Universidade do Minho

Suggestion for a new myopia classification

Poster #8

Jorge Jorge, Ana Pinho, António Queirós, JM González-Méijome
School of Science (Optometry), University of Minho, Braga, Portugal

Reprint Request:
jorge@fisica.uminho.pt

Aim

To propose a new classification for myopia in order to reflect the new knowledge about the onset and development of myopia.

Methods

A literature revision about the myopia classification used in the last 150 years.

Conclusions

Our classification divides myopia in primary and secondary. Primary myopia is the one that is present at the birth or at the early age and it is congenital or hereditary. The secondary myopia onset at the youth or adult age, it is related with external factors and could also be produced after a surgery or an ocular trauma.

Introduction

Myopia results from an eye having excessive refractive power for its axial length. This may occur due either to the eye having a relatively long axial length or to increased dioptric power of the refractive components (cornea and/or lens).

Grosvenor realized that myopia have been classified in several systems in the last 150 years and proposed a new classification. The proposed classification grouped the myopia under the following groups:

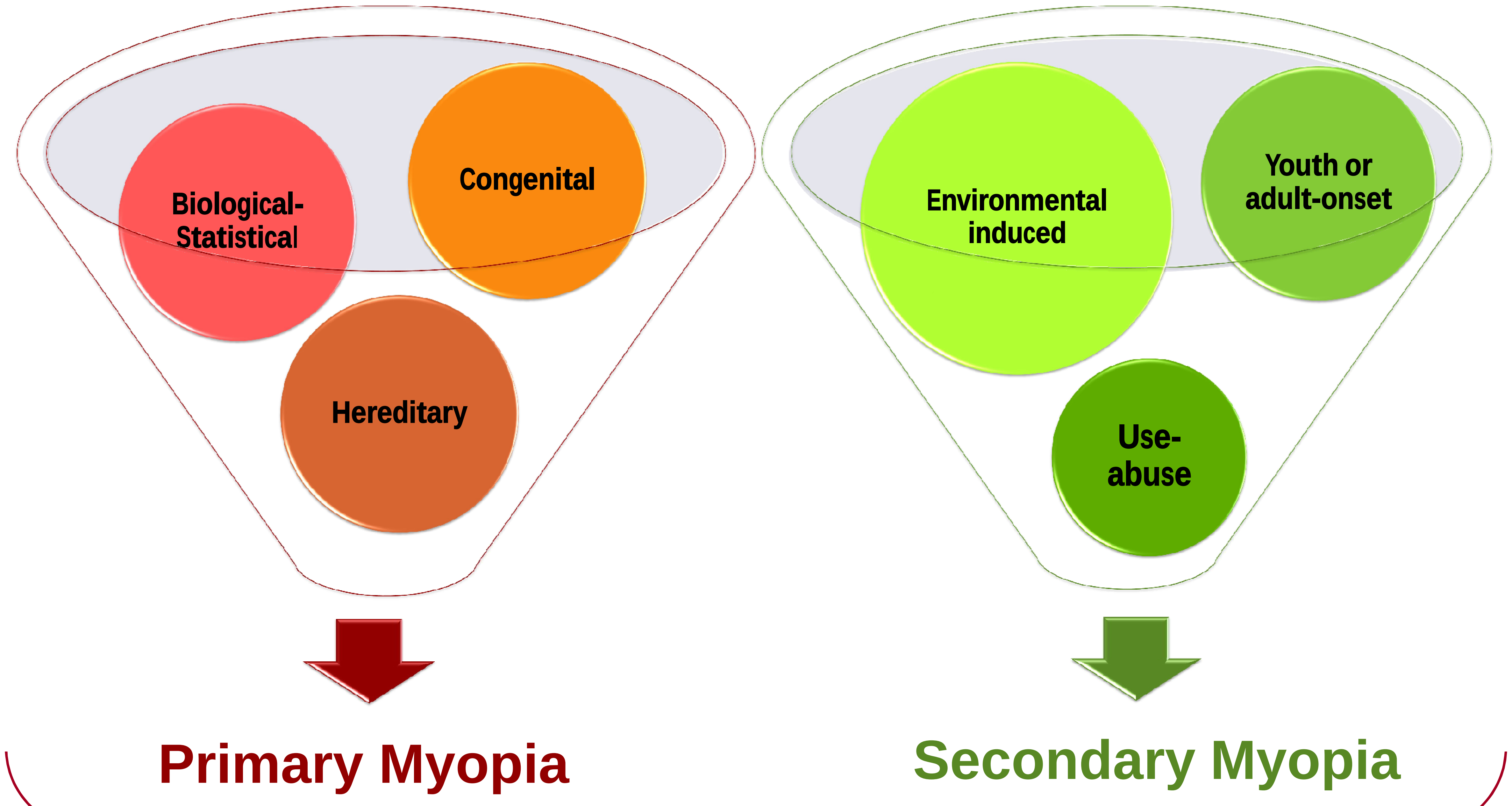
Rate of Myopic progression (Donders)	Stationary Temporarily progressive Permanently progressive
Anatomical Features (Borish)	Axial Refractive Index Curvature Anterior chamber
Degree (Hirsch)	Alpha (Low) Beta (Moderate) Gamma (High)
Physiological and Pathological (Curtin; Duke-Elder and Abrams)	Physiological Pathological
Hereditary and environmentally induced (Kepler / Rosenfield)	Hereditary Environmentally induced
Myopic Development (McBrien and Barnes)	Biological-statistical Use-abuse Emmetropization
Age of Onset (Grosvenor)	Congenital Youth-onset Early adult-onset Late adult-onset
Other Myopias	Nigth myopia Pseudomyopia Open space myopia Instrumental Myopia

Results

Our proposal of classification of myopia divides it in **PRIMARY** and **SECONDARY** Myopia.

PRIMARY MYOPIA is an essential myopia and includes actual myopia classified as the congenital, the biological-statistical, the hereditary myopia, and the pathological myopia. It was present at the birth or appears at the early age. It was permanently progressive. The degree of myopia should at least 4.00/5.00 D.

SECONDARY MYOPIA includes the actual myopia classified as youth or adult-onset, the use-abuse, and the environmentally induced. It could be related with external factors as the drugs effects or special work conditions and could also be produced after cataract or an ocular trauma. The degree was usually less than 4.00/5.00 D. This myopia is the myopia who appears in children at school age or in young adults.



References

Benjamin WJ. Borish Clinical Refraction. 1998. W.B. Saunders Company, Philadelphia.
Grosvenor T. Primary Care Optometry. 2001. Butterworth-Heinemann, Philadelphia
Grosvenor T, Goss DA. Clinical Management of Myopia. 1999. Butterworth-Heinemann.
Rosenfield M, Gilmartin B. Myopia and nearwork. 1998. Butterworth-Heinemann.
Curtin BJ. The Myopias: Basic Science and Clinical Management. 1985. Harper & Row, Philadelphia.
Morgan I ,Rose K. How genetic is school myopia? Prog Retin Eye Res 2005; 24: 1-38.
Jorge J, Almeida JB, Parafita M. What is the Real Prevalence of Myopia? Ophthalmic Physiol Opt 2006; 26, s1: 31.
Jorge J, Gonzalez-Meijome J, Queiros A, Almeida JB, Parafita M. Differences in ametropia prevalence obtained different methods of refraction. Acta Ophthalmol Scand 2006; 84, s239: 165.

Sponsors

HOYA
SPVMED
ESSILOR
FUNDAÇÃO CALOUSTE GULBENKIAN

A COMPARATIVE STUDY OF REFRACTION AND ANTERIOR-POSTERIOR AXIS DYNAMICS IN SUMMER AND WINTER IN MYOPIC CHILDREN

Poster #10

Elena Tarutta, Rusudani Toloraja, Nino Kvaratskhelija

Helmholtz Research Institute of Eye Diseases, Moscow, Russia

tarutta@sumail.ru

AIM:

To study the refraction and anterior-posterior axis (APA) dynamics in children with myopia in winter (from September to March) and summer (from March to September).

METHODS:

25 patients (14 males and 11 females) aged 8-19 with myopia from –1.0 to –9.0 D were examined using autorefractometry (Fig.1) and ultrasound biometry (Fig.2) twice a year (in March and September).

RESULTS:

The average increase in myopia degree during the winter period was 0.690.09 D, APA increase was 0.230.04 mm.

In the summer period, these parameters increased by 0.490.07 D and 0.1 0.03 mm.

The difference for APA is statistically significant ($p<0.05$).

Fig. 1.

Fig. 2.

Fig. 3, Fig. 4.
Active rest in summer.

Fig. 5, Fig. 6.
Intensive visual work and hypodynamia in winter.

CONCLUSION:

Myopia progression and increase of APA in children and adolescents occur faster in the winter period than in summer, which is accounted for by longer daylight duration, more physical activity, less visual work, and a higher level of vitamins in food.

Peripheral Refraction With Accommodation in Young Emmetropic and Myopic Subjects

[1]QUEIRÓS A., [2]CERVIÑO A., [1]GONZÁLEZ-MÉIJOME J.M., [2]MONTÉS-MICÓ R., [1]JORGE J.
[1]School of Science (Optometry), University of Minho, Braga, Portugal; [2]Department of Optics, University of Valencia, Spain

Poster #11

Reprints: aqp@fisica.uminho.pt

Introduction

Peripheral refraction has been suggested as playing an important role in the development of refractive error, particularly myopia[1]. Smith et provided with evidence for this hypothesis when reported that form deprivation in the peripheral retina can affect refractive error development[2].

There is now considerable evidence that myopes have a relatively hyperopic peripheral refraction whereas the opposite happens to hyperopes.
Calver et al[3] recently showed that MSE was not significantly different between emmetropes and myopes for distance targets from 2.5 to 0.40m.

The purpose of the present study was to determine changes in peripheral refraction with different accommodation levels from 0.50D up to 5D between myopic and emmetropic young healthy subjects

Methods

Central and peripheral refractive errors were measured on 15 emmetropic (mean age 22.16 ± 2.95 years) and 25 myopic (mean age 22.20 ± 4.17 years) eyes from 40 young healthy subjects at several fixation distances and eccentricities. Mean Spherical Equivalent (MSE) errors were -0.01 ± 0.14D and -2.47 ± 1.34D for emmetropic and myopic eyes, respectively. Exclusion criteria included any ocular pathology or previous surgery, as well as a refractive astigmatism greater than 1.00D.

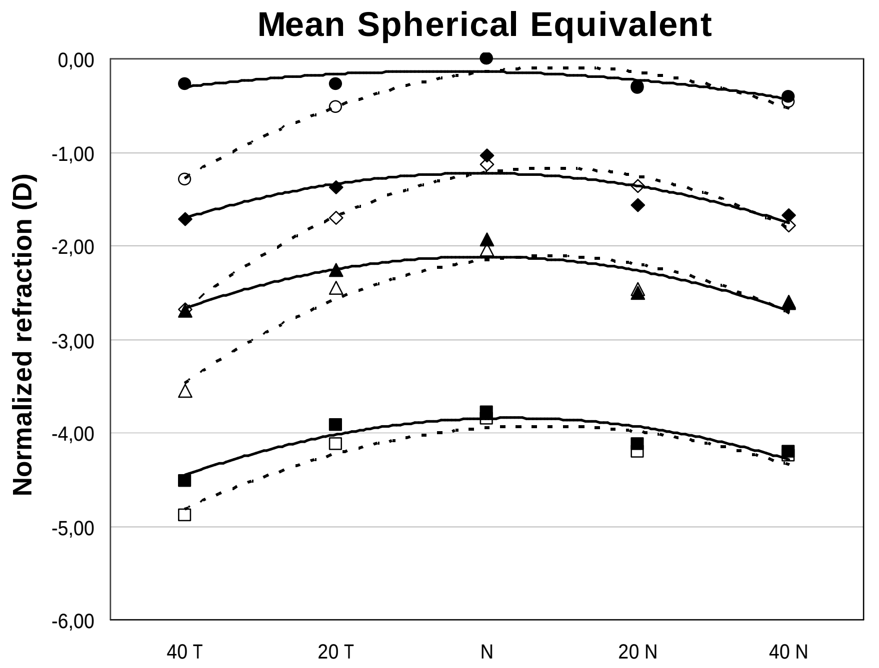
Measurement of peripheral refraction was done monocularly using a Grand Seiko binocular open-field, infrared autorefractor (Grand Seiko WAM-5500). Contralateral eye was occluded. Fixation target consisted on a Maltese cross positioned at the center and at 20 and 40 degrees from the line of sight in straight ahead gaze, both nasally and temporally. Target was set at 2.0m, 0.5m, 0.33m and 0.20m from the eye examined for each eccentricity. Only the right eye was examined and subjects were not cyclopleged prior to data acquisition. Mean of five consecutive measurements were obtained for each position.

Patients were corrected for all measurements[4].

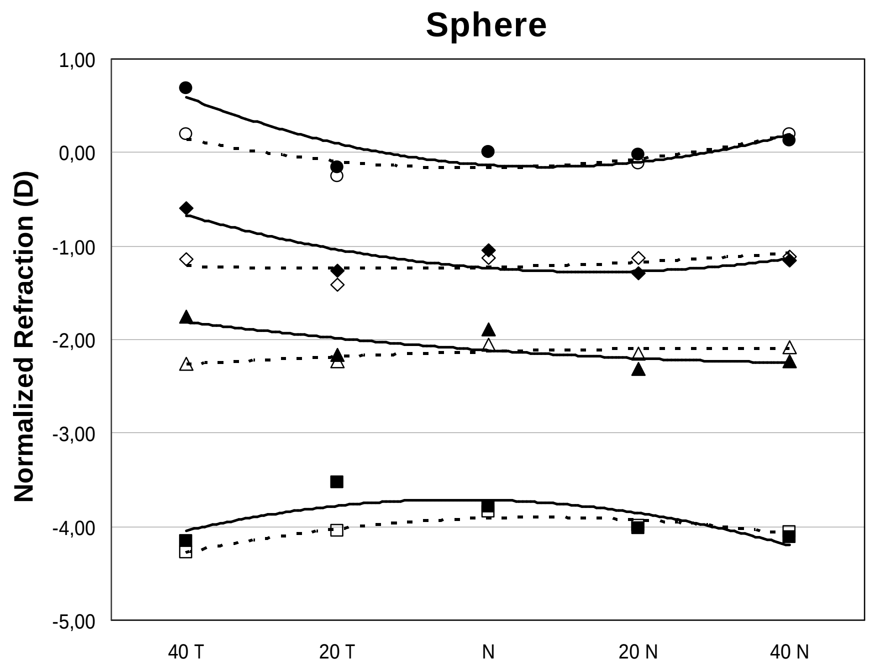
►**Figure 1.** Grand Seiko WAM-5500 binocular, open field, infrared autorefractor

Results

As previously stated by Radhakrishnan and Charman[5], SD tends to increase as the eccentricity of the peripheral measurement increases (table 1), reaching levels of up to a quarter of a diopter for the lower levels of accommodative demand. ANOVA showed differences between myopic and emmetropic eyes in peripheral MSE on the temporal horizontal meridian (figure 2). These differences were significant for the temporal periphery in MSE but not in sphere (figure 3), implying that it is the cylindrical component the responsible for the differences, and disappear for higher levels of accommodation.



▲ **Figure 2.** Normalized peripheral sphere value for the different accommodation levels in emmetropes (empty bins, dashed line) and myopes (full bind, solid line)



▲ **Figure 3.** Normalized peripheral MSE for the different accommodation levels in emmetropes (empty bins, dashed line) and myopes (full bind, solid line)

	2.00 meters				0.50 meters				0.33 meters				0.20 meters			
	Myopic		**Emmetropic**		**Myopic**		**Emmetropic**		**Myopic**		**Emmetropic**		**Myopic**		**Emmetropic**	
Eccentricity	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
40 deg temporal	-0.65	0.29	-1.52	0.22	-2.17	0.26	-2.92	0.20	-3.11	0.22	-3.76	0.17	-4.99	0.16	-5.08	0.12
20 deg temporal	-0.57	0.1	-0.76	0.08	-1.84	0.09	-1.91	0.07	-2.66	0.08	-2.69	0.64	-4.39	0.13	-4.33	0.10
Center	-0.40	0.09	-0.21	0.07	-1.42	0.60	-1.33	0.05	-2.37	0.06	-2.24	0.05	-4.18	0.08	-4.08	0.06
20 deg nasal	-0.76	0.14	-0.52	0.11	-1.95	0.12	-1.57	0.09	-2.97	0.14	-2.66	0.11	-4.56	0.13	-4.39	0.10
40 deg nasal	-0.74	0.28	-0.67	0.21	-2.09	0.28	-1.99	0.21	-2.98	0.25	-2.84	0.19	-4.70	0.16	-4.42	0.12

▲**Table 1.-** Estimated marginal means of refractive MSE value obtained for both refractive groups at the different peripheral locations and accommodative levels. SE = Standard Error

Conclusions

► Results reported here agree with those recently reported by Calver et al[3] of similar changes in peripheral refraction for both myopes and emmetropes with accommodation. Hence, these results do not support the hypothesis of changes in peripheral refraction during near vision tasks as a precursor of myopia development.

► While relative refractive shift in the nasal retina is similar for both refractive groups, refractive shift in the temporal retina is not, yielding significantly more myopic refractive values for emmetropic subjects than myopic subjects.

► Peripheral refraction during high accommodative levels are not significantly different between emmetropes and myopes. The differences observed in MSE for distance vision for temporal eccentricities are maintained for intermediate and near vision up to 3D, however those differences decrease to become unsignificant for higher levels of accommodation (around 5D – 20 cm – in the present study).

► Those differences in peripheral MSE between both groups are attributable to peripheral astigmatism, since results failed to show significant differences between myopes and emmetropes in the spherical component for any accommodative level studied.

References

1. Charman WN. Aberrations and myopia. *Ophthalmic Physiol Opt* 2005; **25:** 285-301.
2. Smith EL III, et al. Peripheral vision can influence eye growth and refractive development in infant monkeys. Invest Ophthalmol Vis Sci 2005; 46: 3965-72.
3. Calver R, Radhakrishnan H, Osuobeni E, O'Leary D. Peripheral refraction for distance and near vision in emmetropes and myopes. Ophthalmic Physiol Opt 2007;27:584-93
4. Queiros A, Gonzalez-Meijome JM, Jorge J. Technical note: influence of fogging lenses and cycloplegia on open-field automatic refraction. Ophthalmic Physiol Opt 2008; 28: 1-6
5. Radhakrishnan H, Charman WN. Peripheral refraction measurement: does it matter if one turns the eye or the head? Ophthalmic Physiol Opt. 2008;28:73-82.

Support

FUNDAÇÃO CALOUSTE GULBENKIAN
SPVMED
ESSILOR
HOYA

Myopic Shift in Peripheral Corneal Curvature Power after Orthokeratology, Standard and Custom LASIK

[1]QUEIRÓS A., [1]GONZÁLEZ-MÉIJOME J.M., [2]VILLA-COLLAR C., [3]GUTIÉRREZ J.R., [1]JORGE J.
[1]School of Science (Optometry), University of Minho, Braga, Portugal; [2]Clínica Oftalmológica Novovision, Madrid, Spain;
[3]Department of Ophthalmology, University of Murcia, Murcia, Spain

Poster #50

Reprints: aqp@fisica.uminho.pt

Introduction

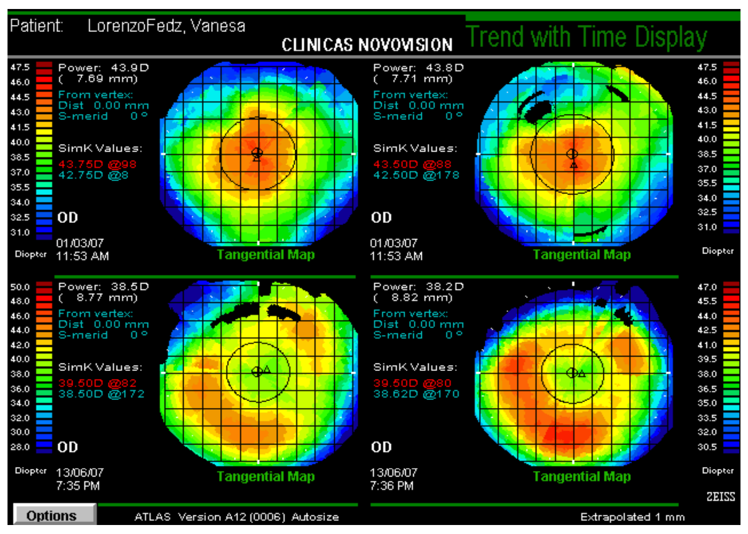
There are about 80 million myopic children world-wide, being that the prevention of the development of the myopia or its retardation constitutes an important area of research for visual scientists. Different approaches to achieve this goal include the use of pharmacologic agents, bifocal and progressive spectacle lenses or rigid gas-permeable contact lenses among others[1-3].

With the recent rebirth of overnight orthokeratology, known as corneal refractive therapy (CRT), and the recent discoveries regarding the role of central and peripheral defocus on emmetropization[4], the interest in this therapy as promissory way to slow down myopia progression has gained new impulse[5].

The purpose of this study was to evaluate the changes in power of the anterior corneal surface after refractive surgery and orthokeratology at central, paracentral and peripheral cornea.

Methods

One hundred and twenty two eyes of 122 patients, mean age of 30.6±7.5 years, of which 70 were female (57.4%) and 53 were male (42.6%), had been analyzed in this study. Of those 43 were submitted to standard LASIK ablation, 40 to customized LASIK and 39 to orthokeratology. Only patients with myopia from -1.00D to -4.25D, and astigmatism below -1.75D were included. Measurements of corneal topography were obtained only 3 months after surgery without retreatment or successful orthokeratology treatment with Corneal Refractive Therapy (Paragon CRT®, Paragon Vision Sciences, Mesa, AZ, USA) Topographical data along the horizontal meridian were collected over a 10-mm chord in 1-mm steps using the tangential power map from Atlas Mastervue Corneal Topographer.



Patient: LorenzoFedz, Vanesa
CLINICAS NOVOVISION
Trend with Time Display

Power: 43.9D (7.69 mm)
From vertex: Dist 0.00 mm S-merid 0°
SimK Values: 43.75D @98 42.75D @8
OD 01/03/07 11:53 AM

Power: 43.8D (7.71 mm)
From vertex: Dist 0.00 mm S-merid 0°
SimK Values: 43.50D @88 42.50D @178
OD 01/03/07 11:53 AM

Power: 38.5D (8.77 mm)
From vertex: Dist 0.00 mm S-merid 0°
SimK Values: 39.50D @82 38.50D @172
OD 13/06/07 7:35 PM

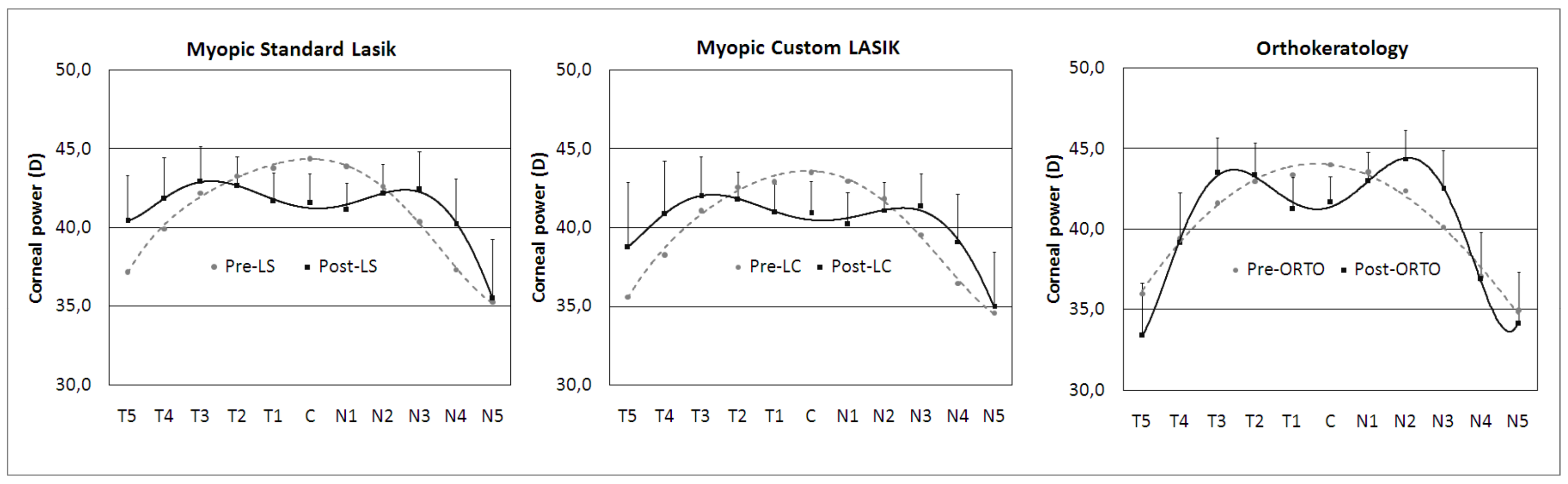
Power: 38.2D (8.82 mm)
From vertex: Dist 0.00 mm S-merid 0°
SimK Values: 39.50D @80 38.62D @170
OD 13/06/07 7:36 PM

ATLAS Version A12 (0006) Autosize
Extrapolated 1 mm

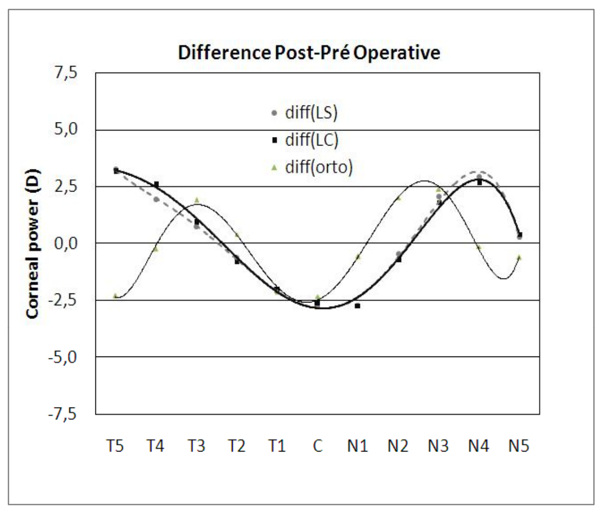
▲ **Figure 1.** Corneal topography was used to quantify the anterior corneal curvature (Atlas Mastervue, Humphrey Zeiss Instruments, San Leandro, CA, USA).

Results

Average refractive error expressed as spherical equivalent was 2.98±0.89D for standard LASIK, -2.94±0.90D for customized LASIK and -2.56±0.82D for orthokeratology (p=0.040, K-Wallis). Pre-treatment corneal topography was not significantly different among groups for any of the 11 positions being measured. (p>0.124, Mann-Whitney Test). There was any difference between post-surgery corneal topography for both LASIK treatments, but the refractive power was different for all positions compared to baseline except for most peripheral nasal location N5. Surprisingly a myopic shift was observed at the nasal and temporal locations at 3 and 4 mm from center. In the orthokeratology group, a sharper and more symmetric myopic shift was observed compared with surgical interventions. Differences were statistically significant at T3, N2 and N3 locations. Contrary to surgery, peripheral cornea after orthokeratology shows a slight flattening, probably as a result of the interaction with the landing zone of the lens.



▲ **Figure 2.** Plots of corneal power as a function of horizontal meridian obtained with relationship between baseline and after intervention



▲ **Figure 3.** Difference between baseline and after intervention

▼**Table 1.-** Descriptive statistics of difference between corneal topography post-pre (mean, S.D.) for myopic standard LASIK, myopic custom LASIK and ortokeratology (values in diopters).

post-pre	Standard LASIK		Custom LASIK		OrtoK	
	mean±sd	p	mean±sd	p	mean±sd	p
Ks (D)	-2.49±1.08	**0.000***	-2.30±1.77	**0.000***	-1.52±0.61	**0.000***
Kf (D)	-2.44±0.97	**0.000***	-2.39±1.73	**0.000***	-1.67±0.69	**0.000***
C (D)	-2.80±1.07	**0.000***	-2.61±1.31	**0.000***	-2.34±0.89	**0.000***
N1 (D)	-2.72±1.06	**0.000***	-2.73±1.61	**0.000***	-0.56±1.44	**0.019***
N2 (D)	-0.47±1.03	**0.005***	-0.72±1.76	**0.014***	+2.01±1.29	**0.000***
N3 (D)	+2.07±1.41	**0.000***	+1.80±2.42	**0.000¥**	+2.38±1.90	**0.000***
N4 (D)	+2.91±2.28	**0.000***	+2.67±3.77	**0.000***	-0.14±2.20	0.692*
N5 (D)	+0.26±4.46	0.704*	+0.41±3.90	0.528*	-0.61±2.88	0.207¥
T1 (D)	-2.11±1.16	**0.000***	-1.98±1.40	**0.000¥**	-2.13±1.40	**0.000***
T2 (D)	-0.63±1.28	**0.002***	-0.79±1.51	**0.002***	+0.40±1.36	0.077¥
T3 (D)	+0.74±1.53	**0.003***	+0.93±2.30	**0.006¥**	+1.89±1.82	**0.000***
T4 (D)	+1.94±2.46	**0.000***	+2.64±2.99	**0.000***	-0.24±3.59	0.657¥
T5 (D)	+3.25±2.53	**0.000***	+3.16±3.53	**0.000***	-2.32±2.72	**0.000***

*Paired Samples Test, ¥ Wilcoxon Signed Ranks Test
Ks: steep keratometry; Kf: flat keratometry

▼**Table 2.-** Comparison of changes (Δ=post treatment – pre treatment) in corneal curvature after treatment from baseline (values in diopters).

	Δ LS – Δ LC		Δ LS – Δ OK		Δ LC – Δ OK	
	mean	p	mean	p	mean	p
Ks(D)	-0.19	0.639¥	-0.97	**0.000¥**	-0.78	**0.000¥**
Kf (D)	-0.05	0.760¥	-0.77	**0.000¥**	-0.73	**0.001¥**
C (D)	-0.19	0.685¥	-0.46	0.057¥	-0.27	0.173¥
N1 (D)	+0.01	0.963*	-2.16	**0.000***	-2.17	**0.000***
N2 (D)	+0.25	0.420*	-2.48	**0.000***	-2.73	**0.000***
N3 (D)	+0.26	0.746¥	-0.31	0.435¥	-0.58	0.645¥
N4 (D)	+0.24	0.722*	+3.05	**0.000***	+2.81	**0.000***
N5 (D)	-0.15	0.876*	+0.87	0.299*	+1.02	0.212*
T1 (D)	-0.14	0.628*	+0.02	0.939*	+0.16	0.617*
T2 (D)	+0.16	0.609*	-1.03	**0.001***	-1.18	**0.000***
T3 (D)	-0.19	0.436¥	-1.15	**0.004¥**	-0.96	**0.049¥**
T4 (D)	-0.70	0.124¥	+2.18	**0.008¥**	+2.87	**0.000¥**
T5 (D)	+0.09	0.906*	+5.57	**0.000***	+5.48	**0.000***

* Independent Samples Test, ¥ Mann-Whitney Test
Ks: steep keratometry; Kf: flat keratometry

Conclusions

Both, surgical and non-surgical interventions show a mid-peripheral myopic shift, which is a bit surprising in LASIK surgery. However, **Corneal Refractive Therapy seems to provide the most appropriate optics to create an effect of sharp myopic shift in the mid-peripheral area** that will potentially work as a positive intervention to slow-down myopia on the light of current knowledge of the influence of parafoveal refraction on ocular growth in animal models. The overall smaller optical zone after CRT, well centrated along the horizontal meridian, and the slight peripheral flattening in this treatment contribute to this effect.

References

1. Negrel, A. D. and Thylefors, B. (1998). The global impact of eye injuries. Ophthalmic Epidemiol. 5, 143-69.
2. Walline, J. J., Jones, L. A., Mutti, D. O., and Zadnik, K. (2004). A randomized trial of the effects of rigid contact lenses on myopia progression. Arch.Ophthalmol. 122, 1760-66.
3. Tan, D. T., Lam, D. S., Chua, W. H., Shu-Ping, D. F., and Crockett, R. S. (2005). One-year multicenter, double-masked, placebo-controlled, parallel safety and efficacy study of 2% pirenzepine ophthalmic gel in children with myopia. Ophthalmology 112, 84-91.
4. Smith EL III, et al. Peripheral vision can influence eye growth and refractive development in infant monkeys. Invest Ophthalmol Vis Sci 2005; 46: 3965-72.
5. Cho, P., Cheung, S. W., and Edwards, M. (2005). The longitudinal orthokeratology research in children (LORIC) in Hong Kong: a pilot study on refractive changes and myopic control. Curr.Eye Res. 30, 71-80.

Support

FUNDAÇÃO CALOUSTE GULBENKIAN
SPVMED
ESSILOR
HOYA