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Review

# Comprehensive Review of Canine Entropion: Types, Surgical Techniques, and Prognosis

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**Simple Summary:** Entropion is a disorder in which the eyelid border flips inward, rubbing the eyelashes or facial hair on the surface of the eye. This may occur in a variety of species, but it is more frequent in dogs. It most commonly affects the lower eyelid; however, it can occur elsewhere on the eyelid. Irritation, discomfort, ulceration, and eye difficulties can result from rubbing. Entropion can be either congenital (present at birth) or acquired later in life (developmental). It is diagnosed by examining the symptoms, the animal's history, and its breed. It is critical to assess the severity of entropion without anesthesia. This research examines several surgical procedures for correcting entropion in dogs.

**Abstract:** Entropion is a condition characterized by the total or partial inversion of the eyelid margin, resulting in contact between the outer skin and the corneal or conjunctival surface, and sometimes both. This condition can affect various animals, including horses, pigs, goats, sheep, rabbits, felines, and particularly canines. It typically manifests in the lower lid's lateral portion but can affect any part of the lid. This contact between eyelashes or facial hair and the cornea or conjunctiva leads to severe irritation, causing self-inflicted trauma, as evidenced by clinical signs of pain, irritation, ulcerations, and vision loss. Entropion can be classified as primary (congenital or developmental) or secondary (spastic and scarring). Diagnosis relies on clinical signs, the animal's history, and its breed. It's essential to assess the degree of entropion in the dog without applying topical anesthesia. This study conducts a literature review on surgical techniques for correcting various types of entropion in canines.

**Keywords:** canine; surgical; Hotz-Celsus technique; eyelids

## 1. Introduction

Abnormalities in eyelid position and function can result in chronic irritation of the cornea and conjunctiva [1]. Entropion is an ophthalmic condition characterized by the partial or complete inversion of the eyelid margin [2]. This condition causes symptomatic contact between eyelashes and the eye's surface, leading to corneal irritation. The primary symptoms manifest as ocular surface irritation [3]. Entropion can affect both the upper and lower eyelids, involving either the entire length or specific areas, and it can affect various animal species, with canines being the most affected [4].

Entropion can be either hereditary or acquired, resulting from chronic injuries or inflammation, and is typically associated with irritation to the conjunctiva, cornea, and sclera [5]. To comprehend the pathogenesis, diagnosis, and treatment of entropion, it's essential to grasp the anatomy of the eye and its adnexa.

## 2. Conformation of the Canine Eye and its Attachments

The canine eye, responsible for vision, consists of the eyeball and its protective appendages (eyelids, eyelashes, conjunctivae, lacrimal apparatus, ocular muscles, blood vessels, and nerves), all

situated within the orbital cavity of the skull. The size of the orbit determines the available space for the eyeball and its attachments [6,7]

The canine eyeball is nearly spherical and comprises three concentric tunics closely layered to form a structured lamina [8]. These tunics are as follows:

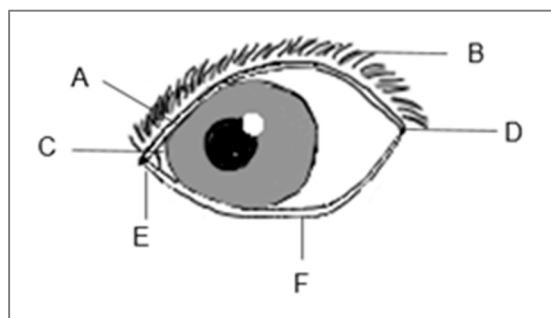
1. The external lamina, or fibrous tunic, includes the cornea and sclera, playing a vital role in shaping and safeguarding the eyeball.
2. The middle vascular tunic, also known as the choroid, nourishes the eyeball and surrounds the ciliary body and iris. It influences the size of the pupil and the shape of the crystalline lens.
3. The inner tunic, called the retina, is a complex, transparent photosensory membrane spanning the optic nerve and connecting to the brain, responsible for converting light into visual signals [6,9].

### 3. Eyelids

The eyelids, also known as palpebrae, are thin folds of skin that continue from the facial skin (Figure 1). They are composed of skin, palpebral muscles, palpebral glands, particularly the meibomian glands, and the palpebral conjunctiva, which lines the inner surface of the eyelids [9].

The primary function of the eyelids is to protect the eyeball [10]. They play a crucial role in shielding the eyes from light, generating a part of the tear film, distributing it across the cornea, and eliminating debris from the corneal and conjunctival surfaces through a lateral-to-medial "zipper" closure. Moreover, the eyelids direct the precorneal tear film into the nasolacrimal drainage system [11].

These eyelids can be affected by conditions that also impact the skin elsewhere on the body, as well as various anatomical abnormalities and conditions involving the conjunctiva and eyeball [9].



**Figure 1.** Structures of the canine eyelids: A) Superior palpebral margin, B) Eyelashes, C) Free edge of the nictitating membrane, D) Lateral canthus, E) Nasal canthus and F) Inferior palpebral margin.

### 4. Cylinders

In dogs, cilia or eyelashes are found exclusively on the upper eyelid, emerging from the anterior parts of the palpebral margin [12,13].

### 5. Muscles

Eyelid closure is primarily achieved through the contraction of the orbicularis oculi muscle, which is situated anterior to the tarsus of both eyelids. In dogs, the upper eyelid is more mobile and is innervated by the oculomotor nerve, in contrast to other palpebral muscles that are innervated by the facial nerve. Additionally, the eyelids have a ligament at the medial canthus and a muscle that functions as a ligament at the lateral canthus, known as the lateral retractor anguli oculi lateralis (retractor anguli oculi lateralis) [14].

### 6. Eyelid Glands

On the palpebral margin, you can find the meibomian or tarsal glands, which produce lipids [15]. These glands are aligned parallel to each other, and their secretions have a thicker consistency compared to those of the lacrimal gland. Furthermore, within the eyelids, there are sebaceous glands known as Zeiss' glands and serous glands referred to as Moll's glands [16].

## 7. Entropion Definition and Types

The most common diseases affecting the eyelids are abnormalities in palpebral position [17]. One such condition is entropion, characterized by the inward rolling of the margin of a part or the entire eyelid. This anomaly appears to result from the difference in tension between the orbicularis oculi muscle and the malaris muscle [18]. Entropion predisposes the cornea and/or conjunctiva to irritation, ulceration, and, in severe cases, perforation [19].

Entropion is a prevalent pathology in dogs, with purebred canines being more affected than mongrels. In many cases, it can be attributed to hereditary factors, although the genetic basis is not yet fully understood. It is evident that certain breeds, such as the Shar-pei, Chow-Chow, and Rottweiler, are more susceptible to primary entropion [20]. Brachycephalic dogs often exhibit ocular issues, including entropion, which can be exacerbated by their prominent nasal folds and the anatomical characteristics of their breeds [2].

Entropion can manifest as lateral, medial, angular, or total, affecting either the lower or upper eyelid [11]. This condition is categorized as either primary (conformational or congenital) or secondary (spastic or cicatricial) [21].

### 7.1. Primary Entropion

Primary entropion, often congenital or conformational, is frequently associated with specific breeds [22]. This type of entropion can vary in terms of the degree of eyelid involvement. Depending on the extent of the rotation of the palpebral margin, it can be classified as mild (45°), moderate (90°), or severe (180°) [23]. It may also be present in different positions, such as medial, angular, or total, affecting either the upper or lower eyelid [24].

Developmental entropion is considered a non-congenital hereditary condition [25]. Breeds like Chow-Chow and Shar-Pei often develop entropion shortly after opening their eyelids, affecting both upper and lower eyelids. Various factors, including skull conformation, orbit anatomy, and the amount of facial skin folds around the eye, can influence its occurrence [26]. In most cases, it is believed to result from an inherited defect, possibly a polygenic condition [25]. Another potential cause of primary entropion is the difference in tension between the orbicularis and malar muscles [24].

In cases of entropion affecting puppies and young dogs, the most common treatments involve the temporary fixation of the affected eyelid with sutures (tacking) or the permanent eversion of the affected eyelids using the modified Hotz-Celsus technique [25].

### 7.2. Secondary Entropion

Secondary entropion can be categorized as either spastic or cicatricial and is less common. This type of entropion typically arises because of other factors, such as trauma, disease, or scarring. It's crucial to address the primary underlying cause, as simply correcting the entropion without addressing the root issue may lead to recurrence [6].

#### 7.2.1. Spastic Entropion

Spastic entropion is characterized by the pronounced contraction of the orbicularis oculi muscle, which is often triggered by painful ocular conditions such as ulcerative and non-ulcerative keratitis, conjunctivitis, tear film instabilities. It can also be induced by painful condition leads to blepharospasm and enophthalmos, causing the eyelid inversion [27].

In many cases of secondary spastic entropion, effective pain management for the underlying ocular condition causing blepharospasm may be sufficient for resolution. However, once entropion

has developed, the irritation it causes can further worsen blepharospasm, exacerbating the entropion. In such cases, a procedure to evert the eyelid, even if only temporarily, is often necessary to relieve blepharospasm and correct the entropion [25].

#### 7.2.2. Cicatricial Entropion

Cicatricial entropion is related to fibrosis caused by severe inflammation of the eyelid or conjunctiva, or by a previous injury or surgical trauma [27].

### 8. Clinical Signs and Diagnosis

Entropion presents a spectrum of clinical signs, with the severity of symptoms varying from mild to severe. In mild cases, patients may exhibit increased tearing (wetting) and subsequently, epiphora. When entropion is moderate, inflammation becomes the prominent sign, accompanied by conjunctivitis featuring pronounced ocular discharge and noticeable eyelid twisting. In more severe instances, patients experience blepharospasm, marked conjunctivitis with copious purulent or mucopurulent discharge, photophobia, depigmentation of the palpebral margin, and neovascularization of the cornea. Severe cases even carry the risk of ulcerative keratitis and potential corneal perforation, with a consequent increased risk of eye loss [28].

Diagnosing entropion involves considering the patient's history, clinical signs, and breed predisposition. An essential step is the direct observation of eyelid positioning. Prior to any detailed examination or manipulation, it is crucial to evaluate the eyes from a distance to gauge the degree of blepharospasm and discomfort, as these symptoms may worsen during closer examination [26].

Upon closer examination, care should be taken to avoid excessive manipulation of the facial skin, which can significantly alter the palpebral position, particularly in breeds with pronounced facial skin laxity [17]. It's also essential to assess the eyelids for their position, presence of swellings, and any abnormalities of the eyelashes. Additionally, the position and size of the lacrimal points should be carefully examined [17]. Observing the animal freely is instrumental in determining the extent of the condition.

### 9. Surgical Procedures for Entropion Correction

While several methods have been proposed for treating entropion, it's crucial to recognize that surgical intervention remains the definitive solution. Several techniques, including the Hotz-Celsus procedure, lateral canthoplasty, Y to V plasty, Stades procedure, or a combination of these methods, are available [11]. The choice of technique depends on factors like the patient's breed, age, the degree of entropion, and its underlying cause [21].

It's essential to note that each surgical procedure has specific indications, success rates, and potential complications (Table 1). In severe cases involving multiple forms of entropion, such as lower and upper lid entropion, medial entropion, and lateral canthal entropion, a combination of surgical procedures or even multiple surgeries may be required for effective correction [11].

#### 9.1. Tacking Procedure

The temporary or "Tacking" method is often preferred over permanent surgical procedures in certain cases. First, it is used when a patient is suffering from spastic entropion due to pain. The "Tacking" method can provide relief while addressing the underlying cause. Second, for young patients, permanent eyelid correction is typically postponed until they reach 5 to 12 months of age, when their facial development is more complete. During this period, the "Tacking" method is employed to prevent ocular irritation and reduce the risk of severe corneal damage in these patients [21].

In the "Tacking" procedure (see Figure 2), two to four nonabsorbable vertical or interrupted simple mattress sutures, typically 4-0 to 5-0 in size, are placed alongside the affected eyelid margin. These sutures, approximately 5 mm in length, ensure proper retraction and tissue attachment. Often, the sutures are left longer to allow for multiple adjustments. They can be removed within 2 to 4



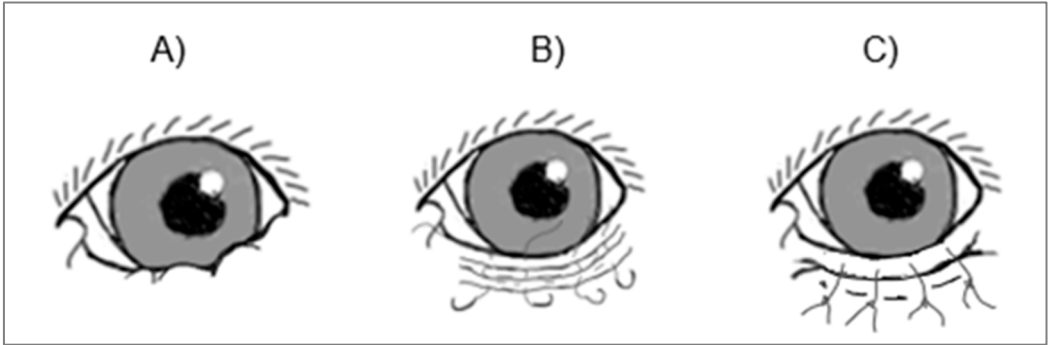
weeks, leaving behind a "scar tunnel" that provides corrective traction at the lid margin. Following "tacking," entropion often does not require further correction. If entropion persists, surgical intervention may become necessary [26].

The "Tacking" procedure is also recommended for adult dogs to address spastic etropion or to prevent secondary trichiasis-entropion from the upper lid to the lower lid following lower lid entropion correction [29].

**Table 1.** Overview: Types of Entropion, Surgical Procedures, and Recommendations.

Entropion Type	Surgical Procedure	Indications	ofSuccess Rates	Potential Complications	Recommended Age*	Ref.
Lower medial eyelid.	and“Tacking” temporary retraction	Temporary relief of entropion. Avoid contact conjunctiva and/or cornea (pain).	Avoid with relief Temporary -		All ages, preferably puppies dogs	[21]
Upper, Lower, Medial, lateral canthal eyelid	andHotz-Celsus procedure	Mild to moderate entropion	High	Minimal complications	All ages	[30]
Upper and lower eyelid	Y to V plasty	Moderate entropion	Moderate	Suture granulomas, eyelid malposition	Usually in adult canines	[31]
Lower eyelid	Quikert-Rathbun	Moderate to severe entropion	Variable	Scarring, eyelid malposition, suture issues	Puppies and young dogs	[26]
Lateral entropion of the lower eyelid	Temporal lateral tarsorrhaphy	Moderate to severe entropion	Variable	Scarring, suture issues	Usually in adult canines	[32]
Central inferior entropion	Wyman	Moderate to severe entropion	Variable	Scarring, suture issues	Usually in adult canines	[33] [31]
Lateral canthal entropion	Arrowhead (Hotz-Celsus modification)	Moderate to severe entropion	Variable	Scarring, suture issues	Usually in adult canines	[34]
Upper eyelid	Stades procedure	Severe entropion ( <i>shar pei</i> breed)	Moderate	Potential for scarring, eyelid malposition	Usually in adult canines	[25]
Lateral lower canthal eyelid.	andRobertson	Severe entropion (large and giant breeds)	Variable	Scarring, suture issues	Usually in adult canines	[17]
Upper, Lower, medial eyelid.	andCombination of methods	Complex multiple types cases,	Variable	Varied complications	Varies depending on case	[18]

\* The column indicates whether the procedure is typically recommended for puppies, juveniles, or adults, but keep in mind that these recommendations may vary depending on the individual evaluation of the case by a professional.

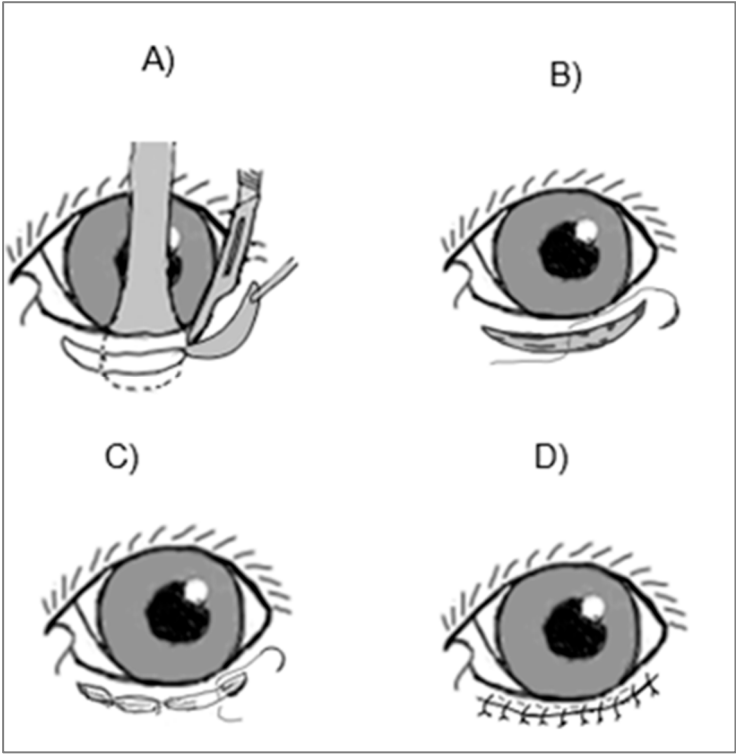


**Figure 2.** Entropion correction by means of retraction sutures (Tacking): A) Affected eye with inferior entropion, B) Use of 2 to 4 simple interrupted sutures, and C) The knots of the sutures are left away from the eye.

9.2. Hotz-Celsus Procedure

The Hotz-Celsus procedure was created by Celsus in antiquity and improved by Hotz in the 19th century. The procedure indicated in cases of conformational entropion in adult dogs is the Hotz-Celsus technique [30]. To perform the technique, the affected eyelid is kept stretched and the eye is protected by a Jaeger plate, or by the palmar surface of the eye or by the palmar surface of the surgeon's index finger [30] [1]. An incision is made at 2 - 2.5 mm from the palpebral margin, parallel to it, with a #15 scalpel blade extending at least 1 mm medial and lateral to the entropion area [24] as shown in Figure 3.

Overcorrection can cause ectropion, which may result in additional surgery, so correctly estimating the amount of tissue to be removed is critical to the success of this blepharoplasty [1].



**Figure 3.** Hotz-Celsus technique for entropion correction. A) The eye is protected with a Jaeger spatula and the cut is made along the length of the entropion starting 3 mm from the margin and skin is removed in a crescent shape. B) Begin closing with simple stitches through the center of the wound. C) and D) Add stitches separated from each other, until the entire wound is covered.

### 9.3. Y-V Procedure

The Y-V procedure is recommended for correcting moderate medial entropion of both the upper and lower eyelids. The procedure commences with an incision, resembling a Y-shape, made through the palpebral skin layers and orbicularis muscle. This incision starts approximately 1-2 mm from the lid margin. The lower part of the Y-shaped incision, often referred to as the Y-leg, overlaps with the V-shaped area to achieve eversion of the lid margin. This is accomplished using a simple suture pattern and a 5-0 to 6-0 nonabsorbable thread [31].

On the other hand, this procedure is indicated for cicatricial entropion, where a Y-shaped incision is created by extending its arms just below the affected palpebral segment. Tension is applied to the skin flap until the eyelid margins return to their normal position, determining the length of the Y-shaped incision's body. The flap is then dissected to remove scar tissue. Finally, the apex of the flap is sutured to the most distal part of the incision, and the remaining edges of the incision are closed [34].

### 9.4. Quickert-Rathbun Procedure

The Quickert-Rathbun procedure involves the use of sutures at the base of the eyelid fornix in puppies, young dogs, and older dogs with lower lid entropion. It can also serve as an alternative procedure to the Tacking method, especially in puppies, particularly when entropion reoccurs after Tacking. In this procedure, a 4-0 two-pronged resorbable suture is inserted from the bottom of the fornix to emerge externally 1-2 mm from the palpebral margin, causing an immediate eversion of the palpebral margin and correction of the entropion. Suture tension can be adjusted to achieve normal or slight ectropion [26]. This technique typically delivers acceptable results in most cases without the necessity for incisional surgery [35].

### 9.5. Lateral temporal tarsorrhaphy Procedure

Lateral temporal tarsorrhaphy is employed as a temporary treatment for lateral lower lid entropion in young dogs. This procedure is conducted under general anesthesia using a single multifilament polyamide mattress suture. The suture is typically left in place for several weeks until the suture slack necessitates removal [32].

### 9.6. Wyman Procedure

The Wyman procedure and its modifications are employed to address the issue of palpebral instability, particularly in large and giant breeds of dogs [33]. This procedure, often combined with the Hotz-Celsus technique, is utilized to treat lower lid entropion. It involves the construction of a pedicle that is anchored in the subcutaneous tissue to evert the eyelid margin. This procedure is also employed in patients who have previously undergone other surgical interventions [31].

The process begins with a skin incision made approximately 1 to 2 mm from the palpebral margin. Subsequently, a tarsal pedicle is constructed along the palpebral margin in the widest part of the entropion using a scalpel. A 5-0 nonabsorbable suture is then passed through a subcutaneous tunnel created with scissors and attached to the tarsal pedicle below the surgical wound to prevent skin laceration. Another incision is made, following the Hotz-Celsus technique, in the skin, and an elliptical-shaped portion is removed. The remaining wound is closed with a simple suture pattern using 5-0 to 6-0 nonabsorbable suture [36] [31].

### 9.7. Arrowhead Procedure

The Arrowhead procedure is employed when the primary component of entropion involves the inversion of the lateral canthus. In such cases, a modification to the Hotz-Celsus technique, known as the arrowhead modification, is carried out [34].

In this procedure, instead of creating an elliptical incision over the lateral canthus, an arrowhead resection is performed. Additionally, a tension suture is placed in the subcutaneous tissue at the



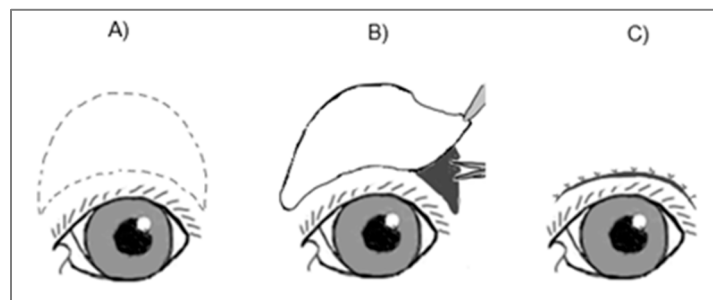
lateral canthus to anchor and stabilize it. A horizontal mattress suture is positioned below the skin incision and the fascia covering the orbital ligament [34].

### 9.8. Stades Procedure

The Stades procedure, described by Stades [24], is employed to correct upper lid entropion while simultaneously preventing its recurrence by creating a band of hairless skin parallel to the palpebral margin (Figure 4) [25].

The procedure involves the removal of 15 to 25 mm of eyelid skin. A skin incision is made along the upper lid margin, positioned 0.5 to 1.0 mm dorsally to the Meibomian gland openings and inferiorly to the first cilia of the eyelid. This incision begins about 2 to 4 mm from the inner canthus and extends 5 to 10 mm beyond the lateral canthus. A second incision is made in an arched fashion, approximately following the sulcus parallel to the dorsal orbital rim, at a maximum distance of 15 to 25 mm from the palpebral rim. The wound edge is then dissected and trimmed, and the skin is sutured with absorbable material to the subcutaneous cellular tissue, maintaining 4 to 5 mm from the palpebral edge [37].

In a study conducted by Kim et al. [21], the Stades forced granulation technique was employed for the correction of upper lid entropion, in combination with the Hotz-Celsus procedure for lower lid entropion. This modification was shown to be effective in preventing recurrence.



**Figure 4.** Stades procedure: **A)** 15 to 25mm of skin is removed from the eyelid in an arc, **B)** The edge of the wound is dissected and cut **C)** Stitches are made with absorbable material, until the entire wound is covered.

### 9.9. Robertson Procedure

The Robertson procedure is especially suited for addressing lateral lower lid entropion and canthal entropion, particularly in large and giant dog breeds. Many giant breeds encounter intricate cases of entropion, primarily attributed to the combination of having long eyelids, sunken eyes, and a lax lateral canthus, which creates a palpebral macro-slit [17].

### 9.10. Other procedures

A newer version of the modified Hotz-Celsus technique employs a CO<sub>2</sub> laser to reduce bleeding and anesthesia time during surgery. This approach avoids the use of sutures and allows the wound to heal by second intention without complications. It proves to be a safe and swift method for treating entropion [18].

An alternative method involves the use of hyaluronic acid (HA) as a substitute for surgical tacking in puppies. HA has been applied for correcting and alleviating entropion symptoms in canines. The treatment entails layered hyaluronic acid (HA) filler injections, which have proven to be effective in maintaining the proper position of the eyelids for approximately 6-8 months post-procedure. While HA can swiftly and effectively alleviate clinical signs, it offers temporary relief [38].

## 10. Postoperative Management

Postoperative management involves the administration of ocular antibiotic ointment and systemic nonsteroidal anti-inflammatory drugs (NSAIDs) for reducing inflammation and providing

analgesia. Sutures are typically removed approximately 10 to 14 days following the surgery. It's worth noting that the eyelids have an excellent blood supply, making them prone to significant bleeding and susceptibility to severe edema and distortion even after minor injuries. Therefore, the use of an Elizabethan collar is essential to prevent self-inflicted trauma

## 11. Prognosis and Prevention

With a well-performed surgical procedure, entropion generally carries a favorable prognosis, even in complex cases involving ulceration. In instances of deep corneal damage, some corneal scars may persist. It's not uncommon for animals from the same family to be affected, making it advisable that animals with primary entropion do not reproduce. Given the strong breed predisposition, it is recommended not to breed animals with this condition, and breed societies should actively work to reduce the incidence of entropion within their specific breed [17].

## 4. Conclusions

Entropion is a common condition in dogs, and certain breeds are more susceptible to it. Understanding the different types of entropion and the appropriate surgical treatments is crucial. The most widely used surgical procedure is the modified Hotz-Celsus, often combined with other techniques. The variety of available techniques underscores the importance of staying updated on surgical methods, whether permanent or temporary.

Future research should continue to investigate the use of CO<sub>2</sub> lasers and hyaluronic acid in treating entropion and explore their broader applications in veterinary ophthalmology, given their potential benefits in various aspects.

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