Comparative Astigmatism Management Procedures and Postoperative Outcome Analysis

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Abstract

Astigmatism is a refractive error caused by non-uniformity in the shape of the cornea or lens of the eye, resulting in distortion of vision at various distances. It can result from genetic factors, developmental issues, or injury. While astigmatism can occur at any age, it often emerges in early childhood and may worsen with age, particularly in adulthood. It is most commonly diagnosed in children and young adults.the purpose of this literature review is to compare the effectiveness and safety of the three main approaches to astigmatism treatment: SMILE, Keratoplasty, and other techniques such as AK and TIOL.

Methods. A clinical study involving patients with mild to moderate astigmatism. Data on visual measurements, astigmatism measurements, and side effects were collected regularly. The results showed that SMILE has small incisions and lower side effects, but there is still a risk of intraoperative complications. Keratoplasty (especially DALK) offers good visual recovery with few postoperative side effects. TIOL are effective in correcting moderate to high astigmatism with permanent correction, but have a risk of complications. AK is a good option for patients who want to correct astigmatism without more invasive laser surgery.

Conclusion. Each method has unique advantages and disadvantages. Choosing the right method can ensure optimal results and clearer vision after surgery.

Keywords. Astigmatism, visual symptops, surgery

Introduction

Astigmatism is one of the common refractive errors, in which there are differences in refraction at various meridians of the eye.[1] Light entering the eye is not focused at a single point, but rather forms a focal line.[2] In other words, astigmatism occurs when parallel light passing through the cornea is not focused at a single point on the retina.[3] Astigmatism can be divided into regular and irregular.

Astigmatism can be divided into regular and irregular. The cause of astigmatism can come from the cornea, lens or retina. Regular astigmatism is divided into with-rule, against-rule, oblique, and bi-oblique astigmatism, where Sturm's conoidal principle explains the optics of regular astigmatism.

Astigmatism can also be classified into simple, compound, and mixed astigmatism."[4] Common symptoms of astigmatism include asthenopia, discomfort, blurred or unclear vision, elongation of objects, and impaired accommodation. Signs of astigmatism may include partial eyelid closure, head tilt, oval or vertically slanted optic disc, and different refractive powers in each meridian. [5]

There are several methods to treat astigmatism, including SMILE, Keratoplasty, corneal cross-linking, Astigmatism keratonomy (AK), and manual small-incision cataract surgery (MSICS). Each method has different advantages and disadvantages. The purpose of this literature review is to compare the effectiveness of various astigmatism treatment methods with data obtained from several sources.

Methods

The research method used is literature review using electronic databases through national and international journals such as Pubmed, ScienceDirect, Google scholar. The inclusion criteria used by the authors were to limit articles or journals published in the last five years starting from 2016 to 2021. This review collected and analyzed data from recent studies that evaluated clinical outcomes and complications related to the treatment procedure.

Discussion

Astigmatism, a condition in which the cornea or lens of the eye has an uneven curvature, can cause blurred or distorted vision. Various methods have been developed to correct astigmatism, each with its advantages and disadvantages. The approaches used are SMILE, Keratoplasty, corneal cross-linking, Astigmatism keratonomy (AK), and manual small-incision cataract surgery (MSICS).

Small-incision lenticule extraction (SMILE) is a relatively new corneal ablation procedure. By dissecting and extracting a predetermined intrastromal lenticule, the surgeon can correct myopia and myopic astigmatism. . SMILE was first introduced in 2011, primarily for the treatment of myopia and myopic astigmatism.[6] In this procedure, a femtosecond laser is used to shape and remove the lenticule through a small incision in the cornea. SMILE does not require flap creation, minimizing the risk of complications such as dry eye syndrome. SMILE appears to have fewer postoperative halos and glare in eyes with larger pupils. This may be due to the more uniform refractive power of the cornea, which causes less change in the higher cornea. In addition, corneal stability is better as the corneal structure remains more intact. Although this procedure has advantages such as small incisions and lower side effects compared to LASIK. However, there is still intracorneal space between the corneal layer and the intrastromal layer which can lead to several complications such as opacities on the corneal surface, black spots during lenticule formation, bubbles in the anterior chamber, and perforation of the corneal layer.[7] From a surgical perspective, SMILE surgery is more challenging and requires more accurate surgical techniques compared to flap-based ablation procedures such as LASIK, mainly due to the manual dissection of the lamellae within the cornea and the delicate extraction of corneal lenticules. As a result, intraoperative complications during SMILE such as unsuccessful lenticule removal or retention of corneal lenticule fragments may occur more frequently.[8]

Keratoplasty, or corneal transplantation, is the main option for patients who have severe astigmatism due to conditions such as keratoconus or corneal damage. The procedure involves replacing the damaged part of the cornea with a graft from a donor. There are two main types of keratoplasty: penetrating keratoplasty (PK) and deep anterior lamellar keratoplasty (DALK). Compared to penetrating keratoplasty (PK), deep anterior lamellar keratoplasty (DALK) presents several advantages that make it currently considered by many corneal surgeons as the surgical procedure of first choice in patients with keratoconus. [9-11] Good visual recovery with few postoperative side effects is a feature of DALK for keratoconus in mid-term studies.[12] However, some evidence is still insufficient to determine which technique may offer better overall results.[13] Patients with keratoconus may require a transplant during the first three decades of life. Corneal transplantation displays good results in young patients with keratoconus even those aged 16 years or younger.[14] This technique is very effective in correcting astigmatism that cannot be addressed by other methods. However, the recovery process can take longer and there is a risk of graft rejection and other complications that require long-term care.

Corneal collagen crosslinking (CXL) is a new treatment for corneal ectasia that increases the strength of the corneal material with the main aim of stabilizing progressive disease. [15] Treatment generally involves first exposing the cornea to a photosensitizing chemical agent, such as riboflavin, followed by exposure to ultraviolet-A (UVA) light, where the interaction of the agent, light, oxygen and collagen tissue leads to an increase in the tensile strength of the cornea. [16] However, CXL is less effective in patients with harder corneas as riboflavin cannot penetrate thick corneas well. This may limit the ability of CXL to stop keratoconus progression in patients with harder corneas.

Astigmatism keratotomy is a refractive surgical procedure that is effective in correcting mild to moderate astigmatism. Although it has some side effects such as dry eyes and more sensitivity to light, these symptoms are usually temporary and can be managed with eye drops. As such, AK is a good option for patients who want to correct astigmatism without having to undergo more invasive laser surgery. Meanwhile, toric intraocular lenses (TIOLs) are the main option for patients who underwent cataract surgery and also have astigmatism. TIOLs replace the eye's cloudy natural lens with an artificial lens specifically designed to correct astigmatism. It provides permanent correction without the need to change the shape of the cornea, making it an effective solution for moderate to high astigmatism. However, the procedure is invasive and there is a risk of the lens rotating or shifting, which may affect the result of the correction.

Manual small incision cataract surgery (MSICS; also called SICS or SECCE) is a low-cost, small-incision form of extracapsular cataract extraction (ECCE) that is commonly used in developing countries. Compared to traditional ECCE, MSICS has the advantage of a sutureless, self-sealing wound.[17-20] However, it still carries the risk of complications, such as posterior capsule tears, which can lead to further problems such as corneal edema and cystoid macular edema (CME). These complications may require additional intervention and may affect the long-term visual outcome.

Conclusion

The various methods to treat astigmatism each have their advantages and disadvantages. SMILE offers quick visual recovery and corneal stability, but is not suitable for high astigmatism as it does not have a proper adjustment system. Keratoplasty, especially DALK, is effective for severe astigmatism, although recovery is long and there is a risk of graft rejection. Corneal Cross-Linking (CXL) is stable in stopping keratoconus, but less effective in thick corneas. Astigmatism Keratotomy (AK) is effective for mild astigmatism, with temporary side effects. Toric Intraocular Lenses (TIOLs) provide permanent correction but are invasive

procedures. MSICS is affordable and effective, but has a risk of complications. The choice of method should be tailored to the patient's condition and needs for best results.

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