



Irregular Astigmatism Correction by Femtosecond Laser Arcuate Keratotomy in a Pediatric Patient

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Case Report

Volume 6 Issue 1

Received Date: May 05, 2021

Published Date: May 20, 2021

DOI: 10.23880/oajo-16000222

Abstract

We report the case of a pediatric patient 3 years old that underwent refractive surgery for the correction of irregular astigmatism after penetrating trauma. A single arcuate keratotomy by femtosecond laser was performed for correcting corneal high order aberrations in the attempt to avoid penetrating keratoplasty and to treat amblyopia.

Keywords: Astigmatism; Keratotomy; Traumatic Cataract; Refractive Surgery

Abbreviations: IOL: Intraocular Lens; DCVA: Distance Corrected Visual Acuity; NCVA: Near Corrected Visual Acuity; HOAs: High Order Aberrations.

Introduction

In children [1] penetrating traumatic injury of ocular anterior segment represents the more frequent cause of non-congenital blindness. Corneal or scleral laceration, traumatic cataract, intraocular foreign body, vitreous hemorrhage, and prolapse of intraocular tissue are most frequent associated clinical conditions. Secondary corneal opacity often affects these patients, inducing significant visual loss and amblyopia in children. Actually acquired traumatic corneal scars after penetrating injuries represent a frequent indication for pediatric keratoplasty, for whom however it is note that corneal perforations determinates a poorest prognosis [2].

In this paper we report the case of a refractive surgery performed to correct irregular astigmatism induced by penetrating corneal trauma. The aim of the treatment was to avoid corneal keratoplasty and to limit visual deprivation

amblyopia.

Case Report

On 16th of February 2010 at 3 years old male child presented to Bambino Gesù Children's Hospital of Rome, Italy, with diagnosis of penetrating trauma in right eye. Informed consent to all the procedures was collected and all experimental investigations followed the guidelines for experimental investigation with human subjects required by the institution. The study adhered to the Tenets of the Declaration of Helsinki.

During the emergency operation performed under general anaesthesia, the lens was removed because of anterior capsule opening and corneal irregular wound across the pupil was sutured by single 10.0 nylon stitches. Two months after, on the 16th of April 2010, an intraocular lens (IOL) was implanted into the sulcus. However, nevertheless contact lens wearing and left eye 6 hours daily patching, six months after IOL implantation Distance Corrected Visual Acuity (DCVA) was 0.2, Near Corrected Visual Acuity (NCVA)

was Jaeger 5, refractive error was +7.0 sphere and -11.0 cylinder axis 85°, topographic astigmatism and corneal High Order Aberrations (HOAs) for 5.0mm pupil were respectively 12.0 diopters (axis 113°) and 3.99 μm . Left eye uncorrected visual acuity was 1.0. In right eye the elevation map showed a steeper inferior asymmetry into the optical zone produced by corneal scar, in the area corresponding to the inferior bow tie (Figure 1). The orthoptic evaluation showed eye suppression to worth lights test in right eye, corneal reflex well cantered, moderate exotropia at cover test and normal ocular motility. On the 12nd of October 2010

a single arcuate keratotomy (AK; 80° arc length, 80% corneal depth and 6.0mm optical zone) centred on the steepest meridian according to the elevation map was performed by the Intra Lase 60KHz femtosecond laser (Abbot Medical Optics). Because of the small eye diameter the docking procedure was performed without suction ring according to the technique previously described [3]. No intraoperative or postoperative complications occurred. The laser treatment reduced refractive astigmatism to 6.50 diopters and HOAs for 5.0mm pupil from 3.39 μm to 1.72 μm (Figure 2).

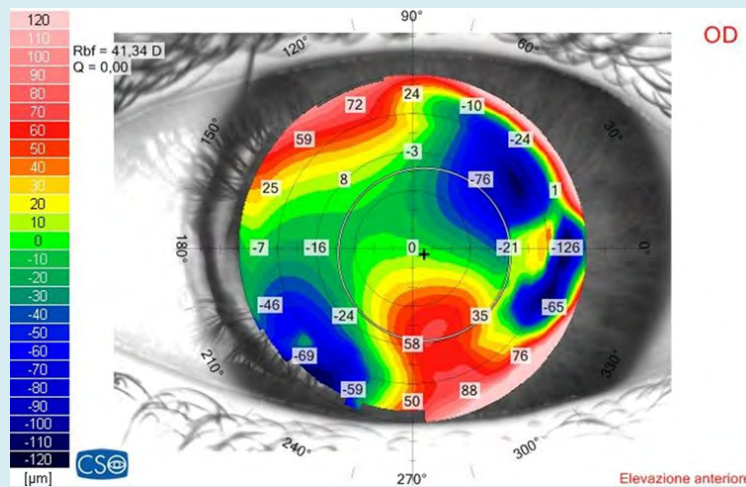


Figure 1: The right eye anterior elevation map (Sirius scheimplflug camera, CSO, Italy) performed before femtosecond laser treatment shows the inferior steepen area corresponding to the corneal scar.

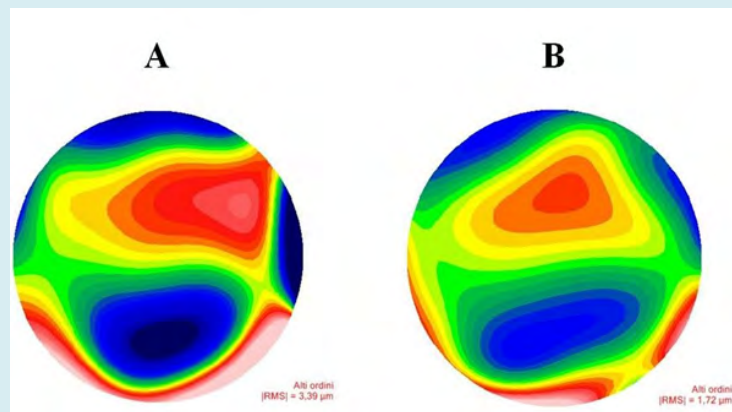


Figure 2: Corneal High Order Aberrations for 5.0mm pupil (Sirius scheimplflug camera, CSO, Italy) measured before (A) and 8 years after (B) femtosecond laser arcuate keratotomy.

After femtosecond laser surgery the patient wore contact lens on right eye and continuously performed left eye 6 hours daily patching until he was 9 years old. DCVA, NCVA, corneal topography and aberrometry measured by Sirius Scheimplflug camera (CSO, Italy) were evaluated during 8

year follow up.

Eight years after trauma, right eye refractive error was +1.0 sphere -6.50 cylinder axis 80°, DCVA was 0.6 and NCVA 1 Jaeger; the right eye suppression was observed both for

distance and near vision, cover test revealed orthotropia to esotropia for near vision, and orthotropia for distance vision; ocular motility appeared normal again. HOAs for 5.0mm pupil as well as the refractive astigmatism amount resulted unchanged over time. Left eye uncorrected visual acuity remained unchanged too.

Discussion

In children ocular traumatic penetrating injuries are common cause of significant visual impairment and amblyopia [4]. Corneal wound across the pupil represents a poor prognostic factor because scarring and residual irregular astigmatism are correlated with unfavourable visual outcome [4].

Pediatric refractive surgery is actually performed in much selected patients. It is generally considered if neurodevelopmental disability determinates poor compliance with high refractive error correction, as well as in case of anisometropic amblyopia, when refractive correction and occlusive therapy do not induce visual acuity improvement [5]. In these last patients, moreover, the timing of treatment results crucial. In fact it is note that amblyopia could be reversed until the age of 8 to 9 years [5].

Some authors observed that AK performed with femtosecond laser was effective and predictable in reducing post keratoplasty high astigmatism [6,7], decreasing complications including corneal perforation [7]. However few papers reported the application of femtosecond technology to pediatric corneal surgery [3,8]. To our knowledge this is the first case reported on femtosecond laser AK in pediatric patients.

In this case report we propose the use of femtosecond laser for performing AK in order to correct irregular astigmatism induced by residual scar in central cornea after penetrating trauma (Figure 3). Since we observed a correspondence between topographic asymmetric bow tie and elevation map inferior steepening, we planned a single AK in the attempt to regulate corneal shape and to decrease corneal high order aberration amount. Nevertheless the young age of this patient, we considered topographic data reliable because of good correspondence of topographic astigmatism data with cycloplegic refraction data. It has been reported an association between the magnitude of induced anisometropia and interocular HOAs difference [9]. A greatest amount of corneal HOAs in amblyopic eyes suggest that non-rotationally symmetric aberrations may be induced by abnormal ocular development as reported in monocular deprivation paradigms of other animal species. Since asymmetric visual experience during development in amblyopic eye appears to be associated with asymmetries

in HOAs [9], our findings confirm the possible role of HOAs in developing amblyopia and suggest that the high precision of femtosecond laser cutting could be considered also in the attempt to regulate irregular corneal shape.



Figure 3: Cornea scars at the slit lamp examination.

We evaluated the opportunity to implant toric IOL, but in children a sulcus implanted IOL could be easily decentred by fibrosis and, in any case, it cannot provide corrections of corneal HOAs that are responsible of amblyopia. Another possible surgical approach could be represented by penetrating keratoplasty, commonly indicated in children in case of acquired traumatic opacities [2,10], but several authors reported a low prognosis rate for graft survival at 1 year [10], mainly in children less than 5 years old [11].

In conclusion, in selected pediatric patients affected by irregular astigmatism, femtosecond laser AK could improve amblyopia treatment and avoid more complex surgery as well as penetrating keratoplasty.

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