Veterinary Ophthalmology

WILEY

ORIGINAL REPORT OPEN ACCESS

Lateral Tarsorrhaphy and Fixation on the Orbital Ligament to Correct Macroblepharon in Dogs: 77 Palpebral Fissures

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Received: 14 August 2024 | **Revised:** 29 December 2024 | **Accepted:** 5 January 2025

Funding: The authors received no specific funding for this work.

Keywords: dog | lateral tarsorrhaphy | macroblepharon

ABSTRACT

Purpose: To describe a surgical method for correcting lower lid entropion, lateral canthal entropion, and macroblepharon.

Methods: Lid margins were incised at a 45° angle, and lateral lid margins and a rhomboid shaped piece of skin were resected based on the degree of macroblepharon. Subcutaneous tissue was sutured with absorbable sutures and anchored to the orbital ligament with a non-absorbable suture to maintain lateral canthal position. A new lateral canthus was formed using a "figure of eight" technique with absorbable sutures, and the skin was closed with simple interrupted sutures. Complications were categorized as minor (wound infections, delayed healing) or major (orbital ligament detachment).

Results: Lateral tarsorrhaphy with orbital ligament fixation was performed on 77 palpebral fissures (PF) in 39 dogs, with English Cocker Spaniels and Great Danes being the most affected breeds. Most dogs were male (72%) with a median age of 23 months; 69% were under 50 months. Of the PF treated, 57 (74%) had no complications, 11 (14%) had minor complications, and 9 (12%) had major complications, including six cases of ruptured orbital ligament fixation and one case of unilateral entropion recurrence. One dog was euthanized due to severe complications from auto-mutilation and lack of compliance.

Conclusion: This surgical method effectively corrects diamond-shaped eyes, although complications can occur, especially in male dogs with excessive facial skin.

1 | Introduction

Certain breeds of dogs, like the Bloodhound, St. Bernard, and Spaniel, exhibit distinctive diamond-shaped eye openings that can lead to persistent conjunctival exposure, including impaired tear distribution and lower ectropion. Additionally, these breeds often present with heavy facial skin folds and hanging ears. Their eyelids, particularly the lower ones, tend to be excessively long, contributing to instability in the lateral canthus, resulting in drooping lower eyelids and inward folding of upper eyelids. Complications such as poorly developed lateral canthal ligaments, excessive tension in this area, and variable enophthalmia further complicate matters [1].

The instability in the lateral canthal region of dogs is primarily due to the lack of a robust and firm lateral canthal ligament. While the lateral retractor anguli oculi muscle partially compensates for the function of the absent ligament, the area remains vulnerable to instability and is prone to entropion [1]. Surgical interventions targeting the lateral canthus typically involve varying degrees of incisions into the upper and lower eyelids, which may not be symmetrical. Therefore, each surgical approach should be tailored to address the specific defect in the lateral canthal region of the individual dog.

Addressing combined lower ectropion and lateral canthal entropion requires surgical intervention focusing on two main

objectives: shortening the lower and upper lid and stabilizing the lateral canthus while correcting the entropion/ectropion. Although existing surgeries can effectively treat lower ectropion, ensuring additional lateral canthal stability remains challenging. Managing combined ectropion–entropion cases in dogs is complex, often requiring additional surgeries like facial skin lifts or resections for optimal outcomes [1].

The methods of Wyman, Gutbrod and Tietz, Bedford, and lateral canthoplasty (2021) focus on shortening both upper and lower lateral eyelids without a fixation on the underlying structures [1–4]. There are only three studies reporting both upper and lower eyelids shortening and additional fixation on the underlying structures with a suture: Bigelbach [5], Grussendorf [6] and Kecova, Miller, and Lindley [7]. Bigelbach anchors the simple interrupted skin sutures to the deep fascia underlying the orbicularis oculi muscle. Grussendorf ties the new formed canthus with non-absorbable suture material (ETHILON 3–0, Ethicon, Bridgewater, NJ, USA) that is fixed inside of its skin to the orbital ligament and Kecova, Miller, and Lindley tie it to the subcutaneous tissue with absorbable suture material (VICRYL 4–0, Ethicon, Bridgewater, NJ, USA) [5–7].

This retrospective study assesses the results of a tarsorrhaphy technique published by Walde et al. [8]. The upper and lower temporal eyelids are shortened, and the subcutaneous tissue is secured to the orbital ligament using a non-absorbable suture material. Subsequently, a new lateral canthus is created using a figure of eight technique with absorbable suture material (Figure 1).

2 | Materials and Methods

Records of patients presented at the ophthalmology unit from the University of Veterinary Medicine Vienna from 2001 to 2023 with the inclusion criteria of undergoing lateral tarsorrhaphy and fixation on the orbital ligament due to macroblepharon (diamond-shaped eye) were reviewed. All the dogs underwent a complete ophthalmic examination by board-certified ophthalmologists, including Schirmer Tear Test, slit lamp biomicroscopy, fluorescein test, tonometry, and indirect ophthalmoscopy. Indications for surgical intervention included the presence of elongated and ptotic (drooping) upper and lower eyelids, combined with an entropion/ectropion configuration and pressure exerted by the sagging upper eyelid, resulting in a downward displacement of the lateral canthus. Data collected for each patient included age at the time of surgery, breed, gender, postoperative treatment, follow-up time, and complications. Before surgery, owners gave written consent for the surgical intervention. The surgery was performed by different ophthalmology residents in training supervised by an ECVO diplomate.

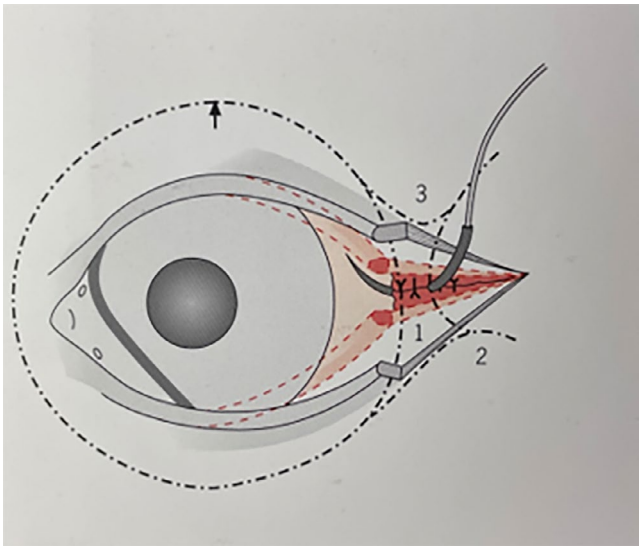

FIGURE 1 | Walde et al. (2008): After resecting excessively long lid margins and suturing the subcutis, a non-absorbable suture is used to secure the subcutis and underlying tissue to the orbital ligament. The illustration shows the contour of the orbital margin, highlighting the orbital ligament (1), zygomatic arch (2), and the zygomatic process of the frontal bone (3).

General anesthesia was induced with PROPOFOL (Hexal, Holzkirchen, Germany) and prolonged with ISOFLURANE (Baxter, Deerfield, Illinois, USA) in most cases. During the operation, patients were given a continuous pain drip of lidocaine, methadone, and ketamine, depending on the individual patients requirement. The operation was monitored with ECG, pulse oximetry, and capnography in every patient. Skin adjacent to the eyes was clipped and prepped 10 min before surgery with POVIDONE-IODINE (B.Braun, Maria- Enzersdorf, Austria, dilution: 1:20) before rinsing with sterile saline. Immediately before surgery, the surgeon performed a sterile skin disinfection with CUTASEPT (Hartmann, Hamburg, Germany). Intraoperatively, most patients received a non-steroidal anti-inflammatory drug. If this was not possible due to kidney problems, paracetamol or metamizole was used as an alternative.

2.1 | Description of Surgical Procedure

The measurement of the lid was performed at the beginning of the surgery while the patient was already under full anesthesia and the palpebral fissure was considered too long if there was abnormal exposure of the conjunctiva. The amount of the resected tissue was usually between 5 and 7 mm, depending on the individual patient. The goal was to reduce the stretched palpebral fissure to a length of 33–35 mm. Lower and upper lid margins were incised at a 45° angle with a scalpel. Subsequently, the excessive lateral lid margins, along with the adjacent skin and subcutaneous tissue, were resected, which resulted in a rhomboid-shaped piece of skin. After suturing the subcutaneous tissue with absorbable sutures, the sutured tissue was fixated with a single non-absorbable suture on the orbital ligament. This exerts traction on the lateral canthus and keeps it in position. A new lateral canthus was created by approximating the two lid margins using a “figure of eight” technique with absorbable suture material (5/0). The skin was closed with simple interrupted absorbable suture material (5/0), ensuring an optimal cosmetic outcome (Figures 1 and 2A–D). The knot of the non-absorbable suture is buried under the skin and therefore less prone to wound infection.

Complications encountered during the follow-up period were noted and classified. Wound infections, characterized by redness (erythema) and purulent discharge, along with delayed

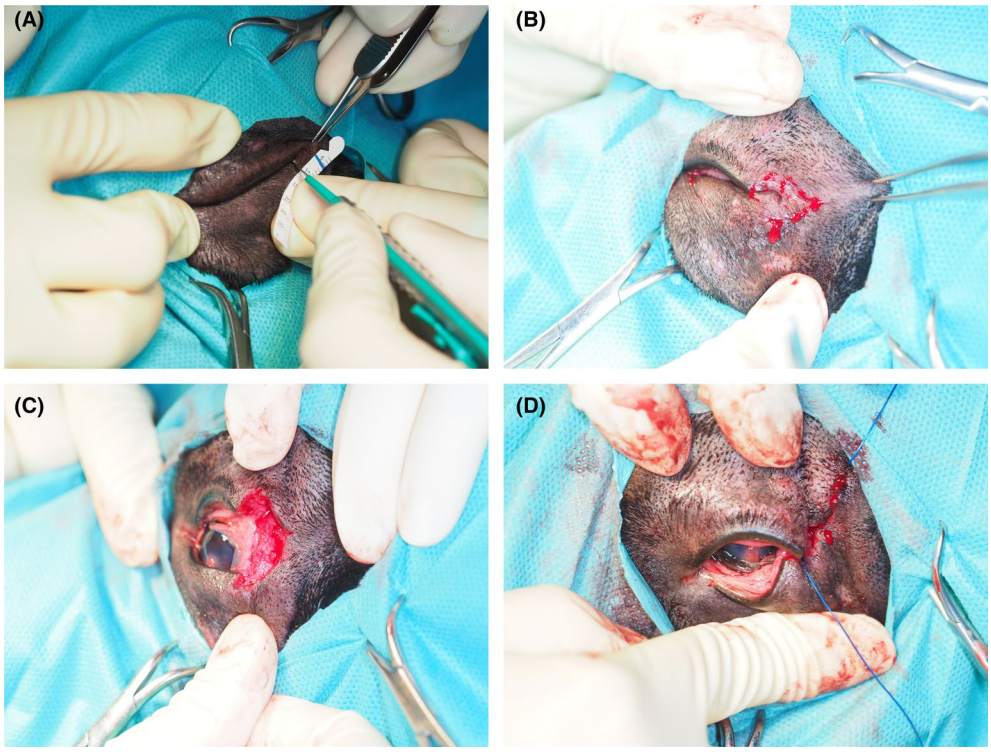

FIGURE 2 | (A) Rottweiler, male, 2 years old. At the start of the surgery, the amount of lid margin that had to be resected was measured with a caliper or STT (Schirmer Tear Test) and marked at the lid margins. The amount of resection was usually between 5 and 7 mm, depending on the individual patient. (B) Rottweiler, male, 2 years old. Lower and upper lid margins were incised at a 45° angle with a scalpel and the triangular shaped piece of skin was pre-cut. (C) Rottweiler, male, 2 years old. A view of the orbital ligament during the surgery. (D) Rottweiler, male, 2 years old. Subcutaneous tissue is sutured with absorbable sutures, and a single nonabsorbable suture is in position but not sutured yet (fixation on the orbital ligament).

wound healing, were classified as minor complications. These conditions reflected localized disruptions in the normal recovery process but were effectively managed with appropriate systemic treatment (14-day course of amoxicillin–clavulanic acid orally) without the need for additional surgical intervention or any cosmetic concerns. Major complications included detachment of the fixation on the orbital ligament (drooping lateral canthus), auto-mutilation, and suture dehiscence from excessive scratching or rubbing of the surgical site or recurrence of entropion. Postoperative care included a 7- to 10-day course of oral pain and anti-inflammatory medication (Paracetamol, Meloxicam), along with the application of a topical antibiotic ointment (Chloramphenicol) for 14 days. Additionally, the use of an Elizabethan collar for a minimum of 14 days was mandatory to ensure proper healing.

3 | Results

Seventy-seven PFs of 39 dogs underwent lateral tarsorrhaphy with fixation on the orbital ligament within 22 years (Table 1). All dogs except one patient (enucleated in one eye due to other reasons) had bilateral surgery. The study group consisted of 20 different breeds and one mixed breed. The most common breeds were English Cocker Spaniels (6), Great Danes (6), and Cane Corsos (4). Gender distribution showed 25 intact males, three castrated males, eight intact females, and three spayed females. The majority of dogs, in total 28, were male (72%), only 11 dogs were female (28%). The age ranged from 4 to 142 months, with the median age being 23 months. The mean age was 40 months and over two-thirds (69%) of the patients were under 50 months of age at the time of surgery.

Fifty-seven PFs showed no complications after surgery (74%) with 13/57 (23%) being female, 5/57 (9%) female spayed, 36/57 (63%) male and 3/57 (5%) male neutered dogs (Table 1). Minor complications were detected in 11 PFs (14%). Of the 11 PFs, three belonged to bitches, six to male dogs, and two to neutered males (Table 1). All minor complications healed with systemic antibiotic administration. MONOSOF 0 (Covidien, Dublin, Ireland) was used as fixation material for the orbital ligament in 9/11 PFs with minor complications, while the other two were fixed with MONOSOF 1–0 (Covidien, Dublin, Ireland).

Nine PFs (12%) belonging to six dogs showed major complications including six cases with ruptured fixation. One PF belonged to a spayed female while the rest (eight) belonged to male dogs. Breeds affected with major complications included one Great Dane OS (fs), one mixed breed dog OU (m), one Mastino Napolitano OU (m), one Saint Bernard OU (m), one English Cocker Spaniel OD (m), and one Bourdeux Mastiff OD (m) (Table 1). One PF was fixed with PREMILENE 1–0 (B.Braun, Maria- Enzersdorf, Austria). Two cases were sutured with PREMILENE 0 (B.Braun, Maria- Enzersdorf, Austria), one with MONOSOF 0 (Covidien, Dublin, Ireland), two with MONOSOF 1 (Covidien, Dublin, Ireland), two with MONOSOF 2–0 (Covidien, Dublin, Ireland), and one with PREMILENE 2-(B.Braun, Maria-Enzersdorf, Austria). The

TABLE 1 | Distribution of breed, gender, number of dogs, no complications, minor and major complications.

		Female n:8			f. spayed n:3			Male n:25			m. neutered n:3		
		pf: 16			pf: 6			pf: 50			pf: 5		
Breeds	***n***	**nc**	**mic**	**mac**	**nc**	**mic**	**mac**	**nc**	**mic**	**mac**	**nc**	**mic**	**mac**
English Cocker Spaniel	6	2			2			5		1	2		
Great Dane	6	2			1		1	6				2	
Cane Corso	4	2						6					
Saint Bernard	3	2						2		2			
Bordeaux Mastiff	2	1	1							1			
New Foundland Dog	2	2							2				
English Bulldog	2	2						2					
Dogo Canario	1							2					
Bloodhound	1				2								
Boxer	1							1	1				
Boerboel	1							2					
Bobtail	1										1		
English Springer Spaniel	1							1	1				
Briard	1							1	1				
Mastino Napolitano	1									2			
Bullmastiff	1							1	1				
Landseer	1		2										
Rottweiler	1							2					
Irish Setter	1							2					
Sharpei	1							2					
Mixed breed	1									2			

Abbreviations: f, female; m, male; mac, major complications; mic, minor complications; *n*, numbers of dogs; nc, no complications; pf, palpebral fissure.

Bordeaux mastiff was operated OD 3 years after the initial surgery due to recurrence of entropion. The Mastino Napolitano had to be euthanized due to lack of compliance (owner was not able to give any medication, severe auto-mutilation). For four of the six cases with ruptured fixation, re-surgery was necessary: Great Dane OS, mixed breed dog OS, and one Saint Bernard dog OU in another clinic. Although the fixation had ruptured in OD of the mixed breed dog and in OD of the Cocker Spaniel, the lid position was adequate and the owners decided against surgery. Success was defined as an adequate position of the eyelid with correction of macroblepharon and no need for further surgery (Figure 3A–D). The success rate of this method was 94.8% (Table 1).

Different non-absorbable suture material was used. MONOSOF 0 (Covidien, Dublin, Ireland) was used in most patients (44 eyes) with nine minor complications. MONOSOF 1–0 (Covidien, Dublin, Ireland) was used in 10 PFs, showing two minor and two major complications and six PFs with good outcomes. PREMILENE 1–0 (B.Braun, Maria- Enzersdorf, Austria) was used in six PFs, and no complications were observed. PREMILENE 0 (B.Braun, Maria- Enzersdorf, Austria) was used in six PFs, showing two major complications and four PFs with good outcomes. PREMILENE 2–0 (B.Braun, Maria- Enzersdorf, Austria) was used in four PFs, with one major complication and three PFs with good outcomes. DERMALON1–0 (Covidien, Dublin, Ireland) was used in one PF with no complication. PROLENE 1–0 (Ethicon, NJ, USA) was used in two PFs, with one major complication and one PF with a good outcome.

Follow-up time ranged from 5 to 1077 days, with a median of 33 days (Figure 4). The short follow-up time of 5 days in one dog is due to the fact that it was conducted by a referring veterinarian via E-mail, and no complications were reported. Thirty-four of 39 dogs had their first recheck within 14 days post-surgery, with three of these rechecks conducted via email or telephone. At the second recheck, between 15 and 31 days post-surgery, 26 dogs were clinically evaluated. A third recheck, between 32 and 120 days, was possible for 21 dogs, with one recheck conducted via email. Finally, a fourth check-up, between 120 and 1077 days post-surgery, was performed in 12 dogs. One patient had follow-up time of only 5 days via pictures on E-mail with the referring vet and one patient had a follow-up by the primary care veterinarian 7 days after the initial surgery (Figure 4).

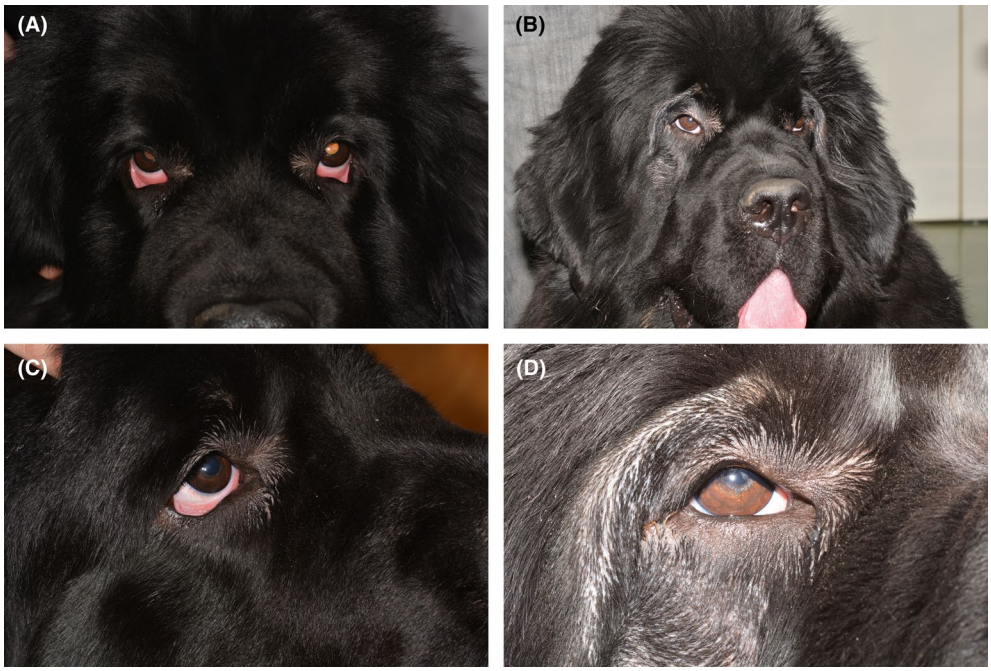

FIGURE 3 | (A) Newfoundland dog (male, 19 months old). The picture of the patient was taken 2 weeks prior to surgery. (B) Newfoundland dog (male, 19 months old). The picture of the patient was taken 2 weeks post surgery. (C) Newfoundland dog (male, 19 months old). An enlarged image of the right eye with macroblepharon 2 weeks before surgery. (D) Newfoundland dog (male, 19 months old). An enlarged image of the right eye after lateral tarsorrhaphy and fixation on the orbital ligament 2 weeks after surgery.

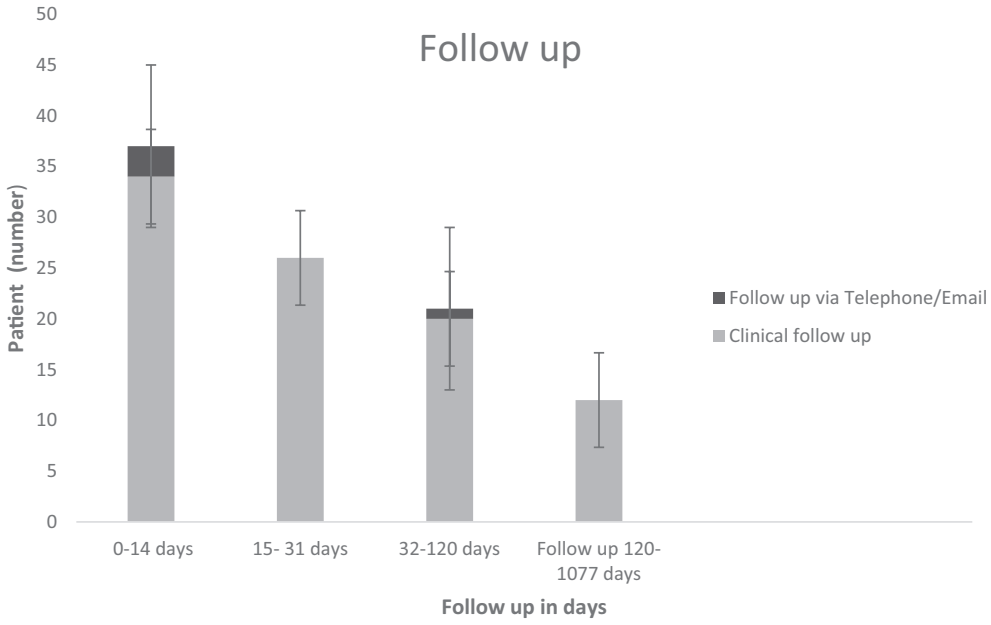

FIGURE 4 | The follow-up chart shows that almost all of the patients had a follow-up for at least 2 weeks. One patient had a follow-up by e-mail, and three patients had a follow-up by phone call. 1st. recheck: (0–14 days) 37 dogs; 2nd recheck: (15–31 days) 26 dogs; 3rd recheck: (32–120 days) 21 dogs, 4th recheck: (120–1077 days) 12 dogs.

All the minor complications occurred within 2 weeks after surgery and were successfully treated with systemic therapy, including oral antibiotics (amoxicillin–clavulanic acid) and extended administration of anti-inflammatory medication (Carprofen or Metacam) (Figure 5). Microbiological samples were not taken and a broad-spectrum antibiosis was chosen for the start of the therapy. Additionally, an Elizabethan collar was used to prevent self-trauma and support the healing process. No surgical interventions were required for patients presenting with minor complications. Four major complications occurred in the first month after the surgery, while the last one occurred 50 days after the initial surgery. The Bordeaux mastiff showed recurrence of entropion 3 years after the initial surgery. Topically antibiotic ointment was given three times daily in the affected eyes till

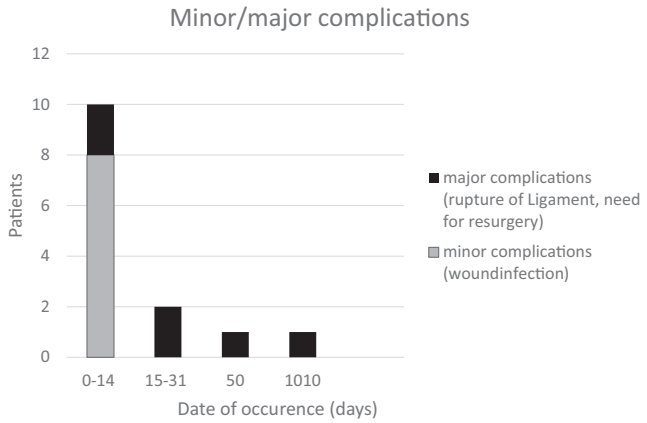

FIGURE 5 | Complications classified by severity (minor and major) and time point of occurrence. All minor complications occurred in the first 2 weeks after surgery. All major complications beside two dogs happened in the first month after surgery.

symptoms of inflammations were gone or resurgery was scheduled as fast as possible.

4 | Discussion

Numerous surgical approaches have been outlined to address macroblepharon, aiming to restore the eyelid position and, consequently, restore normal function with a primary focus on enhancing ocular comfort. Some studies addressed this problem by shortening the upper and lower eyelids [2–4]. Nevertheless, there are only three studies where both upper and lower eyelids are shortened and additionally fixated on the underlying tissue: Bigelbach, Grussendorf, and Kecova et al. [5–7].

Bigelbach (1996) excises a trapezoid-shaped section of skin and orbicularis oculi muscle from the lateral canthus. The wound is closed with 4–0 to 5–0 simple interrupted sutures (suture material not specified), and a figure of eight suture is placed at the new lid commissures. These sutures are anchored to the deep fascia underlying the orbicularis oculi muscle to create permanent lateral tension [5].

In the procedure by Grussendorf [6] for giant breed of dog, a triangular piece of skin is resected; both the upper and lower eyelids are shortened and the new lateral canthus is fixated and repositioned using a traction suture anchored on the orbital ligament with ETHILON 3–0 (Ethicon, NJ, USA). Kecova, Miller, and Lindley (2024) resected a trapezoidal-shaped skin section and the original lateral canthal ligament. They used absorbable suture material (V4-0 Vicryl, Ethicon, NJ, USA) to anchor the canthus to the subcutis, rather than to the orbital ligament, as done in the present study [7]. The deep subcutaneous layer was closed using VICRYL 4–0, Ethicon, NJ, USA, and the united margins of the upper and lower eyelids are tied to the subcutaneous tissue with the same suture. In comparison to the present study, Kecova, Miller, and Lindley [7] used an absorbable suture material (4–0 VICRYL, Ethicon, NJ, USA) to anchor the canthus on the subcutis and not the orbital ligament.

Macroblepharon is frequently observed in large dog breeds [9]. Newfoundland dogs, St. Bernards, Cocker Spaniels, English Bulldogs, Great Danes, and Rottweilers were represented in our study, similar to the publications by Grussendorf with 27 dogs and Kecova, Miller, and Lindley with 85 dogs [6, 7]. In the present study, the majority of dogs were male (72%), as with Carrozza et al. [10] with 20 of 31 treated patients for macroblepharon. In the study by Walter et al. [11], the gender distribution consisted of 58.3% intact males, 25.0% intact females, 8.3% spayed females, and 8.3% neutered males, which is comparable to this study. Grussendorf and Bigelbach do not specifically mention the gender distribution, while Kecova, Miller, and Lindley report 54 of 85 dogs being male [5–7]. This might be due to the fact that males have longer eyelid length than females [11]. Patients with major complications in this study were all male, except one female spayed Great Dane Dog. No other study addresses the gender distribution of postoperative complications. The age of the patients, which had surgery in the present study, spanned from 4 to 228 months with a median age of 23 months and a mean age of 46 months. Most patients were under 50 months, meaning that they were young adult dogs. The animals showed a fully developed skull and were therefore taken to surgery. Operating on young dogs can mean that further surgery may be required as they age and mature. Grussendorf and Bigelbach do not mention the age of their patients [5, 6]. In Bigelbach, only eight dogs with ectropion–entropion were operated with this method, making it challenging to accurately state the success rate. Furthermore, the study does not mention the properties and characteristics of the suture used for fixation [5]. In the study from Kecova, Miller, and Lindley [7] the mean age was 29.5 months, showing comparable results to this study.

This study's method yielded a success rate of 94.8% with 4 of 77 eyes needing a second surgical procedure due to rupture of the fixation. In the study of Grussendorf (2004) for 22 of 27 dogs, the eyelid function was deemed excellent (81% success rate). However, four Great Danes exhibited residual mucus within the conjunctival sac, attributing to residual pocket syndrome. Additionally, one Newfoundland dog experienced lacrimation in one eye, which was attributed to the loss of 50% of the third eyelid. In two dogs, sutures had to be replaced a few days after the initial surgery due to scratching, but no rupture of the fixation had occurred [6]. With Kecova, Miller, and Lindley [7] the success rate was even higher than in the present study with only six of 153 eyes requiring resurgery (96% success rate). Their main complications occurred in two English Bulldogs requiring resurgery in all four eyes due to allergic blepharitis. Minor complications like suture dehiscence occurred in a few dogs and could be fixed under mild sedation and local anesthesia [7]. Minor complications in 11 eyes of eight patients in this study may be attributed to various factors. Except for two English Cocker Spaniels, a Briard and a Boxer, all patients belonged to giant breed dogs. The excessive amount of skin in all breeds, except for the Briard, might have posed a greater challenge for the owner during postoperative care. In Walter et al. [11], heavy and thick skin was linked to more difficult postoperative management by owners, as well as potentially faster resorption of the absorbable suture material due to moisture at the surgical site.

TABLE 2 | All the patients with the concurrent ophthalmologic diseases.

Patient	Breed	Sex	Age (months)	Concurrent eye disease
1	Shar-Pei	Male	14	OU macroblepharon, OU mild ectropion
2	Great Dane	Male	7	OU nictitating cartilage eversion (OS > OD) OU macroblepharon, OU Nictitating gland hyperplasia
3	Cane Corso	Male	8	OS nictitating cartilage zyst after repositioning, OU Macroblepharon
4	Bobtail	Male, Castrated	143	OU cataract (hypermature), OU Macroblepharon, OU lens induced Uveitis
5	Cocker Spaniel	Male, Castrated	90	OU: macroblepharon, mild lower lid ectropion, OU: distichiasis, OU: trichiasis, OU: KCS
7	Cane Corso	Male	11	OU macroblepharon, OU nictitating gland hyperplasia
8	Cocker Spaniel	Male	126	OU macroblepharon, OU: severe KCS, OU pigmentary keratitis
9	Great Dane	Male	47	OU Macroblepharon, OD keratitis with Pannus, OS KCS, OS microphacia
10	Cane Corso	Male	10	OD stromal ulcer, OD secondary anterior uveitis, OD prolapse of the hyperplastic nictitating gland (+/− cartilage of the Nictitating membrane), OU macroblepharon
11	Boerboel	Male	18	OU severe epiphora OS > OD; severe macroblepharon with secondary lower > upper eyelid entropion, OU; enophthalmos, OD; granuloma with lymphofollicular hyperplasia on the anterior surface of the nictitating membrane
12	St. Bernard	Female	64	OU macroblepharon with secondary ectropion/ entropion, OD > OS exposure-related conjunctivitis
13	English Bulldog	Female	10	OD corneal erosion, OU ocular brachycephalic Syndrome, OU macroblepharon, OU distichiasis, OU severe conjunctivitis (+/− allergy-related)
14	Cocker Spaniel	Female	15	OU: severe reactive conjunctivitis, OU macroblepharon, OU KCS, OS hyperplastic nictitating cartilage
15	Rottweiler	Male	33	OS: severe spasmodic entropion, OD mild entropion, OU macroblepharon, status post eyelid correction elsewhere, OS chronic erosion with severe keratitis, OD suspected corneal fibrosis
16	Great Dane	Female, Spayed	16	OU macroblepharon, OS entropion, OS nictitating cartilage resection performed elsewhere in 2018, OS scarring and eversion of tissue located behind the nictitating membrane, OU conjunctivitis, OS KCS
17	Cocker Spaniel	Male	99	OU: macroblepharon, OU KCS both qualitative and quantitative, OS eyelid neoplasm, OD distichiasis, OU trichiasis
18	Irisch Setter	Male	17	OU: entropion of the upper lid, OU macroblepharon, OU medial canthal pocket syndrome, OU keratitis, OS single distichia.

(Continues)

TABLE 2 | (Continued)

Patient	Breed	Sex	Age (months)	Concurrent eye disease
19	Dogo Canario	Male	75	OU macroblepharon and entropion, OS status post wedge excision performed elsewhere, OD corneal ulcer with pannus formation, OU pigment keratitis, OD Retinopathy (suspected dysplasia)
20	English Bulldog	Male	58	OU macroblepharon, OU Upper lid entropion, OU lower lid ectropion, OU conjunctivitis (suspected allergic +/− mechanical), OU Nictitating gland hyperplasia
21	Cane Corso	Female	64	OS corneal dermoid recurrence, OS spastic entropion, OS > OD, OU diamond-shaped palpebral fissure, OU Nucleus sclerosis
22	Cocker Spaniel	Female, Spayed	122	OU KCS, OD keratitis, OU ectropium OU distichiasis OU nucleus sclerosis OU diamond-shaped eye
23	Great Dane	Female	8	OU: macroblepharon, diamond-shaped palpebral fissure; OU eversion of the third eyelid; OU microphacia
24	Great Dane	Male	32	OU: incipient cataract-OS lens coloboma OU diamond-shaped palpebral fissure (macroblepharon-entropium/ectropium)
25	Bloodhound	Female, Spayed	37	OU macroblepharon, OU entropion
26	Mixed Breed	Male	18	OU macroblepharon, OU entropion
27	English Springer Spaniel	Male	17	OU macroblepharon with ectropion, OU chronic conjunctivitis
28	Boxer	Male	37	OU macroblepharon OU distichiasis OL + UL OU chronic. Conjunctivitis, OS corneal Fibrosis, OU nucleus sclerosis
29	Great Dane	Male, Castrated	29	OU Macroblepharon, OU Entropium
30	Bordeaux Mastiff	Male	9	OS corneal erosion, OU severe M macroblepharon (diamond shaped palpebral fissure), OU distichiasis
31	Cocker Spaniel	Male	22	OU atresia of the lower lacrimal point, OU macroblepharon with ectropion, OU conjunctivitis, OD MPP remnants
32	Mastino Napolitano	Male	8	OD prolapse of hyperplastic nictitating gland, OU ocular brachycephalic Syndrome, OU diamond shaped eyes, OU Conjunctivitis follicularis
33	Briard	Male	113	OU severe macroblepharon with ectropion OS eyelid tumor on the upper eyelid, OU severe chronic exposure-related Conjunctivitis, OU blepharitis
34	Bullmastif	Male	23	OU macroblepharon with entropion, OU distichiasis, OU conjunctivitis
35	Newfoundland dog	Male	19	OU macroblepharon with ectropion
36	St. Bernard	Male	35	OU macroblepharon with ectropion, OU distichiasis
37	Landseer	Female	5	OU macroblepharon
38	St. Bernard	Male	95	OU macroblepharon, OS: corneal defect
39	Bordeaux mastiff	Female	17	OU macroblepharon

Abbreviations: OD, Oculus dexter; OS, Oculus sinister; OU, Oculus uterque.

Suture material and intraoperative tissue handling may contribute to secondary surgical site infections [11]. The differences in surgical site infections observed between studies could be attributed, at least in part, to the distinct suture materials used. The specific properties of each material, such as their absorption rate and interaction with tissue, may influence the risk of infection, making the selection of suture material a critical factor in surgical success. Reason for the rupture of the fixation could be the use of relatively thick, non-absorbable suture material for fixation on the orbital ligament. The material could have caused delayed wound healing, leading to the patient's discomfort, prolonged and disrupted healing time, and increased automutilation. More data concerning each suture material would be necessary to draw conclusions. Bigelbach [5] did not mention specific suture material for fixation, so no comparison can be made. Only Grussendorf [6] used a non-absorbable but thinner 3–0 Ethilon (Ethicon) in all patients, with 2/27 dogs needing resurgery.

Multiple surgeons who underwent their training at a veterinary teaching hospital performed the procedure under supervision and this might increase the risk for complications in comparison to Biegelbach, Grussendorf, and Kecova, Miller, and Lindley, with a single surgeon performing the procedure [5–7].

The follow-up time varied widely, ranging from 5 to 1077 days. This variability can be attributed to several factors: Patients often presented with additional ophthalmologic diseases (Table 2) requiring further monitoring, and as a referral clinic, many patients were lost to follow up with their referring home veterinarians. Additionally, patients from distant locations were less likely to return for rechecks. To enhance the reliability of this study, we included a patient with a follow-up of only 5 days, as well as those with at least one follow-up, even if conducted remotely via email or telephone. The loss of nearly 50% of the dogs by the 3-month follow-up is concerning, particularly given the young age of the animals and the potential for continued changes in facial structure as they mature and their skin ages. Extended follow-up would be valuable to monitor for potential recurrence of entropion or detachment of the fixation from the orbital ligament, especially considering that facial morphology in young dogs may continue to evolve over time.

Since all but one major complication (recurrence of entropion) occurred within 50 days post-surgery, a minimum follow-up period of 2 months is strongly recommended to capture potential complications more effectively.

5 | Conclusion

The surgical procedure is a suitable method for correcting diamond-shaped eyes (success rate 94.8%). However, it is essential to inform the owner that significant complications, such as rupture of the fixation on the ligament or recurrence of entropion, may arise. These issues could necessitate additional surgery, with male dog breeds with excessive facial skin being particularly at risk. Due to the postoperative care involving ointment application and wound management, surgery must be carefully considered in patients with poor compliance.

Author Contributions

Maximilian Werner-Tutschku: conceptualization, data curation, formal analysis, investigation, methodology, project administration. **Barbara Nell:** conceptualization, supervision, writing – review and editing.

Acknowledgments

The authors would like to thank the team of the Ophthalmology Service for the help in providing the images for this study.

Ethics Statement

The procedure adhered to the Guidelines for Ethical Research in Veterinary Ophthalmology.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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