New Materials Used for Vision – Orthokeratology

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Using special materials with a reverse geometry for contact lenses is named orthokeratology. It is a non-surgical modern medical alternative to conventional contact lenses for correction of myopia. Orthokeratology is an alternative treatment for patients with progressive myopia, especially children. The contact lenses is using during the night for minimum 6 h. With these special contact lenses children can be treated after 18 years old with refractive corneal surgery. The materials of night contact lens are gas permeable and permit progressive aplanation of central cornea, which induced decreasing of myopia or myopic astigmatism. The purpose for this study is to prove the effectiveness in improving of the quality of vision using "night contact lens". The study also monitored the effectiveness of orthokerathology as a preventive method for amblyopia in myopic or astigmatic patients.

Keywords: contact lenses, orthokeratology, myopia, refractive corneal surgery, myopic astigmatism

Orthokeratology is a modern treatment for children and adults with myopia or myopic astigmatism using a *reverse geometry* for contact lens [1, 2]. The principle is aplanation of central cornea during the night and this effect remains during all the day. Because of that these treatment is well-know also with the name *night time lenses*. Aplanation is more efficient for young children [3, 4]. Orthokeratology prevent refractive amblyopia for children, and after 18 years old children can be treated using corneal refractive surgery [5, 6].

For using *night time lenses* it is necessary to perform corneal topography before and during the treatment to control the efficacy of aplanation [7]. Performing of corneal topography is a very good also as a screening for discover corneal diseases as keratoconus [8-11].

Experimental part

This study is a prospective observational study, on 7 patients (3 females and 4 males), children and adults, diagnosed with refractive amblyopia in a private ambulatory Ophthalmologic Clinic from Iasi. The patients were treated and monitored in a period of 24 months, October 2013 – October 2015. The patients who requested optical correction through orthokeratology are 4 children aged 4-15 years old and 3 young patients (1 female and 2 males). The average age was 18.43 ± 9.24 years. All patients suffer from decreased vision, caused by myopic astigmatism, with progressing values during last year, before the treatment with *night time lenses* (table 1 and 2). This was the reason why all patients accepted the treatment with orthokeratology, as well as because of the fact that wearing glasses is uncomfortable, either aesthetically, emotionally, or even during exercises (e.g., performance boxing – case 3, basketball – case 2 or skiing – case 5). Except for 2 cases (case 2 and 7), the patients previously used alternatively glasses and a soft contact lens.

Including criteria for wearing night contact lenses

- patient aged over 6 years;
- patient with low/moderate myopia or myopic astigmatism (with cylinder of maximum -2.5 diopters);
- patient without a history of ocular or systemic allergies;
- patient without a history of acute ocular inflammation of the anterior segment of the eye;
- patient without a history of a dry eye or corneal hypoesthesia;
- patient without a history of systemic disease, which might affect the eye or might be exacerbated by wearing contact lenses;
- patient with corneal topography interpretation made by Piccollo keratron;
- monitoring period of time: minimum 6 months.

The study was conducted based on a protocol, after signing the informed consent by patients and/or parents. Piccollo keratron bring the possibility of objective

Nr.	Gender	Age years	Objective refraction RE	Objective refraction LE
1	F	9	-4.25 cyl -0.25/164	- 5.25 cyl -0.50/176
2	M	15	-0.75 cyl -0.25/178	- 1.75 cyl - 0.25/4
3	M	14	-4.0 cyl -0.50/116	- 4.0 cyl - 0.25/70
4	M	29	-1.25 cyl -1.50/146	- 1.50 cyl - 1.25/62
5	M	32	- 2.75 cyl -0.50/171	- 2.75 cyl -0.50/1
6	F	21	- 6.50 cyl -0.75/160	- 6.0 cyl -0.75/170
7	F	9	- 4.50 cyl -1/164	- 5.50 cyl -0.75/4

Table 1
DESCRIPTIVE DATA OF THE PATIENTS GROUP

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Nr.	VAwc RE	Refraction RE EqS	VAwc LE	Refraction LE EqS	Motivation
1	0.5	-4. 13	0.5	-5.50	Olympic. Swimming
2	0.4	-0.88	0.3	-1.88	Basketball. IT
3	0.4	-4.25	0.4	-4.13	Boxing
4	0.5	-2.0	0.5	-2.13	IT
5	0.4	-3.0	0.6	-3.0	Pharmacist. Skiing
6	0.2	-6.88	0.2	-6.38	Student. Aesthetics
7	0.4	-5.0	0.3	-5.88	Emotional

Table 2
VALUES OF VISUAL ACUITY AND OBJECTIVE REFRACTION IN PATIENTS WITH ORTHOKERATOLOGY

Nr.	Refraction wc RE	Refraction cc RE	Refraction wc LE	Refraction cc LE
1	-4. 13	-0.25	-5.50	-0.33
2	-0.88	-0.25	-1.88	-0.25
3	-4.25	-0.58	-4.13	-0.75
4	-2.0	-0.20	-2.13	-0.25
5	-3.0	-0.50	-3.0	-0.25
6	-6.88	-2	-6.38	-1.50
7	-5.0	-0.83	-5.88	-1.58

Table 3
VALUES OF OBJECTIVE REFRACTION WC AND CC

interpretation of ocular changes and visual acuities, and data was statistical analysed used Student test. To calculate the objective refraction, we used the value of the spherical equivalent, (EqS) obtained as the mathematic addition of the spherical value with half of the cylinder value.

Results and discussions

For visual acuity we used Snellen optotype. The average of visual acuity in RE (right eye) was VAREwc (without correction) = 0.4 ± 0.1 (limits between 0.2 and 0.5) and VAREcc (with correction) = 0.94 ± 0.11 (limits between 0.7 and 1). In LE (left eye), the mean value of VAwc and cc resembles the one of RE: VALEwc = 0.4 ± 0.14 and VALEcc = 0.94 ± 0.11 (with similar limits as in RE) (table 2). Statistically, there is a statistical significance between the values of VA in RE wc and cc ($p < 0.00001$ - SS), as well as in LE ($p < 0.00001$ - SS). There is no statistical significance between VA in RE and LE, both wc, and cc ($p = 0.5$ NS).

Mean value of objective refraction in EqS, before treatment, was in RE = -3.73 ± 1.98 and in LE = -4.13 ± 1.84. There is no statistical significance between the values of uncorrected subjective refraction ($p = 0.35$ - NS).

The mean value of objective refraction in EqS, after minimum 6 months of treatment was in RE = -0.66 ± 0.63 and in LE = -0.7 ± 0.60 (table 3). There is a statistical significance between the values of objective refraction, both in RE, and LE, wc and cc (RE: $p = 0.00104$ and LE: $p = 0.000265$). The values of refraction shows that *night contact lenses* significantly reduced myopia, by flattening the central cornea, also visible by the maps drawn by corneal topography makes with Piccollo keratron.

The *night contact lenses,* used in orthokeratology, is manufactured after the interpretation of the corneal topography programme. The corneal topography maps are made axial and tangential. The axial (sagittal) topography helps making a quantitative evaluation, in addition to the aerial subjective correction (which it confirms, most of the times) (fig. 1). We can observe a uniform blue plate, corresponding to a correction of 4 diopters (according to the scale on the right side), showing the total correction of refraction for each tested patient.

Tangential topography reveals a red ring, showing the decompression area, while the green-bluish area is the compression area (fig. 2). The red ring indicates that the night time lens had the expected effectiveness.

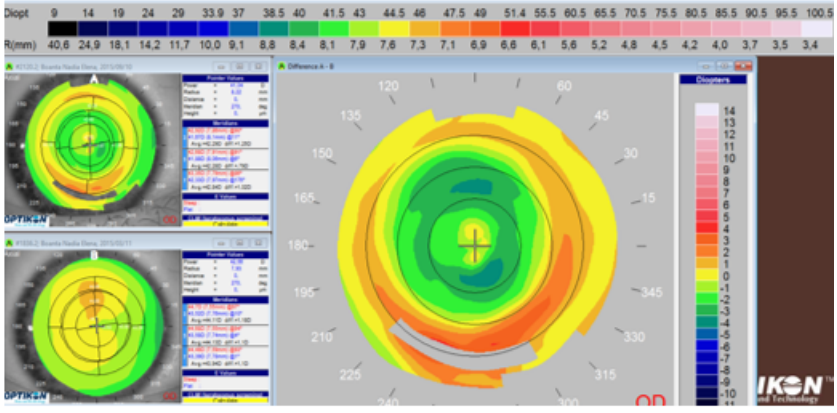

Fig. 1. Axial topography RE (case 7)

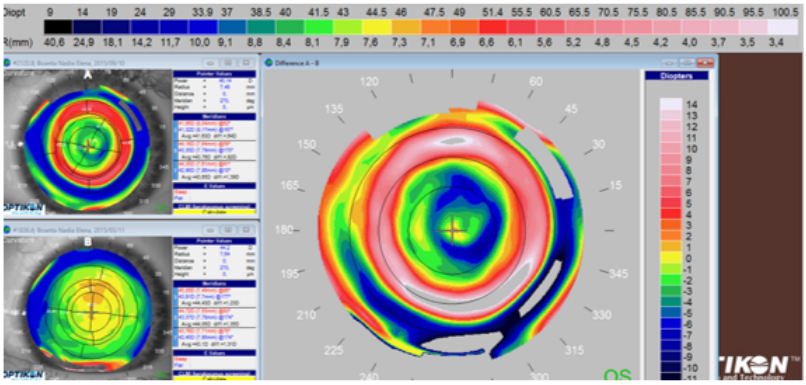

Fig. 2. Tangential topography LE (case 7)

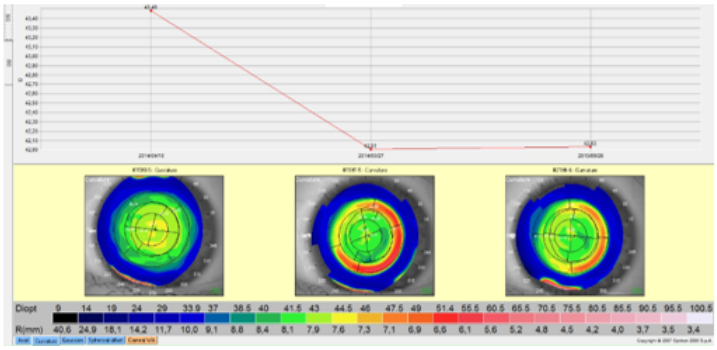

Fig.3. Discontinuous flattening ring LE (case 2)

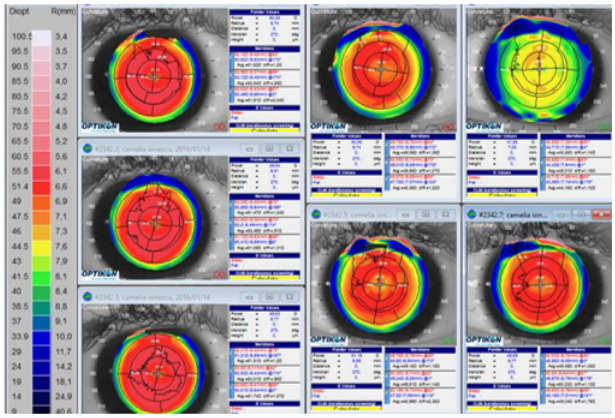

Fig. 4. Superior discontinuous image on corneal topography

Visual acuity was 1 wc during the entire day in 5 patients (71.43%), starting from the first week (*night contact lenses* effect). These are the elements that should be periodically monitored, in order to monitor the effectiveness of *night contact lenses*. It is very important that the patients keep wearing (night by night) the contact lens. A discontinuous wearing, even if not admitted, will be revealed by discontinuity of the red compression ring, despite the fact that the patient has visual acuity of 1 sc (fig.3). One patient wore the contact lenses discontinuously, without complying with the indications, but he remained with a better visual acuity.

It is very important to do correct corneal topography. If the eyelashes are on the cornea the image cannot be used (fig. 4).

None of the patients suffered from complications. One single patient had some difficulties of adapting to the lens, in the beginning of the treatment. Most of the patients complied with all the recommended hygiene instructions. One patient lost a lens while removing it, so we had to change it. In two patients (28.57%), corneal topography was changed at 6 months, so we ordered a new lens. All the patients were pleased with wearing" night time lens" and surprised by the fact that this type of treatment is not recommended by all ophthalmologists.

The patients' behaviour positively changed; they became more sociable, more self-confident. Wearing the contact lenses only at nigh time allowed them doing various daily activities without using glasses. In case of the patient who did performance boxing, the best way to correct the refraction error is orthokeratology. Also, for a patient aesthetically affected by wearing glasses, a solution for developing visual acuity is orthokeratology, at least until the age of 18, when we can perform corneal refractive surgery in order to correct myopic astigmatism.

Conclusions

Orthokeratology reduces myopia by flattening the cornea after wearing night time lenses. The quality of vision is improved and amblyopia is prevented, further on allowing the use of other methods to correct refraction errors. Orthokeratology can be used to prevent amblyopia in myopic or myopic astigmatism patient. Quality of life is much better in the patients treated through orthokeratology, both by raising self-esteem and by lack of discomfort in wearing glasses.

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