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Evaluation of third eyelid transposition and bandage contact lenses for the treatment of corneal ulcers in dogs

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Abstract

Corneal ulcer is a painful ocular condition commonly affecting brachycephalic breeds. Most of the medical and surgical therapies are expensive, hard to obtain, less efficacious or require high technical skill. This study aimed at comparing two simple and low-cost techniques, namely bandage contact lens application and third eyelid transposition, for the treatment of corneal ulcers with respect to efficacy, outcome and ease of application. Both the techniques were found to be beneficial, with all the treated animals regaining almost completely transparent cornea by 14th post-operative day. In the animals treated with bandage contact lens, the healing could be assessed regularly and this was seen as the major advantage in this method. The advantage of third eyelid flap was that it was intact in all the animals, whereas bandage contact lenses were often lost prematurely. Many other minor advantages and disadvantages were observed and duly recorded.

Keywords: Corneal ulcer, bandage contact lens, third eyelid transposition, brachycephalic breeds

1. Introduction

With increased popularity of pets in cities, corneal ulcer is a major emerging ocular affection in brachycephalic breeds of dogs. Corneal ulcers are not only extremely painful, but also pose a serious threat to vision and overall well-being of the animal if left untreated.

Kirschner (1990) [6] stated various etiologies of corneal ulcers such as morphologic and neurologic abnormalities of the eyelids, distichiasis or ectopic cilia, tear film abnormalities, deficiencies of corneal innervation, foreign bodies, microbial infection, spontaneous chronic corneal epithelial defects (SCCED), and ulcerative keratitis associated with bullous keratopathy. Moore (2003) [8] gave a simple and clinically relevant classification of corneal ulcers. He considered ulcers that included only the epithelial layer and minimally involved the stroma or did not involve the stroma at all as superficial ulcers. Ulcers that involved one half or greater than half of the stromal depth could be termed deep ulcers. Ulcers that extended up to the Descemet's membrane could be called Descemetocoeles.

A wide variety of medical and surgical treatments have been devised, with varying efficacies. Popular techniques, like conjunctival grafts or keratoplasties, demand a high level of surgical skill. Treatment with biomembranes and scaffolds is difficult due to high cost and low availability. Medical therapies have been found to be useful only to a limited extent. Many cases of corneal ulcers go untreated or receive inadequate treatment because of lack of awareness about simpler and cheaper techniques.

Against such a backdrop, the present study aimed to evaluate two low-cost treatments (namely application of bandage contact lens and third eyelid transposition) which are minimally invasive and do not require high surgical skill.

Wooff and Norman (2015) [13], Grinninger *et al.* (2015) [5], Morgan *et al.* (1984) [9] and many others reported good outcomes and reduced healing time when bandage contact lenses were used. Authors like Turner (2008) [11] and Cooper (2018) [2] favoured third eyelid transposition technique, stating that third eyelid flap was a quick and easy procedure that was less invasive. It ensured the protection of the cornea and provided compression to the corneal epithelium, which aided in adhesion.

2. Materials and Methods

The study was carried out in the Department of Veterinary Surgery and Radiology, Veterinary

College Hospital, Hebbal, Bengaluru.

Twelve dogs with corneal ulcers were selected and divided into two groups irrespective of breed, age and sex. The Group A, consisting of six dogs with corneal ulcer, were subjected for application of bandage contact lens and Group B, consisting of six dogs with corneal ulcer, were subjected to third eyelid transposition. Details regarding the breed, age and sex of the dogs is given in Table 1a and 1b.

Thorough physical, physiological and ophthalmic examination was conducted to assess the severity of ulcer and to rule out systemic illnesses. Corneal swabs were collected and subjected to culturing and antibiotic sensitivity testing. Diagnosis of corneal ulcer was confirmed using fluorescein dye test. Xerophthalmia was ruled out using Schirmer Tear Test. Vision function tests were performed regularly to assess quality of vision.

2.1 Pre-surgical preparation

The dogs were kept off-feed for approximately 12 hours and without water for approximately 6 hours prior to the procedure. Pre-operative antibiotic Ceftriaxone at 25 mg/kg body weight (intravenous) and analgesic Meloxicam at 0.3 mg/kg body weight (subcutaneous) were administered 30 minutes before the procedure. Atropine sulphate at 0.04 mg/kg body weight (subcutaneous) and Xylazine hydrochloride at 1mg/kg body weight were administered intramuscularly as pre-anaesthetics. General anaesthesia was induced with 2.5% thiopentone sodium at the dosage of 12.5 mg/kg body weight intravenously and maintained with bolus injection of the same to effect.

2.2 Surgical procedure

In both groups, the corneal ulcer was debrided using sterile dampened cotton-tipped ophthalmic swabs from the centre of the ulcer towards the periphery.

Following corneal debridement, for Group A dogs, a soft bandage contact lens (AcuvueR Oasys™ with Hydraclear™ Plus with Base Curve of 8.8mm and diameter of 14mm) was placed on the cornea, taking care to exclude the third eyelid. The lens was removed after 7 days and re-applied for 7 more days if necessary. For Group B dogs, third eyelid transposition was performed by securing the third eyelid to the lateral aspect of the upper eyelid using a single quill suture. The third eyelid flap was released on the 7th day and reapplied if necessary.

2.3 Post-operative care

The dogs were medicated with the appropriate antibiotic in accordance with the results of the antibiotic sensitivity test. Elizabethan collar was applied to prevent self-mutilation.

2.4 Post-operative evaluation

Corneal opacity and vascularisation were evaluated after the surgery and on 7th, 14th and 28th days. Changes in corneal opacity and vascularisation were monitored by using the SPOTS system of grading as introduced by Eaton *et al.* (2017), who included a scale of five categories:

0 - Normal cornea.

1. Minimal corneal opacity. With diffuse illumination, the underlying structures are clearly visible.
2. Mild corneal opacity. With diffuse illumination, the underlying structures are visible, with a reduction in the detail.

3. Moderate corneal opacity. With diffuse illumination, there is a greater reduction in the underlying details but the observer is still able to observe for pupillary response and lenticular changes.
4. Severe corneal opacity. With diffuse illumination, the underlying anterior segment structures cannot be seen.

Corneal vascularisation was evaluated after the surgery and on 7th, 14th and 28th days and graded as follows:

0 - No vascularization observed.

1. Vascularization present but vessels do not penetrate further than 2mm axially.
2. Vascularization present and vessels penetrate further than 2mm axially.

3. Results and Discussion

The haematological and biochemical parameters of all the dogs were in the normal range and did not show any significant variations.

3.1 Microbiological analysis

The organisms isolated from the corneal ulcers were Staphylococcus, Escherichia, Streptococcus and Klebsiella with Staphylococcus species being the most common. The cultures were commonly susceptible to fluoroquinolones, aminoglycosides, tetracyclines and cephalosporins. Moore and Nasisse (1999) [7] were of the opinion that *Staphylococcus* spp., *Streptococcus* spp. and *Enterococcus* spp. were opportunistic bacteria that were isolated from canine eyes.

3.2 Retention of lens

The Mean \pm SE time of retention of the contact lens was 3.22 \pm 0.33 days with the highest retention time being 7 days in a Boxer (Case 4) and a non-descript dog (Case 5) and the lowest being 1 day in a Shih Tzu.

However, Diehl *et al.* (2018) [3] recorded a much higher average retention time (7.5 days) when the same bandage contact lens (AcuvueR Oasys™ with Hydraclear™ Plus) were applied in Beagles. They recorded that each lens remained in place for atleast 1 day and the longest retention time seen in the study was 14 days. Bossuyt (2016) [1] in their study, used Bausch and Lomb Purevision bandage contact lenses and reported a mean retention time of 10.6 days. It was observed that only 30% of the dogs included in the study had exaggerated brachycephalic features, including lagophthalmos. Further, it was observed that only two pugs were included in the study and the bandage contact lens was not retained even for one day in these two dogs. The longer retention times reported may be due to the higher number of non-lagophthalmic breeds included in their studies.

3.3 Time of healing of ulcer

Fluorescein dye test was positive for all animals on 0th day, pre-operatively. In both Group A and Group B, two animals showed negative Fluorescein dye test on the 7th post-operative day and other four animals showed negative fluorescein dye test on 14th post-operative day.

3.4 Schirmer tear test

The Mean \pm SE STT value pre-operatively was 24.00 \pm 0.67 for Group A and 23.17 \pm 0.55 for Group B. Post-operative values on 1st, 3rd, 5th, 7th, 14th and 28th days ranged from 18.33 \pm 0.73 to 22.83 \pm 0.44 for Group A and from 18.17 \pm 0.68

to 23.17±0.55 for Group B. The values were within the normal range with a statistically significant decrease from 7th post-operative day ($p<0.05$) as shown in Fig. 1. The higher readings pre-operatively could be due to the excessive lacrimation due to pain and ocular irritation (Williams and Burg, 2017) [12], which gradually reduced as the ulcer healed.

3.5 Vision function tests

Palpebral reflex, menace response, cotton-ball test and pupillary light reflex were evaluated in all the animals before the surgery, immediately after the surgery and on 1st, 3rd, 5th, 7th, 14th and 28th days post-operatively. Palpebral reflex was normal throughout the study period in all the dogs.

In the dogs treated with bandage contact lens, pupillary light reflex could be assessed regularly and was normal in all the animals from Day 3 onwards. Menace response and response to cotton ball test were initially found to be sluggish and improved by Day 7. They were normal by Day 14.

In the dogs treated with third eyelid transposition, the vision function tests could not be performed until Day 7 due to presence of the third eyelid flap. Pupillary reflex was normal in all animals on day 7. Menace response and response to cotton ball test were initially found to be sluggish and improved by Day 7. They were normal by Day 14.

3.6 Corneal opacity

All the dogs showed moderate to severe corneal oedema and opacity at first presentation. In animals belonging to Group A, a gradual decrease in opacity was seen and was markedly reduced by Day 5. The opacity progressively reduced on subsequent days and was negligible by the 14th post-operative day in 5 out of 6 animals belonging to Group A. The 6th animal showed moderate opacity on the 14th day. Corneal opacity was not observed in any of the animal on 28th post-operative day (Fig. 2-9)

In Group B, the reduction in opacity could not be observed until 7th post-operative day, due to presence of the third eyelid flap. On the 7th day, most of the cases showed mild to moderate opacity, which resolved completely by 28th post-operative day in 4 out of 6 animals. The remaining two animals had a mild degree of corneal scarring and hence displayed mild corneal opacity even on the 28th post-operative day (Fig. 10-14)

3.7 Corneal vascularisation

All the dogs showed mild to extensive superficial corneal vascularization at first presentation. This is could be due to the fact that the animals were presented at different stages of the pathophysiology of the ulcer. In animals belonging to Group A, an increase in vascularisation was seen immediately post-operatively. According to Ramamurthi *et al.* (2006) [10], this could be due to the debridement of the ulcer, which caused inflammation and promoted healing from the healthy borders.

The vascularization progressively resolved on subsequent days and was not observed on 28th post-operative day. In Group B, the vascularisation could not be observed until 7th post-operative day, due to presence of third eyelid flap. On the 7th day, most of the cases showed mild to moderate vascularisation, which resolved completely by 28th post-operative day.

4. Tables and Figures

Table 1a: Anamnesis of dogs belonging to Group A (bandage contact lens)

Breed	Age	Sex
Shih Tzu	3 months	Female
Shih Tzu	4 months	Male
Shih Tzu	3 months	Female
Boxer	8 years	Female
ND	2 years	Male
Pekingese	1 year	Female

Table 1b: Anamnesis of dogs belonging to Group B (Third eyelid transposition)

Breed	Age	Sex
Pug	9 months	Male
Shih Tzu	2 months	Female
Shih Tzu	3 months	Female
Shih Tzu	4 months	Male
Shih Tzu	4 months	Female
Shih Tzu	5 months	Female

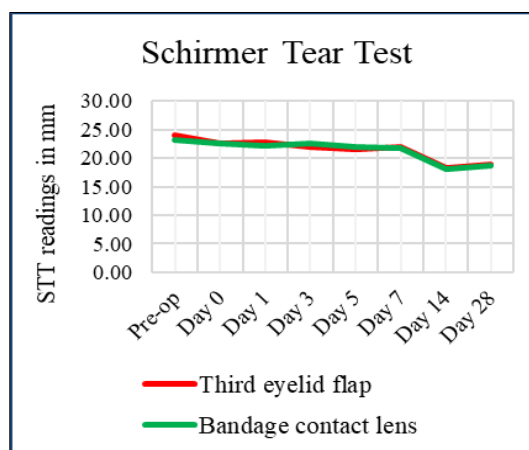


Fig. 1: Trendline of STT values



Fig 2: Pre-operative photo of corneal ulcer in a female Boxer

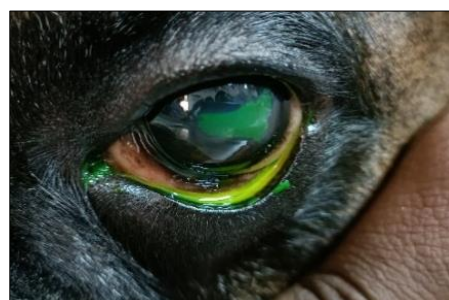


Fig 3: Fluorescein dye test



Fig 4: Day 3 post-operative



Fig 5: Day 5 post-operative



Fig. 6: Day 7 post-operative – lens in-situ



Fig 7: Healed ulcer showing negative Fluorescein dye test on Day 7 post-operative



Fig 8: Reduced corneal opacity and negative Fluorescein dye test on Day 14 post-operative



Fig 9: Appearance of cornea on Day 28 post-operative



Fig 10: Pre-operative photo of corneal ulcer in a Shih Tzu puppy



Fig 11: Positive fluorescein dye test



Fig 12: Day 7 post-operative with negative fluorescein dye test



Fig 13: Improved corneal opacity on Day 14

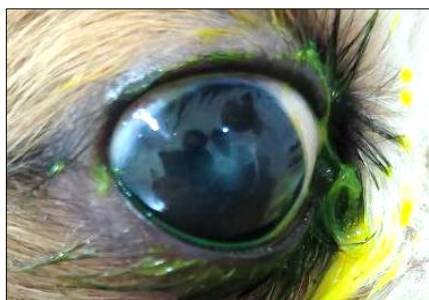


Fig 14: Appearance of healed cornea on Day 28

5. Conclusions

5.1 Bandage contact lens

The lens was soft, easy to place and showed good adherence upon placement. The Base Curve of 8.8 mm was observed to be adequate. The diameter of 14mm was found to be inadequate to cover the entire cornea of brachycephalic breeds like Shih Tzu and Pug. The main advantage was the ability to monitor and assess the corneal healing and vision function. The contact lens had micropores which allowed for proper action and maximum efficacy of topical medications. The main disadvantage observed with the use of bandage contact lens was their premature loss in brachycephalic animals. Corneal opacity was not observed in any of the animals on 28th post-operative day.

5.2 Third eyelid transposition

This technique proved effective in the healing of corneal ulcer. However, it hindered the monitoring and assessment of corneal healing and vision function. Turner (2008) [11] also observed that the hindrance to regular monitoring made it a poor choice in case of infected ulcers. The efficacy of topical medications could not be determined as there have been no studies conducted on the diffusion of topical medications across the third eyelid, to the authors' knowledge. The technique was more invasive than placement of contact lens. Two cases retained mild degree of corneal opacity by 28th post-operative day.

In conclusion, both the techniques were found to be effective for the treatment of corneal ulcers. Application of bandage contact lens was found to be easier, more convenient and less invasive than third eyelid transposition. Bandage contact lens was found to be unsuitable in dogs with extreme brachycephalic and lagophthalmic features. The diameter of the lens was insufficient for use in peripheral ulcers. Third eyelid transposition required greater skill and hindered the monitoring of corneal healing. The risk of self-mutilation was also greater in this technique.

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