



EDITORIAL

Visual Rehabilitation in Keratoconus: The Emergence of a New Era

Zisis Gatzios · Nóra Szentmáry

Received: September 2, 2019
© The Author(s) 2019

Keratoconus is a progressive, non-inflammatory corneal ectatic disease characterized by corneal steepening and thinning, generating a high degree of myopia and irregular astigmatism, thereby severely impairing visual acuity [1]. Traditionally, keratoconus has been managed in first-line treatment with rigid contact lenses, which improved visual acuity in cases of moderate and advanced severity. Corneal transplantation remains an option for patients with very advanced keratoconus, who subsequently achieve mean spectacle-corrected visual acuity of 0.6–0.8 and may also need rigid contact lenses [2]. Today, we use sophisticated diagnostic tools which enable early diagnosis of keratoconus, and we are able to perform corneal cross-linking for stabilization of the corneal conus in relatively early stages of the disease. As a consequence, the need for corneal transplantation

Enhanced Digital Features To view enhanced digital features for this article go to <https://doi.org/10.6084/m9.figshare.9758633>.

Z. Gatzios (✉)
Department of Ophthalmology, University Hospital Basel, Basel, Switzerland
e-mail: zisisg@hotmail.com

N. Szentmáry
Department of Ophthalmology, Semmelweis University, Budapest, Hungary

N. Szentmáry
Department of Ophthalmology, Saarland University Medical Center, Homburg, Saar, Germany

has decreased significantly [3]. However, an increasing number of patients with keratoconus are identified in a 'grey zone', where their contact lens-corrected vision is not great, but it is enough not to consider corneal transplantation. These patients are in need of effective visual rehabilitation, and their expectations are often relatively high.

For the above-mentioned patients, a new era has emerged. A plethora of minimally invasive surgical options have been developed, enhanced and introduced into clinical practice over the past few years. These therapeutic approaches include, among others, the implantation of intracorneal ring segments (ICRS), corneal surface ablation combined with corneal collagen cross-linking (CXL), and implantation of toric phakic intraocular lenses, facilitating effective and, most importantly, safe visual rehabilitation in keratoconus.

The first review article from Sakellaris et al. focuses on the role of ICRS implantation in visual improvement in keratoconus. ICRS represent an effective and safe option for restoring visual acuity in patients with moderate keratoconus, by regularizing corneal shape and thereby reducing keratometric readings, spherical equivalent and high-order aberrations [4]. The authors describe in detail modern implantation techniques and nomograms, patient selection criteria, clinical outcomes and complications, emphasizing the advantages and

disadvantages, as well as controversial issues, regarding this useful therapeutic approach. Zhu et al. provide a thorough update on combined protocols for corneal collagen cross-linking (CXL) with photorefractive surgery for refractive management of keratoconus. Surface ablation treatments combined with CXL result in corneal stabilization and improved visual acuity without compromising the biomechanical profile of the cornea in moderate keratoconus [5, 6]. The authors present current modalities, clinical outcomes and potential complications in an evidenced-based manner, including critical analysis of relevant literature. Finally, Vastardis et al. explore the options of intraocular lens surgery for visual rehabilitation in keratoconus. Nowadays, the use of modern phakic or pseudophakic toric intraocular lenses, alone or in combination with other therapeutic modalities, may correct refractive error in selected patients with keratoconus, demonstrating an excellent safety profile and long-term refractive and keratometric stability [7, 8]. Vastardis et al. report on lens-based solutions for refractive correction, evaluate their clinical outcomes and complications, and most importantly, highlight surgical pearls and pitfalls of this approach.

This new era of ‘modified’ refractive surgery in keratoconus is evolving rapidly, shifting the management paradigm of the disease. The purpose of this special issue is to provide an in-depth overview of the available refractive procedures for visual rehabilitation in keratoconus and to underscore recent advances in this fascinating field which are revolutionizing modern corneal surgery.

ACKNOWLEDGEMENTS

This supplement was not sponsored by outside commercial interests.

Funding. No funding or sponsorship was received for this study or publication of this article.

Authorship. All named authors meet the International Committee of Medical Journal

Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Disclosures. Zisis Gatzios and Nόra Szentmáry have no conflicts of interest to declare.

Compliance with Ethics Guidelines. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

REFERENCES

1. Rabinowitz YS. Keratoconus. Surv Ophthalmol. 1998;42:297–319.
2. Henein C, Nanavaty MA. Systematic review comparing penetrating keratoplasty and deep anterior lamellar keratoplasty for management of keratoconus. Cont Lens Anterior Eye. 2017;40:3–14.
3. Sklar JC, Wendel C, Zhang A, Chan CC, Yeung SN, Lovieno A. Did collagen cross-linking reduce the requirement for corneal transplantation in keratoconus? The Canadian experience. Cornea. 2019. <https://doi.org/10.1097/ico.0000000000002085> (Epub ahead of print).
4. Vega-Estrada A, Alio JL. The use of intracorneal ring segments in keratoconus. ye Vis (Lond). 2016;3:8.
5. Gore DM, Leucci MT, Anand V, Fernandez-Vega Cueto L, Arba Mosquera S, Allan BD. Combined wavefront-guided transepithelial photorefractive keratectomy and corneal crosslinking for visual rehabilitation in moderate keratoconus. J Cataract Refract Surg. 2018;44:571–80.

6. Gréntzelos MA, Kounis GA, Diakonis VF, Siganos CS, Tsilimbaris MK, Pallikaris IG, Kymionis GD. Combined transepithelial phototherapeutic keratectomy and conventional photorefractive keratectomy followed simultaneously by corneal crosslinking for keratoconus: Cretan protocol plus. *J Cataract Refract Surg.* 2017;43:1257–62.
7. Nanavaty MA, Lake DB, Daya SM. Outcomes of pseudophakic toric intraocular lens implantation in keratoconic eyes with cataract. *J Refract Surg.* 2012;28:884–9.
8. Alió JL, Peña-García P, Abdulla GF, Zein G, Abu-Mustafa SK. Comparison of iris-claw and posterior chamber collagen copolymer phakic intraocular lenses in keratoconus. *J Cataract Refract Surg.* 2014;40(3):383–94.