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Intraocular Presbyopia-Correcting Lenses in Patients Who Have Had Corneal Refractive Surgery

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1. Abstarct

An Overview and Background Millions of people have been able to see without glasses thanks to corneal refractive surgery, but this older population is now developing cataracts. After cataract surgery, many of these patients may want to avoid wearing glasses. Intraocular lenses (IOLs) that correct for presbyopia provide a solution; however, corneal changes following refractive surgery may exacerbate the higher-order aberrations and dysphotopic symptoms that these IOLs cause. The purpose of this review is to discuss potential factors that could assist in selecting presbyopia-correcting IOL candidates from postkeratorefractive patients.

1.1. Recent Results: Concentrates on exploring which preoperative measures impact results are deficient. The few studies that have looked at IOLs that correct for presbyopia in postkeratorefractive patients have found that good results are possible. However, studies involving virgin corneas and expert opinion appear to be the only sources of recommendations for preoperative thresholds.

1.2. Summary: In order to make decisions based on evidence, ongoing research into relevant preoperative factors and the appropriate IOLs is necessary as the number of presbyopia-correcting IOLs and postkeratorefractive patients increases. According to the most recent research, presbyopia-correcting IOLs can provide postkeratorefractive patients with satisfactory results and the freedom from glasses if they are selected for the right patients and given thorough counseling. In addition, it's possible that developing postoperatively modifiable IOLs will be the best choice.

2. Introduction

Corneal refractive surgery has helped millions of people achieve clear, glasses-free vision for decades. A considerable lot of these patients are currently creating waterfalls, and because of different variables, postkeratorefractive patients will generally go through waterfall medical procedure sooner than patients with virgin corneas.[1] Self-choosing as a gathering that focuses on exhibition freedom, a large number of these more youthful postkeratorefractive patients keep up with better standards for their refractive results observing waterfall surgery.[2] Presbyopia-remedying intraocular focal points (IOLs, for example, multifocal IOLs (MFIOLs) and expanded profundity of field (EDOF) IOLs, have been displayed to give higher paces of uncorrected moderate and close to vision and, in this way, higher paces of scene freedom than monofocal IOLs.[3] Be that as it may, a large number of these presbyopia-rectifying IOLs are related with an expanded gamble of dysphotopsias and a diminishing conversely, sensitivity.[4] Patients who accomplish 'wonderful' careful outcomes might in any case be disappointed with their results. Dysphotopsias and visual disturbances caused by presbyopia-correcting IOLs are unlikely to be tolerated by patients who are demanding and have high expectations. Patients who are willing to be counseled and who are aware of the risks associated with these IOLs are ideal.

Patients ought to know that Food and Medication Organization (FDA) premarket endorsement preliminaries for all presbyopia-remedying IOL inserts were solely directed on virgin corneas, and preliminaries for the AcrySofPanoptix (Alcon Research facilities, Post Worth, Texas, USA) and Tecnis Symfony (Abbott Clinical Optics, Inc., St Nick Ana, California, USA) showed protests of some level of dysphotopsia, like glare, corona, or starburst, in around 40-half of patients with 20-30% neglecting to accomplish total independence from glasses.[5,6] The FDA supported and other presbyopia-adjusting IOLs. Albeit past corneal refractive medical procedure is certainly not an outright contraindication for presbyopia-rectifying IOLs, it gives a few difficulties that require extra assessment and guiding. There are no comprehensive guidelines for determining which postkeratorefractive patients are suitable candidates, and the difficulties associated with presbyopia-correcting IOLs have not been quantified. The IOL power calculations for these patients pose a further challenge[15]. However, the sole purpose of this review is to discuss potential screening thresholds and other factors to take into account when selecting postrefractive candidates for presbyopia-correcting IOLs. Nonstandardized reporting of results also limits efforts to establish guidelines and interstudy comparisons.

Preoperative Considerations For eyes with virgin corneas, many of the same preoperative considerations apply to postkeratorefractive patients. Higher-order aberrations (HOAs), light scattering, and dysphotopsias are examples of optical phenomena that can have a negative impact on visual outcomes. Preexisting intraocular and ocular surface disorders can also have this effect. Presbyopia-correcting intraocular lenses (IOLs) may not be able to be implanted due to these conditions entirely or in part. Thusly, a complete preoperative ophthalmologic assessment, including emotional and objective measures is recommended.[17] Dry eye sickness (DED), a typical postkeratorefractive gathering, meibomian organ brokenness, and other tear film inconsistencies increment light dissipate and diminish both difference responsiveness and optical quality after IOL implantation. [18] Preoperative visual surface appraisal ought to incorporate dry eye side effect assessments, for example, the ASCRS Speed II Poll, cut light assessment, and other symptomatic measures. Modulation transfer function (MTF), objective scatter index (OSI), Strehl ratio, and aberrometry can all be objectively quantified in today's optical quality analysis systems. [19] Recording the dynamic changes in OSI in unblinking patients correlates strongly with tear film stability.[20] DED and other tear film abnormalities can lead to incorrect IOL calculations and are common causes of patient dissatisfaction.[17] [A] Postkeratorefractive patients should consider punctal occlusion with dissolvable or permanent plugs as a safe and effective treatment for DED prior to and after presbyopia-correction IOL implantation [A]. Dynamic tear film integrity analysis is therefore an effective preoperative tool for assessing the ocular surface, even in patients who are asymptomatic.[18] As a rule, any DED detected on examination warrants aggressive management to improve the accuracy of preoperative IOL calculations and

3. Ocular Pathology

Although well-managed, nonprogressive corneal or retinal diseases may not prevent patients from achieving satisfactory outcomes, corneal abnormalities such as pterygia and dystrophies, particularly Fuch's dystrophy, are contraindications to presbyopia-correcting IOLs. Pupil Diameter Larger pupils are associated with a higher risk of dysphotopsias secondary to HOAs.[23] In eyes with HOAs, more incorrectly focused peripheral rays begin to enter the eye with pupil dilation, resulting in dysphotopsias. Ocular coherence tomography, fluorescein angiography, and visual field testing can evaluate subtle or occult retinal and optic nerve disease that may compound the decreased contrast sensitivity associated Generally speaking, for each multiplying of the student distance across, distortions increment 16-fold.[24] De Vries et al. found that larger pupils with a diameter of 5.18 millimeters under low mesopic conditions had greater difficulty reading and reported greater dissatisfaction with their overall visual outcomes[23]. Asymmetric, irregular pupils also cause dysphotopsias, which most likely prevent patients from receiving presbyopia-correcting IOLs[21]. [10] Ouchi and Shiba found that preoperative photopic pupils less than 3.0 mm had a statistically significant decrease in contrast sensitivity at higher spatial frequencies (12 and 18 cpd) after Tecnis Multifocal (Abbott Medical Optics, Inc.) implantation. However, Fernandez et al. found that an uneven or decenteredcapsulorhexis could result in a decentered IOL, resulting in reduced presbyopia-correcting I implantation of Versario Multifocal (Bausch & Lomb, Rochester, New York, USA) resulted in a statistically insignificant increase in contrast sensitivity for pupils less than 3.0 mm.[26] It is important to note that both studies examined MFIOLs in virgin corneas. Angle Kappa and Alpha Angle kappa is the angle or distance between the patient's visual axis and pupil center, while angle alpha is the difference between the visual axis and limbal center, which corresponds to the capsular bag center. Nonapodized diffractive and nonprogressive refractive MFIOLs are less dependent on pupil dynamics and may be better suited for patients with smaller pupils.[11,21,23]

A large angle kappa or alpha may increase the risk of a decentered multifocal IOL, especially temporarily, which may result in poorer objective outcomes such as reduced MTF and Strehl ratio and increased OSI in addition to halos and glare.[10,29,30] A 2012 study using mechanical eye models found no clinically relevant effects until decentration from the pupil center was greater than 0.75 mm.[10] A 2019 study by Velasco-Barona e Model-specific IOL inner optical diameters vary in size, but the theoretical limit for a particular angle kappa is equal to half of that diameter,[29] [B]. Velasco-Barona et al. Also, the inner optical diameters of the PanOptix and AT LISA tri 839 MFIOLs (Carl Zeiss Meditec, Jena, Germany) were compared and found to have no effect on visual acuities at angle kappas below 0.62 mm. Qi and co., notwithstanding, found that a point kappa above 0.4 mm builds the occurrence of glare and radiances with visual sharpness being impacted at points more noteworthy than 0.5 mm.[32] Lee et al.[33] additionally found that in eyes with virgin corneas going through PanOptix implantation, higher alpha points related with more regrettable visual results, and lower points were prescient of better uncorrected close and distance visual keenness. A few specialists propose staying away from presbyopia-rectifying IOLs in patients with a point alpha more noteworthy than 0.5 mm on beam following gadgets [C]. Nudge the IOLs nasally to position them between the visual axis and pupil center [D] has also been suggested.

4. Aberrometry

Preoperative astigmatism of more prominent than 1.00 D warrants intraprocedural astigmatic keratotomy or a toric IOL, and postoperative refraction ought to be inside 0.50 D of the objective with insignificant astigmatism or poor optical quality and coronas might be prompted with presbyopia-rectifying IOLs.[34,35] Corneal refractive medical procedure essentially modifies regular corneal variation. Due to the fact that older ablation methods typically utilized smaller ablation zones, the time of the photorefractive surgery may also be crucial. Preoperative corneal topography should be performed to examine the size and centration of the previous keratorefractive ablation zones, as larger transitional ablation zones equate to larger optical zones, which are associated with fewer HOAs and are therefore more likely to be compatible with presbyopia-correcting IOLs.[36] Newer wavefront-guided ablation techniques have also contributed to fewer postoperative HOAs.[24] The small aperture EDOF IOL known as the IC-8 (AcuFocus, Inc., Irving, California, USA)

makes use of the pinhole effect to reduce the visual symptoms of HOAs. It has been demonstrated to be effective in patients who have abnormal corneas, such as those who have had post-radial keratectomy[14,37]. IOL asphericity can be used to correct spherical aberrations. Aspheric IOL implants with negative spherical aberrations are likely better suited for virgin or oblate postmyopic surgery corneas, while spherical IOL implants with positive spherical aberrations are likely better suited for hyperprolate, posthyperopic refractive surgery corneas.[40] Adequate refractive outcomes have also been achieved with aspheric MFIOLs in eyes that have undergone posthyperopic surgery.

There are few reports on preoperative HOAs in postkeratorefractive patients undergoing MFIOL implantation. These potential HOA thresholds for MFIOL implantation in postrefractive surgery eyes are derived from ongoing clinical discussions among peers and from publications that have both been peer reviewed and not. A collection of Agarwal et al. cases revealed that waterfall patients with earlier outspread keratotomy had reduced postoperative difference responsiveness in eyes with more than ±0.20 μm of preoperative coma.[14] also, a front corneal trance like state more than ±0.32 μm may cause unfortunate dysphotopsias after diffractive MFIOL implantation in virgin corneas.[43,44] As per a few specialists, presbyopia-rectifying IOLs seem to cause evening defocus and round variations in patients with more than 1 D of contrast between manifest refractions in photopic and mesopic conditions [B]. Potential dynamic calculation in view of preoperative measures. Information from peer-evaluated examinations as well as nonpeer investigated distributions and clinical correspondence among peers [10,14,25,26,32,41,42,C,F]. D, diopter; Dry eye disease, DED; Extended depth of field, or EDOF; Intraocular lens, or IOL; Multifocal intraocular lens, or MFIOL; RK, spiral keratotomy; Z3, total higher-order aberrations of the third order; Z4 complete fourth request higher request deviations.

Vrijman et al. used aspheric MFIOLs to achieve refractive results (AcrysofRestor; Although patient satisfaction and dysphotopsias were not reported, multifocals (Alcon Laboratories, Fort Worth, Texas, USA) were found to be comparable to monofocals in patients with postmyopic and posthyperopic treatments of less than 4 D.[41,42] Some surgeons avoid multifocals in patients who have previously had myopic laser-assisted in-situ keratomileusis (LASIK) corrections of The capsular pack in high myopes is much of the time bigger which might prompt IOL shakiness and more terrible visual symptoms.[45] Night vision issues or hazy vision after LASIK may likewise show a decentered removal possibly making MFIOLs improper. EDOFs may be an option for post-LASIK patients because some surgeons have discovered that they are tolerated better in patients with residual refractive error. [E]. Ruiz-Alcocer et al.'s study utilizing simulated myopic LASIK procedures on EDOF patients (XACT Mono-EDOF; Osaka, Japan-based Santen Pharmaceutical Co., Ltd.) and trifocal (FineVision; PhysIOL, Liège, Belgium) IOL implantation found that the EDOF IOL had better optical quality for distance vision than the trifocal IOL and was less affected by poor calculation accuracy.[46] Fu et al.[30] suggested "micromonovision" target refractions of 0.35 D in the dominant eye and 0.50 D in the nondominant eye to maintain good uncorrected distance visual acuity while providing better uncorrected intermediate visual acuity and uncorrected near visual acuity. These findings, along with those of two other studies examining AT LISA tri 839 MP in post-LASIK patients, also found an average Cocherne et al. conducted a further study on Symfony IOLs. a nondominant eye target of 0.50 to 0.75 D.[48] Future Directions As of right now, no studies have been found that describe the use of accommodating IOLs (AIOL) in eyes that have had keratorefractive surgery in the past. The Crystalens (Bausch & Lomb) and Trulign (toric) AIOLs, both of which have been approved by the FDA, are designed to mimic accommodation by compressing hinged haptic plates that permit anterior lens motion. Although newer AIOLs, such as those designed for ciliary sulcus placement, have shown promising results, AIOLs are a developing technology. Although initial commercial studies on AIOLs were favorable, subsequent independent studies revealed only a modest dynamic focus that eventually faded over time due to atrophy and fibrosis of the capsular bag following phacectomy[15].

The only light-adjustable IOL (LAL) currently on the market is the RxSight, manufactured by RxSight, Inc. in Aliso Viejo, California, USA. Surgeons can noninvasively adjust IOL power by using ultraviolet (UV) radiation to cause silicone polymerization. This could eliminate the need for inaccurate calculation methods and allow for multifocality and EDOF to be implemented.[2,49] A case report described the successful implantation of a LAL in a post-LASIK patient who had a traumatic cataract and achieved a postoperative manifest refraction of +0.50 D, uncorrected distance visual acuity of 20/20, However, it can be prohibitive for patients and doctors to change and lock in treatments without multiple appointments and expensive equipment. Second, LAL implants may fail if UV-light protection is not strictly adhered to until the final lock-in appointment. Refractive-index shaping is the basis for IOL power adjustment with the Perfector femtosecond laser system (Perfect Lens LLC, Irvine, California, USA), which is significantly faster than LAL treatments and does not require specialized IOL material. Surgeons could potentially modify spherical power, asphericity, toricity, and multifocality with a simple and quick in-office procedure[16,53].

5. Conclusion

It is possible for some postkeratorefractive patients to undergo presbyopia-correcting IOL implantation and achieve favorable outcomes with proper preoperative counseling, diagnostic evaluation, and surgical planning. On the other hand, many of the available recommended preoperative thresholds are based on expert opinion or virgin corneas. Preoperative factors like pupil diameter, keratometry, aberrometry, double-pass imaging, angle kappa, angle alpha, and prior refractive treatment amounts should be the subject of additional clinical studies with standard reporting. Examinations, for example, recipient working bends are expected to give indisputable rules and ought to be the focal point of future investigations. The next step in resolving the issue of providing postkeratorefractive patients with tolerable presbyopia-correcting IOLs may be the development of technology for postoperatively modifiable IOLs; However, universal implementation is prevented by the limitations

of the currently available modalities.

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