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TILAPIA SKIN (OREOCHROMIS NILOTICUS) IN THE REPAIR AND PROTECTION OF THE PALATAL SURGICAL BED AFTER AUTOGENOUS GRAFT REMOVAL: A LITERATURE REVIEW

PELE DE TILÁPIA OREOCHROMIS NILOTICUS NO REPARO E PROTEÇÃO DO LEITO CIRÚRGICO PALATINO APÓS REMOÇÃO DE ENXERTO AUTÓGENO: REVISÃO DE LITERATURA

PIEL DE TILAPIA (OREOCHROMIS NILOTICUS) EN LA REPARACIÓN Y PROTECCIÓN DEL LECHO QUIRÚRGICO PALATINO TRAS LA REMOCIÓN DE INJERTO AUTÓGENO: REVISIÓN DE LA LITERATURA

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ABSTRACT

The removal of autogenous palatal grafts is widely used in reconstructive periodontal surgeries to restore the anatomy and functionality of gingival tissues; however, it may cause pain, bleeding, discomfort, and postoperative morbidity due to healing by secondary intention at the donor site. Therefore, alternatives are sought to reduce these effects and promote faster and more comfortable repair. Nile tilapia skin (Oreochromis niloticus) has emerged as a promising biomaterial due to its high concentration of type I collagen, as well as mechanical strength, elasticity, biocompatibility, low antigenicity, sustainability, and low cost. This study analyzed scientific evidence regarding the use of tilapia skin as an occlusive biological dressing for the protection and repair of the palatal surgical bed after autogenous graft removal, considering its structural properties, clinical performance, and advantages compared with conventional dressings. The literature review was conducted using the PubMed, SciELO, Google Scholar, MEDLINE, and BVS databases, employing descriptors in Portuguese and English, following inclusion and exclusion criteria for publications from 2015 to 2025. The studies indicate that tilapia skin promotes faster epithelialization, reduces postoperative discomfort, effectively protects the surgical bed, improves aesthetic outcomes, and presents no relevant complications. Moreover, its versatility allows application in different forms, such as membranes, sponges, and hydrogels. Thus, tilapia skin represents a safe,

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effective, and promising alternative for regenerative dentistry, although more robust clinical studies are needed to standardize protocols and expand its use in surgical practice.

Keywords: Wound Healing. Periodontal Surgery. Biological Dressings. Graft. Tilapia Skin.

RESUMO

A remoção de enxertos autógenos do palato é amplamente utilizada em cirurgias periodontais reconstrutivas para restabelecer a anatomia e a funcionalidade dos tecidos gengivais, mas pode causar dor, sangramento, desconforto e morbidade pós-operatória devido à cicatrização por segunda intenção do leito doador. Por isso, buscam-se alternativas que reduzam esses efeitos e tornem o reparo mais rápido e confortável. A pele da tilápia-do-Nilo (Oreochromis niloticus) tem se destacado como biomaterial promissor por apresentar alta concentração de colágeno tipo I, além de resistência mecânica, elasticidade, biocompatibilidade, baixa antigenicidade, sustentabilidade e baixo custo. Este estudo analisou evidências científicas sobre o uso da pele de tilápia como curativo biológico oclusivo na proteção e reparo do leito cirúrgico palatino após a remoção de enxertos autógenos, considerando suas propriedades estruturais, seu desempenho clínico e suas vantagens em comparação com curativos convencionais. O levantamento bibliográfico foi realizado nas bases PubMed, SciELO, Google Acadêmico, MEDLINE e BVS, utilizando descritores em português e inglês, seguindo critérios inclusivos e exclusivos em publicações entre 2015 e 2025. Os estudos mostram que a pele de tilápia favorece epitelização mais rápida, reduz o desconforto pós-operatório, protege eficazmente o leito cirúrgico, melhora o resultado estético e não apresenta complicações relevantes. Além disso, sua versatilidade permite aplicações em diferentes formas, como membranas, esponjas e hidrogéis. Assim, a pele de tilápia apresenta-se como uma alternativa segura, eficaz e promissora para a odontologia regenerativa, embora sejam necessários estudos clínicos mais robustos para padronizar protocolos e ampliar sua utilização na prática cirúrgica.

Palavras-chave: Cicatrização. Cirurgia Periodontal. Curativos Biológicos. Enxerto. Pele da Tilápia.

RESUMEN

La remoción de injertos autógenos del paladar es ampliamente utilizada en cirugías periodontales reconstructivas para restablecer la anatomía y la funcionalidad de los tejidos gingivales; sin embargo, puede provocar dolor, sangrado, incomodidad y morbilidad postoperatoria debido a la cicatrización por segunda intención del lecho donante. Por ello, se buscan alternativas que reduzcan estos efectos y hagan la reparación más rápida y confortable. La piel de la tilapia del Nilo (Oreochromis niloticus) se ha destacado como un biomaterial prometedor por presentar una alta concentración de colágeno tipo I, además de resistencia mecánica, elasticidad, biocompatibilidad, baja antigenicidad, sostenibilidad y bajo costo. Este estudio analizó evidencias científicas sobre el uso de la piel de tilapia como apósito biológico oclusivo en la protección y reparación del lecho quirúrgico palatino tras la remoción de injertos autógenos, considerando sus propiedades estructurales, su desempeño clínico y sus ventajas en comparación con los apósitos convencionales. La revisión bibliográfica se realizó en las bases PubMed, SciELO, Google Académico, MEDLINE y BVS, utilizando descriptores en portugués e inglés, siguiendo criterios de inclusión y exclusión en publicaciones entre 2015 y 2025. Los estudios muestran que la piel de tilapia favorece una epitelización más rápida, reduce la incomodidad postoperatoria, protege eficazmente el lecho quirúrgico, mejora el resultado estético y no presenta complicaciones relevantes. Además, su versatilidad permite aplicaciones en diferentes formas, como membranas,

esponjas e hidrogeles. Así, la piel de tilapia se presenta como una alternativa segura, eficaz y prometedora para la odontología regenerativa, aunque se requieren estudios clínicos más robustos para estandarizar protocolos y ampliar su uso en la práctica quirúrgica.

Palabras clave: Cicatrización. Cirugía Periodontal. Apósitos Biológicos. Injerto. Piel de Tilapia.

1 INTRODUCTION

Autogenous soft tissue grafts are often used in the treatment of periodontal lesions (Silva *et al.*, 2021). The palate region is one of the most used sites as a donor area, due to the quality and quantity of the tissues, as well as the histological and structural characteristics of the adjacent tissues (Manfredi *et al.*, 2021). However, the removal technique can cause great discomfort and pain, interfering with the quality of life of patients.

In recent years, regenerative medicine and tissue engineering studies have sought methods to restore the function of damaged tissues and organs through the use of cells, biomaterials, and growth factors. A biomaterial, in order to be used, must have mechanical properties (strength and flexibility) similar to those of healthy human tissue, coating and integrating until the injured tissue is replaced. In addition, it must have low toxicity and be free of any type of microbiological contamination, in addition to being easy to handle and widely available (Gaharwar *et al.*, 2020).

Since 2015, the biomaterial from tilapia skin has been studied as an alternative, mainly with regard to histologically demonstrating similarity with human skin, presenting a large amount of collagen and high mechanical resistance (Alves *et al.*, 2015). Nile tilapia (*Oreochromis niloticus*) is an abundantly farmed fish in Brazil and has great acceptance in the market. Fish skin is considered a by-product discarded by the food industry, making it a low-cost input due to its high availability and the national technology consolidated in cultivation (Lima-Junior *et al.*, 2017).

The structure of the skin has a dermis formed by long bundles of compacted and well-organized collagen, predominantly type I collagen arranged in a parallel/horizontal and transverse/vertical manner. In addition, the amount of type I and III collagen was significantly increased compared to human skin (Alves *et al.*, 2015).

With all these advantages, the high concentration of collagen in the fish dermis culminated in the development of the lyophilized biological dressing of tilapia skin (Lima-Junior *et al.*, 2021). The product is biosustainable and accessible to the population, representing an innovation that can be manufactured at low cost and generate a positive ecological impact. The lyophilized biological dressing contributes to the healing process and tissue regeneration, presenting potential for insertion in several biomedical areas, with socioeconomic impact on the public health system in Brazil, such as the treatment of vaginoplasties, the correction of syndactyly in children with Apert syndrome, the treatment of

burns and as an occlusive dressing in reconstructions of the palate, among other applications (Monte *et al.*, 2022; Rodríguez *et al.*, 2020; Lima-Junior *et al.*, 2017; Manfredi, 2022).

Several studies and therapeutic strategies aim to reduce pain and accelerate the tissue regeneration process after the removal of autogenous grafts from the palate (Miranda and Brandt, 2019; Manfredi *et al.*, 2021; Silva *et al.*, 2021). However, a protocol considered ideal has not yet been established.

Tilapia skin is highly studied in dermatological treatments and wound healing; however, its application in periodontal surgeries is still little studied. Therefore, the objective of this study is to analyze scientific evidence on the biomaterial developed through tilapia skin as an alternative dressing in the repair and protection of the palatal surgical bed after autogenous grafts, highlighting the benefits and challenges of its use in the field of periodontal surgery. Specifically, to characterize the biophysical properties of the skin, evaluate its clinical efficacy in the healing of surgical beds, and identify challenges and limitations in its application in periodontal surgery.

2 DEVELOPMENT

2.1 METHODOLOGY

The present study is a narrative literature review, with a descriptive approach, contemplating a qualitative analysis of the literature on the subject in question: tilapia skin used in reconstructive dental surgeries.

To search for scientific articles, the search engines (Google Scholar) were used as search support and the National Library of Medicine -MEDLINE and Virtual Health Library (VHL), Pubmed Central, Scientific Electronic Library Online (SciELO) databases using the following descriptors: Tilapia skin, healing, periodontal surgery, biological dressings and graft, in combinations in Portuguese and English.

The work was organized with the following inclusion criteria: titles and abstracts related to the subject, in addition to experimental clinical studies that address treatments with conventional materials in dentistry, and also investigations on the application of tilapia skin as a biomaterial and its regenerative properties, considering national and international studies published from 2015 onwards.

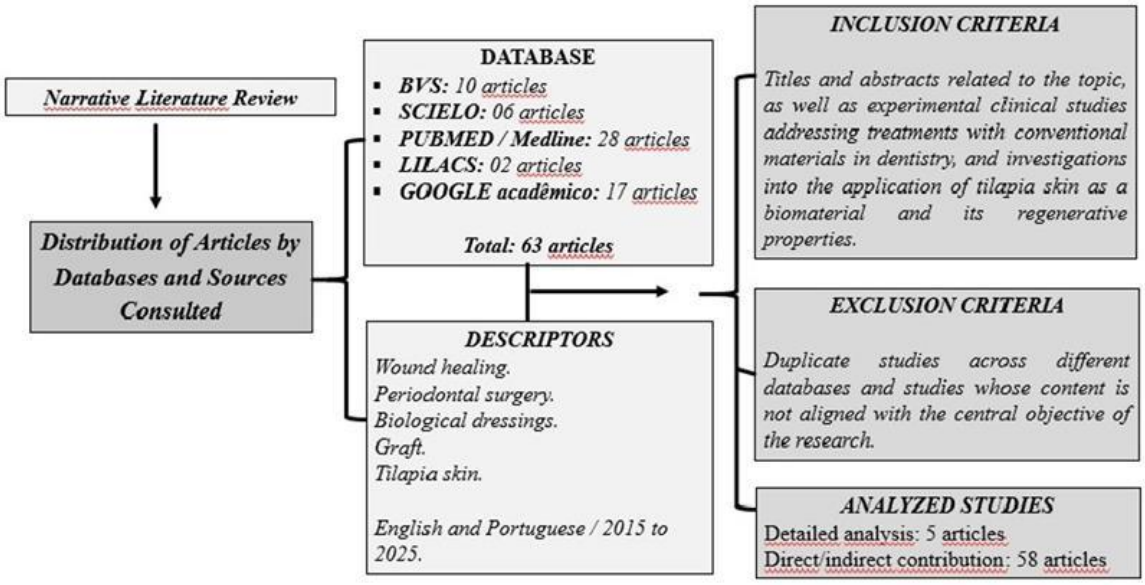
The exclusion criteria include the duplication of studies in different databases and works whose content is detached from the central objective of the research.

The variables observed in the selected studies involve periodontal plastic surgery techniques, characteristics of the graft and surgical bed, types of dressings used, morbidity associated with the procedure, use of tilapia skin and its clinical applications.

The selection of articles was carried out in stages. Initially, titles and abstracts were analyzed to verify their adequacy to the theme. Subsequently, the eligible studies were fully evaluated, considering the previously defined criteria. The distribution of the articles found and selected in academic search engines and databases is presented in Figure 1.

Figure 1

Study methodology and distribution of the articles found and selected by database and documentary sources consulted



Source: Prepared by the authors (2025).

With the application of the inclusion and exclusion criteria, five of the studies were selected for detailed analysis. The works are organized in table 2**,** which managed to serve as a basis for the discussion and elaboration of the final considerations**.** The other scientific works, presented numerically in the Figure, contributed directly and/or indirectly to the construction of the scope of this text considering the variables presented.

2.2 LITERATURE REVIEW

2.2.1 Periodontal Surgeries and Grafts

Periodontal surgeries provide a balance between functionality and aesthetics for the patient. In this sense, dental professionals have been increasingly encouraged to conduct research and seek techniques, with new approaches, based on a more current understanding of periodontal diseases and their relationship with general health (Neto *et al*., 2024).

Miller, in 1993, defined periodontal plastic surgery as surgical interventions indicated for the protection and repair of losses resulting from trauma, anatomical factors and diseases. A classification was established in which characteristics such as width and length are determined in relation to the gingival mucus boundary or the inserted gingiva and the loss of papillae tissues. This division establishes a variation from type I to type IV (Saad and Bassani, 2011).

Factors such as variation in gingival position related to bone defects, invasion of biological space, gingival position associated with recessions, or gingival hyperplasia covering the crown of the tooth directly influence the patient's functionality and aesthetics. In order to correct these conditions, several validated surgical techniques have been developed (Silveira, Silva, and Madureira, 2023)

Recent clinical studies and systematic reviews have highlighted the importance of periodontal plastic surgeries not only for tissue reconstruction, but also for improving the quality of life of patients. According to Tonetti *et al.* (2022), individuals who underwent root covering procedures observed a significant decrease in dentin hypersensitivity, improvements in aesthetics, and an increase in self-esteem, going beyond the clinical aspect, demonstrating the significant relevance of an integrated approach involving oral health, functionality, and psychological well-being.

These current periodontal surgical techniques present satisfactory results, enabling the dental surgeon (DC) to perform these procedures successfully. Proper planning is fundamental, and requires assessing the patient's systemic conditions and risk factors, combined with technical training and the necessary attention, the expected results of excellence will be guaranteed (Rocha and Oleira, 2022).

The use of biomaterials in the periodontal surgical context, such as acellular dermal matrices (ADM), is another important point, as they have been increasingly used. According to Tavelli *et al*. (2020), these substitutes have great biocompatibility and considerably reduce postoperative discomfort, particularly in cases of multiple recessions. In addition, research

such as that of Farias *et al.* (2024) show that, when properly indicated, these techniques offer clinical and aesthetic results comparable to those achieved with connective tissue grafting.

In the search to improve these procedures, periodontal surgery techniques are often associated with the use of grafts. The mucosa of the palate is the most common and favorable donor site, due to the quantity and quality of tissue available (Manfredi, 2022). The removal of the graft from the donor site (palate) can cause discomfort that can vary, usually requiring the use of pain control medications. In addition, other complications become possible, such as cases of hemorrhages, which can make it difficult for the patient to speak and chew (Zucchelli *et al*., 2020; Manfredi, 2021).

As an option, xenogenous materials, such as acellular dermal matrices (ADM) and collagen matrices (XCM), have been investigated as alternatives to palatal grafting, particularly in patients who have anatomical restrictions or comorbid conditions, showing positive clinical results at short and medium term (Santamaria *et al*., 2023; Farias *et al*., 2024).

2.2.2 Graft donor site and healing.

The tissue removed from the patient's own donor area is characterized as an autogenous material, being widely used in dental procedures, especially in the treatment of periodontal plastic surgery (Zucchelli *et al*., 2020). The similar characteristics present in the antero/posterior region of the palate, in relation to the adjacent tissues, make them ideal sites for donation (Manfredi, 2021).

The hard palate region is one of the most commonly used sites as a donor area, both for connective tissue grafting methods and for grafts in areas of gingival recession. The extraction of the epithelialized graft leaves the donor area exposed, which can interfere with the daily activities of patients (Manfredi, 2021). Faced with these challenges, studies are carried out to develop biocompatible biomaterials, which reduce surgical time and provide comfort to patients, reducing post-surgery morbidity (Andrade *et al*., 2021).

In addition to traditional methods, the use of autologous biomaterials, especially leukocyte membranes and platelet-rich fibrin (LPRF), has shown significant importance in the healing process in palatal donor areas. A randomized controlled clinical study indicated that the use of LPRF significantly reduces pain, burning sensation and bleeding in the first two weeks after surgery, in addition to accelerating the reduction of the wound area and improving

clinical healing rates between the third and fourth weeks, compared to treatment by second intention (Miron *et al*., 2020; Keceli *et al*., 2022).

The removal of a connective tissue graft in union with the flap is a successful procedure. However, it should be taken into account that these techniques, when in a vast surgical area, can lead to greater discomfort in the donor area (Stela *et al*., 2023).

When the graft is removed, the wound healing processes begin, with coagulation in the region, which acts as a temporary matrix for cell migration, resulting in the release of growth factors and protective substances against bacteria (Manfredi, 2021).

The inflammatory process is gradual and initiates the formation of new blood vessels and the production of collagen in the clot, replacing it with granulation tissue, with an increase in the presence of fibroblasts, whose function is to promote traction between the edges of the wound. With the development of healing, the granulation tissue matrix is replaced by connective tissue, a process that is completed on average three weeks after surgery (Balbino, Pereira and Curi, 2015).

The beginning of the healing process can cause the patient some discomfort, such as pain, burning and difficulties when chewing. Such postoperative complications influence studies aimed at the use of materials that have the function of healing and protection, seeking to reduce patient discomfort (Manfredi, 2021).

Photobiomodulation with LED or low-intensity laser (PBM) has been widely used as an effective method for healing palatal wounds. Experimental studies conducted in animal models have shown that irradiation of the donor site with 660nm LED favors faster re-epithelialization, greater collagen production, and stimulates the formation of new blood vessels, in addition to reducing inflammatory infiltration (Wang *et al*., 2015; Deana *et al*., 2022). Narrative reviews confirm that PBM plays a role in modulating cellular metabolism, resulting in increased ATP (Adenosine Triphosphate) production, fibroblast proliferation, and extracellular matrix synthesis, contributing to the healing process (Alves *et al*., 2015).

In graft removal surgeries, in the donor area, dressings must be placed in direct contact with the wound caused by the removed tissue, which allows comfort to the patient, protection and helps or accelerates healing. The materials used in these dressings can be categorized as passive and bioactive, with bioactive ones accelerating healing. Among some dressings mentioned in the literature, we can find surgical cement that stands out in its wide use, fibrin-rich plasma, collagen sponge with cyanoacrylate, collagen matrix, and hyaluronic acid (Ribeiro and Martuscelli, 2018; Manfredi, 2021). Surgical cement stands out because,

although considered in disuse, it is still widely used in some works because it favors protection against trauma, pain and hemorrhage. Cements can be classified in three ways: containing zinc oxide and eugenol (wondrpak), not containing eugenol (coe-pak); containing neither zinc oxide nor eugenol (cyanoacrylate). Chart 1 presents some advantages and disadvantages to the use of surgical cement after periodontal surgery (Manfredi, 2021).

Table 1

Some advantages and disadvantages to the use of surgical cement after periodontal surgery

ADVANTAGES	***CONS***
Protection of the surgical wound from mechanical trauma *Stability of the surgical bed during the healing phase* *Patient comfort* *Prevention of postoperative hemorrhage or infection* *Decreased tooth sensitivity* *Clot protection during speech and chewing*	*Little effect on healing* *Increased plaque buildup* *Greater painful symptomatology* *Subsequent microbial invasion* *Irritation to tissues, increasing the chance of infection* *Difficulty chewing* *Discomfort in speech and chewing* *Bad breath* *Alteration of taste* *Possibility of allergic reaction*

Source: (Manfredi, 2021, p. 32).

The uses of surgical cement have a physical and therapeutic function, each with its respective benefits. Regarding physical function, it encompasses tissue stabilization, thus reducing direct contact with external agents. The therapeutic benefits, on the other hand, involve the mechanical protection of the surgical wound region, which drives better healing (Manfredi, 2021; Gusmão *et al*, 2022).

Although surgical cement is still widely used to protect donor areas in periodontal surgeries, recent research presents more options with the potential to reduce some of the undesirable effects. Among these alternatives, resorbable collagen membranes have highlighted benefits by offering mechanical protection, less chance of tissue irritation, and not requiring removal. In addition, these membranes act as selective barriers in the healing process (Basma *et al.,* 2022). A promising option is platelet-rich fibrin (PRF), which acts as a biological dressing, releasing growth factors gradually, aiding in angiogenesis, inflammation management, and accelerated re-epithelialization of the donor region (Miron *et al*., 2017).

Table 2 describes some of the products that are used in periodontal plastic surgeries and their applicability.

Table 2

Materials that are used in periodontal plastic surgeries and their applicability

Material	Description	Source
Surgical cement / Periodontal dressing	*Applied to protect the surgical site, immobilization and patient comfort, they cause allergic reactions.*	PMID: 26056525
Resorbable collagen plugs or sponges	*They act as a mechanical and hemostatic barrier, promote healing and are low irritating.*	PMID: 34483577
Collagen membranes.	*Biodegradable membranes (porcine, bovine, or human origin) serve as a selective barrier. They stimulate the migration of osteoblasts and fibroblasts.*	PMID: 28593053
PRF (Platelet-Rich Fibrin)	*Autogenous membrane prepared from the patient's blood; rich in growth factors.*	DOI: 10.1002/JPER.22-0172
Palatine stensil.	*Rigid prostheses/plates molded to cover the surgical bed, protecting from trauma during chewing and speech in the first days.*	DOI: 10.1002/JPER.22-0172
Natural membranes (gelatin, chitosan, silk, fibroin)	*Biocompatible materials with regenerative potential, still in the experimental or preclinical stage; they have good properties, but less stiffness and consistency in batches.*	DOI: 10.1016/j.cden.2022.05.011

Source: Data available in the literature.

The proposed solutions, applied alone or together, have the potential to expand the alternatives available in clinical practice. They allow the customization of wound protection, adjusting to the particular needs of each patient and favoring more significant results.

2.2.3 Tilapia skin (*Oreochromis niloticus*) as a biological dressing

Collagen has been increasingly studied, explored, and analyzed in regenerative procedures. This protein, with abundance in the extracellular matrix, is a natural macromolecule and has a low inflammatory reaction, in addition to favoring cell adhesion and proliferation. The main sources for obtaining collagen currently come from cattle, pigs and horses. However, recently, research has been exploring alternative products and materials derived from fish (Rodrigues, 2009; Manfredi, 2021).

The tilapia skin is formed by an epidermis covered by a stratified squamous epithelium, followed by abundant layers of collagen. This concentrated bioactive collagen makes tilapia skin a possible option to be used as a surgical bed protection dressing after graft removal (Melo *et al*., 2024).

Based on the scientific works found, five studies in the literature between 2021 and 2025 stood out for presenting uniqueness with what is proposed by the project. The studies present the applicability of lyophilized tilapia skin and extracted collagen in reconstructive dental surgeries, according to the clinical approach.

Table 2

Scientific studies evaluated in detail

	Scientific articles available in the literature.
1	Evaluation of the healing potential of Nile tilapia skin collagen in traumatic oral ulcers in male rats **DOI:** 10.1016/j.archoralbio.2023.105793
2	Characterization of collagen from the skin of Nile tilapia (*Oreochromis Niloticus*) used in occlusive dressings and evaluation of the potential for guided bone regeneration in mandibular angle defects in rats **URI:** http://www.repositorio.ufc.br/handle/riufc/71036
3	Use of tilapia skin for repair and protection of the palate after graft removal **URI:** https://doi.org/10.11606/T.25.2021.tde-08122021-124815
4	The use of Nile Tilapia skin as an occlusive biological dressing for palatal wound healing: A case series **DOI:** 10.33448/rsd-v10i8.17146.
5	Surgical techniques in periodontics: evaluation of the donor site for mucogingival grafts. **URI:** https://revista.aborj.org.br/index.php/rbo

Source: Data available in the literature.

Currently, the main source of medical collagen comes from mammalian connective tissue (Yamada, 2015). However, they have a limited source, high cost, risk of transmission

of zoonoses, and still have religious restrictions in some Asian countries. Such limitations have opened space for the use of other sources of biological materials (Sun *et al.,* 2018).

In this scenario, the raw material of biological grafts or dressings derived from tissues of aquatic animals presents itself as a very promising alternative (Park, 2017; Bronzino, 2017), as in the case of tilapia skin (*Oreochromis niloticus*) (Lima *et al.*, 2017). The studies carried out by researchers from the Center for Research and Development of Medicines at the Federal University of Ceará (NPDM-UFC). These advances have made it possible to produce the lyophilized biological dressing made from tilapia skin, initially developed and used in the treatment of burns, which usually result from domestic and work accidents; they are more common among socioeconomically less favorable people, of working age, and can generate debilitating sequelae. In the Brazilian public network, burns are usually treated with antibiotic ointment, which requires daily changes of wound dressing and causes intense pain. The new dressing reduces outpatient treatment costs by almost 50% and reduces patient pain, improving their recovery and quality of life (Lima *et al.,* 2017).

The lyophilized tilapia skin dressing has also been used in vaginoplasties performed in women with vaginal agenesis or with the vagina occluded after cancer treatments, enabling the complete recovery of the genital structure and function (Dias *et al.,* 2019). Likewise, the material has also been used in sex reassignment surgeries in transgender women (Rodriguéz *et al.,* 2020). In all these cases, tilapia skin dressing reduced or eliminated the need for autografting, reducing postoperative morbidity, increasing the patient's quality of life, and accelerating recovery. Recently, the dressing has also been used in preparation for autografting in complex reconstructive plastic surgeries of the hands in patients with Apert Syndrome, with great success, as well as in dental (palate reconstruction) and veterinary (traumatic wounds in horses) applications (Monte *et al.,* 2022; Manfredi *et al.,* 2022; Costa *et al.,* 2020).

The use of tilapia skin has shown excellent results in the treatment of burns and vaginoplasties, being successfully applied to more than 500 patients — with no records of rejection or infection. The research provided 26 specialized publications and more than 700 journalistic articles, in addition to winning 16 scientific awards in first place. The success of the freeze-dried tilapia skin dressing has influenced new research for the creation of other products for internal use, as well as the decellularized protein matrix (*scaffold*) and added *crosslinker* and the extraction of collagen for use in pharmaceuticals and cosmetics, opening new avenues as a new biomedical device for regenerative medicine (Lima *et al.,* 2023).

The great success is due to the fact that tilapia skin is composed of compacted, long and organized collagen bundles, predominantly type I. The content of type I collagen and total collagen of tilapia skin is higher than that of human skin (Alves *et al*., 2015), which makes it a raw material of interest for the manufacture of medical devices.

The scientific literature shows that regenerative protein matrices, known as biological meshes or dressings, need to be non-toxic, non-immunogenic, adherent to the wound bed, biocompatible, and absorbable. These biomaterials should not convey toxic substances in the body, for obvious reasons, nor should they initiate an exaggerated inflammatory response, with the potential to damage the host tissue itself. In addition, biological screens should not promote an immune response so intense that it results in rejection (acute or chronic) by the recipient organism. When used as a cover, they should prevent the loss of fluids, proteins, and nutrients in the form of exudate, in addition to preventing the entry of invading microorganisms (Moerbeck-Filho *et al*., 2019; Pires, Bierhalz and Moraes, 2015).

The beneficial histological properties of tilapia skin have favored the creation of a device capable of meeting these requirements. In dentistry, with excellent results, Manfredi et al. (2021) investigated the application of Nile tilapia skin (*Oreochromis niloticus*) as an occlusive biological dressing in the repair of the palatal surgical bed after the removal of an autogenous gingival graft. The study, conducted as a randomized clinical trial, had 24 patients divided equally between a control group (treated with Coe-Pak surgical cement) and a test group (treated with tilapia skin). The results showed significant advantages in the group that received the tilapia dressing, including lower intensity pain, faster healing and better aesthetic results.

At the same time, Manfredi et al. (2021) published clinical cases, in which they reported the experience of patients undergoing the same type of procedure. The study demonstrated that the palate covering with tilapia skin was well accepted, with no occurrence of complications, with reduced levels of pain and without interference in speech and chewing functions. Healing was considered satisfactory after 30 days. In the studies by Soares et al. (2023), using topical gel 1% from tilapia skin collagen for the treatment of surgically induced ulcers in the oral mucosa of Wistar rats. Simple orobase (negative control), drug orabase (positive control) and tilapia collagen orobase (test) were compared. It was demonstrated that tilapia accelerated ulcer closure, promoted complete repithelialization, intensified angiogenesis, higher density of type I and III collagen, and increased expression of TGFβ, αSMA, and PECAM1. Treatable animals gained more weight until day 20 ($p<0.05$).

Collagen taken from tilapia skin is a very promising material, with several possibilities for use in dentistry. It can be applied in different forms, such as sponges, hydrogels, membranes, and even nanocollagen fibers (Putri *et al.,* 2024). Its therapeutic potential has applicability in the treatment of wound healing, dry socket healing, bone necrosis, grafts, flap surgery and periodontal tissue regeneration. In the studies by Lima Verde (2023), the mineral composition and compatibility of tilapia collagen in guided bone regeneration (GBR) in rat mandibular defects was analyzed. The results showed that tilapia collagen performed as well as the commercial product used as a control, facilitating bone regeneration, with little inflammatory reaction and excellent biocompatibility.

Due to its excellent biocompatibility and because it is non-toxic, the potential of hydrolyzed collagen extracted from tilapia skin is studied in the viability and differentiation of periodontal ligament fibroblasts in vivo with the prospect of its use in the recovery of periodontal tissues (Manfredi, 2021). When compared to the submucosa of the small intestine of the pig in healing processes, tilapia skin did not show inferiority compared to other biomaterials, indicating an excellent biocompatibility and inflammatory process (Baldursson *et al*., 2015). The use of collagen from fish influences the biological environment to the formation of collagen in the wound (Cruz *et al.,* 2021).

In several areas of regenerative medicine, tilapia skin (*Oreochromis niloticus*) has been standing out as a great alternative biomaterial for its excellent cost-benefit ratio. In the first studies with 1st and 2nd degree burns, the therapy helped reduce morbidities suffered by patients (Alves *et al*., 2015). In view of its applicability in dentistry, the use of collagen dressing has already denoted a rapid healing of the graft donor bed, reducing morbidity, compared to surgical cement available on the market. Thus, the efficacy and success of healing is observed from the use of dressings made of collagen (Manfredi, 2021). All these studies highlight that the use of tilapia skin in dentistry is multidimensional: from mucosal treatments, periodontal regeneration and possible support to guided bone regeneration, through the use of collagen in different therapeutic forms.

3 FINAL CONSIDERATIONS

The use of tilapia skin (*Oreochromis niloticus*) as a biological dressing has shown promise in the field of regenerative dentistry, especially in periodontal reconstruction surgeries. This biomaterial, rich in type I collagen, highly available, low cost and with excellent biocompatibility, has been shown to be effective in the healing of palatal surgical beds,

comfort, faster epithelialization and better aesthetic result compared to other dressings available on the market.

From the scientific evidence, it was found that, although clinical studies are still initial in number, the results obtained so far point to a high therapeutic potential of tilapia skin not only in dentistry, but in several medical specialties. In addition to accelerating tissue regeneration, the material contributes to the reduction of morbidity associated with the removal of autogenous grafts, representing an important advance in the quality of life of patients undergoing these interventions.

Despite the positive results, more controlled clinical studies are still needed, with larger samples and long-term follow-up, to define specific application protocols in dental practice. In view of this, it is concluded that tilapia skin stands out as a biosustainable, safe and effective alternative, with great potential for insertion in the therapeutic arsenal of periodontal dental surgery and regenerative medicine as a whole.

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