

The Level of Improvement of Visual Acuity in High Corneal Astigmatism with Rigid Gas Permeable Contact Lenses

Dalibor Opačić¹, Snježana Miljak² and Ksenija Čuruvija-Opačić³

¹ University of Zagreb, University Hospital Center Zagreb, Zagreb, Croatia

² University of Split, University Hospital Center Split, Department of Ophthalmology, Split, Croatia

³ Polyclinic of Ophthalmology and Internal Medicine, Zagreb, Croatia

ABSTRACT

The aim of this study was to calculate the level of improvement of visual acuity comparing the best corrected visual acuity (VA) achieved with spectacles with the best corrected VA achieved with rigid gas permeable (RGP) contact lenses in patients with high, simple or compound corneal astigmatism (myopic, hypermetropic and mixed). The investigation of patients included auto-kerato-refractometry, manual keratometry, corneal topography and visual acuity with Snellen chart. The best corrected VA obtained with spectacles was compared with the best corrected VA obtained with RGP contact lenses in 72 patients (116 eyes). All patients showed a significant improvement in visual acuity with RGP lenses from one to seven lines compared to spectacles ($p=0.0001$). Level of improvement in VA represented as the number of lines obtained was as follows: 74 percent of patients got two to four lines more in VA with RGP lenses compared to spectacles, and almost 10 percent of patients got five to seven lines. RGP contact lenses provide a significant improvement in VA compared to VA reached with spectacles in patients with high corneal astigmatism. The benefit in VA with RGP lenses is higher as the astigmatism is higher.

Key words: astigmatism, RGP contact lenses

Introduction

Astigmatism is a common refractive anomaly. It may be the result of different causes, but distortion of the spherical shape of the cornea to the toric one is the most common cause¹. In the NHANES study with a representative sample of the US civilian population older than 20 years (14,213 participants), refractive error data were obtained for 12,010 (84.5%). The age-standardized prevalence of astigmatism was 36.2% (95% CI, 34.9%–37.5%)². In a population-based Gutenberg health study in Germany with 15,010 participants aged 35–74 years astigmatism was present in 32.3%³. This data showed that astigmatism is a very frequent visual disorder, but the incidence of high astigmatism is actually low. In a large cohort of 20000 contact lens wearers 45 percent had astigmatism higher than 0.75 DCyl, but in only 2 percent astigmatism was higher than 3.00 DCyl⁴. Previous studies showed that

RGP contact lenses are useful in providing improvement of visual acuity compared to spectacles or soft contact lenses in patients with irregular astigmatism⁵⁻¹⁰.

It is known that regular corneal astigmatism could be successfully corrected with RGP contact lenses. This type of lenses is considered as the best option for correction of astigmatism^{11,12}. Surprisingly, there is a small amount of data in the indexed journals about the exact level of improvement in visual acuity achieved with RGP lenses compared to spectacles, particularly in patients with high regular corneal astigmatism.

Objective of this study was to calculate the level of improvement of visual acuity comparing the best corrected visual acuity achieved with spectacles to the best visual acuity reached with RGP contact lenses in patients with high, simple or compound corneal astigmatism (myopic, hypermetropic and mixed).

Materials and Methods

In this study astigmatism is defined as high when measured 3.00 dioptic cylinder (Dcyl) and higher. The investigation of patients included auto-kerato-refractometry, manual keratometry, corneal topography and visual acuity with Snellen chart.

Seventy-two patients (116 eyes) with astigmatism from 3.00 to 7.00 Dcyl, aged 5 to 51 years were corrected with spectacles, followed by RGP lenses. The best corrected visual acuity achieved with spectacles was compared to the best corrected visual acuity obtained with RGP lenses. The improvement of visual acuity is expressed in lines using Snellen chart which is generally accepted by professionals for visual acuity measurement.

Spherical contact RGP lenses were used in correction up to 3.50 Dcyl, and back toric RGP lenses were used from 3.50 to 7.00 Dcyl. All RGP lenses were from the same manufacturer.

Statistics

The data were statistically evaluated with Mann-Whitney U test (SPSS 14.0., SPSS Inc., Chicago, IL, USA). Some data were expressed as percentage values and mean values.

Results

The largest number of the examined patients had compound myopic and mixed astigmatism as shown in Table 1.

Achieved median of correction with contact lenses was 1.0; interquartile range (IQR) 0.8–1.0, while with spectacles median of correction was 0.6; IQR 0.5–0.7.

Overall, we reached significantly better visual acuity in our patients with RGP lenses compared to spectacles. ($p=0.0001$, Figure 1).

In our study 74% of the patients got 2 to 4 lines more in visual acuity with RGP lenses compared to spectacles, and almost 10% got five to seven lines (Table 2).

TABLE 1
ASTIGMATISM REPRESENTED BY TIPE AND NUMBER IN EXAMINED PATIENTS

Astigmatism type	Number of eyes	%
Compound myopic	43	37.0
Mixed	38	32.8
Compound hyperopic	18	15.5
Simple hyperopic	9	7.8
Simple myopic	8	6.9

No of eyes = 116 (100%)

TABLE 2
IMPROVEMENT IN VISUAL ACUITY EXPRESSED IN LINES ACHIEVED WITH CONTACT LENSES COMPARED TO SPECTACLES

Improvement in lines	Number of eyes	%	%
1	19	16.4	16.4
2	21	18.1	
3	44	37.9	74.1
4	21	18.1	
5	7	6.0	
6	3	2.6	9.5
7	1	0.9	

No of eyes = 116 (100%)

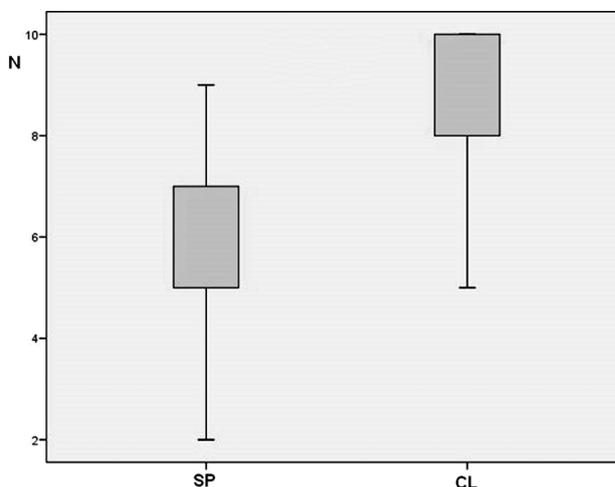


Fig. 1. The difference in visual acuity after correction in patients with high corneal astigmatism (>3.00 Dcyl). N = number of lines after correction, SP = spectacles, CL = contact lenses. $p=0.0001$.

The improvement in visual acuity with RGP lenses compared to that with spectacles is higher when astigmatism is higher. Patients with 3.00 to 3.75 Dcyl got on average 2.32 lines with RGP lenses, patients with 4.00 to 4.75 Dcyl got on average 2.93, patients with 5.00 to 5.75 Dcyl got on average 3.36 lines, and patients with 6.00 to 7.00 Dcyl got four lines with RGP lenses (Table 3).

Discussion and Conclusion

In the study of Jupiter and Katz it was shown that RGP contact lenses provide a significant improvement in visual acuity compared to spectacles correction in patients with irregular astigmatism. Patients with 20/25–20/30 spectacle visual acuity achieved a one line average improvement with RGP contact lenses. Patients with 20/40

TABLE 3
AVERAGE IMPROVEMENT IN VISUAL ACUITY
IN RELATION TO ASTIGMATISM SEVERITY

Corneal cylinder	No of eyes	%	Average improvement in lines
3.00–3.75	38	2.8	2.3
4.00–4.75	44	37.9	2.9
5.00–5.75	25	21.6	3.4
6.00–7.00	9	7.7	4.0

No of eyes = 116 (100%)

spectacle visual acuity achieved a two line average improvement. Patients with spectacle acuity 20/50–20/200 achieved a four line average improvement, and patients with spectacle acuity 20/400 a six line average improvement⁸.

Recently a few studies about correction of astigmatism with soft contact lenses have been published, but all these studies evaluated patients with low regular astigmatism under 2.00 Dcyl^{13–15}.

In the study of Micahud et al. low- and high-contrast visual acuity and stereoscopy were evaluated at both near

and far with current spectacles and empirically calculated soft toric lenses and RGP toric/bi-toric contact lenses at all distances in patients with moderate and high astigmatism. Visual acuity was measured as reduced under low contrast versus high contrast, but there was no difference in the comparative results between glasses or soft or RGP contact lenses under each condition¹⁶.

In the study published in Chinese, Dai Z. et al. compared visual acuity achieved with spectacles to visual acuity with RGP contact lenses in 31 eyes with mixed astigmatism. Results of this study showed much better visual acuity with RGP lenses compared to spectacles¹⁷.

In other Chinese study by Li et al. spherical RGP contact lenses were used for correction of high corneal astigmatism (≥ 3.00 Dcyl). According to the data from the study (55 eyes in 41 patients) thirty eyes (54.5%) corrected with RGP lenses had better VA than with spectacles, twenty two eyes (40%) had corrected VA with RGP lenses equal to that with spectacles, while three eyes (5.5%) had corrected VA with contact lenses lower than with spectacles¹⁸.

Our results with RGP lenses in correction of regular astigmatism over 3.00 Dcyl showed significantly better visual acuity compared to spectacles ($p=0.0001$), with an improvement in visual acuity up to seven lines. In visual acuity the higher the astigmatism the more beneficial RGP lenses are.

REFERENCES

1. TWA M, MOREIRA S. Astigmatism and Toric Contact Lenses. In: MANNIS MJ, ZADNIK K, CORAL-GHANEM C, KARA-JOSE N (Eds) Contact Lenses in Ophthalmic Practice, (1ed, Springer-Verlag, New York, 2004). — 2. VITALE S, ELLWEIN L, COTCH MF, FERRIS FL, SPERDUTO R, Arch Ophthalmol 126 (2008) 1111. DOI: 10.1001/archophthalmol.2009.303. — 3. WOLFRAM C, HOHN R, KOTTLER U, WILD P, BLETTNER M, BUHREN J, PFEIFFER N, MIRSHAHI A. Br J Ophthalmol, accessed 15.3.2014. Available from: URL: <http://bjo.bmj.com/content/98/7/857.long>. DOI: 10.1136/bjophthalmol-2013-304228. — 4. HOLDEN BA. Australian Journal of Optometry, 58 (1975) 279. — 5. SCHEIN OD, ROSENTHAL P, DUCHARME C, Am J Ophthalmol, 109 (1990) 318. — 6. KOK JH, VISSER R, Cornea, 11 (1992) 518. — 7. PULLUM KW, BUCKLEY RJ, Cornea, 16 (1997) 612. — 8. JUPITER DG, KATZ HR, CLAO J 26 (2000) 14. — 9. ALIO JL, BELDA JI, ARTOLA A, GARCIA-LLEDO M, OSMAN A, J Cataract Refract Surg, 28 (2002) 1750. — 10. LEAL F, LIPENER C, CHALITA MR, URAS R, CAMPOS M, HOFLING-LIMA AL, Arq Bras Oftalmol, 70 (2007) 247. — 11. KASTL PR, Ophthalmol Clin North Am, 16 (2003) 359. — 12. OPACIC KC, Acta Clin Croat, 51 (2012) 305. — 13. RICHDALE K, BERNTSEN DA, MACK CJ, MERCHEA MM, BARR JT, Optom Vis Sci, 84 (2007) 969. — 14. KURNA SA, SENGOR T, UN M, AKI S, Clin Ophthalmol, 4 (2010) 959. — 15. YOUNG G, SULLEY A, HUNT C, Eye Contact Lens, 37 (2011) 20. — 16. MICHAUD L, BARRIAULT C, DIONNE A, KARWATSKY P, Optometry, 80 (2009) 375. — 17. DAI Z, ZHONG X, YANG X, GONG X, LI S, WEI L, ZENG J, Yan Ke Xue Bao, 20 (2004) 240. — 18. LI J, KANG X, RAO Y, LI L, YANG L, WANG F, Chinese Journal of Optometry & Ophthalmology, 1 (2007) 57. DOI: CNKI:SUN:ZYK.0.2007-01-017.

K. Ćuruvija – Opačić

Polyclinic of Ophthalmology and Internal Medicine, Langov trg 6, 10000 Zagreb, Croatia
e-mail: ksenija.co@gmail.com

STUPANJ POBOLJŠANJA VIDNE OŠTRINE U VISOKOM KORNEALNOM ASTIGMATIZMU POSTIGNUT SA TVRDIM PLINOPROPUSNIM KONTAKTNIM LEĆAMA

SAŽETAK

Cilj ovog istraživanja bio je utvrditi stupanj poboljšanja vidne oštrine uspoređujući najbolju postignutu vidnu oštrinu sa načalama u odnosu na onu postignutu tvrdim plinopropusnim (RGP) kontaktnim lećama u pacijenata sa visokim

jednostavnim ili složenim astigmatizmom (kratkovidnim, dalekovidnim i miješanim). Pregled pacijenata uključivao je auto – refraktokeratometriju, manualnu keratometriju, kornealnu topografiju i vidnu oštrinu Snellenovim tablicama. Najbolja vidna oštrina postignuta sa naočalama uspoređena je sa najboljom vidnom oštrinom postignutom sa RGP kontaktnim lećama u 72 pacijenta (116 očiju). Posebno je iskazan stupanj poboljšanja vidne oštrine postignut sa RGP kontaktnim lećama u usporedbi sa naočalama. Svi pacijenti su imali značajno poboljšanje vidne oštrine sa RGP kontaktnim lećama, od jednog do sedam redova iskazano Snellenovim tablicama, u usporedbi sa naočalama ($p=0,0001$). U našoj studiji 74% pacijenata dobilo je dva do četiri reda više u vidnoj oštrini sa RGP lećama u usporedbi sa naočalama, a gotovo 10% pacijenata dobilo je 5 do 7 redova poboljšanja u vidnoj oštrini. RGP kontaktne leće osiguravaju značajno poboljšanje vidne oštrine u usporedbi sa naočalama kod pacijenata sa visokim kornealnim astigmatizmom. Boljitak u vidnoj oštrini sa RGP lećama je to veći što je astigmatizam viši.