THE RELEVANCE OF EYE BANKS AND PEOPLE AWARENESS IN THE CORNEAL TRANSPLANT PROCESS

A RELEVÂNCIA DOS BANCOS DE OLHOS E DA CONSCIENTIZAÇÃO DAS PESSOAS NO PROCESSO DE TRANSPLANTE DE CÓRNEA

AMANDA REBOUÇAS BEZERRA DE **MENEZES**[1], AMANDA BEZERRA DUARTE **DE OLIVEIRA**[1], GUILHERME PINHEIRO **DIÓGENES**[1], FRANCISCO NEPOMUCENO **NETO**[2], JOÃO CRISPIM MORAES LIMA **RIBEIRO**[3*]

1. Acadêmico do Curso de Graduação em Medicina do Centro Universitário Christus, Fortaleza, CE, Brasil; **2.** Mestrando do Centro Universitário Christus, Fortaleza, CE, Brasil; **3.** Professor Doutor, Docente da Disciplina de Oftalmologia do Curso de Medicina do Centro Universitário Christus, Fortaleza, CE, Brasil.

* Joaquim Nabuco, St. 505, Meireles, Fortaleza, Ceará, Brazil. ZIP-CODE: 60125-120. jcmlribeiro@gmail.com

Received: 07/24/2024. **Accepted:** 07/29/2024

ABSTRACT

Corneal diseases are responsible for around four to five percent of the causes of reversible blindness in the world and affect more than eight million people, making corneal transplantation necessary, as this is the main treatment to restore vision in patients with opacities of the cornea. Medical knowledge regarding the different types of corneal transplantation has made this an extremely safe and effective procedure, having been widely performed today. To this end, eye banks play an essential role in providing high-quality tissues to corneal surgeons through the harvesting, processing, evaluation, classification, storage, and proper distribution of ocular tissues. Therefore, this study aims to present a narrative review of the different approaches to organizing eye banks and the cornea supply process recorded in the literature. The study consists of a narrative review in which 26 articles were selected through research in the MEDLINE, EMBASE, AND LILACS databases. There is, globally, an undeniable gap between the supply and demand for donor corneas. It is necessary to improve appropriate training techniques and methods for surgeons and technicians to routinely evaluate donor viability criteria, in addition to raising public awareness about corneal transplantation. Model eye bank systems should be mirrored and serve as a reference for centers with a deficit in offering donor corneas.

KEYWORDS: eye banks; corneal transplantation; cornea.

RESUMO

As doenças da córnea são responsáveis por cerca de 4 a 5% das causas de cegueira reversível no mundo e afetam mais de 8 milhões de pessoas, tornando necessário o transplante de córnea, pois essa é a principal opção para restaurar a visão em pacientes com opacidades da córnea. A ceratoplastia é o procedimento de maior sucesso entre os transplantes e tem sido o mais realizado na atualidade. Para isso, os bancos de olhos desempenham um papel essencial no fornecimento de tecidos de alta qualidade aos cirurgiões de córnea por meio da captação, do processamento, da avaliação, da classificação, do armazenamento e da distribuição adequada dos tecidos oculares. Desse modo, este estudo tem como objetivo apresentar uma revisão narrativa sobre as formas mais abordadas de organização dos Bancos de Olhos e do processo de transplante de córnea registrado na literatura. O estudo consiste em uma revisão narrativa, em que foram selecionados 26 artigos mediante pesquisa nas bases de dados MEDLINE, EMBASE E LILACS. Concluiu-se que existe, globalmente, uma lacuna inegável entre a oferta e a procura de córneas de doadores. Sendo necessário melhoria das técnicas e dos métodos de treinamento adequados tanto para cirurgiões quanto para técnicos, precisando avaliar, rotineiramente, os critérios de viabilidade dos doadores, além da conscientização sobre o transplante de córnea. Adiante, o futuro é promissor com maior otimização dos resultados e ampliação dos limites dos cuidados, alcançando novos patamares com as ciências médicas.

PALAVRAS-CHAVE: Banco de olhos; transplante de córnea; córnea.

1. INTRODUCTION

In the context of the origins of reversible blindness on a global scale, around 4 to 5% of them arise from conditions that affect the ocular structure called the cornea[1,2], ranking third among the main causes of blindness in the world, after cataracts and glaucoma, and affecting more than 8 million people[1]. Diseases such as keratoconus, bullous keratopathy, trachoma, Fuchs' dystrophy and infectious keratitis, if not treated promptly and properly, can progress to loss of vision, making corneal transplantation necessary, as this is the main option for restoring vision in patients with corneal opacities[2].

Corneal transplantation or keratoplasty is the

The most successful procedure among transplants and the most frequently performed today are the eye banks, which supply corneal surgeons with high-quality tissues by collecting, processing, evaluating, classifying, storing and properly distributing ocular tissues[3]. The increase in this procedure has been

influenced by technological developments and various other factors, such as improved microsurgery instruments, better means of tissue preservation, better medical control in the post-operative period, as well as a better understanding of the physiology of the corneal surface. These factors have allowed progressively better corneal transplant results to be obtained, making it one of the most performed eye surgeries worldwide[4].

Another extremely important factor in the numerical growth of corneal transplants is the better organization of the work carried out by eye banks, which enable surgeons to be notified quickly and select eligible patients, providing better conditions for transplanting the donor cornea[3]. However, there is still a clear discrepancy between the number of patients needing a transplant and the tissues available. One conclusion from the recent global survey on eye banks and corneal transplantation calculated that there is only one cornea available for every 70 corneal recipients worldwide, which shows that the world is facing a drastic mismatch between the demand and supply of donor corneas[5].

It is estimated that around 12.7 million people in the world need a corneal transplant, but the lack of access to transplantation is a major challenge, mainly because corneal donation rates do not keep pace with the growing demand for transplantation[6]. There are many identified factors that may contribute to the current shortage of corneal grafts, including a lack of an efficient system for notifying potential donors, a reduced number of institutions storing eye tissue, a lack of information, culture and religion[7].

Therefore, the aim of this study is to present a narrative review of the most widely discussed ways of organizing eye banks and the corneal transplant process in the literature, as well as to observe what has been studied to propose strategies to improve this process and optimize the time until the transplant takes place.

2. MATERIAL AND METHODS

The study consists of a narrative review conducted in the MEDLINE databases using the descriptors ("corneal transplantations" OR "cornea transplantation") AND "Eye Banks" AND "cornea", EMBASE using the descriptors ("cornea transplantation" OR "cornea transplant") AND "eye bank" AND "cornea" and LILACS using the descriptors "corneal transplantation" AND "Eye Banks" AND "cornea".

Thirteen articles were selected from a total of 324 found by searching the Embase, Medline and LILACS* databases. The inclusion criteria were articles available in English, Portuguese and Spanish, published between 2018 and 2023. Duplicate articles, those that did not address the topic of interest and those that did not meet the inclusion criteria were excluded. In addition to these, in order to enrich the discussion, 16 articles published between 2002 and 2023 were manually selected, of which only 13 were used, according to their relevance and suitability to the topic. In short, 26 articles were used to produce this integrative review.

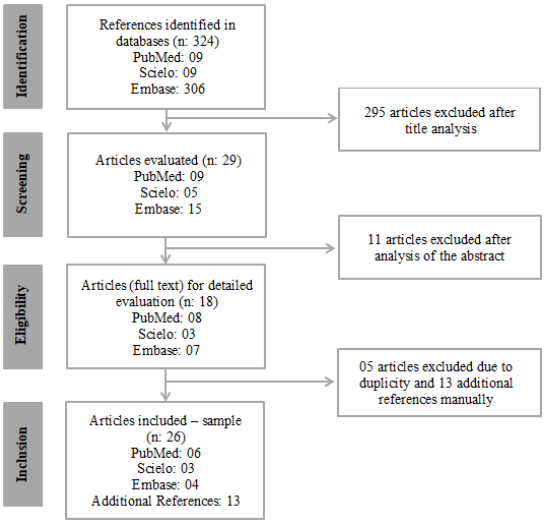

Figure 1. Flow diagram of the selection of articles for the integrative review on corneal transplantation and eye banking. **Source:** Author.

3. DISCUSSION

This integrative review resulted in the selection of 26 articles, the main findings of which are shown in Table 1.

Table 1. Summary of the data extracted from the 26 selected articles, ordered from oldest to most recent.

Autor / Ano	Título	Conclusão
Ehlers; 2002 (13)	Corneal banking and grafting: the background to the Danish Eye Bank System, where corneas await their patients	É vital a colaboração entre os bancos de olhos e os cirurgiões para melhorar a qualidade dos tecidos transplantados.
Sano et al., 2010 (4)	Analysis of the transplanted corneas at Santa Casa de São Paulo Eye Bank	A manutenção dos cuidados oculares após o óbito do paciente doador é fundamental para preservar a qualidade das córneas.
Gaum et al., 2012 (24)	Tissue and corneal donation and transplantation in the UK	A colaboração e integração entre bancos de olhos, cirurgiões oftalmologistas e empresas conduz a serviços mais eficientes possibilitando inovação e desenvolvimento.
Bonfadini, et al., 2014 (15)	Donation and waiting list for corneal transplantation in the State of Rio de Janeiro	A baixa notificação de possíveis doadores e a alta taxa de negativa familiar na doação associado ao insuficiente número de córneas disponibilizadas por Bancos de Olhos são os principais fatores que limitam o aumento do número dos transplantes de córnea no Brasil.
Tandon et al., 2017 (11)	Upgradation and modernization of eye banking services: Integrating tradition with innovative policies and current best practices	Para o desenvolvimento de bancos de olhos, é essencial que sejam desenvolvidas políticas baseadas em diretrizes e protocolos reconhecidos, bem como a criação de programas hospitalares no manejo das córneas coletadas.
Gupta et al., 2018 (19)	Eye donation and eye banking in India	A prioridade dos bancos de olhos nos países em desenvolvimento deverá ser o aumento da aquisição de córneas, a melhoria da qualidade e a redução de custos.
Almeida, Kara-Junior., 2018 (2)	Critical analysis of the different data sources on corneal transplantation in Brazil	A divulgação de dados epidemiológicos de forma mais eficaz ajudaria a aprimorar o sistema de transplante brasileiro, a fim de tornar mais efetiva a capacidade de suprir a demanda populacional.
Sousa, Sousa; 2018 (17)	Eye bank procedures: donor selection criteria	As contraindicações desempenham papel fundamental na padronização dos critérios de seleção da córnea, reforçando a necessidade de análise minuciosa dos tecidos antes do seu transplante.

Wojcik et al., 2020 (8)	Corneal storage methods: considerations and impact on surgical outcomes	As novas tecnologias médicas permitem aos bancos de olhos capacidade de armazenamento a longo prazo reduzindo as taxas de descarte.
Moshirfar et al. 2021 (14)	Corneal Donation: Current Guidelines and Future Direction	Conjunto de doadores pode ser expandido por meio de melhorias significativas nos métodos e nas técnicas de avaliação da córnea
Salz et al., 2021 (16)	Risk of SARS-CoV-2 virus transmission from donor corneal tissue: A review	Devem ser feitas avaliações e reavaliações frequentes para salvaguarda de todos os envolvidos no banco de olhos e no transplante.
Aiello et al., 2022 (9)	Effect of Covid-19 on Eye Banks and Corneal Transplantations: Current Perspectives	Comitês oftalmológicos e de bancos de olhos devem promover atividades que encorajem os médicos e educar as comunidades para a doação de tecidos.
Kacheri et al., 2022 (25)	Eye Donation: Awareness, Knowledge, Willingness, and Barriers among Paramedical and Allied Health Science Students at a Tertiary Care Teaching Hospital in South India	Os estudantes da saúde e médicos são o futuro do sistema de saúde, uma vez que são os pilares que o sustentam, e o seu grau de conhecimento e sensibilização é crucial na promoção da doação de córnea.
Christy et al., 2023 (1)	Evolution of eye banking in India – A review	Criação de um sistema forte e independente para cuidar da logística e levar em consideração os avanços tecnológicos – cirúrgicos e outros.
Yujia, et al., 2023 (22)	Overview of corneal transplantation for the non ophthalmologist	O transplante de córnea é um procedimento amplamente realizado, porém seu conhecimento é escasso fora da especialidade da oftalmologia. Médicos generalistas devem ter conhecimento do procedimento para incentivar seus pacientes a serem doadores de córnea
Anitha, et al., 2023 (3)	Corneal blindness and eye banking: Current strategies and best practices	Os Bancos de Olhos podem aprender com as experiências uns dos outros e trabalharem para alcançar melhores resultados nos transplantes de córnea em todo o mundo. Ressalta a importância da partilha de conhecimento e dos esforços colaborativos para enfrentar desafios comuns e implementar melhores práticas nas instituições.

Source: Own Authorship.

Eye Bank

The eye bank project was conceived by Vladimir Petrovich Filatov, in the mid-Soviet Union, by collecting and storing corneas from cadavers that had been dead for hours. This initiative was further developed by the *Eye Bank Association of America* (EBAA), founded in 1961 by the American *Academy of Ophtalmology and Otolaryngology*. The EBAA is a reference in eye banks and is responsible for standardizing and accrediting them[3].

With almost 200,000 surgical procedures performed worldwide every year, corneal transplantation (keratoplasty) is one of the main types of organs and tissue transplantation, yet it faces a serious shortage of donors. To overcome this major challenge, eye banks play a crucial role, constantly expanding their research and developing technologies aimed at more efficient tissue storage and transportation. These institutions stand out by promoting high-quality tissues resulting from good selection, storage and distribution, as well as having advanced research centers, which seek to reduce dependence on donor material and implementing new surgical techniques and tools to minimize trauma and improve the results of corneal transplants[3,8].

The Eye Bank organization functions as a complex structure responsible for the recovery, evaluation, preservation and distribution of corneal tissues, playing a vital role not only in donation, but also in the collection and preservation of tissues, which are critical stages in the process to guarantee quality. The standardization of procedures by eye banks is necessary as it directly influences the final quality of corneal tissue and, consequently, post-operative success. In addition, constant improvement in the use of ocular tissues and the use of new techniques are essential for the development of an eye bank[9,10,11] .

Examples of organizational models can be defined for these institutions.

- *The Centralized Eye Bank* is a single central organization responsible for: donation, evaluation, storage and distribution of corneas;
- *The Community Eye Bank*, on the other hand, is a service established at community level, in collaboration with non-governmental organizations (NGOs) and local organizations;
- The complexity of the *Hospital Eye Bank* is integrated into a hospital or eye care center and is the model used in Brazil, India, Singapore and most European countries[3].

As a result of the implementation of the eye bank structure in the transplant process, thousands of people have benefited and successfully received the procedure. However, due to infectious and communicable diseases, increased regulation and the emergence of new techniques and technologies to refine and redefine corneal transplantation, eye banks need to keep moving forward in the face of the challenge of providing high quality tissue, safely and in time for transplantation[4,12].

Transmissible diseases remain a significant concern in corneal graft surgery. Studies conducted in Denmark revealed that bacterial infections were almost completely eradicated with the use of antibiotics in the culture media. To date, the Danish Eye Bank has not recorded any cases of transmission of bacterial or fungal infections from donors to recipients. However, viruses, prion diseases and other microorganisms still pose a potential risk[13].

Therefore, prior to transplantation, eye banks carry out a thorough screening of eye donors for eligibility following detailed guidelines such as the *Guidelines* proposed by the *National Program for Control of Blindness* (NPCB). Screening procedures include serological tests for hepatitis B, hepatitis C, syphilis, HIV 1 and 2, Covid-19 and various other infectious diseases, as well as a review of the donor's medical history and a physical inspection to assess the overall quality of the tissue using various imaging methods and techniques[11, 14, 15].

These precautions must be ensured since corneal transplantation also carries a risk of disease transmission, as has been documented in several studies. More recently, there has been a significant threat from SARS-Cov-2, which, despite heterogeneous opinions about a potential risk of transmission of SARS-CoV-2 through ocular tissue, cannot yet be completely ruled out. Thus, various diseases contraindicate corneal donation, such as

rabies, syphilis, tuberculosis, hepatitis B and C, Creutzfeldt-Jacob disease, HIV, herpes simplex virus, bacterial or fungal keratitis, among many others[14, 16].

Contraindications play an essential role in standardizing the criteria for choosing a cornea, reinforcing the importance of thorough tissue analysis before transplantation. These lists protect the Hippocratic principle of "*primum non nocere*". However, every transplant carries the risk of transmitting potentially harmful agents to the recipient. Therefore, the aim of these procedures is not to eliminate this risk, but to reduce it to an acceptable level. Maintaining a balance between tissue safety and availability requires prudence, but without applying disproportionate rigor[17].

There is still a lack of clarity about the contraindications of corneal donors among doctors and other health professionals, despite decades in the field of tissue donation, a fact that is a cause for concern, since it makes it impossible to donate corneas that could be used[18].

The success of corneal transplantation can largely be attributed to developments in preservation techniques. An ideal preservation technique will require indefinite storage of corneal tissues, with better retention of endothelial cell viability, allowing for a reduction in tissue disposal rates. For this reason, the storage of corneas collected for transplantation is one of the critical stages for the functioning of eye banks, since maintaining the density and endothelium of the cornea are fundamental criteria for the results of transplants[8]. However, there are several challenges to this, one of which is minimizing the time between death and recovery, since endothelial viability worsens exponentially with delayed enucleation[1].

The wait for corneal harvesting is -12 hours after death, with greater chances of use and less risk of infection; for patients on mechanical ventilation, it is possible to harvest them within 72 hours. As for the use of the graft, the indication is immediate, if possible, or within 12 hours, with up to 48-72 hours being acceptable. In addition, it should be noted that collection also requires enucleation of the eyeball or *in situ* excision of the corneoscleral disc[11].

As well as the delay in enucleation, another challenge is tissue distribution, since the lack of donor material in some regions and the need for compatibility between the donor and the recipient shows the need for adequate transportation to enable tissue exchange. However, this process is still hampered by the lack of an effectively functioning network that connects regions with good donor tissue recovery to those with greater demand. This makes it difficult to distribute surplus donor corneas to areas in need, thus depriving those who need the tissue and reducing the utilization rates of eye banks[1, 13].

It is therefore necessary to work on infrastructure, human and technological resources, training and the appropriate use of resources to achieve a balance between the demand for and supply of donor corneas in the world[19].

Corneal Transplant

Corneal transplantation is one of the only options for restoring vision in patients with corneal opacities of various etiologies, and since its first introduction in the 20th century, this procedure has become standard practice for replacing the damaged cornea with a derivative. The success of this procedure depends on 3 factors: the quality of the donated cornea, the nature of the recipient's pathology and post-operative care[3,6] .

Clinical studies show that 63.6% of bilateral corneal blindness with an indication for keratoplasty is due to infections, and these infections tend to be more common in rural areas and in populations with low socioeconomic conditions. Other data shows that approximately 4.9 million people have bilateral corneal blindness and 23 million have unilateral corneal blindness, causing a serious drop in quality of life. The most common indications for pediatric keratoplasty are infectious keratitis, followed by congenital glaucoma and trauma. Graft failures occur in 18.4% of cases, half of which are due to infections[11,20].

The five biggest causes of blindness in the world are cataracts, glaucoma, refractive errors, age-related macular degeneration and corneal diseases. Epidemiological data indicate that corneal dysfunctions are the third leading cause of blindness in the world, as well as the second leading cause of reversible blindness. Considering these circumstances, blindness caused by corneal dysfunctions cannot be neglected, as it is the third leading cause of blindness in the world, and the tissue transplant procedure is a key factor in combating this statistic[15, 18, 21].

In general, failure or irreversible tissue damage can be indications for transplantation. Superficial lesions such as abrasions are reversible, as are regular refractive errors that can be corrected. The most common indication for corneal transplantation is endothelial dysfunction, corresponding to 42% of the causes of surgery, and encompassing a range of disorders that prevent adequate hydration of the corneal stroma. Another common indication for transplantation is tissue ectasia and thinning, which contributes to the poor structural integrity of the cornea. Among these disorders is keratoconus, in which there is a structural, multifactorial and progressive corneal alteration. Other indications for transplantation include scarring, ulceration and perforation, and there must be epithelial and endothelial dysfunction, but the stroma is usually the damaged structure in these cases[22].

Keratoplasty can be classified into therapeutic, tectonic and optical. Therapeutic keratoplasty is performed to remove an infected portion of the cornea, mainly in cases of recalcitrant or perforated infectious keratitis. Tectonic keratoplasty provides support and maintains the integrity of the globe, while optical keratoplasty aims to restore vision. Over time, several advances have been made that have led to refinements in visual quality and post-operative results[6].

There are various anatomical and clinical parameters that need to be assessed before planning the type of corneal transplant. The procedure can be classified based on its purpose (therapeutic, tectonic, optical), as well as based on the different techniques used to replace the diseased part of the tissue[6].

Corneal transplantation has evolved in terms of adopting techniques to replace only layers of the cornea rather than its full thickness[14].

The selective diseased part replacement technique has many advantages in terms of fewer intraoperative complications, maintaining globe integrity and less chance of graft rejection in the postoperative period compared to full thickness penetrating keratoplasty[6].

Complications associated with transplantation can occur at any time during the perioperative period. The most catastrophic outcome in this period is expulsive choroidal hemorrhage, which usually occurs due to a sudden drop in intraocular pressure after the globe is incised. This complication also has other risk factors, such as anticoagulant therapy, advanced age, glaucoma, high intraocular pressure, among others. The most common complication after corneal transplantation is wound dehiscence[6].

Cataracts and glaucoma are also commonly associated with the prolonged use of corticosteroids after the procedure. Endophthalmitis, retinal detachment and macular edema are other serious complications that can occur in the postoperative period, but their incidence has been reduced with the advent of new treatments, such as topical antibiotic prophylaxis to prevent endophthalmitis and corneal ulcers. Graft failure can also occur due to immune rejection, which is why topical steroids are prescribed for immunosuppression, and should be de-prescribed if necessary. In repeated transplants, other drugs, such as topical cyclosporine, can be used to prevent rejection[22].

Transplant awareness and barriers

One of the most transplanted tissues worldwide is the cornea. However, there is a considerable shortage of corneas to be donated. Although 12.7 million people worldwide need a corneal transplant, there is only 1 cornea available for the 70 needed[2,23].

Consequently, many patients experience a significant deterioration in their quality of life. Since even a small reduction in visual acuity can have a profound impact on a person's ability to perform their duties in the workplace or lead their life safely. Thus, the improvement in visual acuity after transplantation is remarkable, resulting in a dramatic improvement in the patient's quality of life, economic opportunities and independence[24].

However, organ donation is still a complex process involving various social, ethical and legal factors. Just as there has been an increase in the number of corneal transplants and their techniques, the need for donor corneas is also growing, which contributes to a shortage of supply and demand, especially in developing countries[6.]

A major factor impacting on the number of corneal transplants is the inefficiency of communication channels between ophthalmic departments and corneal banks, so implementing better donor notification systems would help to overcome the low availability of corneas[7].

In addition, there is a lack of awareness among the population about organ and tissue donation, as well as among health professionals themselves in carrying out this educational role, since they play a fundamental role in explaining the subject to the population[25].

The main reasons for not obtaining eye tissue from solid organ donors include family refusal, often due to ignorance of the deceased's wishes, concerns about external disfigurement and religious or cultural objections. Research shows that only 55.4% of donors were aware of the possibility of eye donation and only 44.3% of these volunteered to donate. Factors such as prior knowledge, literacy and

socioeconomic status seems to have no influence on the donation process[11,24].

It is therefore necessary for young professionals in training to be well-informed about the implications and benefits of encouraging eye donation, so that they can advise families to donate. Likewise, the media is a relevant tool for ensuring that this information has a long-term impact and should be used consciously[5,25].

In the UK, eye bank teams are assigned to encourage corneal donation, educate and train clinical staff, approach families of potential donors and carry out eye tissue recovery. These initiatives have resulted in a qualitative increase in eye donations, helping to improve the donation and procurement process[24].

However, this reality of encouraging and educating the community is not a reality in many countries around the world. Eye banks still face barriers in many places to moving forward and even operating independently, since even if there is external support, they need to raise enough funds to be able to operate autonomously after these external investments have been withdrawn. Even if eye banks are implemented, it is necessary for the community and government entities to understand their importance and provide the necessary support so that they are prepared and can operate independently successfully[26].

The eye bank system and the process up to transplantation is still something to be studied more and more to optimize it, since in countries such as India there is still a lack of organization in the system, as well as improper regulations and legislation that prevent improvements in the process of corneal donation, distribution and transplantation[19].

For the transplant to be successful, a trained team is needed to carry out the procedure, operated by trained corneal surgeons who make appropriate use of the donated tissue. The lack of availability of professionals with such technical skills, as well as specialized centers to support the transplant, still seems to be preventing progress in achieving access to this procedure in countries such as India. Factors such as a longer

learning curve for keratoplasty, the reduction in revenue for the private sector through this surgery, the need for infrastructure, human resources and networks to maintain an eye bank to maintain good tissue quality are obstacles to the advancement of transplantation[19].

In Brazil, for example, one of the biggest obstacles to the donation and collection of corneas in the country is the low number of notifications of donation by the family, due to factors such as: inability to understand the concept of brain death, fear of deforming the body after removal of the eyeball (enucleation), fear of organ trafficking and lack of knowledge about the system of distribution and allocation of organs and tissues. In this respect, in addition to campaigns, it is essential to promote knowledge about health[15].

4. CONCLUSION

More than a century has passed since the first corneal transplant surgery, with continuous evolution. Personalized corneal component replacement strategies to replace diseased layers and conserve healthy components, ever-improving instrumentation, and engineering marvels have helped achieve greater levels of vision restoration with faster recovery, better quality of vision, more reliable vision restoration, minimized complications, greater longevity, and quote success.

However, globally there is an undeniable gap between the supply and demand for donor corneas, mainly due to the lack of knowledge and awareness of donation in the community, and it is the responsibility of doctors to provide information and clarify the importance of the procedure to the families of potential donors. In addition, it is of the utmost importance to improve techniques and appropriate training methods, both for surgeons and technicians, and to routinely assess donor viability criteria.

There is also a need for social and governmental support for eye banks, the main structure responsible for guaranteeing the safety and quality of their recipients, as well as new studies and research that seeks tools to optimize communication between eye banks and ophthalmic centers, ensuring greater efficiency in the process of capturing tissues until they are used in transplantation, quickly and safely; as well as new technologies aimed at improving this process. It is also important to emphasize the importance of eye banks in the process of visual rehabilitation of patients with blindness due to corneal diseases, through all the processes such as collection, storage and distribution. Thus, the strengthening and continuous improvement of eye banks is indispensable for the advancement of eye health practices.

5. REFERENCES

[1] Christy JS, Bhadari AH, Mathews P, Srinivasan M, Vanathi M. Evolution of eye banking in India - A review. Indian J Ophthalmol. 2023 Sep; 71(9):3132-3141. doi: 10.4103/IJO.IJO_1882_23. PMID: 37602599; PMCID: PMC10565934.

[2] Almeida HG, Kara-Junior N. Critical analysis of the different data sources on corneal transplantation in Brazil. Rev Bras Oftalmol. 2018;77(3):142-5.

[3] Anitha V, Tandon R, Shah SG, Radhakrishnan N, Singh S, Murugesan V, Patwardhan V, Ravindran M. Corneal blindness and eye banking: Current strategies and best practices. Indian J Ophthalmol. 2023 Sep; 71(9):3142-3148. doi: 10.4103/IJO.IJO_1942_23. PMID: 37602600; PMCID: PMC10565931.

[4] Sano RY, Sano FT, Dantas MC, Lui AC, Sano ME, Neto AL. Análise das córneas do Banco de Olhos da Santa Casa de São Paulo utilizadas em transplantes [Analysis of the transplanted corneas at Santa Casa de São Paulo Eye Bank]. Arq Bras Oftalmol. 2010 May-Jun;73(3):254-8. Portuguese. doi: 10.1590/s0004-27492010000300009. PMID: 20730283.

[5] Gain P, Jullienne R, He Z, Aldossary M, Acquart S, Cognasse F, Thuret G. Global Survey of Corneal Transplantation and Eye Banking. JAMA Ophthalmol. 2016 Feb; 134(2):167-73. doi: 10.1001/jamaophthalmol.2015.4776. PMID: 26633035.

[6] Singh R, Gupta N, Vanathi M, Tandon R. Corneal transplantation in the modern era. Indian J Med Res. 2019 Jul; 150(1):7-22. doi: 10.4103/ijmr.IJMR_141_19. PMID: 31571625; PMCID: PMC6798607.

[7] Martin C, Tschernig T, Loic H, Daas L, Seitz B. Corneae from body donors in anatomy department: valuable use for clinical transplantation and experimental research. BMC Ophthalmol. 2020 Jul 13; 20(1):284. doi: 10.1186/s12886-020-01546-2. PMID: 32660508; PMCID: PMC7359266.

[8] Wojcik, Gabriela, Stefano Ferrari, Vito Romano, Diego Ponzin, Sajjad Ahmad, and Mohit Parekh. "Corneal Storage Methods: Considerations and Impact on Surgical Outcomes." Expert Review of Ophthalmology. 2021; 16(1):1–9. doi:10.1080/17469899.2021.1829476.

[9] Aiello F, Gallo Afflitto G, Pocobelli G, Ponzin D, Nucci C. Effect of Covid-19 on Eye Banks and Corneal Transplantations: Current Perspectives. Clin Ophthalmol. 2022 Dec 30; 16:4345-4354. doi: 10.2147/OPTH.S379849. PMID: 36606249; PMCID: PMC9809163.

[10] Victer TNF, Loiola DS, Lucas MB, Chalita MRC, Sampaio TL, Báo SN. Causes of death and discard of donated corneal tissues: Federal District eye bank analysis 2014-2017. Rev Bras Oftalmol. 2019; 78(4):227-32.

[11] Tandon R, Singh A, Gupta N, Vanathi M, Gupta V. Upgradation and modernization of eye banking services: Integrating tradition with innovative policies and current best practices. Indian J Ophthalmol. 2017 Feb; 65(2):109-115. doi: 10.4103/ijo.IJO_862_16. PMID: 28345565; PMCID: PMC5381288.

[12] Lambert N G; Chamberlain W D. The structure and evolution of eye banking: a review on eye banks' historical, present, and future contribution to corneal transplantation. Journal of Biorepository Science for Applied Medicine 2017; 5:23-40.

[13] Ehlers N. Corneal banking and grafting: the background to the Danish Eye Bank System, where corneas await their patients. Acta Ophthalmol Scand. 2002 Dec; 80(6):572-8. doi: 10.1034/j.1600-0420.2002.800604.x. PMID: 12485275.

[14] Moshirfar M, Odayar VS, McCabe SE, Ronquillo

YC. Corneal Donation: Current Guidelines and Future Direction. Clin Ophthalmol. 2021 Jul 12; 15:2963-2973. doi: 10.2147/OPTH.S284617. PMID: 34285462; PMCID: PMC8285277.

[15] Bonfadini G, Roisman V, Prinz R, Sarlo R, Rocha E, Campos M. Donation and waiting list for corneal transplantation in the State of Rio de Janeiro. Rev Bras Oftalmol. 2014; 73(4):237-42.

[16] Salz AK, Acharya M, Hofmann N, Wittmershaus I, Sangwan V, Börgel M, Mathur U. Risk of SARS-CoV-2 virus transmission from donor corneal tissue: A review. Indian J Ophthalmol. 2021 Jun; 69(6):1592-1597. doi: 10.4103/ijo.IJO_3249_20. PMID: 34011748; PMCID: PMC8302275.

[17] Sousa SJFE, Sousa SBFE. Eye bank procedures: donor selection criteria. Arq Bras Oftalmol. 2018 Jan-Feb; 81(1):73-79. doi: 10.5935/0004-2749.20180017. PMID: 29538600.

[18] Seth A, Singh T, Monga P, Kalra S, John M, Thambi L. *et al*. Immediate donation of eyes after life: the first prospective, nurse driven, smart phone-based observational study on cornea donation in india. Indian Journal of Transplantation 2020; 14(3):208. https://doi.org/10.4103/ijot.ijot_24_20

[19] Gupta N, Vashist P, Ganger A, Tandon R, Gupta SK. Eye donation and eye banking in India. Natl Med J India. 2018 Sep-Oct; 31(5):283-286. doi: 10.4103/0970-258X.261189. PMID: 31267994.

[20] Latifa F. Alanazi, Shaikha H. Aldossari, Mohammed A. Gogandy, Ghazai A. Althubaiti, Beshayer F. Alanazi, Abdullah M. Alfawaz, Attitude, beliefs and awareness towards corneal donation in Saudi Arabia, Saudi Journal of Ophthalmology. 2019; 33(2):121-129, ISSN 1319-4534 https://doi.org/10.1016/j.sjopt.2019.02.003.

[21] Moshirfar, et al. A paradigm shift in eye banking: how new models are challenging the status quo. Clinical Ophtalmology. 2019; 13. doi: 10.2147/OPTH.S181534

[22] Zhou, Yujia, et al. Overview of Corneal Transplantation for the Nonophtalmologist. Transplantation Direct, 2023; e1434; doi: 10.1097/TXD.0000000000001434

[23] Chaurasia S, Mohamed A, Garg P, Balasubramanian D, Rao GN. Thirty years of eye bank experience at a single centre in India. Int Ophthalmol. 2020 Jan; 40(1):81-88. doi: 10.1007/s10792-019-01164-y. Epub 2019 Aug 22. PMID: 31440937.

[24] Gaum L, Reynolds I, Jones MN, Clarkson AJ, Gillan HL, Kaye SB. Tissue and corneal donation and transplantation in the UK. *Br J Anaesth*. 2012; 108 Suppl 1:i43-i47. doi:10.1093/bja/aer398.

[25] Kacheri A, Mudhol R, Chougule S, Reny R, Kamath S, Kamath R. Eye Donation: Awareness, Knowledge, Willingness, and Barriers among Paramedical and Allied Health Science Students at a Tertiary Care Teaching Hospital in South India. ScientificWorldJournal. 2022 Feb 23; 2022:5206043. doi: 10.1155/2022/5206043. PMID: 35250393; PMCID: PMC8890897.

[26] Jeng, B H.; Ahmad, S. In pursuit of elimination of corneal blindness: Is establishing eye banks and training surgeons enough? American Academy of Ophtalmology, 2020. https://doi.org/10.1016/j.ophta.2020.06.042 ISSN 0161-6420/20.