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Impact of Keratoconus on Patient Well-being: A Comprehensive Review

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Abstract

The present review aimed to investigate the impact of keratoconus on patient well-being. Improving the quality of life of patients remains a key focus in modern medicine. The advent of advanced therapeutic methods has significantly slowed the progression of numerous diseases. Among the various causes of visual impairment, corneal diseases play a major role. Statistically, one in four people with vision problems suffers from a corneal condition. In particular, keratoconus is a pressing concern globally, affecting a significant portion of the young and working-age population. Researchers have investigated various factors that contribute to the development of keratoconus, including genetic, environmental, mechanical, allergic, and other causes. As the disease progresses, it can severely affect the quality of life of patients. However, surgical treatments such as cross-linking have shown significant improvements, leading to reduced anxiety and better overall outcomes. With the advancements in diagnostic technology, healthcare providers can now assess and enhance the quality of life for keratoconus patients during treatment.

Keywords: Corneal damage, Keratoconus, Health, Pharmacotherapy

Introduction

Keratoconus is a significant condition that demands attention from healthcare professionals due to its impact on vision. It is characterized by the progressive thinning of the cornea, its deformation, and the onset of ametropia with irregular astigmatism, leading to a decline in visual acuity. The prevalence of keratoconus is influenced by social and regional factors [1-3]. The condition is particularly prevalent among young individuals, with active development occurring during puberty; however, the progression tends to stabilize as individuals age. The disease affects between 50 and 265 individuals per 100,000 people. In 4.3–15% of cases, keratoconus affects only one eye, but over the next 16 years, ophthalmologists observe the disease progressing to the second eye in 50% of cases. Keratoconus significantly impacts the quality of life of patients, not only due to the decreased visual acuity but also because of the increased risk of severe emotional and mental health issues [4-7].

Many healthcare professionals have attempted to classify keratoconus, but the classification system proposed by Abugova [4] has gained practical application. This system identifies several types of keratoconus, including island-top, blunt-top, peak-shaped, peak-shaped atypical, low-top, and low-top atypical. Based on the nature of the disease, three distinct forms of keratoconus have been recognized: non-progressive, slowly progressing, and rapidly progressing. The treatment approach for keratoconus depends on the stage of the disease, with the primary objectives being to improve visual acuity, slow the disease progression, and enhance the patient's quality of life [8-12]. Treatment methods include: the use of

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glasses or soft contact lenses during the early stage, rigid gas-permeable lenses for more advanced stages, and corneal transplantation at the late stage. The treatment process is complicated by the fact that keratoconus can have a genetic basis, and may be part of the broader pathology of the eye. As a result, this condition remains a topic of significant interest for both medical professionals and researchers [13-18].

The present review study aimed to investigate the impact of keratoconus on patient well-being.

Results and Discussion

Keratoconus: developmental possibilities and classification

Numerous researchers have explored the various factors contributing to the development of keratoconus, including hereditary, environmental, mechanical, and allergic causes. The environmental situation, including increased radiation, has been shown to have a considerable impact on the health of individuals, with a higher incidence of keratoconus observed in areas with increased radiation pollution. Additionally, the endocrine theory has gained support, as dysfunction in the endocrine glands has been identified in many cases of keratoconus. The disease often begins during puberty, a period when hormone production in the endocrine glands is at its peak [19-21].

Keratoconus can also occur in combination with other conditions, such as diabetes, and is often linked to autoimmune disorders like hypersensitivity to allergens, asthma, irritable bowel syndrome, and ulcerative colitis. Research has shown that around 50% of individuals with keratoconus have a history of atopic diseases. The mechanical theory of keratoconus development is also well-documented, with factors such as frequent eye rubbing and the prolonged use of contact lenses contributing to corneal damage. Genetic predisposition is another significant factor, as familial cases of keratoconus have been reported in medical practice, supporting the theory of a hereditary component in the disease's development [22-24].

Several classifications of keratoconus are outlined in the scientific literature. Early classifications primarily focused on the disease's progression stages and the measurement of visual acuity without correction. However, this indicator was later deemed unreliable. Among the various classification systems, M. Amsler's system is considered one of the most suitable, identifying four stages of the disease, as shown in **Table 1**.

Table 1. M. Amsler's classification of keratoconus

Stage	Observed changes
I	- Early signs of nerve fibers in the cornea
	- Changes in endothelial cells
	- Minor changes in ophthalmometric readings
II	- Appearance of keratoconus lines
	- Distorted ophthalmometric readings
III	- Clouding of Bowman's membrane
	- Noticeable ophthalmometric changes
IV	- Significant clouding of the corneal stroma
	- Changes in Descemet's membrane

Given advances in medical technology, which allow for more detailed observations at a microscopic level, this classification is becoming less relevant. Identifying keratoconus in its subclinical stage is now considered the most important aspect of diagnosis.

Another classification system, proposed by J. Buxton, is presented in **Table 2**.

Table 2. J. Buxton's classification of keratoconus

Stage	Observed changes
I	- Corneal radius around 7.5 mm
	- Irregular astigmatism
II	- Corneal radius between 7.5 mm and 6.5 mm
	- Changes in ophthalmometric readings
III	- Corneal radius less than 6.5 mm
IV	- Corneal radius less than 5.6 mm

The classification provided by Kasparov and Kasparov [15] offers a more detailed approach, categorizing keratoconus into three stages:

- Stage I: Chronic progressive, further divided into early, developed, and advanced sub-stages.
- Stage II: Acute, either in the initial or advanced phases.
- Stage III: Complicated forms of the disease, including subluxation of the lens or Castroviejo syndrome.

These stages are accompanied by treatment recommendations. However, with ongoing technological

advancements, the existing classification systems are being refined to accommodate the latest insights.

In terms of treatment, the main goals for healthcare providers are:

- Correcting existing optical issues.
- Stabilizing the disease process.
- Restoring corneal function and structure.

Treatment options can be broadly divided into surgical and non-surgical approaches. Non-surgical treatments generally involve glasses or contact lenses. Although glasses may initially provide relief, they become less effective as astigmatism progresses. For patients with more advanced disease, contact lenses are a common solution. Several types of contact lenses are available:

- Soft lenses
- Rigid gas-permeable lenses
- Scleral lenses
- Hybrid lenses

Rigid gas-permeable lenses are the most effective for correcting refractive errors and improving the regularity of the corneal surface. However, they can cause corneal erosion and increase the risk of infection.

Scleral lenses can be used at various stages of keratoconus and have been shown to reduce stress on the corneal surface. However, there is ongoing debate among doctors regarding the impact of wearing contact lenses on the disease's progression. Some researchers suggest that contact lenses may contribute to keratoconus progression by causing mechanical stress, which can lead to corneal inflammation and thinning. Conversely, other experts argue that these lenses can help stabilize the condition [25-27].

Surgical options are often recommended when contact lenses or glasses are no longer effective. For example, femtolaser refractive autokeratoplasty is considered for stage III or IV keratoconus. This technique involves deep, non-penetrating resection of the corneal stroma to restore the shape of the cornea.

Corneal collagen crosslinking, another surgical method, not only stabilizes the disease but also aids in treatment. This method strengthens the cornea by creating bonds between collagen fibers through a photochemical reaction. However, it is only suitable for patients with corneas thicker than 400 microns. The procedure can reduce the degree of myopia and astigmatism, and it slows disease progression. The effects typically last for three years, after which collagen renewal decreases, and in some cases, there is a slight decline in vision and progression of the disease [28-31].

A combination of photorefractive and phototherapeutic keratectomy has been suggested for stages I and II of keratoconus, particularly for patients over 40 or those unable to tolerate contact lenses. This approach helps form a fibrocellular membrane that enhances corneal strength. Femtolaser circular keratotomy, which creates a deep circular incision, helps reduce astigmatism and strengthens the cornea by stimulating connective tissue formation.

Epikeratoplasty can also be used to reduce astigmatism and improve the shape of the cornea, but it requires a lengthy recovery period. This method's advantage is the low risk of immunological and postoperative complications, thus minimizing the chances of implant rejection.

For acute keratoconus, penetrating keratoplasty is the primary treatment, achieving transparent grafting in nearly 95% of cases. However, this procedure carries a high risk of postoperative complications. Intrastromal or interlayer keratoplasty, which involves placing a graft into the cornea's layers to protect it from external factors, is also common. This method has a high success rate in terms of graft transparency and tissue compatibility [32-35].

The impact of keratoconus on patient welfare

Studies on keratoconus often focus on how the disease affects the patient's psychological and emotional well-being. Some researchers have observed common personality traits among patients, such as lower adaptability, disorganization, anxiety, and passive aggression. However, other studies argue that these traits are not unique to keratoconus patients but are seen in individuals with other chronic eye conditions due to reduced vision.

The timing and progression of the disease can significantly affect the patient's psychosocial development. Research has debunked the notion of a "keratoconic personality" after comparing individuals with keratoconus and those with severe myopia. No significant personality differences were found between the two groups.

Several studies have explored the connection between keratoconus and mental health disorders. One case involved a patient with schizophrenia and keratoconus, which developed at the age of 17 years. The patient, who

had a history of psychotropic drug use, experienced a schizophrenia relapse after undergoing bilateral keratoplasty at the age of 21 years. The patient linked the worsening of his condition and symptoms, such as incoherent speech, to the implantation of corneal segments. Other cases involving young adults with both keratoconus and schizophrenia have also been reported, with symptoms like disorganization, suicidal tendencies, and body dysmorphia [36-40].

Despite extensive research, a direct link between keratoconus and schizophrenia remains inconclusive. However, there is evidence suggesting that mental illness can indirectly influence the development and progression of keratoconus.

The progression of keratoconus can be influenced by a disruption of normal bodily functions or a loss of self-control, which leads to mechanical damage to the cornea. Constant rubbing of the eyes, resulting from mechanical irritation, can cause keratectasia. Repeated damage to the corneal epithelium may result in stretching, thinning, and disruption of the fibrillar matrix, which compromises the integrity of the cornea.

A rapid progression of bilateral corneal ectasia has been observed in patients with bilateral keratoconus, particularly in cases involving neurological disorders such as Tourette's syndrome, which is characterized by repetitive motor tics. This condition can lead to compulsive eye rubbing, exacerbating the disease.

As the disease progresses, a decline in the patient's quality of life is often noted. However, significant improvements have been observed following surgical treatments, such as corneal crosslinking. Studies show that anxiety levels decrease in patients after such procedures, and many patients experience long-term improvements in their quality of life after treatments like crosslinking and corneal transplantation [40-44].

Conclusion

The concept of "quality of life" began to gain attention in the 1960s, being defined as a state where a person's physical, social, and emotional needs are optimally satisfied. Health assessment is a key factor in determining one's quality of life, making it a critical component of medical goals. Enhancing a patient's quality of life is often used as a measure of the effectiveness of medical treatments.

For patients with keratoconus, the impact of visual impairment on quality of life can be more significant than the effects of many other diseases, including those affecting the cardiovascular system. Therefore, evaluating and improving the quality of life in these patients is of paramount importance.

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References

1. Santodomingo-Rubido J, Carracedo G, Suzaki A, Villa-Collar C, Vincent SJ, Wolffsohn JS. Keratoconus: an updated review. Cont Lens Anterior Eye. 2022;45(3):101559. doi:10.1016/j.clae.2021.101559
2. Davidson AE, Hayes S, Hardcastle AJ, Tuft SJ. The pathogenesis of keratoconus. Eye (Lond). 2014;28(2):189-95. doi:10.1038/eye.2013.278
3. Sheludchenko VM, Osipyan GA, Arestova ON, Djalili RA, Khraystin Kh. Comparative assessment of the quality of life of keratoconus patients before and after intrastromal keratoplasty. Vestn Oftalmol. 2021;137(5):40-6.
4. Abugova TD. Clinical classification of primary keratoconus. Mod Optom. 2018;4:17-23.
5. Romero-Jiménez M, Santodomingo-Rubido J, Wolffsohn JS. Keratoconus: a review. Cont Lens Anterior Eye. 2010;33(4):157-66. doi:10.1016/j.clae.2010.04.006
6. Cassidy D, Beltz J, Jhanji V, Loughnan MS. Recent advances in corneal transplantation for keratoconus. Clin Exp Optom. 2013;96(2):165-72. doi:10.1111/cxo.12047
7. Lucas SEM, Burdon KP. Genetic and Environmental Risk Factors for Keratoconus. Annu Rev Vis Sci. 2020;6:25-46. doi:10.1146/annurev-vision-121219-081723
8. Jurkiewicz T, Marty AS. Correlation between Keratoconus and Pollution. Ophthalmic Epidemiol. 2021;28(6):495-501. doi:10.1080/09286586.2021.1879173
9. Ozer MD, Batur M, Mesen S, Tekin S, Seven E. Long-Term results of accelerated corneal cross-linking in adolescent patients with keratoconus.

Cornea. 2019;38(8):992-7. doi:10.1097/ICO.0000000000001975
10. Weng SF, Jan RL, Wang JJ, Tseng SH, Chang YS. Association between atopic keratoconjunctivitis and the risk of keratoconus. Acta Ophthalmol. 2021;99(1):e54-e61. doi:10.1111/aos.14509
11. Mas Tur V, MacGregor C, Jayaswal R, O'Brart D, Maycock N. A review of keratoconus: diagnosis, pathophysiology, and genetics. Surv Ophthalmol. 2017;62(6):770-83. doi:10.1016/j.survophthal.2017.06.009
12. Belin MW, Jang HS, Borgstrom M. Keratoconus: diagnosis and staging. Cornea. 2022;41(1):1-11. doi:10.1097/ICO.0000000000002781
13. Ortiz-Toquero S, Rodriguez G, de Juan V, Martin R. Repeatability of wavefront aberration measurements with a placido-based topographer in normal and keratoconic eyes. J Refract Surg. 2016;32(5):338-44. doi:10.3928/1081597X-20160121-04
14. Belin MW, Kundu G, Shetty N, Gupta K, Mullick R, Thakur P. ABCD: a new classification for keratoconus. Indian J Ophthalmol. 2020;68(12):2831-4. doi:10.4103/ijo.IJO_2078_20
15. Kasparova EA, Kasparov AA. Six-year experience with excimer laser surgery for primary keratoconus in Russia. J Refract Surg. 2003;19(2 Suppl):S250-4. doi:10.3928/1081-597X-20030302-17
16. Aatila M, Lachgar M, Hamid H, Kartit A. keratoconus severity classification using features selection and machine learning algorithms. Comput Math Methods Med. 2021;2021:9979560. doi:10.1155/2021/9979560
17. Seitz B, Daas L, Hamon L, Xanthopoulou K, Goebels S, Spira-Eppig C, et al. Stage-appropriate treatment of keratoconus. Ophthalmologe. 2021;118(10):1069-88. [In German]. doi:10.1007/s00347-021-01410-8
18. Mohammadpour M, Heidari Z, Hashemi H. Updates on managements for Keratoconus. J Curr Ophthalmol. 2017;30(2):110-24. doi:10.1016/j.joco.2017.11.002
19. Downie LE, Lindsay RG. Contact lens management of keratoconus. Clin Exp Optom. 2015;98(4):299-311. doi:10.1111/cxo.12300
20. Siddiqui SA, Singh P, Khan S, Fernando I, Baklanov IS, Ambartsumov TG, et al. Cultural, social and psychological factors of the conservative consumer towards legal cannabis use—a review since 2013. Sustainability. 2022;14(17):10993. doi:10.3390/su141710993
21. Schornack MM. Scleral lenses: a literature review. Eye Contact Lens. 2015;41(1):3-11. doi:10.1097/ICL.0000000000000083
22. Abdellah MM, Ammar HG. Femtosecond laser implantation of a 355-degree intrastromal corneal ring segment in keratoconus: a three-year follow-up. J Ophthalmol. 2019;2019:6783181. doi:10.1155/2019/6783181
23. McKay TB, Priyadarsini S, Karamichos D. Mechanisms of collagen crosslinking in diabetes and keratoconus. Cells. 2019;8(10):1239. doi:10.3390/cells8101239
24. Saad S, Saad R, Jouve L, Kallel S, Trinh L, Goemaere I, et al. Corneal crosslinking in keratoconus management. J Fr Ophtalmol. 2020;43(10):1078-95. doi:10.1016/j.jfo.2020.07.002
25. Fay J, Juthani V. Current trends in pain management after photorefractive and phototherapeutic keratectomy. Curr Opin Ophthalmol. 2015;26(4):255-9. doi:10.1097/ICU.0000000000000170
26. Nagpal R, Maharana PK, Roop P, Murthy SI, Rapuano CJ, Titiyal JS, et al. Phototherapeutic keratectomy. Surv Ophthalmol. 2020;65(1):79-108. doi:10.1016/j.survophthal.2019.07.002
27. Kubaloglu A, Sari ES, Cinar Y, Cingu K, Koytak A, Coşkun E, et al. Comparison of mechanical and femtosecond laser tunnel creation for intrastromal corneal ring segment implantation in keratoconus: prospective randomized clinical trial. J Cataract Refract Surg. 2010;36(9):1556-61. doi:10.1016/j.jcrs.2010.04.028
28. Mezhidov BS, Belyaeva AA, Bimarzaev KSM, Bektashev AS, Shekhshebekova AM, Dzgoeva MG, et al. Prospects for creating 3d models of internal organs based on computer and magnetic resonance imaging images in emergency surgery and resuscitation. Pharmacophore. 2021;12(1):8-14.
29. Osipchuk GV, Povetkin SN, Nagdalian AA, Rodin IA, Vladimirovna MI, Ziruk I, et al. The issue of therapy postpartum endometritis in sows using environmentally friendly remedies. Studies. 2019;10(2):82-4.
30. Lopes D, Loureiro T, Carreira R, Rodrigues Barros S, Nobre Cardoso J, Campos P, et al. Transepithelial or intrastromal femtosecond laser arcuate

keratotomy to manage corneal astigmatism at the time of cataract surgery. Arch Soc Esp Oftalmol (Engl Ed). 2021;96(8):408-14. doi:10.1016/j.oftale.2020.09.008

31. Soleimani M, Shahbazi A, Mohammadi N, Tabatabaei SA. Complications of intrastromal bevacizumab injection in lamellar keratoplasty. Int J Ophthalmol. 2020;13(2):356-8. doi:10.18240/ijo.2020.02.22
32. Wahrendorf I. How to live with keratoconus. Klin Monbl Augenheilkd. 2006;223(11):877-88. German. doi:10.1055/s-2006-927144
33. Tatematsu-Ogawa Y, Yamada M, Kawashima M, Yamazaki Y, Bryce T, Tsubota K. The disease burden of keratoconus in patients' lives: comparisons to a Japanese normative sample. Eye Contact Lens. 2008;34(1):13-6. doi:10.1097/ICL.0b013e3180515282
34. Moschos MM, Gouliopoulos NS, Kalogeropoulos C, Androudi S, Kitsos G, Ladas D, et al. Psychological aspects and depression in patients with symptomatic keratoconus. J Ophthalmol. 2018;2018:7314308. doi:10.1155/2018/7314308
35. Aslan MG, Besenek M, Akgoz H, Satılmaz MF, Hocaoglu C. Evaluation of personality features and mental state of keratoconus patients. Beyoglu Eye J. 2021;6(4):272-9. doi:10.14744/bej.2021.24482
36. Maslova AY, Tskaeva AA, Ashurova ZA, Abazova A, Ismailov MM, Ismailova MM, et al. Study of the effect of Baricitinib on the Course of COVID-19. J Pharm Res Int. 2021;33(35A):204-13. doi:10.9734/jpri/2021/v33i35A31890
37. Mannis MJ, Ling JJ, Kyrillos R, Barnett M. Keratoconus and personality-a review. Cornea. 2018;37(3):400-4. doi:10.1097/ICO.0000000000001479
38. Moreira LB, Alchieri JC, Belfort R Jr, Moreira H. Psychological and social aspects of patients with keratoconus. Arq Bras Oftalmol. 2007;70(2):317-22. Portuguese. doi:10.1590/s0004-27492007000200023
39. Cavanna AE, Seri S. Tourette's syndrome. BMJ. 2013;347:f4964. doi:10.1136/bmj.f4964
40. Rindner EC. Living with Tourette's syndrome. J Psychosoc Nurs Ment Health Serv. 2007;45(8):19-23. doi:10.3928/02793695-20070801-05
41. Magomedova AS, Sheripovna DK, Kunkueva SA, Muskhanov MI, Ibragimov AK, Khazamova SO, et al. Application of a simulation system using augmented reality to practice the skills of minimally invasive spine surgery. J Pharm Res Int. 2021;33(42A):66-73. doi:10.9734/jpri/2021/v33i42A32385
42. Algahtani FD. Healthy lifestyle among ha'il university students, Saudi Arabia. Int J Pharm Res Allied Sci. 2020;9(1):160-7.
43. Hanawi SA, Saat NZ, Zulkafly M, Hazlenah H, Taibukahn NH, Yoganathan D, et al. Impact of a healthy lifestyle on the psychological well-being of university students. Int J Pharm Res Allied Sci. 2020;9(2):1-7.
44. Salehzadeh H, Ebrahemzadih M, Nourani MR, Kourghi M, Taheri RA. The impact of lead contamination on psychiatric disorders and quality of life. J Biochem Technol. 2019;10(2):18-27.