

## Sportsman Requires Specialty Soft Lens for Bilateral Keratoconus

**Muzzi MG\***

Optom. – FAAO, Italy

**\*Corresponding author:** Maria Giulia Muzzi, Optom – FAAO, Italy – Via Renata Viganò, 12 – 44124- Ferrara, Italy, Email: mariagiuliamuzzi@occhioxocchio.it

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### Abstract

Keratoconus is a corneal disease that generally requires the correction with rigid gas permeable contact lenses because the vision is better if compared to spectacle's vision. In the market is now possible to find various solutions in order to help patients to achieve the best vision and comfort. This case report shows the fitting of a special geometry of soft contact lens for keratoconus, chosen because it was the best solution in vision, comfort, handling and use for the patient. During the follow up it has been necessary to change some lens parameters to optimise the fitting.

**Keywords:** Keratoconus; Contact Lens For Keratoconus; Topography; Slit Lamp Images

**Abbreviations:** RGP: Rigid Gas Permeable.

### Introduction

Keratoconus is a corneal disease of the eye that results in progressive thinning of the cornea and usually both eyes are affected. Generally, it causes blurry vision, double vision, near-sightedness, oblique or high corneal astigmatism, and light sensitivity [1]. At the beginning, the symptoms of keratoconus cannot be so different from those of any other refractive error of the eye for this reason most of those patients wear spectacle lenses or disposable soft lens. As keratoconus progresses, the amount of irregular astigmatism increases due to the distortion caused by the distension of the cornea as it becomes ectatic [1-3]. This irregular astigmatism is non-orthogonal and making it difficult to achieve an adequate refraction, both objective and subjective. Spectacle's prescription is therefore less effective and does not provide suitable optical results, particularly in the later stages of the disease. The progression causes corneal deterioration and visual acuity becomes impair at all distance, also night vision is often poor. Although keratoconus is a bilateral condition, in which one eye tends to lead while the other eye lags behind

in its progression; the anisometropia or antimetropia that cause results in spectacles magnification intolerances. Some person has vision in one eye that is markedly worse than that in the other and it depends from the different keratoconus stadium. As the condition progresses it is necessary to use rigid gas permeable lenses (RGP). This type of lens provides a good vision with a good visual correction but does not arrest the progression of the condition. In order to correct keratoconus it is possible to use other solutions like hybrid, scleral or specialty soft lens. Hybrid and scleral contact lenses achieve good vision and comfort but they can create some problems in handling due to the removal and insertion. Another solution is to use specialty soft contact lenses for irregular cornea. Some people find good vision and comfort with a piggyback lens combination, in which RGP lenses are worn over soft lenses, both providing a degree of vision correction.

Contact lenses eventually become necessary in nearly all cases of keratoconus, to provide optimal vision and approximately from 10% to 26% of patients eventually need corneal surgery [1-3]. Keratoconus is a pathology that can be surgical treated with: corneal transplant, corneal rings

implants and cross-linking [4-9]. Corneal cross-linking involves the application of riboflavin solution into the eyes that is activated by illumination with UV-A light for approximately thirty minutes. The riboflavin involves new bonds to form across adjacent collagen strands in the stromal layer of the cornea, which recovers and preserves some of the cornea's mechanical strength. To increase the penetration of the riboflavin into the stroma, generally the corneal epithelial layer is removed. This procedure is known as the "Dresden protocol". People that are considered for treatment must undergo an extensive clinical workup, including corneal tomography, computerized corneal topography, endothelial microscopy, ultrasound pachymetry, biomicroscopy and other exams [8,9]. Among the keratoconus that progress, only from 11% to 27% of cases, in which vision correction is no longer possible, cornea, becomes too much thin and corneal transplant or penetrating keratoplasty are the last solutions [7].

Corneal grafting or corneal transplantation is a surgical intervention where a damaged or diseased cornea is replaced by donated corneal tissue, named graft. When entire cornea is replaced, it is known as penetrating keratoplasty but when only a little portion is replaced, it is known as lamellar keratoplasty. Keratoconus is the most common grounds for conducting a penetrating keratoplasty, generally accounting for around a quarter of such procedures [8]. One of the most important tools in detecting and managing keratoconus is topography. A common deficiency in the ability to detect keratoconus has been the use of an axial, sagittal, rather than instantaneous, tangential or local, radius of curvature. Sagittal scales look specifically at the visual optics of the cornea, while tangential scales assess the physical shape of the cornea [3].

## Case Report

A young man of 35 years old white male came to our clinic in June 2018 with a diagnosis of bilateral keratoconus. He came to us because he makes part of the Ferrara's Canoe Club for the Paralympic division and our clinic has a convention with this sport association. He reported poor vision with his spectacles lenses most of all on right eye. He told to me that he is a non-commissioned officer of the navy in Italy and his specialisation was underwater. Indeed most of his military missions were on a submarine. During a military control on 2014, he discovered an osseous cancer to the spinal column and he stopped to work underwater. From Taranto, city based in the southeast of Italy, he moved to Milan to be cured. Chemotherapy and other pharmacological treatments

showed collateral effects like keratoconus evolution; it was just presented in right eye at first stadium. At the end of the pharmacological treatments and after many surgical interventions, he presented a medium-advanced keratoconus on right eye and early conus on left eye.

Before being operated, he was given several cycles of radiotherapy and many of the medicines that he had to take contained cortisone. Until today, five years since the discovery of the cancer have not yet fully passed for this reason he is still doing preventive cycles of chemotherapy and he takes lot medicines with cortisone. Probably cortisone and other medical components have accentuated keratoconus evolution in both eyes but it must also consider that he already presented a familiarity with this pathology because his grandfather suffered of it [5,6]. He told also that due to the radiotherapy cycles, he was not subjected to a cross-linking because the oncologist did not to give the permission to do this intervention. After a detailed anamnesis, it was emerged that patient wore spectacle lenses, before discovering the cancer, only during the night for distance vision because he complained about glare and flare. Patient's medical history with keratoconus was only from his grandfather, on mother side, that presented bilateral keratoconus; this can explain the presence of it on the right eye since the beginning and the evolution after the pharmacological treatments and the radiotherapy cycles [5,6].

After all medicaments care and treatments he took, his visual acuity got worse and without correction he was able to read 20/40 for RE and 20/22 for LE at distance. Nowadays, he was obliged to wear spectacle lenses all the day and with the following correction +00.00 -4.00 ax 68° (RE) and -00.75 (LE) he achieved 20/22 in binocular vision. Probably spectacles were made with this correction to balance and not create diplopia problem in binocular vision. During the control, it was made an objective and a subjective refraction with the following data:

- BVA (best visual acuity) -04.25 -7.00 ax 80° for RE 20/32
- BVA (best visual acuity) -00.75 -0.75 ax 100° LE 20/22

Due to his canoe training and the gain in vision his ophthalmologist prescribed the fitting of contact lens. Before fitting contact lenses cornea was checked in the slit lamp in order to avoid problems. With the diffuse technique, it was checked the external part of the eyes like eyelids, eyelashes and conjunctiva. It was also used sodium fluorescein to control if there were corneal staining, erosion and/or other problems. Both part of the eyes were in good state without damages or marks. New topographies were made and showed the following situation [3,10-14].

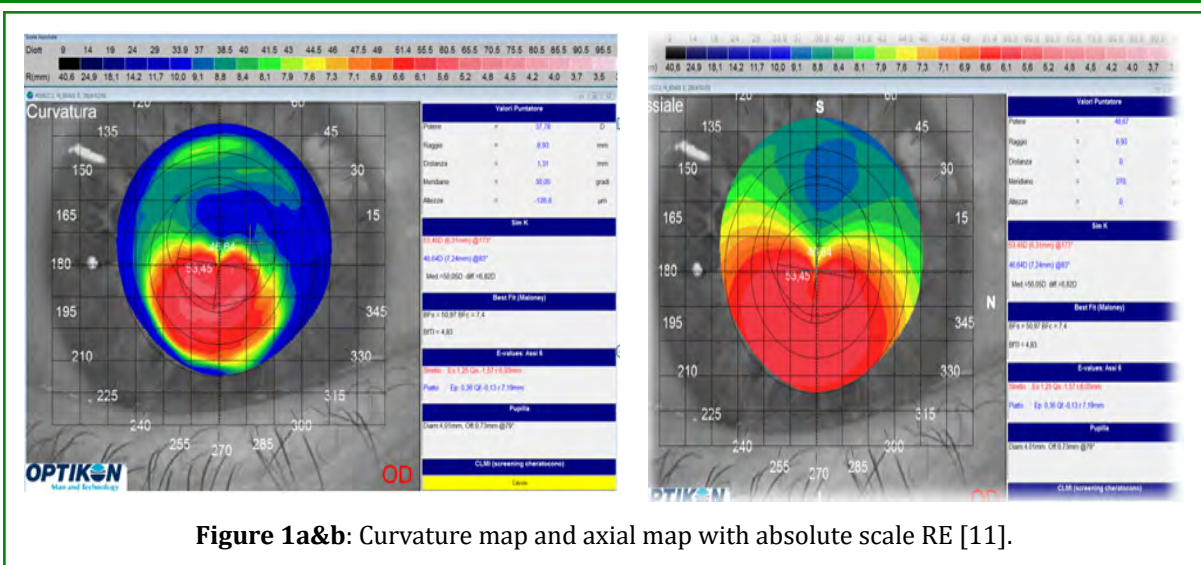


Figure 1a&b: Curvature map and axial map with absolute scale RE [11].

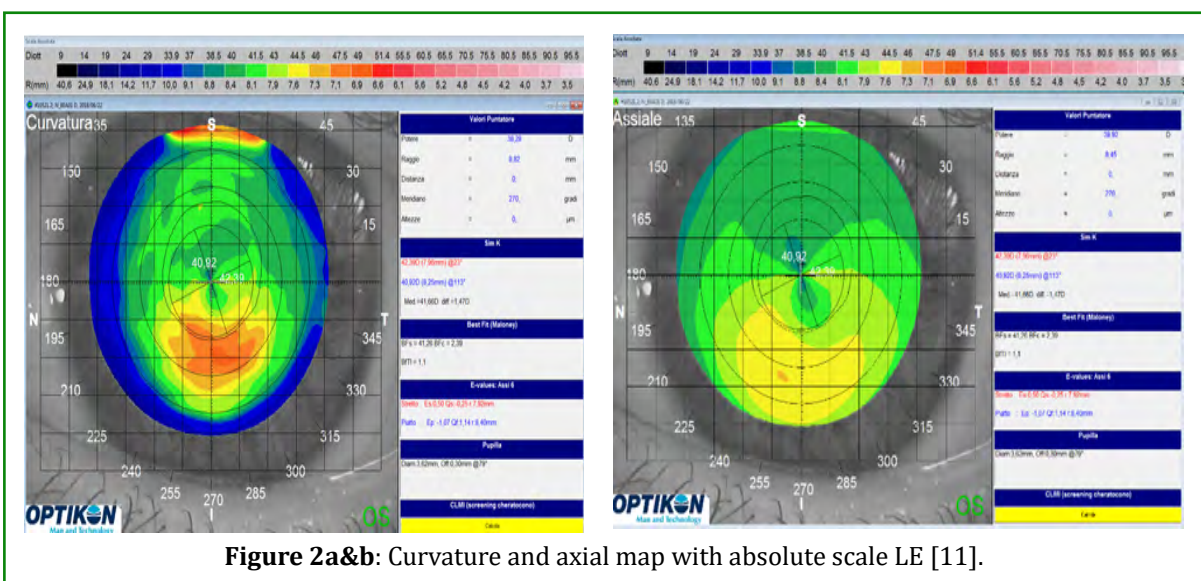


Figure 2a&b: Curvature and axial map with absolute scale LE [11].

Following ophthalmologist instruction, he was fitted with a corneal RGP geometry for irregular cornea but he was completely in discomfort and he explained that he did not want to wear this type of lens also if he achieved a very good visual acuity. To improve the fitting to be more comfortable, diameter was increased, the edge lift was decreased, base curve was a little be steepen but he was never in comfort. It was explained to him the solution of using a scleral or hybrid contact lens but he was afraid of the big diameter and of the handling in fitting the lens also if he was in comfort. Because of the large diameter, he did not even want to try lenses, so the last solution proposed to him was using a specialty soft contact lens for irregular cornea that perhaps cannot achieve a good vision as a RGP or hybrid contact lens [10]. He was happy of hearing about this solution and the fit began. Using the trial set and following the fitting rules, first

lenses were RE 7.40 14.80 -06.00 EL STD EP 0.35 and LE 8.20 14.80 -02.00 EL STD EP 0.35. The starting BOZR for ectasia corneas was chosen starting from the mean K and flattened from 0.8mm to 1.00mm [2,3,10-13]. The patient was in comfort but not too much, for this reason it was decided to let him the lenses for 30 minutes and doing all evaluations afterwards. After 30 minutes of wear, the comfort was the same like at the begging. Looking at the fitting in the slit lamp it was observed that the lenses had good centration but an excessive movement causing discomfort and the rotation of laser mark, which can penalise the vision. Binocular visual acuity achieved was 20/22 very clear and some letters of the line 20/20, with the following over refraction RE +1.25 -4.50 ax 75° and LE +1.00 -1.00 110°. Just before lenses removal, fitting was rechecked in the slit lamp to confirm the rotation of the laser mark from 6 hour and the excessive movement



because it was around 1.5mm.

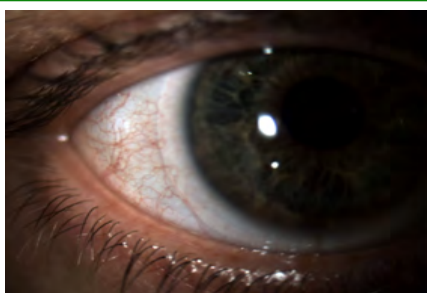
The fitting procedure means that the lens should demonstrate movement on blink from 0.5mm to 1.0mm and if there is excessive movement the edge lift should be decreased. Lenses had good alignment on the bulbar conjunctiva without impingement, but blinking it was noticeable a very light fluting on the right lens at eight o'clock. The diameter was correct in both eyes because it was 1.5mm beyond the limbus. The lenses ordered were RE 7.40 14.80 -04.75 -4.50 ax 75° EL -1.00 EP 0.35 and LE 8.20 14.80 -1.00 -1.00 ax 110° EL -1.00 EP 0.35. It was decided not to increase the central thickness in order to avoid a possible reduction of the corneal transmissibility. This type of lens showed good visual correction with an aspheric back optic zone in combination with a front toric surface, also the design controlled the aberration [13].



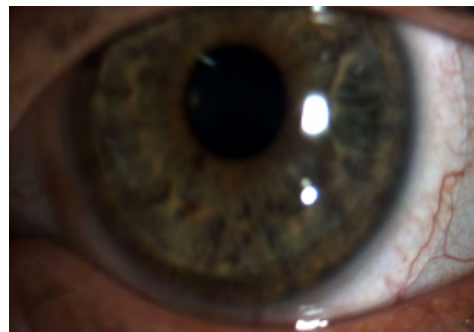
**Figure 3:** Good centration RE [12].



**Figure 4:** Laser Mark RE [12].



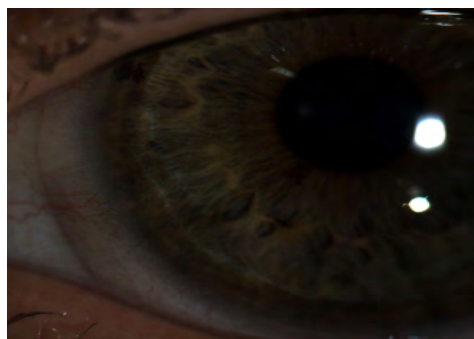
**Figure 5:** Fluting at 8' RE [12].



**Figure 6:** Good centration LE [12].



**Figure 7:** Laser Mark LE [12].



**Figure 8:** Periphery LE [12].

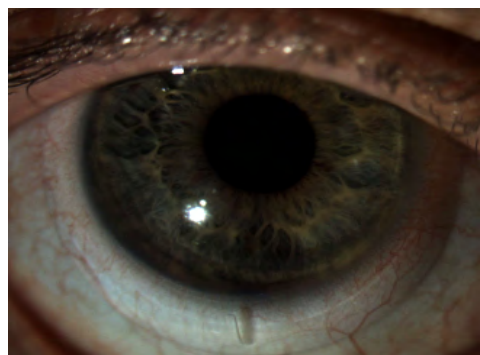
### Follow up #1

The patient came back at the begging of July 2018 for the lenses dispensing. After the insertion, his visual acuity remained stable with the same binocular visual acuity of 20/22 and he could read some letters of the line 20/20. The control in the slit lamp showed the correct lens movement, and good stabilisation of the laser mark at six o'clock. The light fluting on the right lens at eight o'clock disappeared. Lenses were dispensed to the patient with the peroxide care system. The chosen material was silicone hydrogel with the following technical features: water content 49%, Dk 49 and modulus of 0.8 [13]. This type of silicone hydrogel tolerates peroxide care system without creating any problems for the

lenses. In particular, the peroxide recommended is one of the highest cleaning and disinfection performances which complete the cycle disinfection in two hours only. It was very effective for the removal of protein deposits and it was not necessary for the patient to rub the lenses. An appointment has been made for another check one week later [14,3].



**Figure 9:** Good centration RE [12].



**Figure 10:** No fluting on RE [12].



**Figure 11:** Good centration LE [12].

### Follow up #2

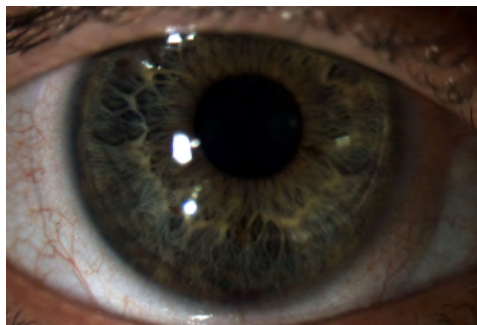
The patient came one week later, mid July 2018, for the

control. The fitting in the slit lamp was the same without any changes on the lenses. To achieve better vision it was noticed a little over refraction of +00.25 in both eyes in order to reach more contrast. He told that he had the sensation to feel the lenses on the eyes and sometimes during the day he was in discomfort. To be sure of these issues, another check was made one month later because he would be out of Italy for summer holidays. The peroxide system care with the daily tablet was explained again. It was made also a control in the slit lamp to check cornea, limbus area and bulbar conjunctiva. Bulbar conjunctiva was examined to avoid general staining but also related to contact lenses wear. Limbus area was analysed to avoid problems of hyperaemia, limbal staining and oedema. Final part of the control was focused on the cornea to avoid smile stain like inferior epithelial arcuate lesions or seals (superior epithelium arcuate lesions), mechanical or foreign body under the lenses that could cause scratches, 3 and 9 o'clock staining and general staining. Fortunately none of this occurred [15-17].

### Follow up #3

The patient came at the beginning of August 2018 to verify the fitting and control if the past issues were still present. In the slit lamp, it was checked the cornea again, limbus and bulbar conjunctiva state in order to avoid general staining, mechanical damages and inferior epithelial arcuate lesion like smile stain in both eyes. There were no punctuating diffuse spots or other problems in right and left eyes. He told that it was very happy in using his contact lenses but the sensation of the lens on the eye was still present [18]. He told that the quality of vision was not so better than in the past and during the night he presented double vision and around the lights he saw glows. This double vision was not changed or decreased with the over refraction. To achieve better vision and reduce double vision the fitting guide recommends to flat the radius if possible; luckily in this case it was possible thanks to the parameters range.

The lenses tried from the diagnostic set were 7.60 14.80 -05.00 EL STD EP 0.35 RE and 8.60 14.80 +00.00 EL STD EP 0.35 LE [2,3,10-13]. With these lenses, he was suddenly best in comfort than the other and he felt them better in the eyes. Lenses were well centred and the laser mark at 6' o'clock was very stable. There was no fluting in both eyes and no impingement on the bulbar conjunctiva. Also the over refraction, compared to the one obtained during the first fitting in June, was lower and no cylinder power was requested on the left eye. The visual acuity achieved with this new lenses and the over refraction was +1.50 -4.50 80° RE and -00.25 LE that provided a binocular vision of 20/20. With the RE in monocular vision he was able to read 20/28 and with left eye 20/20.



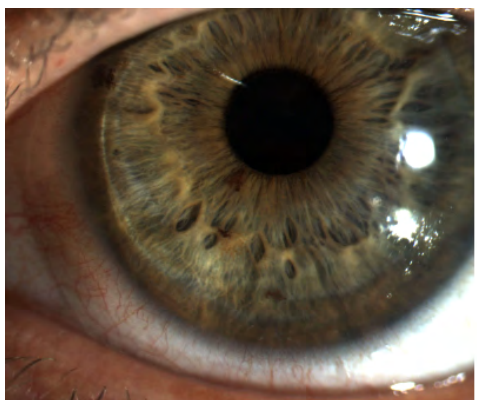
**Figure 12:** Good centration and no fluting RE [12].



**Figure 13:** No impingement on bulbar conjunctiva RE [12].



**Figure 14:** Good centration and no fluting LE [12].



**Figure 15:** No impingement on bulbar conjunctiva LE [12].

The lenses ordered were RE 7.60 14.80 -03.50 -4.50 80° EL STD EP 0.35 and LE 8.60 14.80 -00.25 EL STD EP 0.35. This time it was not necessary to decrease the lens periphery because the movement was correct.

#### Follow up #4

Patient came back ten days later to receive the lenses and in the slit lamp control the fitting was good like at the beginning of the month. There was no fluting in both eyes and no impingement on the bulbar conjunctiva and the movement was stable and good, about 1.00mm. Lenses were well centred and laser mark was stable at 6 o'clock. Binocular visual acuity was 20/20 clear and without double vision. Single vision was the same 20/28 with RE and 20/20 with LE. The lenses were dispensed with the peroxide care system. Every month, since September 2018, patient comes to our clinic to buy the peroxide system care and to have a very quick control in the slit lamp and visual acuity. He never complained about his lenses and he was very happy in discovering this solution. He also noticed that his migraine was reduced from the past.

#### Discussion

First lens used in fitting irregular cornea like keratoconus is RGP corneal contact lens. Soft specialty lenses represents an alternative in management irregular cornea for those who are unable to tolerate rigid lenses [3,10-14]. This specialty soft contact lens is used for optical correction of the irregular cornea most of all in keratoconus cases. Specialty soft contact lens for irregular cornea generally takes advantage of the central thickness more increased, compared to the disposable contact or custom soft lenses, to change the irregular astigmatism in regular astigmatism in order to reduce its degree. In fact, if topography is made with this kind of lenses, it is possible to see the astigmatism hourglass more regular and not so much exasperated [2,3]. The design used presents an aspheric back optic zone and the secondary curves are combinations of spherical curves and tangent angles. This lens presents a front surface spherical aberration control to achieve better vision. To be suitable also for post surgical cornea, for the flattened base curves, this lens has a reverse geometry.

The fitting guide shows that to improve better vision it is necessary to choose the flattest base curve that guarantees the best visual acuity; if the lens then moves too much or looks flat it is sufficient to close the periphery [2,3,10-13]. Being thicker, the lens tends to form a little lacrimal meniscus that can penalize visual acuity. Peripheral fit is adjusted by edge lift control and it is possible to adjust periphery independently of the base curve selected. For example, in cases of optimal vision but the overall fit is tight, may be it is possible to notice some bubbles trapped at the limbus or



blanching of conjunctival blood vessels or scleral indentation on removal or limbal injection. If no one of this signs occurs patient could also complain discomfort after several hours of wear, to solve all previous problem mentioned it is sufficient to order a new lens with an increased edge lift. By the way, in case of optimal vision but overall fit is close, may be it is possible to notice excessive movement at the blink or laser mark not stable or lens decentered; in this case it is sufficient order a new lens with a decreased edge lift. This case report was ideal because the patient was a new contact lens wearer and he was making the transition from spectacle lenses to specialty lenses. It was chosen this lens geometry because patient could not tolerate discomfort caused by corneal rigid gas permeable lenses but at the same time he did not want to try scleral or hybrid contact lenses due to handling to fit and remove them from the eyes. This geometry is available in hydrogel with a water content of 72% and DK value equal to 34 but also in silicone hydrogel Lagado with a water content of 49% and a DK of 49%; for this fitting the material choose was Lagado silicone hydrogel [2,3,10-13]. During every follow up it was important to check cornea in the slit lamp in order to avoid problems and control how lenses would have settled on the cornea even if the lens fitted is a soft lens.

To control the cornea, the limbus area and the bulbar conjunctiva sodium fluorescein was used. At every check in the slit lamp, bulbar conjunctiva was controlled to avoid staining because in some cases it is asymptomatic. Its possible presence, from minimal diffuse punctuate to deep, confluent in all of eye part (superior, nasal, inferior, temporal) [15-17]. Another important inspection is made in the bulbar conjunctiva to analyze the possible staining made by mechanical trauma of conjunctival epithelium due to lens fit or design, tight fitting, lens edge or decentration or caused by solution toxicity [17]. This control is important because sometimes it is asymptomatic and generally it does not affect clinical performance. During the fitting of any contact lenses, it is essential to check always the status of the limbus because, if the cells are damaged they cannot be repaired. To avoid problems in the limbal area, hyperemia and limbal staining are verified. Generally limbal hyperemia can be related to short-term clinical sign of corneal hypoxia related to oxygen performance of lenses used, mechanical irritation like trauma or poor lens fit, atopic or allergic reaction in solution toxicity, infection or inflammatory problems like tight lens syndrome. Sometimes symptoms are unknown and depend on causes [16].

Principal signs are engorged of limbal blood vessels with possible subsequently neovascularization problems. Limbal staining could be caused by hypoxia, tight lens, mechanical irritation, allergic reaction, toxic solution reaction or anterior segment infection and principal sign is staining around limbal area over conjunctiva and cornea. Last part of the control in

the slit lamp was involved to check cornea state with the direct illumination using the diffuse technique: with medium to high magnification with fluorescein sodium with blue cobalt and yellow barrier filter. Cornea staining is very important to check because his incidence is up to 60% in contact lens wearer's booth rgp and soft. This staining is probably caused by mechanical trauma of foreign body, damaged lens, lens edge, material stiffness or thick lens design but also toxic of care regimen hypersensitivity [14,3]. Generally, in our clinic this geometry was used when other fitting fail but the most important thing is to explain to the patient that this solution can achieve a visual acuity less if compared to other solution like RGP or hybrid lenses. The best fitting was achieved with the RGP lenses for irregular cornea, but discomfort and the lack of compliance from the patient side helped in the choice of the best solution for him. With his lenses, patient is able to practice his training with the canoe wearing contact lenses with a special mask that protects his eyes. Due to the life style of the patient, the best care system for him is the peroxide because it helps to disinfect and clean lenses including also the completely removal of protein deposits. With the peroxide system, it was added a multipurpose solution with Aloe Vera to rinse and disinfect lenses quickly after canoe training. This multipurpose is patented in eye cell protection and for silicone hydrogel materials to remove lipid deposits.

## Conclusion

This case demonstrates the importance of having a global knowledge of all lenses solutions that can help optometrist in achieving the best fitting for his patient. Sometimes it is necessary to change the state of mind and consider all solutions in order to preserve corneal health, good visual acuity, comfort and happiness for the patient. If a fitting is perfect in visual acuity and fluo pattern, but patient is not happy due to the comfort, handling or other problems, it is possible that he will never use lenses. Fit ends when optometrist is happy with his fitting and patient is happy with his lenses; maybe the lenses fitted are not the best solution but for him they are the best. Optometrist can be the guide for the patient and it is important to listen and to understand every single need.

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