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Bacterial Microbiota of Canine Corneal Ulcers Treated with Tilapia Skin Graft: Implications for Postoperative Ocular Safety

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ABSTRACT

Corneal ulcers in dogs are frequently associated with microbial contamination, which may compromise healing and lead to severe ocular complications. The use of tilapia skin as a biotechnological graft has emerged as a promising alternative for corneal repair; however, its influence on the ocular microbiota remains poorly understood. This study aimed to evaluate the bacterial microbiota of canine corneal ulcers treated with tilapia skin graft, focusing on the presence and evolution of microorganisms during the surgical and postoperative periods. Microbiological samples were collected from dogs presenting deep corneal ulcers or perforations, using sterile swabs applied to both central and peripheral regions of the lesion. Samples were transferred to Stuart transport medium and subjected to standard microbiological analysis. Initial cultures revealed the presence of clinically relevant bacteria, including *Pseudomonas* spp. and *Klebsiella* spp., commonly associated with ocular infections. Postoperative evaluation demonstrated a notable reduction in bacterial growth, with no detectable microbial proliferation after 20 days of treatment under topical antibiotic therapy. These findings suggest that the use of tilapia skin graft does not promote microbial persistence and may be associated with a favorable microbiological environment during the healing process. This study highlights the importance of monitoring ocular microbiota in corneal repair procedures and supports the safety of tilapia skin as a biotechnological material in veterinary ophthalmology. Further studies with larger sample sizes are required to confirm these findings and explore long-term microbiological dynamics.

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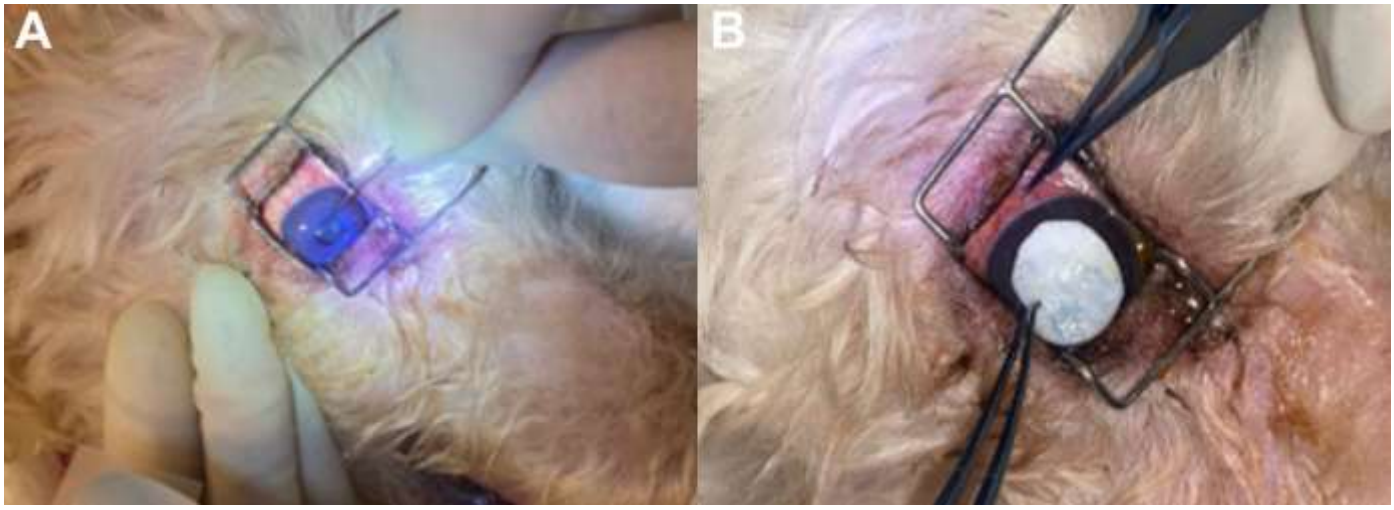
1. INTRODUCTION

Corneal ulcers in dogs represent a significant ophthalmological condition characterized by the loss of corneal epithelium, stromal degradation, and inflammatory cell infiltration, which can rapidly compromise ocular integrity and vision. The disruption of the corneal barrier facilitates microbial colonization, particularly by opportunistic pathogens, making secondary infections a critical concern in clinical management. Among the most frequently isolated microorganisms in canine corneal ulcers are species of *Staphylococcus*, *Pseudomonas*, and *Klebsiella*, which are associated with disease progression and delayed healing (Tsvetanova et al., 2021).

In recent years, the use of biological scaffolds has emerged as a promising alternative in corneal repair, aiming to restore structural integrity while supporting tissue regeneration (Figure 1). Among these, tilapia skin has gained attention due to its high collagen content, biocompatibility, and low cost, making it an innovative biomaterial for ophthalmological applications. Previous studies have demonstrated its successful use in corneal reconstruction, highlighting its potential as a xenograft capable of promoting epithelial healing (Melo *et al*., 2022).

Figure 1. Clinical presentation of canine corneal ulcer before and after surgical repair using tilapia skin graft. (A) Deep corneal ulcer prior to intervention. (B) Postoperative aspect showing tilapian skin graft.



All corneal repairs described in this article were performed at the Optivet Clinic (Fortaleza, Ceará, Brazil), and the use of the images was authorized by the owners through the signing of an Informed Consent Form. **Source**: author.

Despite advances in surgical techniques and biomaterials, the microbiological profile of corneal ulcers following therapeutic and surgical interventions remains poorly characterized, particularly regarding postoperative microbial dynamics. The presence or persistence of bacterial communities after surgical intervention may directly influence healing outcomes, postoperative complications, and therapeutic strategies, particularly regarding antimicrobial use. Understanding the dynamics of ocular microbiota in this context is essential to ensure both the safety and efficacy of emerging biotechnological approaches (Hindley et al., 2016).

In this context, the present study aims to evaluate the bacterial microbiota associated with corneal ulcers in dogs treated with a tilapia skin graft, focusing on the identification of microorganisms present during the surgical procedure and their evolution during the postoperative period.

2. MATERIALS AND METHODS

2.1. Study design and animals

This study was designed as a descriptive observational investigation involving dogs diagnosed with deep corneal ulcers or corneal perforations and treated with a tilapia skin graft. All procedures were conducted in a veterinary clinical setting specialized in ophthalmology. The inclusion criteria comprised animals presenting advanced corneal lesions requiring surgical intervention, regardless of age, sex, or breed. Clinical evaluation was performed prior to surgery to confirm diagnosis and determine eligibility for grafting procedures, following standard ophthalmological examination protocols (Gelatt et al., 2021).

2.2. Surgical procedure and graft application

Corneal repair was performed using a tilapia skin graft as a biological scaffold. The biomaterial was previously prepared according to established protocols to ensure sterility and preservation of its structural properties. The graft was applied directly over the corneal lesion during surgery, aiming to restore tissue integrity and promote epithelial regeneration. All animals received topical anesthesia prior to the procedure, ensuring adequate analgesia during sample collection and surgical manipulation (Melo et al., 2023).

2.3. Microbiological sample collection

Microbiological samples were collected immediately after surgical intervention. A sterile swab was gently applied to both the central and peripheral regions of the corneal lesion, ensuring adequate sampling of the affected area. The collected material was immediately transferred to tubes containing Stuart transport medium and subsequently processed for microbiological analysis. This approach is widely used for preserving bacterial viability during transport and ensuring reliable culture results (Quinn et al., 2011). The microbiological sampling procedure is illustrated in Figure 2.

Figure 2. Microbiological sample collection procedure: Sterile swab collection from central and peripheral regions of the corneal ulcer immediately after surgical intervention, followed by transfer to Stuart transport medium.

Source: author

2.4. Microbiological analysis

Samples were subjected to standard bacteriological culture techniques for the isolation and identification of microorganisms. The presence of bacterial growth was evaluated qualitatively, with particular attention to clinically relevant genera commonly associated with ocular infections. Identification of isolates was based on morphological and biochemical characteristics according to established microbiological protocols (Markey et al., 2013).

2.5. Postoperative monitoring

Following surgery, animals were monitored clinically and received standard postoperative care, including topical antibiotic therapy (Melo et al., 2024). A second microbiological evaluation was conducted 20 days after the surgical procedure to assess changes in the ocular microbiota and detect potential bacterial persistence or recolonization. This follow-up period is considered relevant for evaluating early healing responses and microbial dynamics in corneal repair (Hindley et al., 2016).

2.6. Ethical Aspects

All procedures were conducted in accordance with ethical principles for animal experimentation. As this study was based on clinical cases treated in a veterinary setting, formal approval by an ethics committee was not required; however, all interventions followed accepted standards of animal welfare and clinical practice.

3. RESULTS AND DISCUSSION

Microbiological evaluation of corneal ulcers at the time of surgical intervention revealed the presence of clinically relevant bacterial genera, including *Pseudomonas* spp. and *Klebsiella* spp., which are commonly associated with severe ocular infections and rapid corneal degradation in dogs. These findings are consistent with previous reports indicating that opportunistic Gram-negative bacteria play a central role in the progression of deep corneal ulcers, particularly in cases involving tissue perforation or delayed treatment (Tsvetanova et al., 2021). The identification of these pathogens at baseline reinforces the severity of the clinical cases included in this study and highlights the importance of immediate and effective therapeutic intervention. Clinical and microbiological data of all patients are summarized in Table 1.

Table 1. Clinical and microbiological characteristics of patients

Patient	Breed	Sex	Age	Diagnosis	Preoperative Culture	Postoperative Culture
Pérola	Shih Tzu	Female	6 months	Deep ulcer	*Klebsiella* sp.	No growth
Eloy	Shih Tzu	Male	11 years	Deep ulcer	*Pseudomonas aeruginosa*	No growth
Meg	Shih Tzu	Female	9 years	Deep ulcer	*Pseudomonas sp.*	No growth
Tita	Poodle	Female	14 years	Perforation	*Klebsiella* sp.	No growth
Bag	Shih Tzu	Male	5 years	Perforation	*Pseudomonas* sp.	No growth

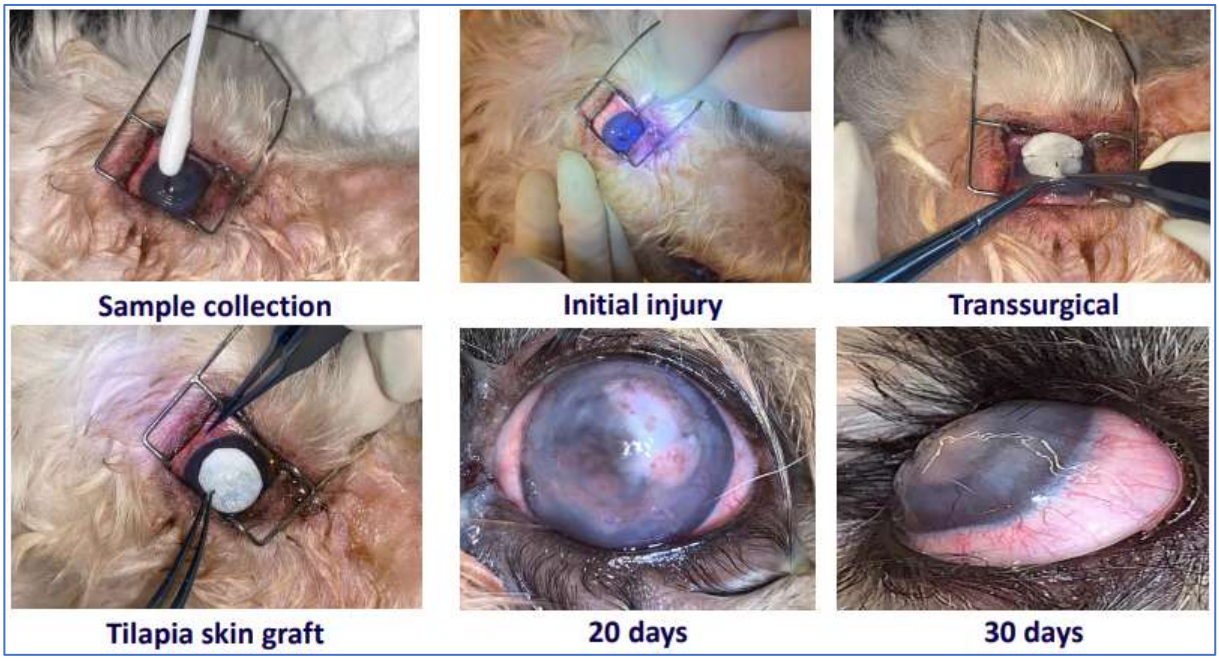
Source: author

Following surgical repair using the tilapia skin graft, a marked reduction in bacterial presence was observed during postoperative monitoring. Notably, all patients (100%) showed absence of bacterial growth after 20 days, regardless of the initial pathogen identified. This result suggests a favorable microbiological environment during the healing process and indicates that the graft did not act as a substrate for bacterial colonization. Similar outcomes have been reported in studies evaluating biological scaffolds, where adequate tissue coverage and restoration of epithelial integrity contribute to limiting microbial proliferation (Lima-Júnior et al., 2019).

The absence of detectable bacterial growth in the postoperative period may also be attributed to the combined effect of the graft and adjunctive antimicrobial therapy. Topical antibiotics, such as tobramycin, are widely used in the management of corneal ulcers and are particularly effective against Gram-negative organisms, including *Pseudomonas* spp. However, beyond pharmacological intervention, the structural properties of tilapia skin, including its high collagen content and biocompatibility, may contribute to the formation of a physical barrier that supports tissue regeneration and reduces microbial adherence (Costa et al., 2021).

From a microbiological perspective, the results of this study suggest that the use of tilapia skin graft does not predispose the ocular surface to persistent or recurrent infection, which is a critical concern in corneal repair procedures. The maintenance of a controlled microbial environment is essential for successful healing, as persistent infection is one of the main factors associated with graft failure and corneal melting. In this context, the findings reinforce the safety profile of this biomaterial and support its application in veterinary ophthalmology (Melo et al., 2025).

Figure 3. Clinical evolution of corneal repair using tilapia skin graft - Representative clinical progression of corneal healing: (A) initial lesion, (B) intraoperative graft placement, (C) 20 days postoperative, (D) 30 days postoperative showing complete epithelialization.



Source: author.

Despite these promising results, some limitations must be considered. The relatively small sample size and the descriptive nature of the study limit the generalization of the findings. Additionally, the temporal gap between the experimental procedures and data analysis may influence the contextual interpretation of the results, although all data were properly recorded and analyzed using consistent methodological criteria. Future studies involving larger populations and longer follow-up periods are necessary to better understand the long-term microbiological dynamics associated with the use of tilapia skin grafts.

Overall, the integration of clinical, microbiological, and biomaterial perspectives provides a comprehensive understanding of the role of tilapia skin graft in corneal repair. The observed reduction in bacterial growth, combined with the absence of postoperative contamination, highlights its potential as a safe and effective biotechnological alternative. These findings may have translational relevance beyond veterinary medicine, particularly in the development of infection-resistant biomaterials for ocular surface reconstruction.

4. CONCLUSION

The present study provides relevant evidence that the use of tilapia skin graft in the surgical management of canine corneal ulcers is associated with a favorable microbiological profile during the healing process. Despite the presence of clinically significant bacterial pathogens at the time of surgery, no bacterial growth was detected in the postoperative period, indicating effective control of ocular microbiota and absence of microbial persistence.

These findings suggest that, in addition to its structural and regenerative properties, tilapia skin does not promote bacterial colonization and may contribute to a protective microenvironment that supports corneal recovery. This aspect is particularly important in severe cases, where infection represents a major risk for therapeutic failure.

Although limited by sample size, this study advances the understanding of microbiological behavior in corneal repair using biotechnological grafts and reinforces the safety of tilapia skin as a biomaterial in veterinary ophthalmology. Future investigations should focus on larger cohorts and long-term follow-up to further elucidate the interaction between biomaterials and ocular microbiota.

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