THERAPETICALLY OPTIONS IN CORNEAL ASTIGMATISM CORRECTION IN CATARACT PATIENTS

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Keywords: *astigmatism, cataract*

Abstract: *In the last years, with the IOL premium appearance, the cataract surgery becames a refractive procedure with spectacle dependence decrease as a main purpose. Therefore, the corneal astigmatism management on this patiens is very important and the purpose of this paper is to present the astigmatism correction possibilities.*

Cuvinte cheie: *astigmatism, cataractă*

Rezumat: *În ultimii ani, odată cu apariţia cristalinelor premium, operaţia de cataractă a devenit o procedură refractivă ce are ca scop reducerea dependenţei pacientului faţă de ochelari. De aceea managementul astigmatismului cornean la aceşti pacienţi este important iar lucrarea îşi propune prezentarea modalităţilor de corecţie a acestuia.*

SCIENTIFIC ARTICLE OF THEORETICALLY PREDOMINANCE

The main goals in cataract surgery through small incisions are the emetropy and the lack of surgical induced astigmatism.

Choosing the correct treatment will depend on many factors including the lifestyle, the medical history, the grade of refractive defects. Arcuate keratotomy, limbal relaxing incisions, toric IOL, laser excimer treatment and different types of incisions has been related in literature for the astigmatism correction after cataract surgery.(1)

Before the refractive surgery appearance the eyeglasses and the contact lenses were the only way to correct the astigmatism and many people still prefer it. The actual progress in technology influences the solutions for astigmatism correction. The most used procedures can be split in two categories: non-laser procedures (astigmatic keratotomy) and laser procedures (PRK, LASIK).

Incisional procedures

Arcuate keratotomy is like radial keratotomy but, the incisions are made in the periphery of the cornea for astigmatism correction in a few special cases (the residual astigmatism after keratoplasty or cataract surgery). The astigmic keratotomy contains 2 groups – the limbal relaxing incisions (LRI) and the corneal relaxing incisions (CRI).

Limbal relaxing incisions (LRI)

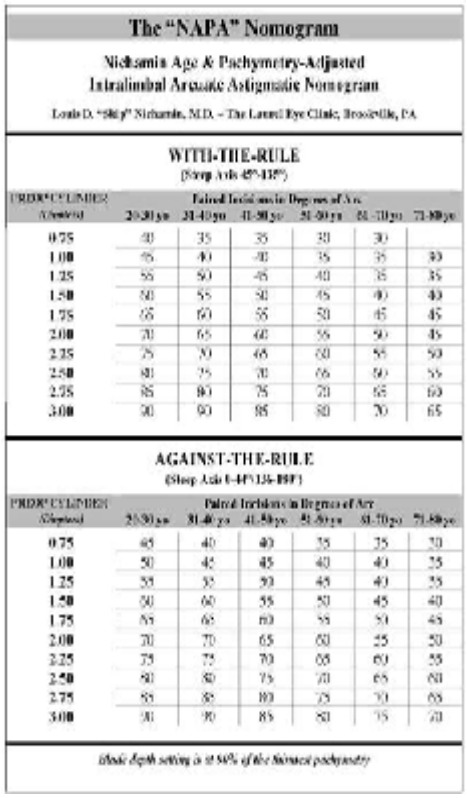
Through the last years, the patient's over request got to the fast increase of premium IOL implantation popularity. The removal of the significantly corneal astigmatism is one of the key factors in multifocal and/ or accommodative IOL implantation success.

This ophthalmological trend determined the doctors to review the limbal relaxing incisions procedure.

A recent study made of Dr. Ray Oyakawa shown a 96% success rate in patients with significant visual astigmatism at the cataract surgery time. LRI became the most popular way for astigmatism correction in patients with cataract surgery and IOL implantation.

To helping the ophthalmologists in astigmic reduction, there are available a number of published nomograms. The Louis D. Nichamin's NAPA nomogram is one of the most used nomograms. Dr. Nichamin advises to set the knife on the incision place at 90% from peripheral corneal thickness.

Table no. 1. NAPA Nomogram



The "NAPA" Nomogram

Nichamin Age & Pachymetry-Adjusted Intralimbal Arcuate Astigmatic Nomogram

Louis D. "Skip" Nichamin, M.D. – The Laurel Eye Clinic, Brookville, PA

WITH-THE-RULE

(Steep Axis 45°-135°)

PREOP CYLINDER (Diopters)	Paired Incisions in Degrees of Arc					
	21-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs	71-80 yrs
0.75	40	35	35	30	30	
1.00	45	40	40	35	35	30
1.25	55	50	45	40	35	35
1.50	60	55	50	45	40	40
1.75	65	60	55	50	45	45
2.00	70	65	60	55	50	45
2.25	75	70	65	60	55	50
2.50	80	75	70	65	60	55
2.75	85	80	75	70	65	60
3.00	90	90	85	80	70	65

AGAINST-THE-RULE

(Steep Axis 0-44°/136-180°)

PREOP CYLINDER (Diopters)	Paired Incisions in Degrees of Arc					
	21-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs	71-80 yrs
0.75	45	40	40	35	35	30
1.00	50	45	45	40	40	35
1.25	55	50	50	45	40	35
1.50	60	60	55	50	45	40
1.75	65	65	60	55	50	45
2.00	70	70	65	60	55	50
2.25	75	75	70	65	60	55
2.50	80	80	75	70	65	60
2.75	85	85	80	75	70	65
3.00	90	90	85	80	75	70

Blade depth setting is at 90% of the thinnest pachymetry

The LRI advantages:

- easier to make, less dependent of pachimetry , less

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Articol intrat în redacţie în 08.02.2011 şi acceptat spre publicare în 16.07.2011

ACTA MEDICA TRANSILVANICA September 2011; 2(3)490-492

over corrections, fast postoperative stabilization, the corneal topography is more smooth.

- the LRI is the best choice in low and moderate astigmatism (under 3 D).

Disadvantages:

- a larger incision (ordinary 1 or 2 incisions made on 1-2 hours)

- can induce under correction or changes in the topographic pattern (coupling effect) due to the wrong alignment with the steepest axis or due to the inadequate length of the incisions to full cover the steepest axis.(2)

Relative contraindications of the LRI: keratoconus, autoimmune diseases, peripheral corneal diseases, the Terrien degeneration, previous corneal surgery, especially incisional procedures

Figure no. 1. Limbal relaxing incision

Corneal relaxing incisions (CRI)

The astigmatic effect of the clear corneal incisions was proved to be efficient for the pre-existent astigmatism control in modern cataract surgery, through incisions on the steepest meridian. Lever and Dahan observed that the clear corneal incisions are self-sealing, without farther risks, don't need special surgical devices and are effective in pre-existent astigmatism treatment. The clear corneal incisions are invasive and generate a stable flattening effect over the time, while the opposite incisions improve the flattening effect.(1)

The placement of the facoemulsification incision on the steepest axis corrects small astigmatisms and is enough for the most of the eyes.

CRI advantages:

- shorter, powerful incision (corrects a bigger astigmatism), placement in a smaller optical zone (smaller coupling effect), "multifocal" effect (better focus depth).

CRI disadvantages:

- bigger discomfort, major risk of corneal perforation (the incision is more dependent of the accurate pachimetry), can cause many corneal irregularities and irregular astigmatism.
- bigger risk of over correction, therefore are made in patients with high astigmatism.
- the risk of lost BCVA.

Both LRI and CRI can be use in combination with toric implants or the strategic placement of the cataract surgery incision for the high astigmatism treatment.

Laser procedures

Photorefractive keratotomy (PRK) was the first refractive surgery technique available in USA and is still popular in the astigmatism treatment in patients with large pupil or very thin cornea.

LASIK is the most used procedure because 90% of the patients have less than 6 diopters astigmatism. The technique changes the refractive power of the cornea allowing the light rays to focus properly on the retina.

The toric IOL implantation

The artificial toric lenses are count one of the ideal solutions for the patients with cataract and astigmatism. The toric IOL are safe, made of nontoxic silicone or acrylic material, flexible and easy to implant and without historic issues after implantation. One of the toric lenses implantation issues was the postoperative lens rotation.(3)

Now on the market are two toric lenses Staar toric IOL approved by FDA 10 years ago and Acrysof toric IOL approved 5 years ago. The toric intraocular lenses give the possibility to reduce or eliminate more precisely the patient astigmatism, especially if in the estimated postoperative astigmatism calculation will be consider the induced astigmatism through corneal incision.(4)

The success of the toric lens belongs to the accuracy and stability of correction. For accuracy its take into account the surgical induced astigmatism also. The artificial lens mast be implanted and precisely aligned with the requested correction axis. This alignment will be obtained using the corneal marking for the detection of accurate intraoperative position of the lens. For stability the lens must keep the same position through time. This last element is the key of this lens success for a long term.(5)

Remain the challenge regarding to the stability and the accuracy of the correction allowing that this ophthalmic procedure through its nature is a variable procedure.

The artificial toric lenses are safe and efficient for treating more than 1D astigmatism and now the lenses have a excellent rotational stability.(6)

A prospective clinical study was made on eyes with more than 1D pre-existent corneal astigmatism; in one group it was implanted the Acrysof toric IOL while in other group was made corneal incisions on the steepest axis and it was implanted the spherical IOL's. At 3 month postoperative it was evaluate the VA, refraction, contrast sensibility and the axis that the toric IOL was implanted.(7)

In group with toric IOL 95 % of eyes achieved 20/40 UCVA or more, and 70% of eyes achieved 20/25 UCVA or more.

In group with corneal incisions 80% of eyes achieved UCVA 20/40 or more, and 50% of eyes achieved 20/25 UCVA or more.

The refractive cylinder significant decreased in both groups, from -1.75+/-0.71 to -0.62+/-0.46 D in the toric group, from -1.61+/-0.67 to -0.97+/-0.51 D in the incisions group ($P< 0.1$).

The contrast sensibility was similar exception the spatial highest frequency which was better in the toric group.

The surgical induced astigmatism as long as can be in the lowest level will vary between eyes and between surgeons and can significant affect the results.(8)

The marking process of the cornea for the right alignment of the lens can be less perfect and the alignment to the axis intraoperatory can be less exact. The IOL may rotate in the postoperative period. All of this alignment and stability errors will combine for reduce the potential efficiency of any toric. The more of this errors will be controlled the less will be there effect. In generally for each grade of error in the IOL alignment the efficiency in astigmatism correction will decrease with 3.33%.

After FDA approval of Acrysof IOL, the toric IOLs kept obtaining popularity.

This IOL is made to be implanted in patients with cataract and corneal significant preexistent astigmatism. The Acrysof toric IOL give excellent visual results and an excellent rotational stability. The IOL mean value of rotation was less than 4 degree at 6 month after implantation.

The Acrysof toric IOL has a single piece design SN60AT, is a hydrophobic acrylic IOL with yellow cromofor incorporate. The optic has 6 mm. It can be implanted through a 2.2mm incision. The IQ version is an aspheric toric. The lens has the axis marked with 3 dots on both sides of optics periphery which is the most refringent axis.(9)

Figure no. 2. IOL Acrysof Toric

The Staar toric IOL is made from silicon with plate haptics can be implanted through 3 mm incision; don't implant in a compromise capsular bag. It is available in two models, with two cylindrical powers. The axis is marked with two lines in periphery of the lens.

Figure no. 3. IOL Staar Toric

These lenses are monofocal wherefore the patients will need a pair of glasses. In the last year the pseudoaccomodative toric IOL is present on the market.

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CONCLUSIONS

The therapeutically options used in astigmatism correction are: LRI for less than one diopter astigmatism, toric IOL or LRI for 1- 3 D astigmatism and combination of toric IOL or LRI (CRI) with strategically cataract incision placement in more than 3 D astigmatism.

For improving the outcomes of the patient the cataract surgeons will find usefully the LRI and easy to made in order to achieve postoperative optimal results.(10)

The toric IOL implantation alone or in addition with LRI or the placement of incision in the most refrigent axis, can treat with success the astigmatism and should take in to consideration for the astigmic patients which want freedom from glasses. The toric IOLs are a attractive option in those cases where the relaxing incisions are not enough powerful and predictable.(11)

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