions. Conclusions: The surgeon must take into account the surgical induced astigmatism for a predictable functional postoperative outcome, especially when one wants to implant a toric IOL. Changing the position of the main incision can help reducing the pre-existing astigmatism.*

Cuvinte cheie: *cataractă, incizie, cristalin artificial rigid şi foldabil*

Rezumat: *Introducere In studiul efectuat am urmărit să analizăm dacă rezultatele funcţionale după chirurgia cataractei prin facoemulsificare depind sau nu de tipul de cristalin artificial implantat. Material şi metodă: Studiu clinic, prospectiv, desfăşurat în perioada 2001-2009, în care s-au luat în studiu 4 loturi, la care s-au implantat cristaline artificiale din polimetil-meta-acrilat (PMMA)- lotul 1(incizie de 6 mm) şi lotul 2 (5,5 mm), sau cristaline acrilice hidrofile ori hidrofobe- loturile 3 (pe incizie de 2,8 mm) şi 4 (2,2 mm). Analiza astigmatismului indus postoperator s-a realizat prin programul SIAC_104. Rezultate: Astigmatismul indus chirurgical în cazul inciziilor de peste 5,5 mm este semnificativ statistic mai mare decât cel indus de incizii mai mici de 3 mm; de asemenea semnificativ statistică este diferenţa de astigmatism indusă prin inciziile de 2,8 mm respectiv 2,2 mm. Concluzii: Chirurgul trebuie să ţină cont de astigmatismul indus chirurgical pentru o predictibilitate bună a rezultatului postoperator funcţional, mai ales când dorim să implantăm cristaline torice.Schimbarea poziţiei inciziei principale poate contribui la diminuarea astigmatismului preexistent.*

INTRODUCTION

In the study we sought to examine whether functional outcome after cataract surgery by phacoemulsification depends or not on the type of artificial lens implanted.

MATERIAL AND METHOD

Clinical prospective trial, conducted between 2001-2009 at the Emergency Military Hospital "Dr. Constantin Papilian" form the city of Cluj-Napoca.

We divided the patients into 4 study groups (50 patients in each of them), differentiated by the type of the main incision made. The incision was made according to the artificial lens used (*polymethyl-meta-acrylate* (PMMA) – rigid intra-ocular lens (IOL) or *hydrophilic or hydrophobic acrylic*-foldable). For the PMMA lens (mostly implanted between 2001 and 2004) we made a 3.2 mm incision in two planes, at the limbus, through which we performed phacoemulsification, then enlarged it to 6 mm (group I) or 5.5 mm (group II) in order to insert the implant. Between 2005-2009 we implanted mostly foldable *hydrophilic* IOLs folders (eXcellens-Idea, Rayner, Rotho) and foldable *hydrophobic* IOLs (Alcon-SA60AT, IQ, MA60AT or Toric), through a clear cornea incisions in 2 planes of 2.8 mm (group III) and 2.2 mm (group IV).

Inclusion criteria of the patients within the study were the following: no complications during the phacoemulsification process, postoperative control at 12 months with kerato-refractometric assessment, placement of 2-3 suture threads (10-0 prolene) for lots I and II but removed 3 months postoperatively, in some cases a 10-0 prolene suture thread for group III but removed 6 weeks postoperatively.

Exclusion criteria from the study were: complications (or incidents) during surgery, *per secundam* implantation, patients with traumatic cataracts, pterygium, retinal disease or final control earlier than 12 months after surgery (did not show-up for control at the established date or visited the ophthalmologist in another service closer to home).

RESULTS

The data was processed using the SIAC_104 program (freeware) that calculated the surgically induced astigmatism and postoperative value based upon the preoperative and postoperative keratometry.

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Table no. 1. Values measured for group I, with a limbic incision of 6 mm located at 95

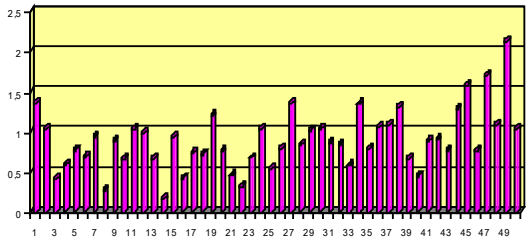


Table no. 2. Values obtained in patients where we practiced the incision of 5.5 mm (group II)

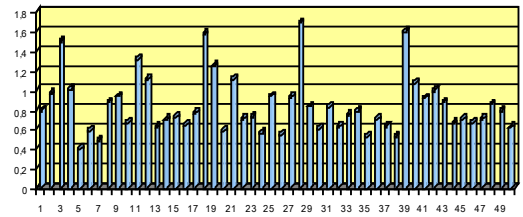


Table no. 3. Postoperative results in group III, with clear corneal incision of 3 mm, 110

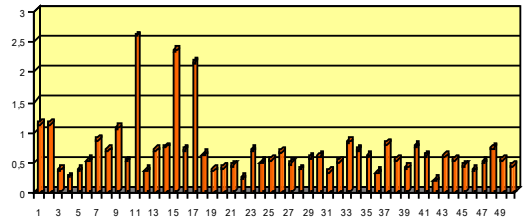
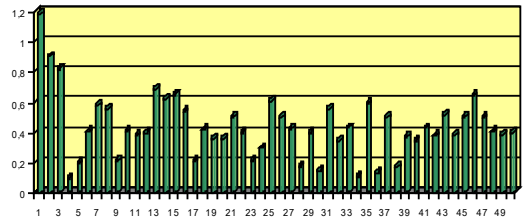


Table no. 4. Postoperative astigmatism values in group IV (2.2 mm incision)



For group I, we have the following data:
Average induced astigmatism value = 0892 D
Standard deviation = 0372 D
Max = 2.14 D, Low = 0160 D
Median = 0860 D
Average Absolute Deviation from Median = 0275 D

For group II, we noted the following figures:
Average induced astigmatism value = 0842 D
Standard deviation = 0295 D
Max = 1.69 D, Low = 0400 D
Median = 0750 D
Average Absolute Deviation from Median = 0213 D

For group III, we noted:
Average induced astigmatism value = 0676 D
Standard deviation = 0.476 D
Max = 2.58 D, Low = 0.20 D
Median = 0550 D
Average Absolute Deviation from Median = 0250 D

In group IV, we noted:
Average induced astigmatism value = 0439 D
Standard deviation = 0202 D
Max = 1.18 D, Low = 0110 D
Median = 0420 D
Average Absolute Deviation from Median = 0144 D

In order to statistically compare the values between these three groups we used the unpaired t test. We have null hypothesis: *what are the chances that the surgery induced astigmatism differences between various types of incisions are random?*

Thus, for group I and group II have a standard deviation Sdev = 0.336 and p = 0.46.

Between group I and III we have Sdev = 0.427 and p = 0.013.

Between group II and III we have Sdev = 0.396 and p = 0.039.

Between group III and IV we have Sdev = 0.366 and p = 0.0016

For every patient we noted the intraoperative cataract hardness, graded on a scale from 1 + to 4 +, and where needed we used half measures. After each phacoemulsification intervention we noted the amount of ultrasound used in each case (quantification performed by the Legacy machine, *Alcon, Forth Worth, TX*). Thus we have ultrasound amplitude (AP) and the percentage used (U.S.%). In our series of eyes operated on by phacoemulsification we found a statistically good correlation between the hardness of the cataract and the amount of U.S. used (q = +0.37).

DISCUSSIONS

Despite the fact that, as demonstrated by the studies made by Kohnen and Kasper, during the implantation of a foldable lens the incision gets enlarged by 3 - 4.5% extra, this does not influence the postoperative outcome.(4) So, if we eliminate our series of patients this as disturbing factor of the final results.

Comparing similar studies we find that Gogeta refers to a similar study where the incision of 5.5 mm determined a postoperative astigmatism of 0.88 D, while the results with the 3.2 mm incision were much better (0.2 D induced astigmatism). (3)

Bartels shows in his study, at 2 months, an induced astigmatism of 0.78 D for the 5.5 mm incision, but at 6 months the vector calculus showed a value of astigmatism of 0.28 D + / - 0.54 D at the axis of 174^0. (2)

In a study made by Sabina Kurz, one identifies in the series of patients (70 eyes) an induced astigmatism (average) of 0.7 D-with a 2.75 mm-incision: very close to our obtained value. (5)

Against-the-rule astigmatism is preferred by surgeons, mostly because it allows a better uncorrected visual acuity (UVA).(1,4) The incision in the upper quadrant usually induces against-the-rule astigmatism, and in our study the incision was located at $95\text{-}110^0$. This is supported in a large study by Tejedor (on 574 patients). He found, using a superior incision (2.8 mm) an induced astigmatism of 1.33 + / - 0.81 D for the patients where the overall astigmatism has not changed and 0.77 + / - 0.74 D for those where the type of astigmatism has changed (against-the-rule / with-the--rule). He concludes that 75% of cases which had reversed the pre-and postoperative astigmatism had an initial corneal astigmatism <1.5 D (7)

In our series of patients we noted that the incision depends a lot on the preoperative keratometry values and that we tended to perform the incisions according to these values for optimal results of the surgery. Low levels of surgically induced astigmatism are obtained if the steeper meridian is located near the incision (95 or 110 degrees), and generally for the with-the-rule astigmatisms.(6,10)

CONCLUSIONS

As we progress to small incisions (3 mm and below), the induced astigmatism after surgery is statistically significantly reduced, such as can be seen in our study. The small amount of astigmatism induced by the incision of 2.2 mm (0.439 D) compared to that induced by the incision of 2.8 mm (0.676 D) is therefore not the result of chance. We note however that the amount of astigmatism induced by the incisions necessary for PMMA lens implantation was not so high (0.842 D for 5.5 mm and 0.892 D for 6 mm), thanks largely to a good suture and removal of the 10-0 thread on time, not earlier than 12 weeks, to allow a better corneal wound healing and a stable reduction in astigmatism.

During the time of our study the incision necessary for foldable IOL implantation was reduced from 3.2 mm to 2.2 mm.

The surgeon must take the decision upon the type of incision depending on the type of lens that will be inserted (PMMA or foldable).This also depends on a number of medical reasons related to the type of cataract (hard or traumatic etc.), associated diseases (diabetes, cataract in an eye with uveitis, glaucoma), patient age (congenital cataracts, juvenile), or other local conditions.(6,9) The surgeon should always take into account the preoperative astigmatism when choosing the incision (location and size), and where one uses large incisions the proper placement of a suture thread will help reducing the postoperative astigmatism.(8)

Referring strictly to the incision induced astigmatism, we must mention its importance when we are dealing with toric implants. The power calculation for these IOLs needs a known value of induced astigmatism (usually 0,5 D as standard), which if is not "respected" or falsely chosen may lead to changes in the final postoperative refraction compared to the anticipated outcome.(7,10)

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