

Surgical Treatment and Analysis of Canine Penetrating Corneal Trauma Due to Plant-Derived Foreign Bodies: A Case Report

Key words

canines;
plant-derived foreign body;
penetrating corneal trauma;
keratotomy;
foreign body removal;
corneal repair

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Abstract: The objective of this study is to present a case of canine penetrating corneal trauma caused by plant-derived foreign bodies, successfully treated with keratotomy. A 2-year-old female Border Collie presented with two corneal foreign bodies, conjunctival congestion, blepharospasm, and a small amount of serous discharge in the left eye. Keratotomy was performed to remove the foreign bodies from the cornea. During the procedure, one foreign body was observed to have penetrated the anterior chamber. Following removal, the anterior chamber was irrigated, and the cornea was sutured. Postoperative treatment included both topical and systemic medications. Examination confirmed that the foreign bodies were plant-derived. Postoperative assessments at 2 and 4 weeks showed a reduction in corneal edema, formation of limbal neovascularization, decreased conjunctival congestion, resolution of blepharospasm, and absence of ocular discharge. The 5-month postoperative follow-up demonstrated normal corneal clarity and physiological function, a clear anterior chamber, and normal vision. Keratotomy has been demonstrated to be an effective intervention for corneal foreign bodies, allowing thorough removal of fragile and deeply embedded materials. Postoperative medications effectively prevented infections and promoted corneal healing. This case report provides valuable insights into the diagnosis and management of canine penetrating corneal trauma caused by plant-derived foreign bodies.

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Introduction

Corneal foreign bodies represent a common cause of traumatic ophthalmic conditions in canines. These foreign bodies can lead to corneal perforation, infections, and inflammatory reactions (1). The clinical presentation typically includes acute unilateral blepharospasm and serous ocular discharge. This condition is most commonly observed in canines younger than five years, particularly among working and hunting breeds, reflecting a correlation with behavioral patterns and activity levels (2). The management of corneal foreign bodies is influenced by their location, composition, size, shape, duration, and extent of damage

to the cornea and adjacent ocular tissues. When the corneal surface has self-sealed or the foreign bodies are fragile, keratotomy to enlarge the wound should be considered the primary option (3). The selection of appropriate surgical instruments should be based on the nature and angle of entry. Plant material is a common type of corneal foreign body in canines, associated with a risk of inducing significant inflammatory reactions and microbial infections (4), necessitating prompt removal. This case report describes a canine with plant-derived corneal foreign bodies partially embedded in the anterior chamber, successfully treated

through keratotomy. Postoperatively, the cornea remained clear without any loss of visual acuity or ocular abnormalities, demonstrating the procedure's efficacy and safety. This report aims to serve as a reference for diagnosing and managing corneal trauma in canines caused by plant-derived foreign bodies.

Case Presentation

A 2-year-old female Border Collie, weighing 17 kg, presented with eye discomfort following activity in the woods the previous evening.

Clinical examination revealed normal body temperature, pulse, and respiration. The left eye (OS) presented with a small amount of serous discharge, blepharospasm, corneal edema, and conjunctival hyperemia and swelling (Figure 1A). Additionally, two corneal foreign bodies were detected (Figure 1B), with no signs of entropion or ectopic cilia. The gross ophthalmic examination of the right eye (OD) revealed no abnormalities. The menace response was positive in both eyes (OU). The direct and consensual pupillary light reflexes were positive in OU, while the dazzle reflex was positive in OD but difficult to assess in OS due to blepharospasm. Gonioscopy revealed no abnormalities in the anterior chamber angle. The Schirmer Tear Test (STT) measured 17 mm/min in OD and 33 mm/min in OS. The intraocular pressure was 17 mmHg in OD and 19 mmHg in OS. Slit-lamp examination revealed that the penetration points of the foreign bodies were located in the lower quadrant of the cornea (OS). The anterior chamber appeared clear without aqueous flare and had a normal depth, with no abnormalities in the iris, pupil, or lens. Retro-illumination after mydriasis revealed silhouettes of the foreign bodies through fundus reflection in OS, indicating spikeshaped fragments. Fluorescein staining and Seidel test were negative in OU.

Based on these examinations, a diagnosis of corneal foreign bodies was made. After consulting with the owner, keratotomy was scheduled and performed the same day. Preoperative imaging revealed no abnormalities, with all blood and biochemical tests within normal limits.

Dexmedetomidine 5 µg/kg, butorphanol 0.2 mg/kg, and propofol 4 mg/kg were slowly administered intravenously to induce anesthesia, with isoflurane used to maintain anesthesia. The canine was positioned in lateral recumbency with the operative eye facing upward, and its head was secured using a vacuum molding pillow. Blood pressure and electrocardiogram monitoring were initiated. For sterile preparation, the periocular fur was shaved, and the periocular skin was disinfected with a 1:10 povidone-iodine solution. A surgical drape was applied, and an eyelid retractor was employed to optimize corneal exposure. The cornea and conjunctiva were initially rinsed with saline, followed by a 1:50 povidone-iodine solution, and then thoroughly rinsed again with saline. Under a surgical microscope (10×), the larger foreign body was identified. The cornea was stabilized with toothed forceps in the left hand, while a keratome in the right hand created a corneal incision above the foreign body. The toothed forceps were then used to grasp the foreign body, followed by gentle extraction of a portion of it (Figure 2A). The incision was then extended toward the narrow end of the foreign body along its longitudinal axis, revealing that the end of the foreign body had protruded into the anterior chamber. The remaining portion of the foreign body was extracted, resulting in a minor amount of aqueous humor leakage (Figure 2B). The anterior chamber remained stable and was irrigated thoroughly with saline through the corneal incision. A second corneal incision was created above the smaller foreign body using a keratome, facilitating its gentle extraction with toothed forceps. The corneal incisions were intermittently sutured using an 8/0 absorbable suture (Figure 2C). Following the suturing, the

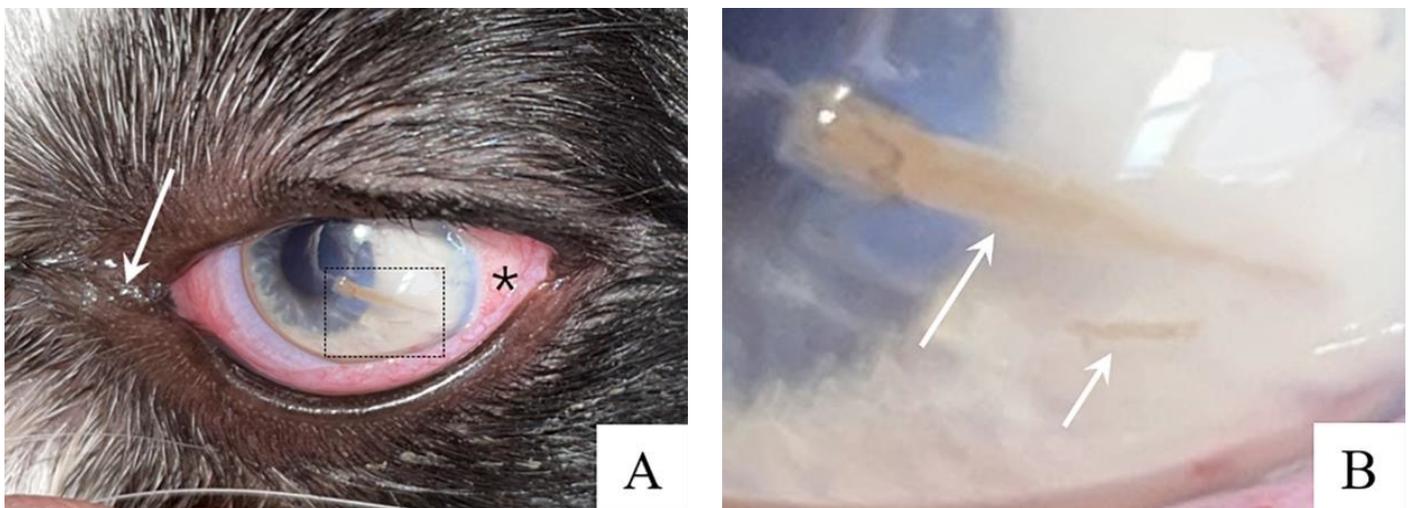


Figure 1: **A** Clinical photograph of the left eye at the initial examination. Grossly (A), conjunctival congestion (asterisk), and serous discharge around the eye (arrow) can be observed, and two foreign bodies can be seen within the cornea (dashed box). **B** Clinical photograph of the left eye at the initial examination. The area outlined by the dashed box in A is centered and enlarged in B to demonstrate the foreign bodies are embedded in the cornea in an oblique direction (arrows)

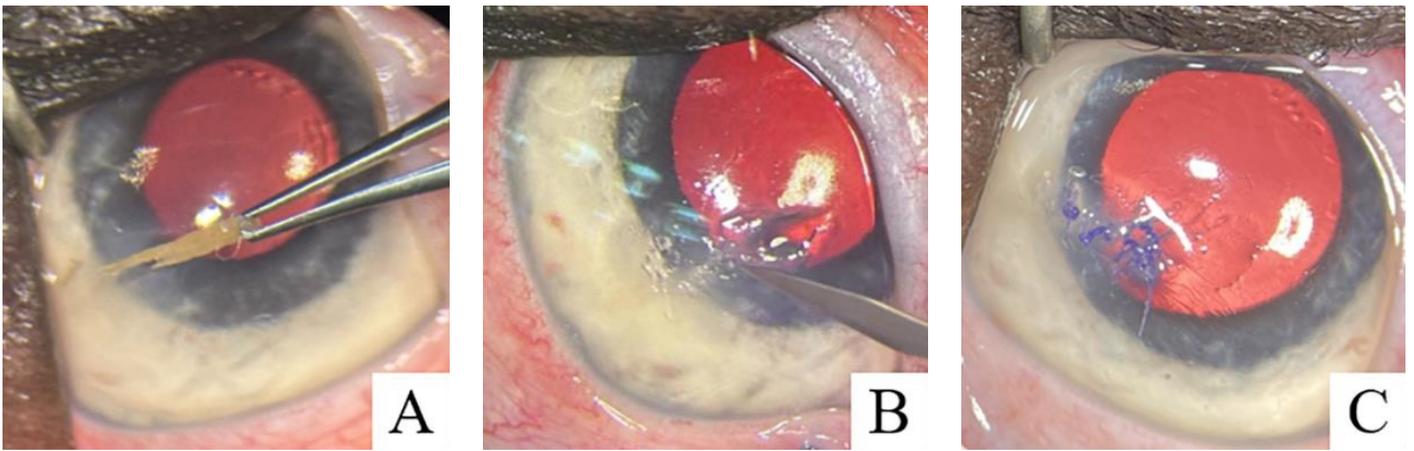


Figure 2: **A** Surgery photograph through an operating microscope (10x). An ophthalmic toothed forceps was used to grasp the wider side of the foreign body through the corneal incision and extract a portion of the foreign body (A). **B** Surgery photograph through an operating microscope (10x). Subsequently, a keratome was used to enlarge the corneal wound, and a minor amount of aqueous humor leakage occurred after the foreign body was removed (B). **C** Surgery photograph through an operating microscope (10x). The last photograph showed the corneal incisions received interrupted sutures after the anterior chamber irrigation (C).

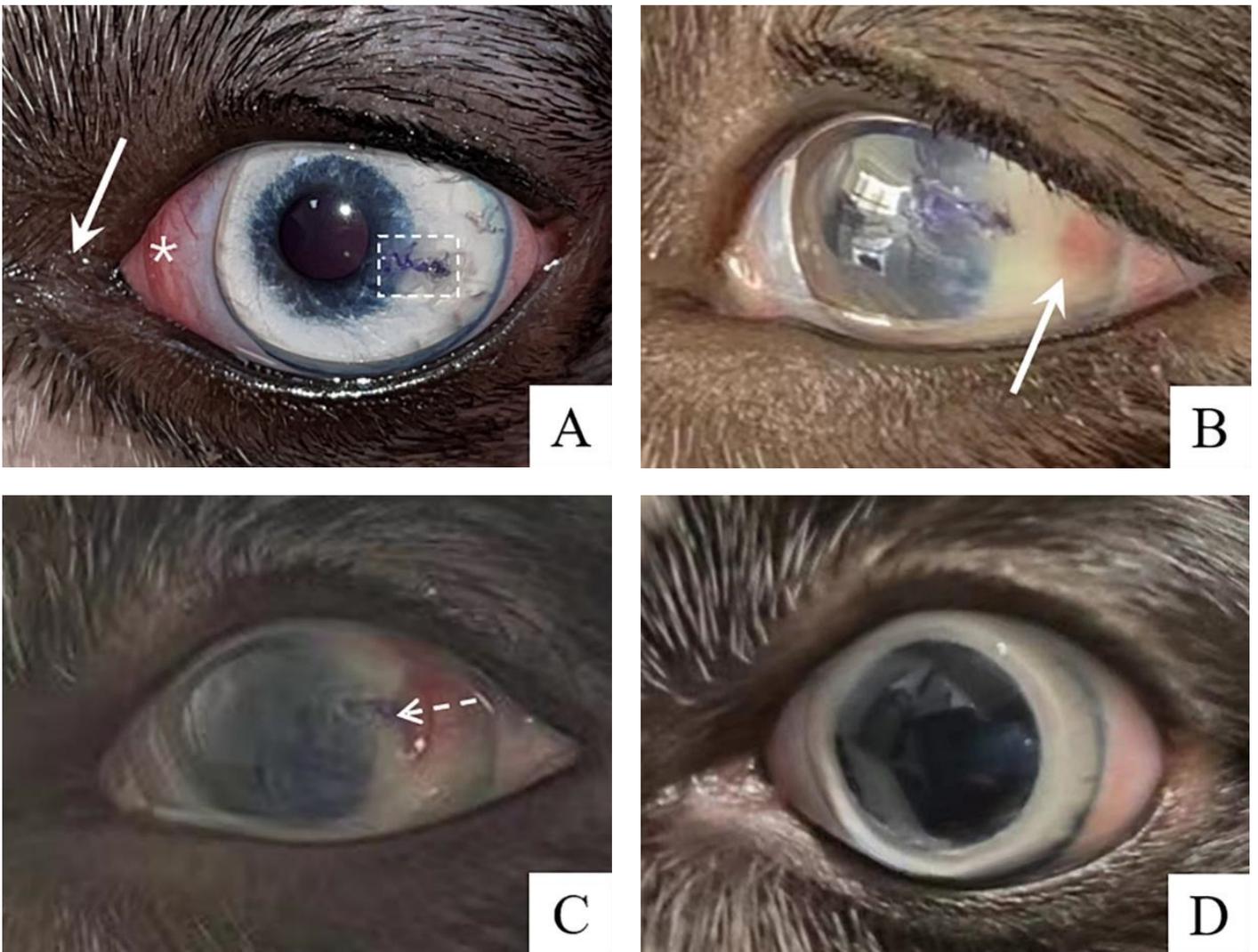


Figure 3: **A** Photograph taken of the postoperative follow-up. At 4 days after surgery (A), there is a small amount of discharge around the eye (arrow), corneal edema at the surgical site (dashed box), and mild conjunctival congestion (asterisk). **B** Photograph taken of the postoperative follow-up. At 2 weeks after surgery (B), the conjunctival congestion and the discharge around the eye disappeared. Limbus neovascularization appeared (arrows). **C** Photograph taken of the postoperative follow-up. At 4 weeks after surgery (C), the corneal edema at the surgical site was reduced, and corneal neovascularization grew towards the surgical site (direction of the arrow). **D** Photograph taken of the postoperative follow-up. At 5 months after surgery (D), the vascularization of the cornea has completely disappeared

ocular surface was rinsed with saline, marking the conclusion of the surgery.

Once the canine had fully recovered from anesthesia, an Elizabethan collar was applied to prevent self-injury. Postoperative treatments included: ceftiofur sodium (Wright; Hebei Yuanzheng Harmony Pharmaceutical) 5 mg/kg, IV, SID, for 5 days; meloxicam (Metacam; Boehringer Ingelheim) 0.2 mg/kg, SC, SID, for 2 days; tropicamide phenylephrine eye drops (Mydrin-P; Santen Pharmaceutica) gtt, TID, for 1 week; tobramycin eye drops (Tobrex; Alcon) gtt, TID, for 2 weeks; levofloxacin eye drops (Cravit; Santen Pharmaceutica) gtt, TID, for 2 weeks; and recombinant bovine basic fibroblast growth factor eye gel (Beifushu; Essex Bio-Technology) TID, for 2 weeks.

During the surgery, the corneal foreign bodies were identified as being plant-derived (Figure 3). Preoperatively, secretion from the lesion area was collected for aerobic bacterial and fungal cultures, which revealed no inflammatory cells, pathogenic bacteria, or fungi.

Four days postoperatively, the blepharospasm disappeared (Figure 4A). At the second and fourth weeks postoperatively, slit-lamp examination revealed that neovascularization originating from the limbus was growing towards the surgical site, with a clear anterior chamber without hemorrhage or fibrin (Figures 4B, C). Pupillary light reflex and menace response tests indicated normal photosensitivity and object discrimination abilities in the canine. Although the owner did not attend the follow-up visits as scheduled, the 5-month postoperative follow-up revealed a transparent cornea, complete wound healing without scarring, and normal vision (Figure 4D).

Discussion

The cornea's exposure to the external environment makes it susceptible to foreign body contact, a frequent cause of corneal trauma. Border Collies' high activity and exploratory drive, coupled with their instinctual herding behaviors, predispose them to frequent exposure to dense vegetation, such as underbrush and woodlands. According to a study, Border Collies rank among the top five breeds for incidence of corneal foreign bodies (5%), exceeding the rates of other ophthalmic conditions (3%). Furthermore, two years of age represents the peak incidence period (2). In this case, the affected canine presented with clinical symptoms of corneal foreign bodies following activity in the woods, suggesting the entry of plant-derived material, consistent with the foreign bodies extracted during surgery. The canine may have failed to prevent the foreign bodies from entering the eye due to inattention or high speed while playing, resulting in the blink reflex failing to stop the foreign bodies (3).

Ophthalmic examination revealed that the corneal puncture wound was small, suggesting that the foreign bodies

fractured upon piercing the cornea without enlarging the puncture wound. The foreign bodies appeared flat and obliquely embedded in the cornea, sealing the wound and preventing aqueous humor leakage. This resulted in a negative Seidel test making it challenging to rule out corneal perforation (1). The anterior chamber exhibited normal depth without fibrin or blood, making it unclear whether the foreign bodies had penetrated it. This could be due to the short retention time of the foreign bodies, absence of pathogenic bacteria, minimal entry into the anterior chamber, and stable positioning, all of which minimized movement and irritation, thereby preventing significant inflammatory reactions. The dazzle reflex was difficult to assess due to blepharospasm, which resolved in postoperative examination, leading to a positive dazzle reflex. Tear production in the affected eye increased due to pain but returned to normal in postoperative examination. After identifying and locating the two foreign bodies through slit-lamp examination, gonioscopy was used to examine the anterior chamber angle, and retro-illumination was employed to differentiate between foreign bodies and structures mimicked by accumulated blood or tissue debris, which excluded the presence of other foreign bodies (2). In choosing ophthalmic imaging examinations, ultrasound biomicroscopy (UBM), which is suitable for detecting small plant-derived foreign bodies, was avoided to prevent further damage caused by pressure on the spike-like foreign bodies (5). In vivo confocal microscopy (IVCM) identifies the location and depth of foreign bodies (6), whereas magnetic resonance imaging (MRI) differentiates wooden foreign bodies from surrounding tissues (7). However, these examinations were not performed due to equipment unavailability. Nonetheless, a combination of non-invasive ophthalmic examinations utilizing slit-lamp biomicroscopy, gonioscopy, and retro-illumination techniques effectively identified the foreign bodies. This approach facilitated successful treatment, thereby mitigating the lack of imaging examinations and providing an alternative solution for clinical examinations under limited conditions.

Although some studies indicate that sterile foreign bodies may be well-tolerated in the cornea and anterior chamber (8), the organic material properties of plant-derived foreign bodies in this case carry the risk of secondary infection, as well as potential risks associated with prolonged retention, such as chronic corneal scarring leading to permanent visual impairment (9). Consequently, we opted for surgical intervention rather than risking further trauma by retaining the foreign bodies. A study has demonstrated that most deep stroma and full-thickness foreign bodies are removed via needle tip, while some full-thickness foreign bodies are extracted through a corneal limbal incision (2). However, considering that plant-derived foreign bodies can absorb moisture from surrounding tissues in the cornea and anterior chamber, which reduces their tensile strength and increases the risk of fragmentation (10), and given their flat shape and oblique penetration that complicates removal with a needle, forceps were employed for extraction.

Furthermore, although corneal perforation could not be confirmed preoperatively, the clarity of the anterior chamber and absence of aqueous flare suggest that even if the foreign body penetrated the anterior chamber, the majority of it remained anterior to Descemet's membrane and was positioned away from the corneal limbus. Consequently, a superficial keratectomy was performed. During surgical preparation, it is imperative to consider the potential impact of foreign body removal on the anterior chamber. Viscous agents were prepared to address potential anterior chamber collapse. Provisions for autologous corneal transplantation to close the incision are also made. Intraoperatively, upon confirming that the larger end of the foreign body had penetrated the anterior chamber, it was removed with a small amount of aqueous humor leakage and no chamber collapse. The anterior chamber was irrigated with saline to reduce the risk of infection. Given the small size and firm, healthy margins of the deep wound, direct suturing of the cornea was chosen (1). The foreign bodies were successfully removed, and the corneal incision was closed with the anterior chamber remaining stable. Postoperatively, intraocular pressure remained within the normal range.

Postoperative treatment aims to prevent complications and promote corneal repair. In this case, no pathogenic bacteria or fungi were detected in the secretion culture from the lesion area. However, due to the corneal perforation, systemic and topical broadspectrum antibiotics were chosen to prevent infections. Tropicamide eye drops were used to prevent spasms of the iris and synechiae that may be produced by postsurgical uveitis (3). The recombinant bovine basic fibroblast growth factor (rb FGF) in the eye gel with Carbomer-based was used to promote the regeneration of the corneal epithelium. Meloxicam was used to relieve pain.

In cases of corneal penetration caused by plant-derived foreign bodies, the postoperative recovery is often influenced by various factors, such as inflammation, microbial infections, and other complications. However, this case demonstrated an excellent prognosis in multiple aspects. A study indicated the uveitis score was statistically significantly positively correlated with the prevalence of enucleation, suggesting a poorer prognosis and a longer recovery period. In cases of full-thickness corneal foreign bodies, 91% presented uveitis (2). In contrast, no signs of uveitis were detected in this case, thereby reducing the risk of poor prognosis. Furthermore, multiple studies have reported a risk of secondary infections associated with plant-derived foreign bodies. However, microbiological testing of samples from this case revealed no pathogenic microorganisms, reducing the risk of infection. Additionally, stringent, individualized postoperative pharmacological management and monitoring ensured proper healing of the corneal incision. Compared to similar cases documented in the literature, this case successfully avoided several factors that could have prolonged the recovery period. The successful recovery can be attributed not only to timely surgical intervention but also to favorable preoperative conditions, meticulous

postoperative management, and the completeness of the clinical approach, all of which were crucial to the patient's smooth recovery.

Conclusions

Timely removal of the foreign bodies mitigated the risk of corneal necrosis and bacterial keratitis in this case. The implementation of an individualized medication regimen and close monitoring of the patient's recovery process ensured a smooth postoperative recovery. The absence of complications in this case indicates the effectiveness of timely treatment and postoperative medication.

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Kirurško zdravljenje in analiza penetrirajoče poškodbe roženice pri psih zaradi tujkov rastlinskega izvora: poročilo o primeru

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Izveček: Namen te študije je bil predstaviti primer penetrirajoče poškodbe roženice pri psu, ki so jo povzročili tujki rastlinskega izvora in je bila uspešno zdravljena s keratotomijo. Dveletna psička pasme border collie je imela v roženici dva tujka, kongestijo veznice, blefarospazem in majhno količino seroznega izcedka v levem očesu. Opravljena je bila keratotomija za odstranitev tujkov iz roženice. Med postopkom je bilo ugotovljeno, da je en tujek prodrl v prednjo komoro. Po odstranitvi je bila prednja očesna komora sprana, roženica pa zašita. Pooperativno zdravljenje je vključevalo lokalna in sistemska zdravila. Pregled je potrdil, da so bili vzrok tujki rastlinskega izvora. Pooperativne ocene po 2 in 4 tednih so pokazale zmanjšanje edema roženice, nastanek limbalnih neovaskularizacij, zmanjšanje kongestije veznic, odpravo blefarospazma in odsotnost očesnega izcedka. Petmesečno pooperativno spremljanje je pokazalo normalno prosojnost roženice in fiziološko delovanje, čisto prednjo komoro in normalen vid. Keratotomija se je izkazala za učinkovit poseg pri zdravljenju roženičnih tujkov, saj omogoča temeljito odstranitev krhkih in globoko zagozdenih tujkov. Pooperativna zdravila so učinkovito preprečevala okužbe in spodbujala celjenje roženice. To poročilo o primeru zagotavlja dragocen vpogled v diagnostiko in zdravljenje penetrirajoče poškodbe roženice pri psih, ki jo povzročijo tujki rastlinskega izvora.

Ključne besede: psi; tujek rastlinskega izvora; penetrirajoča poškodba roženice; keratotomija; odstranitev tujka; sanacija roženice