



Managing Postoperative Astigmatism in Cataract Surgery: A Short Review

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Abstract

Cataract surgery is no more a visual rehabilitation surgery. Today along with cataract removal, astigmatism correction has become a routine procedure. Patients want a spectacle free life at any stage of life. 10 years before it was still impressive to have a residual of +2.0 D astigmatism following cataract surgery. But in last 10 years, a lot of technological advancement has happened. The residual astigmatism following cataract surgery has come down from 1.5D to 0.75D, even 0.5D when a premium IOL is implanted. Here we are going to discuss in short the journey of astigmatism correction from choosing the incision in steep axis to Toric IOL implantation and so on.

Keywords: Astigmatism; Surgery; Limbal relaxing incisions (LRI)

Introduction

Cataract surgery has evolved a long way from being simple lens extraction to refractive procedure. Now a days patients wants a spectacle free life following cataract surgery. As a result it is utmost important to correct the pre-existing corneal astigmatism and also to reduce surgery induced astigmatism. Studies have shown that 35% - 40% of cataract patients have ≥ 1.0 D of astigmatism. And around 20% have ≥ 1.5 D. A no of techniques along with special intra ocular lenses (IOLs) have been developed till now and the process is still evolving [1-3].

Basic corneal architecture

Incisions made during SICS or phacoemulcification surgery dissect the corneal lamellae and reduce tension between fibers. Change in tension, causes deformation of the shape of cornea and its resultant astigmatism. It is the size, shape, position and architecture of the incision which can determine the final astigmatic effect on it. Experiments by Koch, Kuglen has shown that induced astigmatism is proportional to the cube of the incision length [4].

Again the closer the incision is from visual axis, the more it causes astigmatism. As the cornea is more of oval in shape, so any incision in superior cornea is nearer to visual axis than temporal cornea. So superior incisions tends to produce more astigmatism than temporal incisions [8].

Cornea shows coupling effect due to distribution of corneal lamellae, which is steepening of axis, 90 degree away from flattened axis [5]. It is possible to plan the surgical incision in correct plane and reduce the pre existing astigmatism successfully. Limbal relaxing incisions (LRI), Clear corneal incisions (CCI), paired opposite clear corneal incision (OCCI), Toric IOL and bioptics are various approaches to advocate pre existing astigmatism.

Pre OP evaluation

Keratometry is quiet accurate to measure the steep axis for most of the patients. In cases of forme fruste keratoconus, arrested keratoconus, irregular astigmatism, post LASIK patients corneal topography can precisely tell the astigmatic nature of cornea. Surgically induced astigmatism (SIA) must be calculated specially in cases of

low pre existing astigmatism or where premium IOLs are going to be implanted. It can be calculated from online calculators accurately. Post - op residual astigmatism should be less than 0.5 D for patients seeking spectacle independence.

Incision on steep meridian

An easy way to reduce pre existing astigmatism is to place the incision on the steep meridian and flatten it. It works best for with the rule astigmatism. A clear corneal phaco incision of 3 - 3.2 mm induces 0.5 - 0.67 D of astigmatism [6,7]. 2.4 mm induces 0.35 - 0.21 D of astigmatism. Whereas micro incisional phaco incisions less than 2.2 mm produces minimal flattening of cornea [7,9].

Surgeon can predict up to 0.75D of SIA, and it best works when patient have less than 1 D of pre existing astigmatism. Less than 0.5 D astigmatism does not need correction. Up to 0.5 D of myopic against the rule astigmatism apparently improves the near vision [10].

Astigmatism is higher in manual SICS surgery due to larger size. Moreover, temporal and supero temporal incision creates lesser astigmatism compared to superior incision. Approximately 1.28D of astigmatism is seen following SICS which can be recommended for patients having pre existing astigmatism more than 1 D [11].

Limbal relaxing incisions

LRIs can correct (0.5 - 3.0) D of astigmatism [12]. A clear corneal incision, between 5 - 7 mm of optical zone, up to (90 - 95)% depth of corneal thickness/600 micron, straight or arcuate incision, is given in the steep axis. Based on the age, amount of astigmatism, thickness of cornea the length of incision can be extended from 30 degree to 45, 60 or even up to 90 degrees. As the incision is given in the mid periphery approximately 0.5 mm anterior to anterior limbal border, the chances of perforation, visual disturbances, dry eye are very less. Because of coupling action it flattens the steep axis along with steepen the axis 90 degree away from the original incision [16]. When the incision site fall on the arch area, one must be careful to first carry away with the surgery with the phaco surgery wound corresponding to the arc site, following extending the incision for astigmatic correction. Otherwise, chances of wound leak during surgery with anterior chamber instability can complicate the whole surgery.

Several nomograms are in use now a days to calculate the degree of arc like Donnenfield nomogram, Nichamin nomogram even

online calculators are available at <http://www.Iricalculator.com/> [13-15].

Proper centration is important as the effect of correction wins off with wrong axis selection for every 5 degree. Cyclorotation of eye should be kept in mind and eye should be marked in proper axis before starting surgery. Verion and Callisto are wonderful devices to mark the correctly. Now a days femtosecond laser is used for LRIs, its available on Intralase (Abbott Medical Optics) on LenSx, LensAR, Victus, OptiMedica [17,18].

Eyes with corneal ectasia, irregular astigmatism are not advised for LRIs. LRI s are better suited for regular astigmatism but many studies state that, their predictability is questionable [19].

Paired opposite clear corneal incisions (POCCI)

This technique was first described by Lever and Dahan of placing another clear corneal incision 180 degree opposite to the first CCI [20]. It enhances the effect of first incision and do not need any special instruments to make it. According to Lever and Dehen POCCI corrects astigmatism up to 1.5 D. But the technique is not much popular due to lack of predictability, absence of nomogram and higher risk of post op infection due to multiple incisions [21].

Toric IOL implantation

Toric IOL was first invented in 1988. It is much more predictable than the other techniques used before. From 0.75 - upto 6.0 D of astigmatism can be corrected with toric IOLs [22,23].

It can correct astigmatism at any axis. But if the lens rotates following surgery it reduces the astigmatic power of the lens. Rotation of 10 degree reduces astigmatic correction by one third, 20 degree by two third and by > 30 degree rotation the astigmatic correction becomes nil [24,25]. It is very important to place the axis of the lens correctly and remove and visco elastic substance behind IOL to prevent post op rotation. In myopic eyes or eyes with pseudoexfoliation, placing a CTR to prevent rotation is advisable. Alcon AcrySof Toric lenses T6 - T9 corrects up to 6D in the IOL plane where 4.0 D is corrected in corneal plane. These lenses are coated with adhesive material which maintains their stability furthermore [26].

The IOL power can be calculated from Toric IOL calculator online at <http://www.acrysoftoriccalculator.com>.

Now monofocal and presbyopia correcting extended depth toric IOLs also have come to market. AMO TECNIS Toric from Abbott medical optics has toric IOLs which corrects from 1.00D - 4.0D of astigmatism and they have lenses of +5D to +34D [26]. Regular astigmatism is best treated with toric, even in cases of arrested keratoconus, pseudoexfoliation patients it has shown good results, but long term multicentric study is still lacking.

Future of astigmatism correction

Intra operative aberrometry uses wavefront technology and real-time information during surgery. It takes accountability of aphakic astigmatism, SIA, posterior corneal astigmatism while calculating the IOL power. Eyelid speculum pressure, corneal hydration, viscoelastic substances - they poses drawback in the process but few multicentric studies are going on in this era to find out the possible correction. Almost a perfect IOL power can be placed in bag by this method but its still in an early stage of development. Despite all the measures, residual astigmatism is still seen. Ideally it should be < 0.75D. Resultant refractive error following cataract surgery can be corrected by laser refractive procedures like LASIK or for older patients with PRK. In extreme conditions even Piggyback IOLs can be tried too. Barrett's toric calculator, Abulafia-Koch formula are pretty good in calculating IOL powers now [27].

Conclusion

Cataract surgery has come a long way and its evolving more towards robotics now. As a cataract surgeon it has become a responsibility to give our patients, as minimal residual astigmatism as possible. With evolving technology, spectacle free life is not very difficult to achieve for everyone anymore.

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The authors of the article have no financial interest of any instrument/procedure aforementioned.

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