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OSTEO-ODONTO-KERATOPROSTHESIS: AN INNOVATIVE APPROACH BETWEEN DENTISTRY AND OPHTHALMOLOGY IN VISUAL REHABILITATION

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Pedro Guimarães Sampaio Trajano dos Santos[1], Rosana Maria Coelho Travassos[2], Luciane Farias de Araujo[3], Maria Regina Almeida de Menezes[4], Maria Tereza Moura de Oliveira Cavalcanti[5], Verônica Maria de Sá Rodrigues[6], Alexandre Batista Lopes do Nascimento[7], Josué Alves[8], Priscila Prosini[9], William Jose Lopes de Freitas[10], Rodolfo Scavuzzi Carneiro Cunha[11],

[1] Undergraduate in Dentistry
Recife Dental School, Brazil
Recife – Pernambuco, Brazil
E-mail: pedroguimaraessampaio@gmail.com
[2] PhD in Endodontics
University of Pernambuco
Recife – Pernambuco, Brazil
E-mail: rosana.travassos@upe.br
[3] PhD in Radiology
University of Pernambuco
Recife – Pernambuco, Brazil
E-mail: luciane.araujo@upe.br
[4] PhD
University of Pernambuco, UPE
Recife, Pernambuco, Brasil
E-mail: regina.menezes@upe.br
[5] PhD in Dentistry
University of Pernambuco
Recife – Pernambuco, Brazil
E-mail: tereza.moura@upe.br
[6] PhD in Dentistry
University of Pernambuco
Recife – Pernambuco, Brazil
E-mail: veronica.rodrigues@upe.br
[7] PhD in Dentistry
University of Pernambuco
Recife – Pernambuco, Brazil
E-mail: Alexandre.nascimento1@upe.br
[8] PhD in Dentistry
University of Pernambuco, UPE
Recife, Pernambuco, Brasil
E-mail: Josue.alves@upe.br
[9] PhD in Dentistry
University of Pernambuco, UPE
Recife, Pernambuco, Brasil
E-mail: priscila.prosini@upe.br
[10] PhD in Dentistry
University of Pernambuco, UPE
Recife, Pernambuco, Brasil
E-mail: profwilliamfreitas@gmail.com
[11] Master's student in Dentistry
Recife School of Dentistry, Brazil
Recife, Pernambuco, Brasil

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Ailton Coelho de Ataíde Filho[12] and Luciano Barreto Silva[13]

ABSTRACT
Objective: The objective of this narrative literature review article is to address a rare and innovative technique capable of restoring vision to blind patients, through the visual prosthesis called ‘’ Osteo-Odonto-Keratoprosthesis ’’. Methodology: Therefore, searches were made in databases in order to acquire this content. The searches were carried out in the following databases: The Cochrane Library; PubMed; Science Direct; Scielo; PROSPERO in conjunction with Google Academy Results: Studies have shown that Osteo-Odonto-Keratoprosthesis is an innovative way of restoring vision to a blind patient, this occurs through the surgical removal of a tooth from the patient, where it will serve as support for the creation of an artificial cornea, a technique in which the tooth is prepared in a rectangular shape with a hole in the center, where a plastic optical lens will be positioned that will later give rise to a new functional cornea. Conclusion: This innovative technique consists of restoring vision, is innovative and has great potential, even though it is complex, and has a well-defined technique, which already has existing cases of patients who had their vision restored through this technique. However, it is clear that in each case, it is necessary to analyze whether this technique is possible to be performed on the patient or not, considering that it is necessary for the patient to have teeth, and that they have to be in adequate conditions, so that they can be removed and used in this technique, which sometimes does not occur, especially when the patient is elderly.

Keywords: Cornea. Ophthalmology. Dentistry. Ocular Vision. Visual Prostheses.

E-mail: scavuzzi@gmail.com
[12] Specialist in Restorative Dentistry
Recife Dental School, Brazil
Recife, Pernambuco, Brasil
E-mail: ailtonataide@hotmail.com
[13] PhD in Endodontics
University of Pernambuco
Recife – Pernambuco, Brazil
E-mail: lucianobarreto63@gmail.com

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INTRODUCTION

Approximately 440 million people in the world suffer from some form of visual impairment and another 40 million are blind, health problems that negatively affect human life. Taking into account the fact that a large part of the population has some form of visual impairment or problem, more studies have been developed, research that sought to create new forms of treatment and surgeries that could restore vision. Histologically, the cornea is composed of stratified squamous epithelial tissue, a transparent and convex layer located in the anterior portion of the eye on its surface, serving to protect the internal tissues of the eye and transmitting light (Akpek et al., 2014), being extremely important and essential in human vision. Most of the pathologies that cause blindness have some relationship with the cornea, which encouraged researchers in the field of ophthalmology to look for ways to rehabilitate corneas or even ways to create new, healthy and effective corneas (Bourne et al., 2017; Ramrattan et al., 2001).

Thus, with the aim of rehabilitating the vision of patients with corneal deficiencies, ways to obtain biocompatible artificial corneas with the potential to rehabilitate optical functions began to be created, with options such as: Aurolab, Boston type I, Boston type II, Tibial Bone Keratoprosthesis and osteo odonto-keratoprosthesis being developed (Gomes & Alves, 2020). Osteo-odonto-keratoprosthesis is a technique that consists of creating a cornea from an extracted tooth, where a quadrangular surface will then be made, steps that must be performed by an Oral and Maxillofacial Surgeon, so that the Ophthalmologist can then take over the rest of the operation, where the tooth fragment will be used as a support for a cylindrical acrylic optical lens, then both will be implanted in subcutaneous tissue where they have undergone maturation, so that they can later be implanted in the patient's eyeball, and can serve as a new cornea, rehabilitating the optical capacity of patients who have severe bilateral corneal blindness but for whom conventional corneal transplant methods are not viable, for example (Tan et al., 2012).

This technique consists of combining the oral and maxillofacial surgeon with an ophthalmologist, joining dentistry with medicine, an interprofessional relationship between distinct areas but that when combined can bring the ability to see to someone with impaired visual capacity, being an innovative, complex and potential technique. Thus, the objective of this narrative literature review article is to address a rare and innovative technique capable of restoring vision to blind patients, through the visual prosthesis called ‘’Osteo-Odonto-

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Keratoprosthesis", in addition to addressing the interprofessional relationship between dentistry and ophthalmology.

METHODOLOGY

This paper is a narrative literature review. For this reason, it was necessary to use another scientifically proven paper, published in the scientific world, that could serve as a guide for how this paper should be structured, how its approach should be, specific characteristics of this type of article and what things do not fit within the content of this review. Thus, Rother's (2007) work was the study that best fit this role, an article that addresses the differences between systematic and narrative reviews, giving characteristics of both, which was useful and essential for understanding and structuring this review article. In addition, as it is a literature review, a range of articles, research and studies that address the topic that is being discussed in this article is necessary. Therefore, searches were made in databases in order to acquire this content. The searches were carried out in the following databases: The Cochrane Library; PubMed; Science Direct; Scielo; PROSPERO in conjunction with Google Academy. Aiming to obtain only information and content related to the topic being addressed, keywords were used during the searches, terms that help to filter and narrow down the search results, helping to facilitate the obtaining of only subjects that are related to what is being addressed in the article, thus, the following descriptors were used: Cornea; Ophthalmology; Dentistry; Ocular Vision; Visual Prostheses.

RESULTS

ARTIFICIAL CORNEAS

The development of artificial corneas emerged as a response to the limitation of transplants in patients with severe ocular surface diseases, especially in cases where there is immunological failure or multiple rejected transplants. Currently, the main keratoprosthesis available include the Boston Keratoprosthesis (KPro), AlphaCor, Aurolab KPro, and Osteo-Odonto-Keratoprosthesis (OOKP). Boston KPro types I and II demonstrate good results in eyes with a moist surface and minimal anatomical integrity.

However, their application is limited in extreme cases of dry eye or scarred conjunctiva. AlphaCor, in turn, composed of polyacrylamide hydrogel, has a high rate of extrusion, opacification, and failure in the medium term (Gomes & Alves, 2020). OOKP, on the other hand, stands out as the only effective alternative for patients with bilateral limbal

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stem cell deficiency, severe dry eye and cicatricial conjunctivitis, as in cases of ocular pemphigoid, Stevens-Johnson syndrome and alkali burns. Studies demonstrate device retention rates of over 85% after five years and maintenance of useful vision in up to 67% of cases after ten years (Tan et al., 2012). A long-term review by Stevens et al. (2014) confirmed vision stability for over 15 years in more than 70% of patients undergoing OOKP, even in the presence of previous surgical failures. In addition, OOKP is the only keratoprosthesis that does not depend on the presence of a moist ocular environment, as it uses autologous tissue, which provides a lower risk of rejection and greater biological integration. Singh et al. (2019) further emphasize its superiority in end-stage ocular surface disorders, where other keratoprosthesis fail consistently.

BIOCOMPATIBILITY, CELLULAR FUNCTION AND BIOCHEMISTRY OF TOOTH CELLS

The use of the dental root as a support for the optical lens is based on the natural biocompatibility of dental tissues with the recipient organism, being a biologically and immunologically tolerable solution. Dentin and root cementum are composed predominantly of crystalline hydroxyapatite, type I collagen and non-collagenous proteins that favor the mineralization and stability of the implant. Preparation of the dental root involves the removal of the pulp content and treatment with an antimicrobial solution, preserving the integrity of the dental hard tissue.

The retentive structure is modeled in a rectangular shape, axially perforated to receive the PMMA (polymethyl methacrylate) lens, which has a refractive index compatible with the human eye and high light transmissibility. Recent histological evaluations by Zhang et al. (2020) demonstrated that tooth-derived tissues maintain cellular viability and integration, with low inflammatory cell infiltration and presence of functional fibroblasts after subcutaneous implantation. Histological studies performed after the subcutaneous maturation phase reveal the formation of new vessels around the dental block, in addition to the presence of viable fibroblasts and the absence of significant chronic inflammation. Experimental models with primates, as described by Khodadad et al. (2013), further validated the biological adaptation of dentin in ocular and subcutaneous environments, supporting its long-term viability. This demonstrates that dentin, even outside its original environment, is capable of remaining functional and compatible with the host's living tissues (Tan et al., 2012). The optical lens is cemented to the dental block with acrylic cement, and the optical portion remains exposed in the visual axis after implantation. The optical and

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mechanical stability of the assembly is one of the characteristics that guarantee the clinical longevity of the OOKP.

OSTEO-ODONTO-KERATOPROSTHESIS

Osteo-Odonto-Keratoprosthesis is performed in two main surgical phases:

- **Phase 1:** an autogenous tooth is extracted, usually the lower canine, due to its long root morphology and favorable thickness. After preparation of the tooth and insertion of the PMMA lens, the assembly is implanted in the patient's own retroauricular or jugal subcutaneous tissue, where it remains in the vascularization process for 2 to 4 months.
- **Phase 2:** consists of removing the osteodental-lens complex from the subcutaneous tissue and implanting it in the eyeball, after excision of the opaque cornea and preparation of the scleral bed. The device is then fixed with sutures to the sclera and covered with conjunctiva as much as possible, leaving the optical lens exposed.

In a clinical series with more than 180 patients, the results revealed that the technique maintains functional visual acuity (better than 20/200) in more than 60% of patients after 10 years, with implant retention above 85% in the same period. The average longevity of the lens exceeds 15 years in many cases, with replacement only being necessary in rare cases of opacification (Tan et al., 2012). The main complications include secondary glaucoma (27% of cases), partial bone resorption (8–10%), and retinal detachment (up to 11%). Nevertheless, they are considered manageable with continuous monitoring and specific surgical or pharmacological interventions. The success of OOKP depends on an experienced multidisciplinary team, strict control of the maturation and implantation phases, in addition to the active involvement of the patient in the postoperative period, with periodic visits and specific care of the lens and ocular cavity.

INTERPROFESSIONAL RELATIONSHIP: DENTISTRY AND OPHTHALMOLOGY

The implementation of OOKP requires the joint action of different medical specialties, especially dentistry (oral and maxillofacial surgery) and ophthalmology, characterizing an interprofessional model of action that transcends the traditional limits of medical care. The dental surgeon is the professional responsible for selecting and extracting the most suitable tooth, performing the preparation of the root block and performing the initial subcutaneous

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implant. His/her role requires in-depth knowledge of dental anatomy, hard tissue surgery and infection control.

In turn, the ophthalmologist is responsible for planning the ocular bed, excising the damaged cornea and attaching the prosthesis to the eyeball. In addition, he/she is responsible for the clinical follow-up of the patient, monitoring ocular complications, intraocular pressure and lens positioning. This partnership represents one of the rare examples of the concrete application of clinical interdisciplinarity. The union between dentistry and ophthalmology results not only in technical efficiency, but also in a humanized approach focused on solving problems that were considered, until recently, without a solution. Qualitative studies report that this cooperation not only enhances therapeutic success, but also promotes greater exchange of knowledge among professionals, expanding mutual understanding and generating innovation in clinical practice (Gomes & Alves, 2020).

DISCUSSION

The analysis of the reviewed studies shows that Osteo-Odonto-Keratoprosthesis represents a revolution in the visual rehabilitation of patients with irreversible corneal blindness that cannot be treated by conventional methods. Its effectiveness derives not only from the mechanical robustness of the dental substrate, but also from its biocompatibility and the immunological adaptation promoted by the use of autologous tissue. This gives the technique a higher success rate when compared with fully synthetic prostheses, especially in hostile ocular environments. The invasive and highly technical nature of the procedure, however, limits its performance to reference centers with highly trained professionals in both areas. In addition, the procedure requires rigorous patient selection: the patient must have at least one tooth in good structural condition, be clinically fit to withstand multiple surgeries, and be able to adhere to intensive and continuous monitoring.

This reduces the population spectrum eligible for the technique. Associated complications, although relatively controllable, are still significant. Secondary glaucoma, for example, can develop silently, requiring early intervention and monitoring by digital tonometry and imaging tests. Bone resorption, although rare, can compromise the stability of the tooth-lens assembly and is more common in elderly patients, smokers, or those with uncontrolled osteoporosis. Another critical point concerns unequal access to the technique. In developing countries, OOKP is still rare due to its high cost, lack of specialized centers,

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and limited public policies aimed at highly complex surgical ophthalmology. This scenario requires that initiatives for professional training, incentives for translational research, and democratization of access to technology be stimulated through public policies and international collaboration. From an ethical standpoint, OOKP raises important reflections on the use of invasive techniques in patients with functional expectations of limited vision. The decision to undergo the procedure should be shared, preceded by multidisciplinary counseling, and supported by well-defined protocols of psychological evaluation, family support, and realistic expectations. Even so, the positive impact of the technique is undeniable. Patients previously considered incurable begin to develop visual autonomy, recover self-esteem and reintegrate into society. Clinical evidence of successful cases reinforces the humanizing potential of the technique, which transcends its surgical complexity to represent a true new beginning in the lives of many individuals.

CONCLUSION

This innovative technique consists of restoring vision. It is innovative and has great potential, even though it is complex. It has a well-defined technique, which already has existing cases of patients who had their vision restored through this technique. However, it is clear that in each case, it is necessary to analyze whether this technique is possible to be performed on the patient or not, considering that it is necessary for the patient to have teeth, and that they are in adequate condition, so that they can be removed and used in this technique, which sometimes does not occur, especially when the patient is elderly. In addition, the importance of the interprofessional relationship between the areas of dentistry and medicine is evident, as this relationship can be beneficial to various treatments and the patient's health, which shows that dentistry and medicine when combined can be more effective than when separated, demonstrating the importance of the relationships between different professions within the health area.

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