

(Возможный)

Механизм стабилизации  
близорукости при пользовании  
ортокератологическими  
линзами Paragon CRT

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Киев, Украина

# Методы:

- Ретроспективный анализ 2-х групп пациентов с миопией.
- 1245 – линзы Парагон (CRT group)
- 144 – пользователи очков и МКЛ (Control group).

Groups	Total # Patients	Age	Myopia (D)	Axial Myopia	Mixed Myopia	Refractive Myopia
Glasses & Contacts	144	14,6 +/- 3.0	3.63 +/- 1.46	71	45	28
CRT	1245	14.4 +/- 2.6	3.62 +/- 1.37	606	404	235

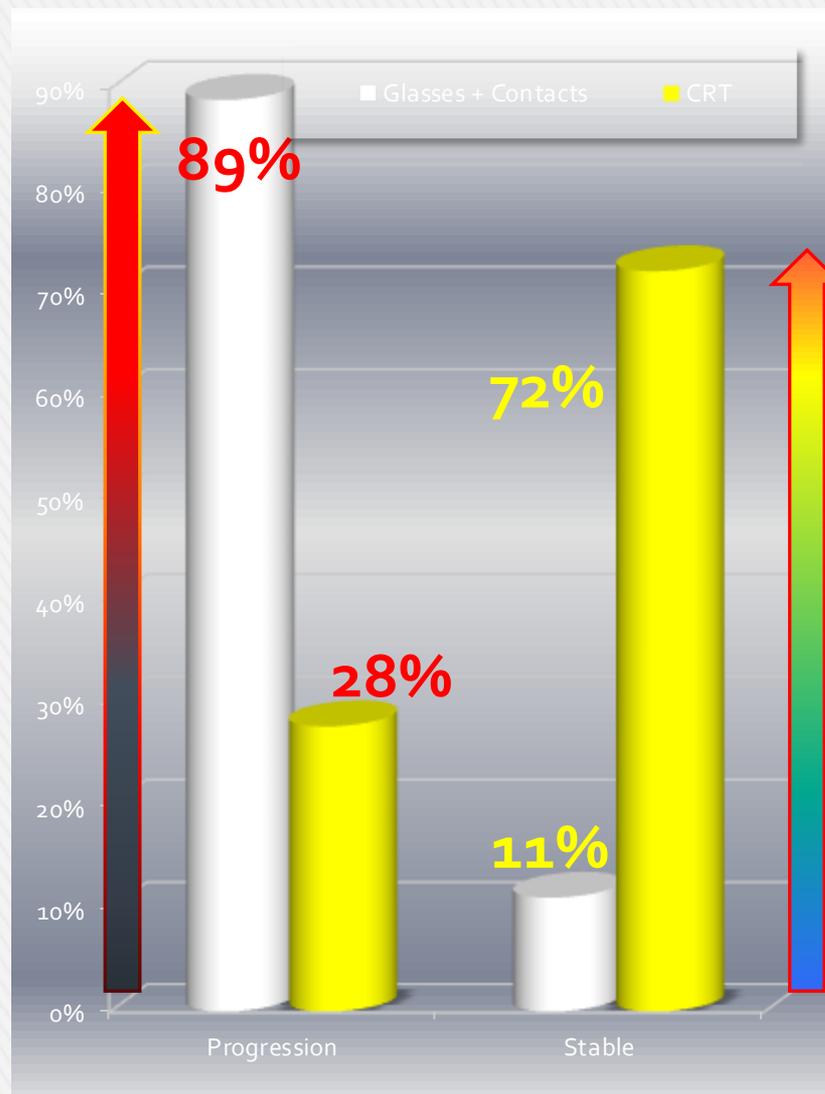
- Стандартные исследования.
- Резервы аккомодации положительные.
- ПЗО, рефракция в линзе
- Осмотр каждые 3 месяца (CRT group)



# Прогрессирование Миопии на 1.0D и более

Группы	Прогресс.	Стабильн.
Очки и МКЛ 144 пациента	128 (88.9%)	16 (11.1%)
CRT 1247 пациентов	348 (27.8%)	899 (72.2%)

- Чем же отличаются глаза с Прогрессией Миопии от глаз со Стабильной Миопией?**



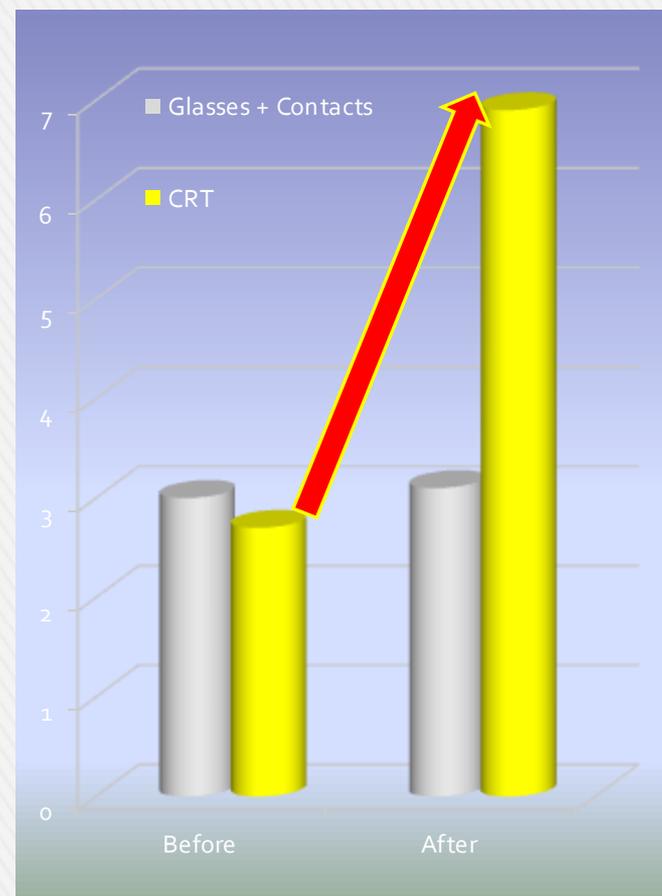
# Изменения ПЗО в ходе проведения рефракционной терапии



■ Очки и МКЛ  
■ Линзы Paragon CRT

# Результаты: Разница в Резерве Аккомодации

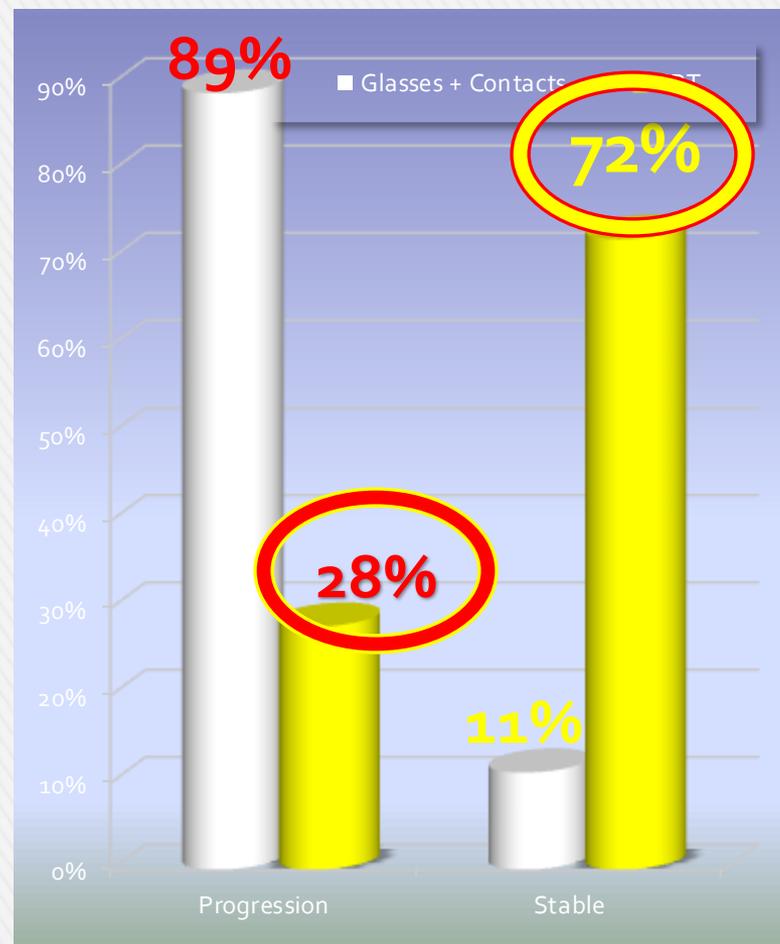
Группы	Исходн.	4 года набл.
Очки и МКЛ	3.0 +/- 2.1	3.1 +/- 2.3
CRT	2.7 +/- 1.8	6.9 +/- 2.7



# Прогрессирование Миопии на 1.0D и более

Groups	Progression	Stable
Glasses + Contacts	128 (88.9%)	16 (11.1%)
CRT	348 (27.8%)	899 (72.2%)

- Что отличает пациентов со стабилизированной и прогрессирующей миопией в группе пациентов, пользующихся линзами Paragon CRT?



# Stable Myopia vs. Progression in CRT Group

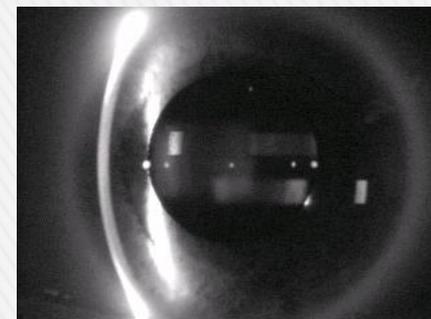
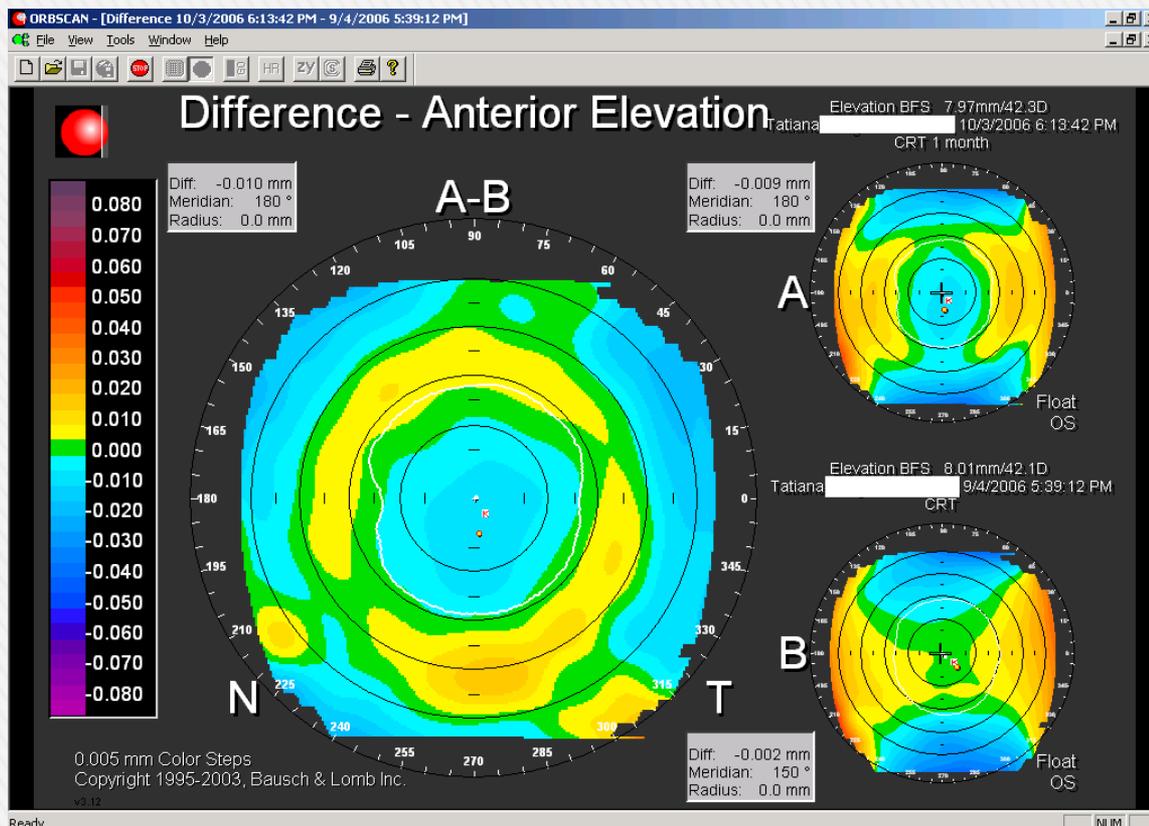
Parameters	Stable Refraction & Axial Length (899)		Increased Eye Axial Length and Myopic Refraction (348)	
	Before CRT	After CRT	Before CRT	After CRT
BUVA	0.16±0.15	0.93±0.09	0.15±0.14	0.89±0.14
Refraction	-3.67±1.3	<b>+0.23±0.52</b>	-3.47±1.45	<b>-0.55±0.47</b>
MRS (ROL)	0.35±0.28	<b>+0.23±0.42</b>	0.29±0.34	<b>-0.41±0.46</b>
Cylindrical (ROL)	-0.09±0.49	-0.21±0.38	-0.23±0.54	-0.34±0.5
Axial Length	24.65±0.87	24.44±0.94	24.6±0.86	25.28±0.8
Reserve of Accommodation	2.67±1.8	6.96±1.6	2.67±1.8	3.54±2.71

# Выводы:



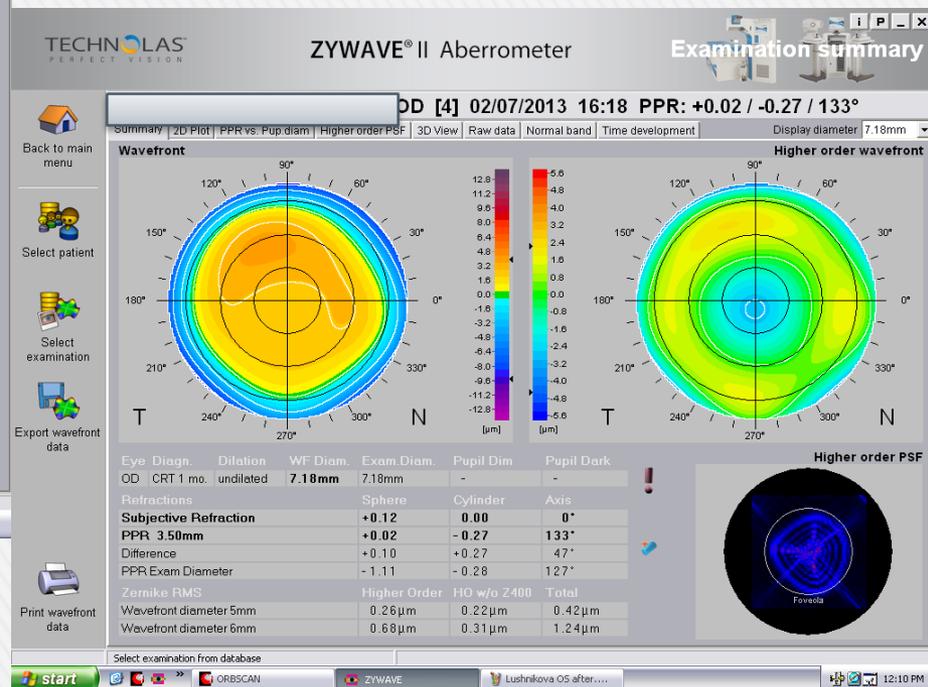
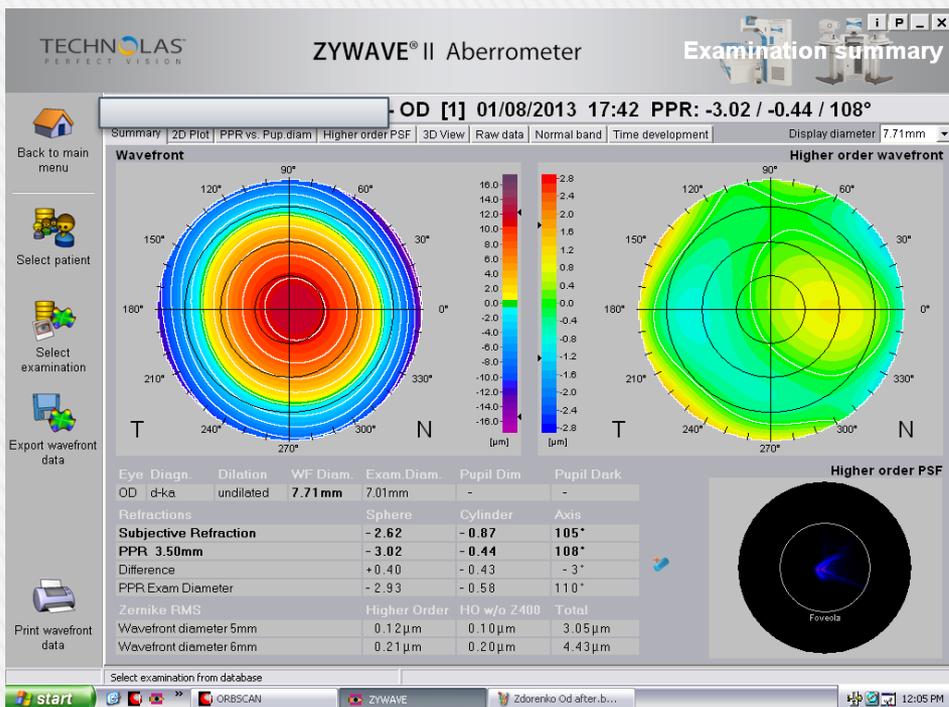
- Применение рефракционной терапии линзами Paragon CRT оказывает стабилизирующее действие на развитие близорукости.
- Стабилизация прогрессирования миопии у подростков сопровождается значительным увеличением работоспособности цилиарного тела (увеличением резервов аккомодации) и может быть объяснена этим эффектом.

» Уплотнение центральной зоны роговицы приводит к дозированному ослаблению оптической силы, а следовательно, коррекции близорукости.



○ Изменение конфигурации поверхности роговицы неизбежно приводит к появлению аббераций высшего порядка.

Известно, что любое индуцированное уплощение центральной части роговицы приводит к индуцированию сферических аббераций



- » В данной работе мы провели ретроспективный анализ историй 34 пациентов, пользующихся рефракционной терапией и изучили изменение аберраций высшего порядка в ходе пользования линзами Paragon CRT.
- » В анализируемую группу были отобраны пациенты, у которых в результате рефракционной терапии была достигнута полная коррекция миопии, рефракция была эметропической и острота зрения 100%.
- » Средняя степень близорукости до лечения была 3.71Д.
- » Средняя оптическая сила плоского меридиана – 43.87Д
- » **Все пациенты были удовлетворены качеством своего зрения.**

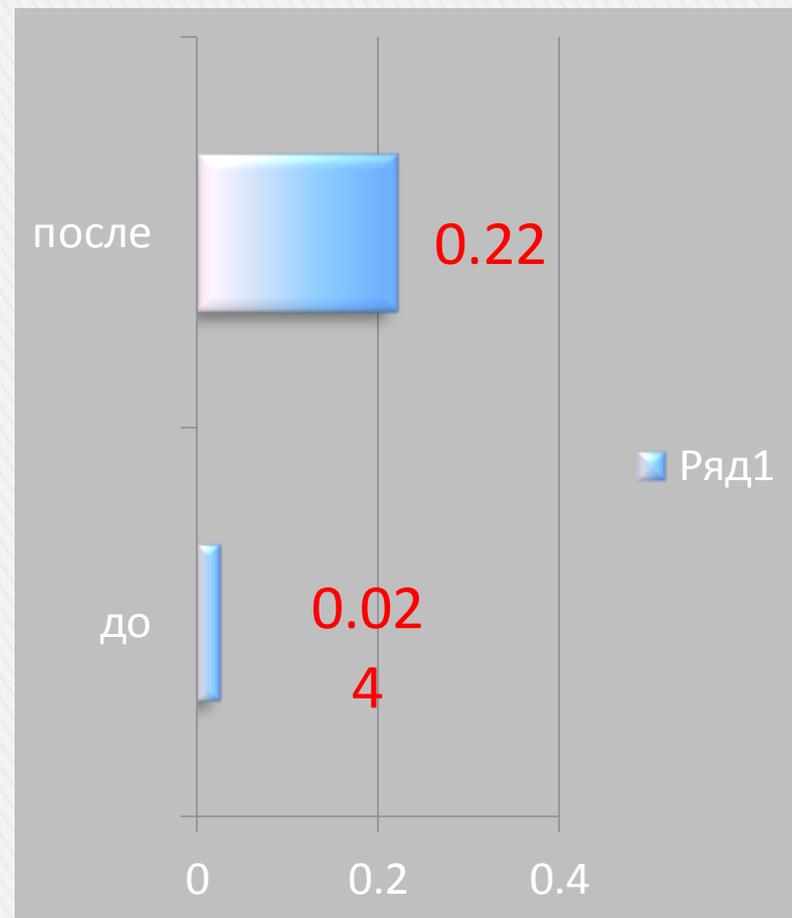
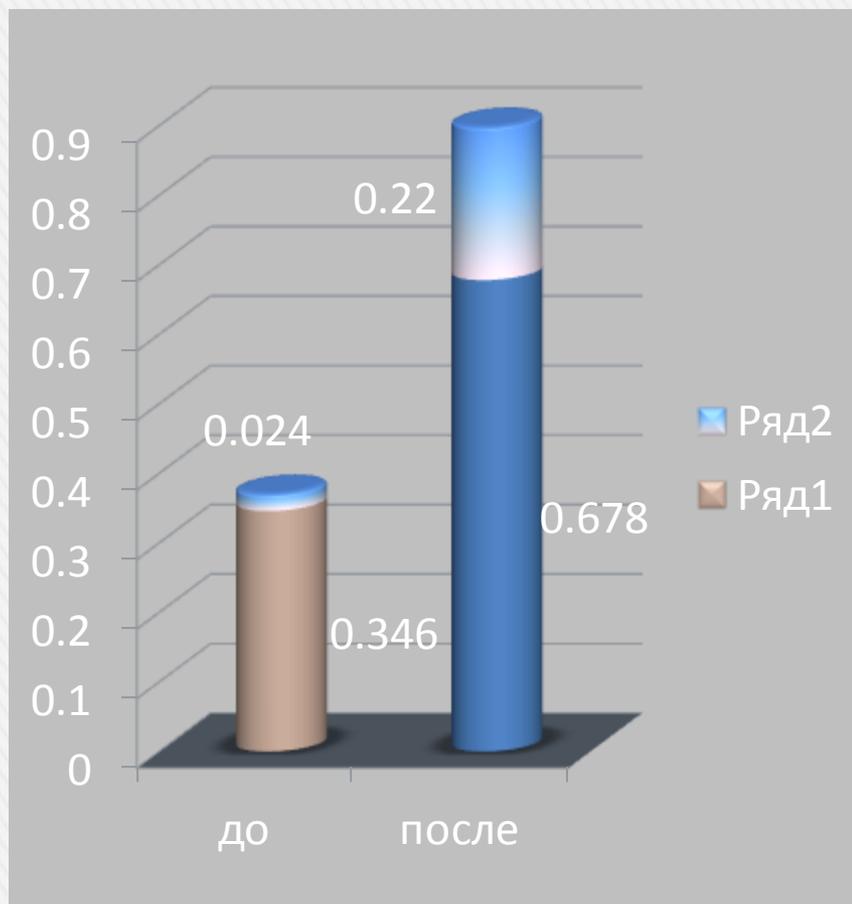
**ДО начала  
рефракционной терапии**

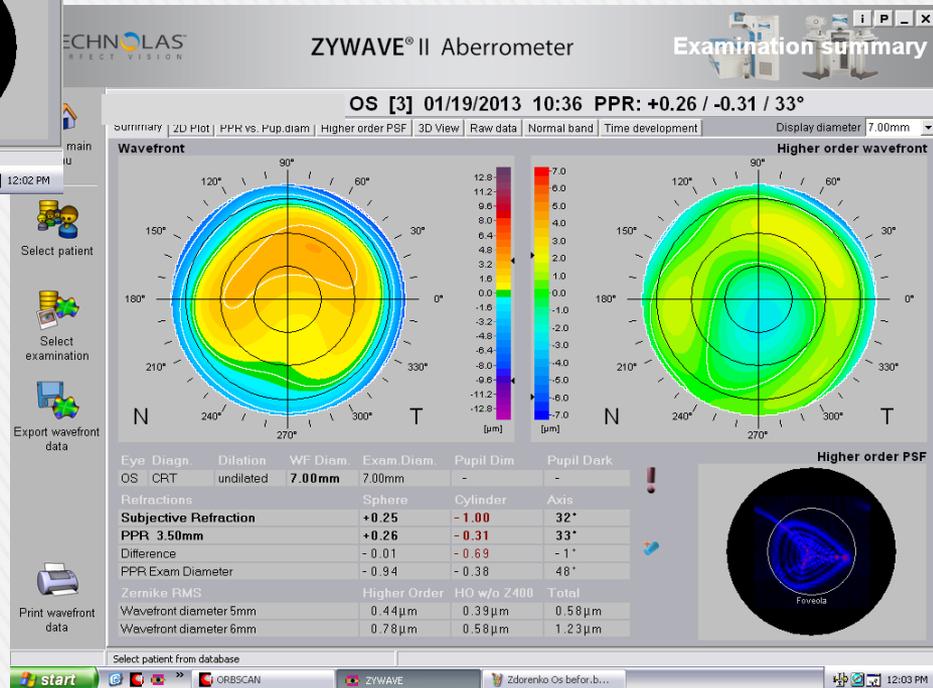
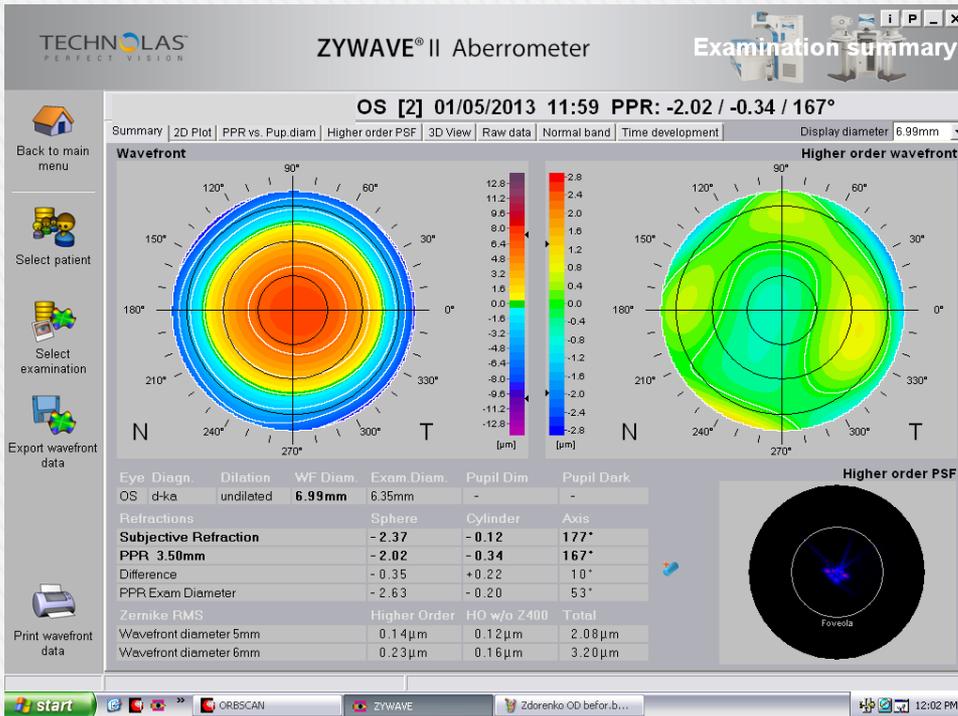
- » Средняя сферическая рефракция была +3.71Д.
- » Средняя астигматическая рефракция -0.62Д
  
- » уровень aberrаций высшего порядка ( при ширине зрачка 6 и более мм) **0.346мкм.**
- » Из них, сферических aberrаций **0.024мкм.**

**Через 1 месяц  
после начала терапии**

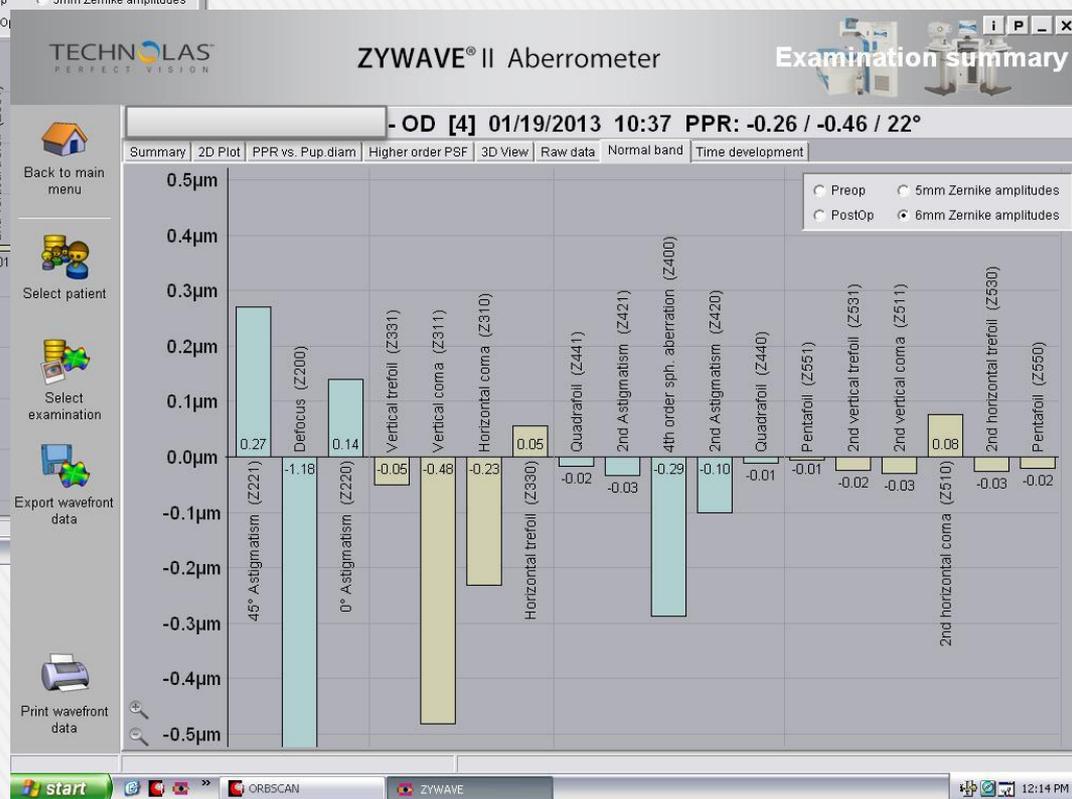
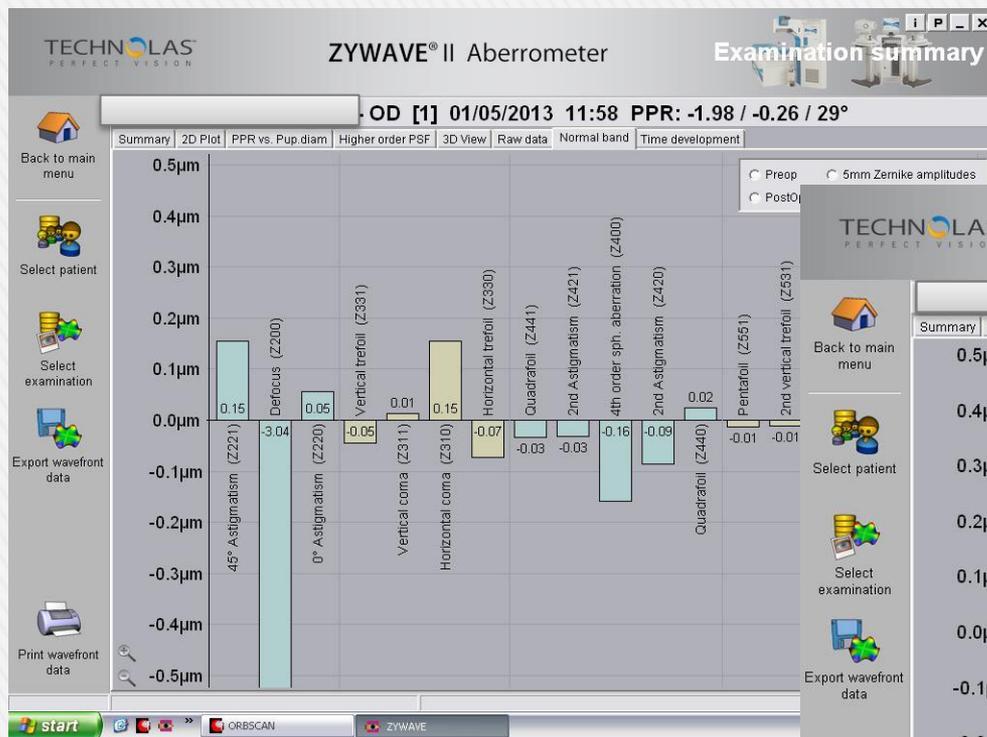
- » Средняя сферическая рефракция была +0.11Д.
- » Средняя астигматическая рефракция -0.42Д
- » Острота зрения у всех пациентов – 100%.
  
- » Уровень aberrаций высшего порядка п – **1.022мкм.**
- » Из них, сферических aberrаций – **0.22мкм.**

# Динамика абберраций высшего порядка в ходе рефракционной терапии:





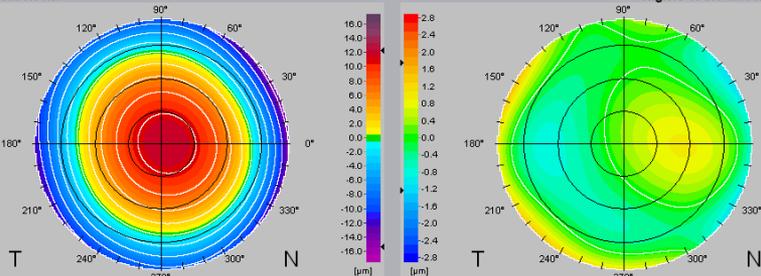
При анализе характера сферических aberrаций мы обратили внимание, что у всех пациентов преобладали сферические aberrации с отрицательным знаком.



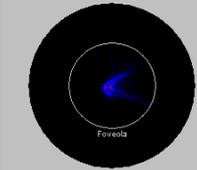
- OD [1] 01/08/2013 17:42 PPR: -3.02 / -0.44 / 108°

Summary | 2D Plot | PPR vs. Pup. diam | Higher order PSF | 3D View | Raw data | Normal band | Time development | Display diameter 7.71mm

Wavefront Higher order wavefront



Eye Diagn.	Dilation	WF Diam.	Exam Diam.	Pupil Dim	Pupil Dark
OD d-ka	undilated	7.71 mm	7.01mm	-	-
<b>Refractions</b>					
		Sphere	Cylinder	Axis	
<b>Subjective Refraction</b>		- 2.62	- 0.87	105°	
<b>PPR 3.50mm</b>		- 3.02	- 0.44	108°	
Difference		+ 0.40	- 0.43	- 3°	
PPR Exam Diameter		- 2.93	- 0.58	110°	
<b>Zernike RMS</b>					
		Higher Order	HO w/o Z400	Total	
Wavefront diameter 5mm		0.12 µm	0.10 µm	3.05 µm	
Wavefront diameter 6mm		0.21 µm	0.20 µm	4.43 µm	



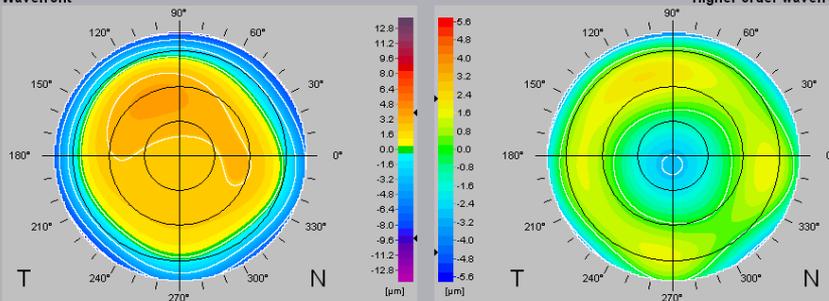
- Back to main menu
- Select patient
- Select examination
- Export wavefront data
- Print wavefront data

- Select patient
- Select examination
- Export wavefront data
- Print wavefront data

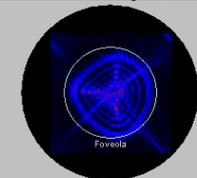
I - OD [4] 02/07/2013 16:18 PPR: +0.02 / -0.27 / 133°

Summary | 2D Plot | PPR vs. Pup. diam | Higher order PSF | 3D View | Raw data | Normal band | Time development | Display diameter 7.18mm

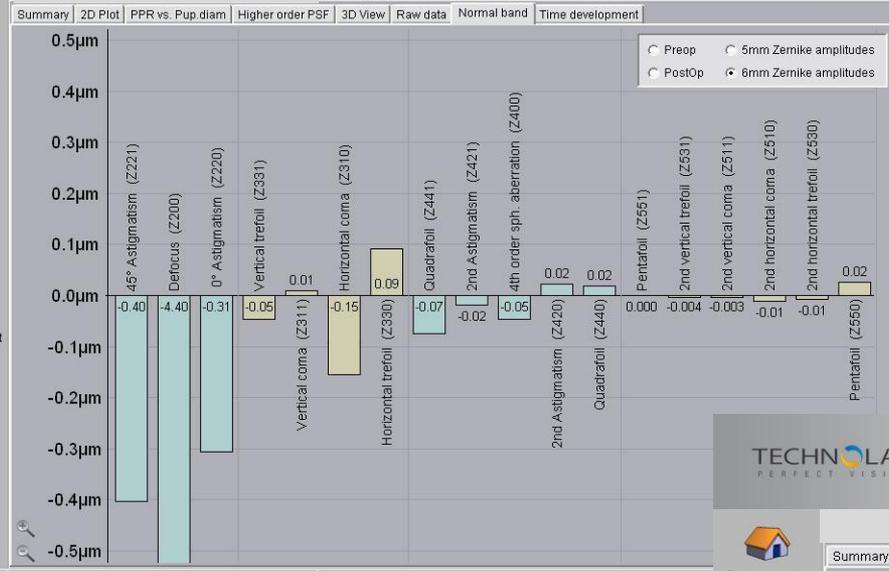
Wavefront Higher order wavefront



Eye Diagn.	Dilation	WF Diam.	Exam Diam.	Pupil Dim	Pupil Dark
OD CRT 1 mo.	undilated	7.18mm	7.18mm	-	-
<b>Refractions</b>					
		Sphere	Cylinder	Axis	
<b>Subjective Refraction</b>		+ 0.12	0.00	0°	
<b>PPR 3.50mm</b>		+ 0.02	- 0.27	133°	
Difference		+ 0.10	+ 0.27	47°	
PPR Exam Diameter		- 1.11	- 0.28	127°	
<b>Zernike RMS</b>					
		Higher Order	HO w/o Z400	Total	
Wavefront diameter 5mm		0.26 µm	0.22 µm	0.42 µm	
Wavefront diameter 6mm		0.68 µm	0.31 µm	1.24 µm	

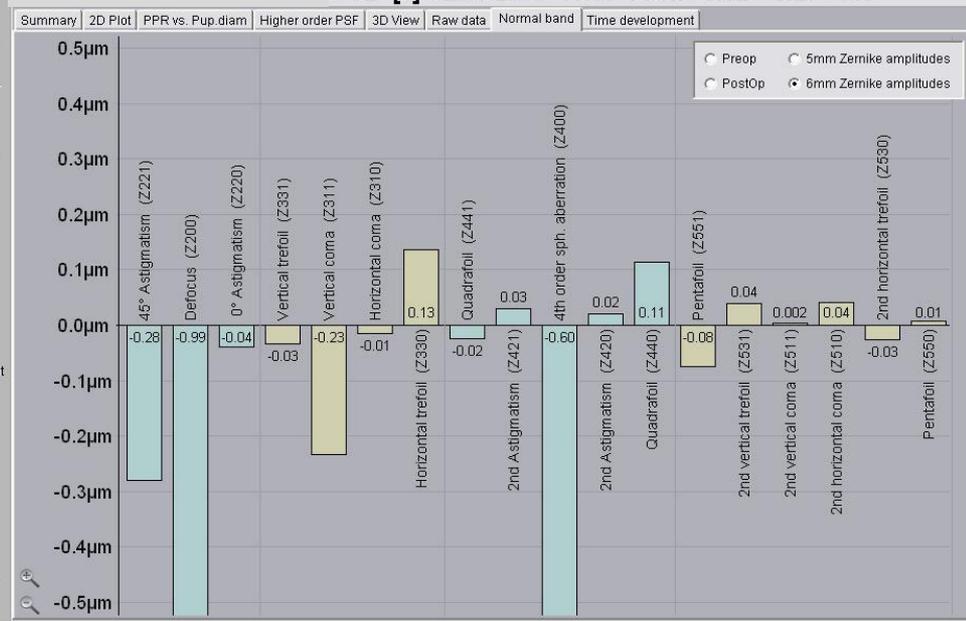


OD [1] 01/08/2013 17:42 PPR: -3.02 / -0.44 / 108°



- Back to main menu
- Select patient
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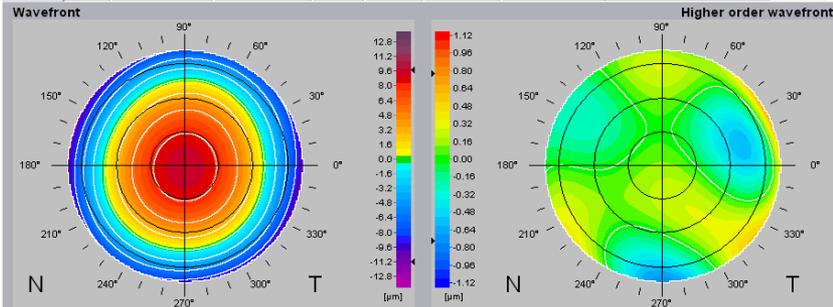
- OD [4] 02/07/2013 16:18 PPR: +0.02 / -0.27 / 133°



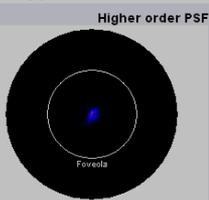
- Back to main menu
- Select patient
- Select examination
- Export wavefront data
- Print wavefront data

- OS [2] 01/08/2013 17:44 PPR: -2.79 / -0.69 / 75°

Summary | 2D Plot | PPR vs. Pup.diam | Higher order PSF | 3D View | Raw data | Normal band | Time development | Display diameter: 6.92mm



Eye Diagn.	Dilation	WF Diam.	Exam.Diam.	Pupil Dim	Pupil Dark
OS d-ka	undilated	6.92mm	6.29mm	-	-
Refractions		Sphere	Cylinder	Axis	
<b>Subjective Refraction</b>		-3.12	-0.62	84°	
PPR 3.50mm		-2.79	-0.69	75°	
Difference		-0.33	+0.07	9°	
PPR Exam Diameter		-2.97	-0.45	70°	
Zernike RMS		Higher Order	HO w/o Z400	Total	
Wavefront diameter 5mm		0.14 μm	0.12 μm	2.98 μm	
Wavefront diameter 6mm		0.18 μm	0.17 μm	4.31 μm	

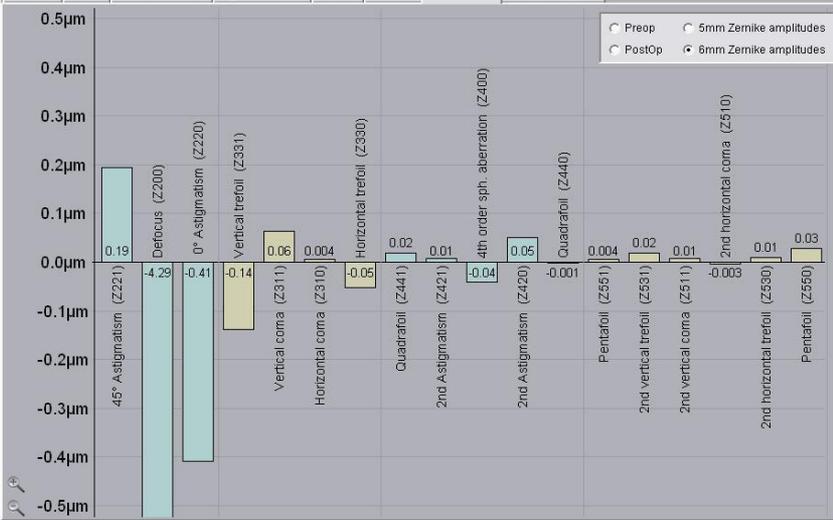


Select examination from database

- Back to main menu
- Select patient
- Select examination
- Export wavefront data
- Print wavefront data

- OS [2] 01/08/2013 17:44 PPR: -2.79 / -0.69 / 75°

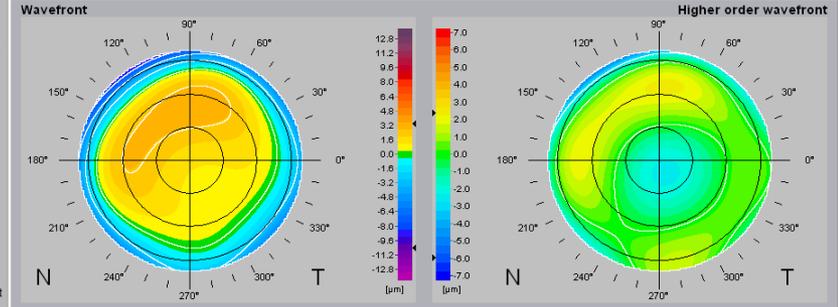
Summary | 2D Plot | PPR vs. Pup.diam | Higher order PSF | 3D View | Raw data | Normal band | Time development



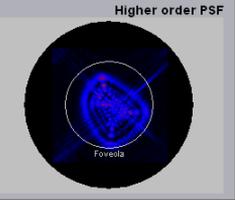
- Back to main menu
- Select patient
- Select examination
- Export wavefront data
- Print wavefront data

- OS [3] 02/07/2013 16:17 PPR: +0.13 / -0.28 / 63°

Summary | 2D Plot | PPR vs. Pup.diam | Higher order PSF | 3D View | Raw data | Normal band | Time development | Display diameter: 6.70mm



Eye Diagn.	Dilation	WF Diam.	Exam.Diam.	Pupil Dim	Pupil Dark
OS CRT 1 mo.	undilated	6.70mm	6.70mm	-	-
Refractions		Sphere	Cylinder	Axis	
<b>Subjective Refraction</b>		-0.25	0.00	0°	
PPR 3.50mm		+0.13	-0.28	63°	
Difference		-0.38	+0.28	-63°	
PPR Exam Diameter		-0.86	-0.32	51°	
Zernike RMS		Higher Order	HO w/o Z400	Total	
Wavefront diameter 5mm		0.35 μm	0.28 μm	0.47 μm	
Wavefront diameter 6mm		0.87 μm	0.60 μm	1.42 μm	

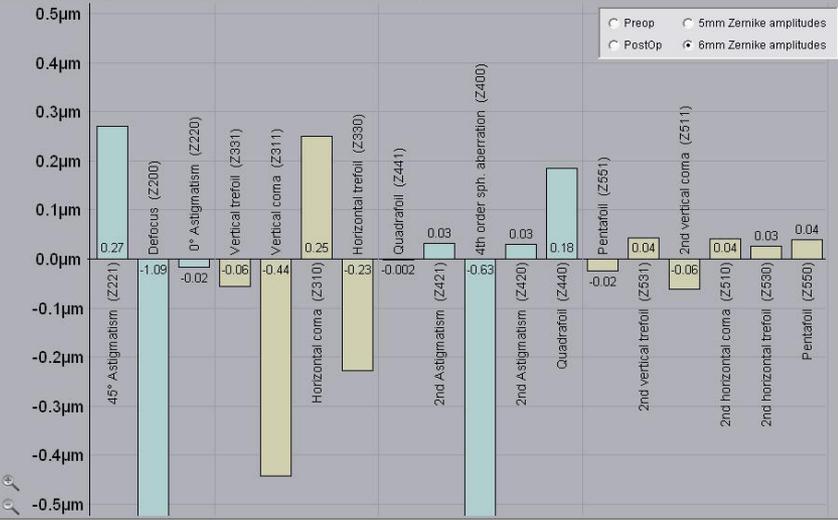


Select examination from database

- Back to main menu
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- OS [3] 02/07/2013 16:17 PPR: +0.13 / -0.28 / 63°

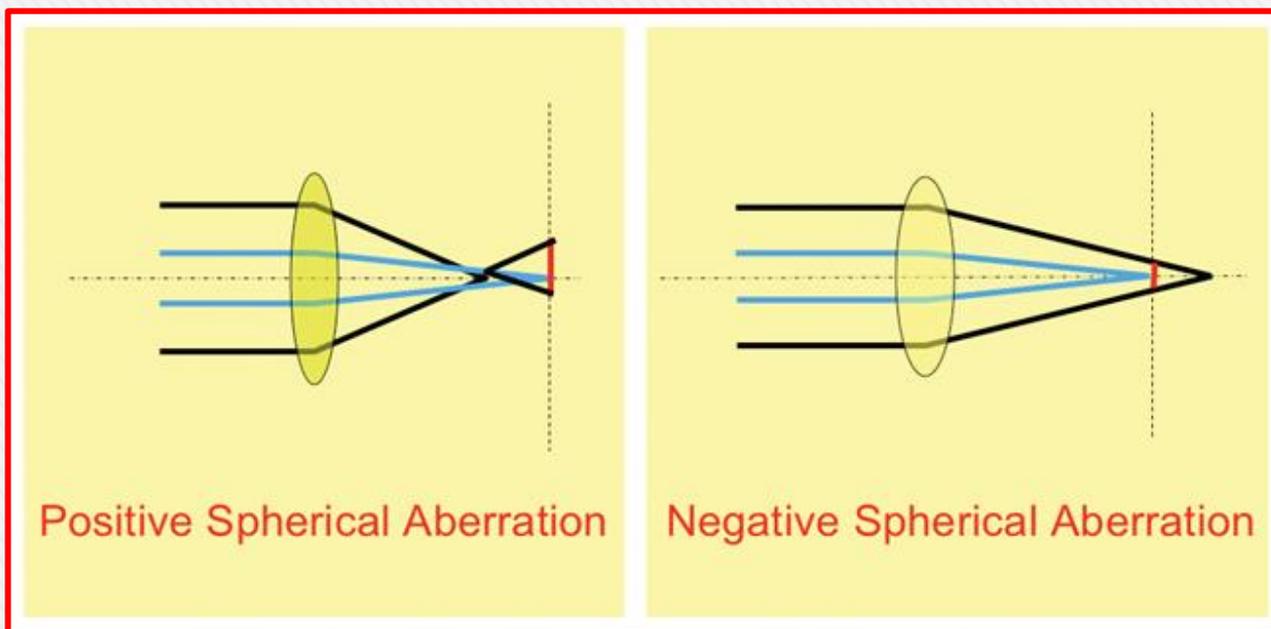
Summary | 2D Plot | PPR vs. Pup.diam | Higher order PSF | 3D View | Raw data | Normal band | Time development



- Back to main menu
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## Отрицательные сферические аберрации УМЕНЬШАЮТ Глубину Фокуса.

В таком глазу для осуществления «фокусировки» надо использовать всю силу аккомодации.



# Выводы:



- Рефракционная терапия в ходе коррекции близорукости увеличивает количество aberrаций высшего порядка. При этом существенная часть этих aberrаций увеличивается за счёт сферических aberrаций.
- Рефракционная терапия индуцирует отрицательные сферические aberrаций, что приводит к УМЕНЬШЕНИЮ Глубины Фокуса.
- Отрицательные сферические aberrации способствуют развитию резервов аккомодации и...
- являются одним из звеньев механизма стабилизации близорукости.



Спасибо за Внимание!

# К ДИСКУССИИ...

(Послесловие)



# Article ▶ Orthokeratology: An Update

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Volume 1 | Issue 1

Optometry & Visual Performance

**Table 3: Studies providing evidence that orthokeratology reduces myopic progression.**

Study	Details of Study	Findings
Corneal Reshaping and Yearly Observation of Nearsightedness (CRAYON) study <sup>64</sup>	2-year study in the USA in 2007 compared 28 children (8-11 yrs old) undergoing orthokeratology with an age-matched control group of 28 children wearing soft or rigid gas permeable contact lenses.	Axial length and vitreous chamber depth were significantly slowed in the orthokeratology group by an annual average of 0.16mm and 0.10mm, respectively.
Myopia Control with Orthokeratology contact lenses in Spain (MCOS) study <sup>65</sup>	A prospective study in Spain compared 31 children with orthokeratology to 31 well matched children with single vision spectacle wear.	There were no changes in best-corrected visual acuity or significant adverse health effects from orthokeratology wear.
Controlling Astigmatism and Nearsightedness in Developing Youth (CANDY) <sup>66</sup>	20 myopic children not treated with orthokeratology were compared to 28 myopic children treated with orthokeratology.	Myopic progression of 0.36D per year in normally corrected myopia reduced to 0.03D per year with orthokeratology lens wear.
Overnight Orthokeratology lens wear slows axial eye growth in myopic children (ROC) <sup>67</sup>	14 children of Eastern Asian ethnicity wore an overnight orthokeratology lens in one eye and a conventional daily wear rigid (RGP) lens in the other for 6 months. The lens-eye treatment was reversed for a second 6 month period.	Axial length initially decreased with orthokeratology then returned to baseline at 6 months, whereas eyes with an RGP lens increased in axial length over the same 6 month period.
Corneal reshaping inhibits myopia progression (CRIMP) <sup>68</sup>	10-year retrospective study in Australia compared 32 children (under 18 yrs) utilizing orthokeratology with 32 well matched children utilizing spectacle correction.	An 86% slowing in myopia progression was found (- 0.29D change in control group and -0.04D change in orthokeratology group). 70% of orthokeratology wearers did not experience myopia progression.
Influence of overnight orthokeratology on axial elongation in childhood myopia <sup>69</sup>	Compared the axial elongation of 42 myopic children in Japan using orthokeratology lenses compared with 50 well matched children wearing spectacle lenses over a 2 year period.	Axial myopic lengthening has been shown to be retarded by 36% with orthokeratology over a 2 year period. The axial length increased by 0.39mm and 0.61mm in the Orthokeratology and control groups, respectively.
Stabilization of Myopia by Accelerated Reshaping Technique (SMART) study <sup>70</sup>	5-year longitudinal study still in progress in USA. Large scale (>150 patient multicentre evaluation) study comparing children (8-14yrs) using orthokeratology and soft contact lenses.	3rd year report: 85% reduction in myopia control; the orthokeratology test group progressed by -0.15D compared with the soft contact lens control group, which progressed by -1.02D).
Retardation of myopia in Orthokeratology (ROMIO) <sup>71</sup>	2-year study still in progress.	First year results showed a 41% retardation of axial length with orthokeratology compared with control group.

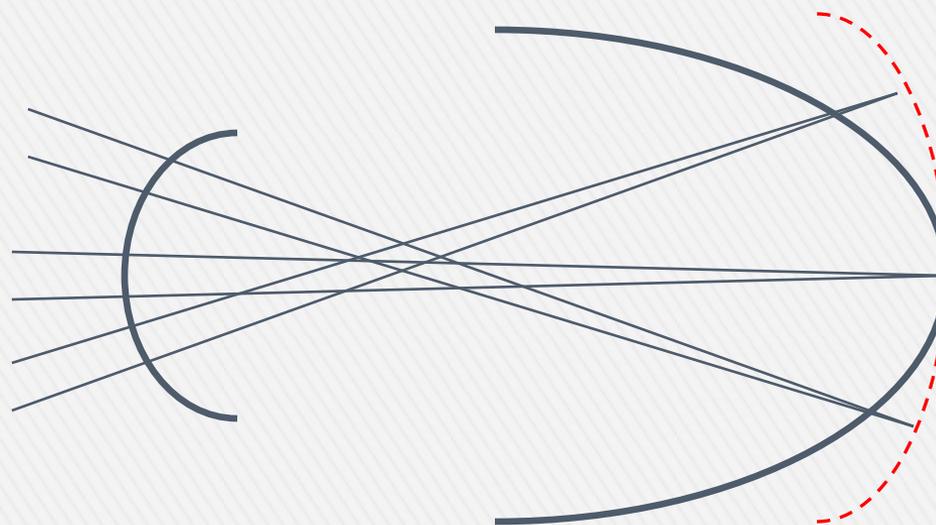
# CRAYON Study

Jeffrey J. Walline, OD PhD

The Ohio State University College of Optometry

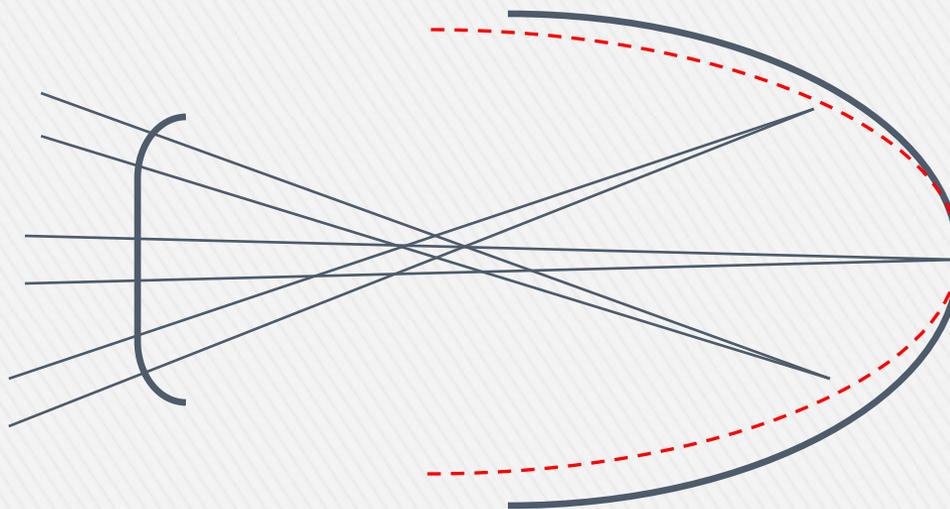


# How Corneal Reshaping May Work

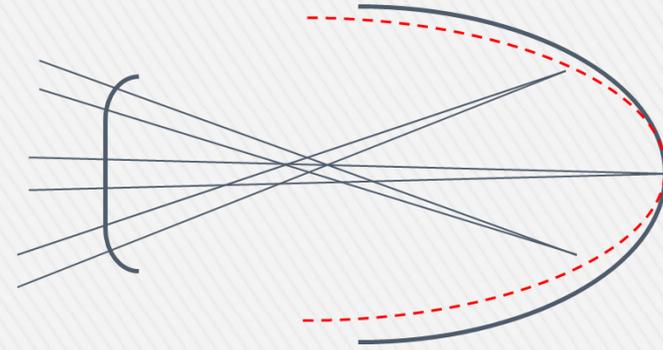
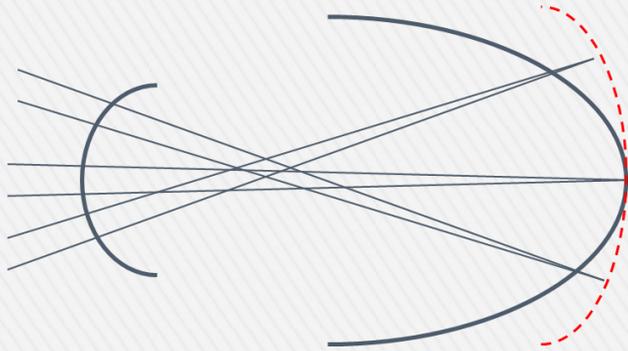


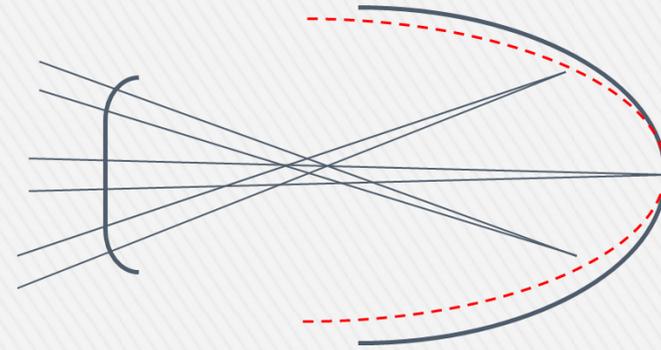
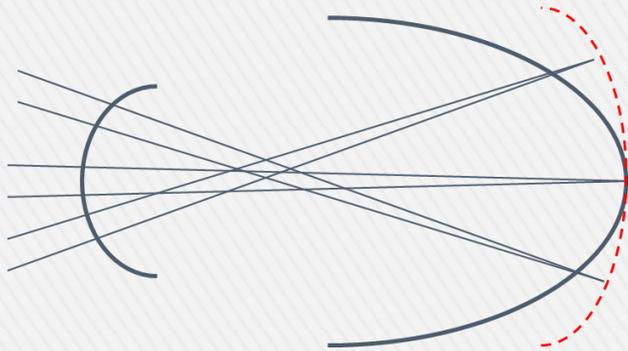
Myopia correct with glasses

# How Corneal Reshaping May Work



Myopia correct with corneal reshaping



A diagram of a lens illustrating positive spherical aberration. Parallel light rays enter from the left. The central rays converge at a point further to the right, while the peripheral rays converge at a point closer to the lens. A vertical dashed line indicates the focal plane for the peripheral rays, which is in front of the focal plane for the central rays.

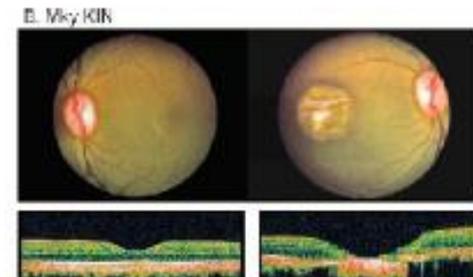
Positive Spherical Aberration

A diagram of a lens illustrating negative spherical aberration. Parallel light rays enter from the left. The central rays converge at a point closer to the lens, while the peripheral rays converge at a point further to the right. A vertical dashed line indicates the focal plane for the peripheral rays, which is behind the focal plane for the central rays.

Negative Spherical Aberration



## ■ Peripheral Refraction and Myopia Development

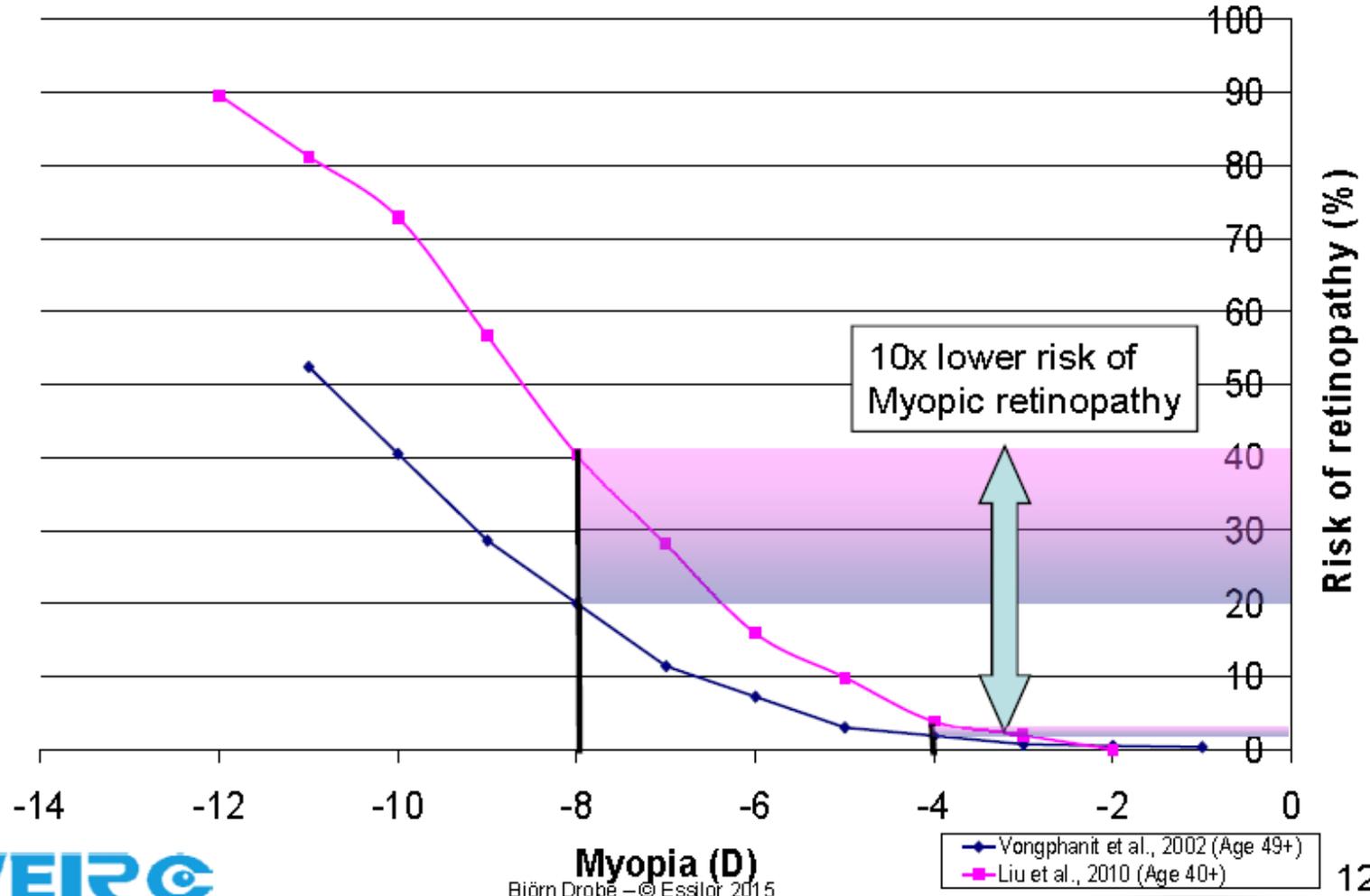
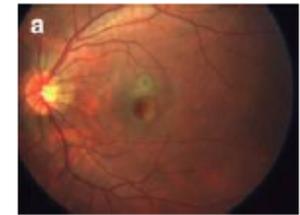


### Effects of Foveal Ablation on Emmetropization and Form-Deprivation Myopia

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**CONCLUSIONS.** Visual signals from the fovea are not essential for normal refractive development or the vision-induced alterations in ocular growth produced by form deprivation. Conversely, the peripheral retina in isolation, can regulate emmetropizing responses and produce anomalous refractive errors in response to abnormal visual experience. These results indicate that peripheral vision should be considered when assessing the effects of visual experience on refractive development. (*Invest Ophthalmol Vis Sci.* 2007;48:3914-3922) DOI:10.1167/iovs.06-1264

# Why ?





Спасибо за Внимание!  
и  
Терпение!!!