

## PAPER

# Use of bandage contact lenses for treatment of spontaneous chronic corneal epithelial defects in dogs

P. GRINNINGER\*, A. M. J. VERBRUGGEN†, I. M. G. KRAIJER-HUVER\*, S. C. DJAJADININGRAT-LAANEN\*, E. TESKE‡ AND M. H. BOEVÉ\*

\*Ophthalmology Section, Department of Clinical Sciences of Companion Animals, Utrecht University, 3584 CM Utrecht, The Netherlands

†Kliniek voor specialistische diergeneeskunde, 3068 SB Rotterdam, The Netherlands

‡Internal Medicine Section, Faculty of Veterinary Medicine, Utrecht University, 3584 CM Utrecht, The Netherlands

Dr. Grinninger's current address is Hauptstraße 44/13, 8302 Nestelbach, Austria.

Presented in abstract form at the Annual Congress of the European College of Veterinary Ophthalmologists, Trieste, May 2012.

**OBJECTIVE:** To determine whether polyxylon bandage contact lenses influence healing time and ocular comfort in the management of spontaneous chronic corneal epithelial defects in dogs.

**METHODS:** Twenty dogs with spontaneous chronic corneal epithelial defects were included. All dogs were treated by debridement under topical anaesthesia at the first presentation. Ten dogs were assigned to the study group (application of a polyxylon bandage contact lens), and the remaining ten served as a control group. The healing time and ocular (dis)comfort were evaluated by assessment of the clinical findings and an owner-based questionnaire. All dogs received the same topical and systemic medication.

**RESULTS:** Healing time for dogs in the study population was significantly shorter (mean 14±0 days) than for dogs in the control group (mean 36±17 days; P=0.005). The spontaneous chronic corneal epithelial defects had completely healed at the first recheck in all dogs with a polyxylon bandage contact lens. The duration of blepharospasm following debridement was significantly shorter in the study population (mean 4±4 days) than in the control group (mean 30±20 days; P=0.001).

**CLINICAL SIGNIFICANCE:** The use of polyxylon bandage contact lenses is beneficial in the management of spontaneous chronic corneal epithelial defects.

*Journal of Small Animal Practice* (2015) **56**, 446–449  
DOI: 10.1111/jsap.12360

Accepted: 9 March 2015; Published online: 17 April 2015

## INTRODUCTION

Multiple therapeutic options with variable success rates have been described for the management of spontaneous chronic corneal epithelial defects (SCCEDs). These include topical treatment with aminocaproic acid, aprotinin, chondroitin sulfate, epidermal growth factors, fibronectin, glycosaminoglycans, insulin-like growth factor, substance P and tetracycline (Kirschner 1990, Ledbetter *et al.* 2013). Surgical options comprise epithe-

lial debridement, diamond burr debridement, punctate or grid keratototomy, superficial keratectomy, and nictitating membrane flaps (Kirschner 1990, Kindler & Schieszler 2012, Ledbetter *et al.* 2013). Additional management options include thermal cautery (Bentley & Murphy 2004), cyanoacrylate tissue adhesive (Bromberg 2002), collagen shields (Morgan & Abrams 1994) and soft contact lenses (Schmidt *et al.* 1977, Morgan *et al.* 1984, Morgan & Abrams 1994, Espejo & Gomez de Iturriaga 2010, Martinez *et al.* 2010).

Previous reports describing the use of soft contact lenses have demonstrated encouraging results. In one study, contact lenses (Bausch & Lomb or Warner-Lambert Company) appeared to be beneficial in the treatment of superficial and recurrent corneal ulcers in cats and dogs (Schmidt *et al.* 1997). Regrettably, the lenses were often lost before therapeutic effectiveness could be appropriately evaluated. Improved healing was seen in 75% of the cases suffering from chronic superficial corneal ulcers or severe corneal irritation in another study (Morgan *et al.* 1984). Again, the major disadvantage of the lenses was their repeated loss. Since commercially available soft contact lenses for veterinary use have been developed, their therapeutic potential in animals has increased. Hydrophilic polyxylon bandage contact lenses (BCLs) designed for dogs have been demonstrated to be an effective tool in the management of refractory ulcers as they help to protect the new epithelium and to maintain apposition to the stroma (Morgan & Abrams 1994, Bentley & Murphy 2004, Espejo & Gomez de Iturriaga 2010, Chandler *et al.* 2010, Martinez *et al.* 2010, Gosling *et al.* 2013). However, few clinical studies have been published that critically evaluate the effectiveness of soft contact lenses in the management of SCCEDs (Morgan *et al.* 1984, Morgan & Abrams 1994, Gosling *et al.* 2013). Therefore, the objective of the present study was to determine whether polyxylon BCLs (AcriVet Pat D, S&V Technologies AG, Acrivet veterinary division, Berlin, G) positively influence healing time and improve comfort in the therapy of SCCEDs in dogs.

## MATERIALS AND METHOD

Twenty dogs that were presented to either the Faculty of Veterinary Medicine, Utrecht University (NL) or a private referral clinic in Rotterdam (NL) were enrolled in the study. Before inclusion, all dogs underwent a complete ophthalmic examination including Schirmer tear test (Intervet Inc. Roseland, NJ, USA), slit lamp examination (SL 14 handheld slit lamp, Kowa, Tokyo, Japan), fluorescein staining (Haag-Streit International, K oniz, CH) applanation tonometry (Tono-Pen, Mentor, Norwell, MA, USA) and indirect ophthalmoscopy (Heine Omega 200, Heine Optotechnik, Herrsching G). SCCED was diagnosed using the following criteria: presence of an epithelial defect surrounded by non-adherent epithelium, retention of fluorescein dye, and no clinical evidence of infection. Exclusion criteria were: presence of tear film abnormalities, abnormal lid function or lid anatomy.

Prior to participation in the study, all owners provided informed consent. All research was performed in accordance with the institutional animal care committee of Utrecht University. At both participating clinics, the criteria and treatment were identical. During initial presentation, all dogs were treated by debridement of the corneal ulcer with a Meyerhoefer chalazion curette under topical lidocaine (Lidocaine 0.4%, AST farma, Oudewater, NL), with a 5 $\times$  magnifying loupe. In this randomized study, two groups were created with 10 dogs in the study group (application of a BCL), and the remaining 10 served as a control group. Commercially available BCLs (AcriVet Pat D, S&V Technologies AG, Acrivet veterinary division, Berlin, G)

were used, which composed of 2-hydroxyethylmethacrylate and vinylpyrrolidone and 75% water. The inner surface of these lenses contains a nanostructure for better dispersion of eye drops and support of self-purification. They are permeable to oxygen and have no refractive power. The lenses are available in nine different types (Table 1) depending on the diameter (15.5–22.0 mm) and curvature (8.5–11.8 mm). BCL size was selected using a measuring stencil. The BCL was placed immediately following debridement under topical anaesthesia, and using a small plastic forceps supplied by the manufacturer.

To minimize the risk of infection and provide analgesia by inducing cycloplegia, respectively, all dogs in both groups received a combination of polymyxin B and trimethoprim ophthalmic drops (Polytrim, Allergan Allergan Inc., Irvine, CA, USA) q 8 hours and atropine drops (Atropine 0.5%, ASTfarma BV, Oudewater, NL) q 24 hours until the corneal erosion had healed. Oral treatment consisted of carprofen 2 mg/kg (Rimadyl, Pfizer, Capelle a/d IJssel, NL) q 12 hours for 3 days after the debridement. An Elizabethan collar was used at the discretion of the owners to prevent self-trauma. Throughout the study, these treatments are referred to as standard therapy.

All cases were rechecked at 14-day intervals until the SCCED had healed. The SCCED was considered healed when no epithelial defect was detectable using slit-lamp biomicroscopy and the cornea no longer retained the fluorescein dye. If the corneal defect was present, the debridement was repeated, medication continued and a recheck was performed 14 days later. If the corneal defect persisted at the third recheck, the affected eyes were treated by another method such as punctate or grid keratotomy and/or a nictitans flap.

The owner questionnaire evaluated ocular (dis)comfort, blepharospasm and excessive lacrimation, missed treatment applications and adverse effects. All applicable data were entered into a spreadsheet (Microsoft Excel 2010, Microsoft Corporation, Washington, USA). Numerical values are reported as mean $\pm$ SD. Normal distribution of data was assessed using the Kolmogorov–Smirnov test. t-Test for independent samples were used in order to determine the difference between the duration of the corneal erosion, healing time, ocular comfort and duration of excessive lacrimation between the two groups. Chi-square

**Table 1. Overview of different AcriVet Pat D BCL sizes**

BCL size	Diameter (mm)	Base curve (mm)	Recommended for
D1	18.0	9.6	Medium-sized dogs – Collies, Huskies
D2	18.0	9.8	Bigger medium-sized dogs – Retrievers, Boxers
D3	20.0	10.4	Large dogs
D4	15.5	8.5	Young dogs
D5	22.0	11.4	Very large eyes
D6	22.0	11.8	Cover the range between the other lenses
D7	20.0	11.2	Cover the range between the other lenses
D8	20.0	10.8	Cover the range between the other lenses
D9	18.0	10.0	Cover the range between the other lenses

tests were used to assess the distribution of female and male dogs. With the Mann–Whitney test a comparison between the groups was made concerning age. A value of *P* less than 0.05 was considered significant for all analyses.

## RESULT

The duration of SCCED prior to referral ranged from 7 to 127 days (mean  $45 \pm 34$  days) in the study population and 7 to 120 days (mean  $50 \pm 39$  days) in the control group. This difference was not significant ( $P > 0.05$ ). Medical treatment prior to referral included topical antimicrobials ( $n=22$ ), topical atropine ( $n=1$ ), topical vitamin A ointment ( $n=3$ ) and oral non-steroidal anti-inflammatory drugs ( $n=3$ ). None of the dog had received topical or oral corticosteroids. Surgical management prior to referral included epithelial debridement ( $n=4$ ), etching with iodine or phenol ( $n=2$ ), grid keratotomy ( $n=1$ ) and a third eyelid flap ( $n=1$ ) alone, or in combination ( $n=1$ ).

Jack Russell terriers ( $n=5$ ) and crossbred dogs ( $n=5$ ) were the most commonly affected breed in both groups, followed by Maltese ( $n=2$ ) and Staffordshire bull terriers ( $n=2$ ). Other breeds represented by one dog each were Airedale terrier, Alaskan malamute, beagle, Border collie, boxer, and Rottweiler.

The dogs age ranged from 1.3 to 11.2 years with a mean age of  $8.4 \pm 6.6$  years in the study group and a mean age of  $7.8 \pm 6.5$  years in the control group. The gender distribution was male ( $n=5$ ), neutered male ( $n=5$ ), female ( $n=3$ ) and neutered female ( $n=7$ ). There was no significant difference in the distribution of ages ( $P > 0.05$ ) or gender ( $P > 0.05$ ) between the treatment groups.

From the nine available contact lens sizes only D1 ( $n=1$ ), D2 ( $n=4$ ), D3 ( $n=1$ ) and D4 ( $n=4$ ) were used (Fig 1). Sizes D5–D9 were not selected for any dog.

At the first recheck, the SCCED had resolved in all eyes treated with a BCL ( $n=10$ , 100%), compared to 4 of 10 (40 %) eyes treated with the standard therapy only. Mean healing time was  $14 \pm 0$  days in the study group and  $36 \pm 17$  days (range 14–62 days) in the control group. The overall success rate was found to be

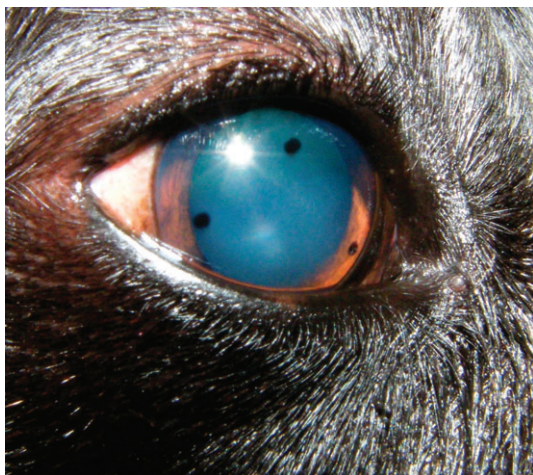


FIG 1. AcriVet Pat D BCL in situ at the first recheck

significantly higher in the study population than in the control group ( $P=0.005$ ). Analysis of the owner questionnaires revealed that the duration of blepharospasm was significantly longer in the control group (3–62 days, mean  $33 \pm 20$  days) than that in the study group (1–14 days, mean  $4 \pm 4$  days). There was no significant difference ( $P > 0.045$ ) between the two groups regarding the duration of excessive lacrimation. The duration of excessive lacrimation was 1–14 days (mean  $7 \pm 6$  days) and 3–14 days (mean  $4 \pm 5$  days) in the control group. Out of 10 ulcers, 6 ulcers in the control group persisted by the third recheck, i.e. after two debridements. These were subsequently treated by grid ( $n=3$ ) or punctate keratotomy ( $n=2$ ) and third eyelid flap ( $n=1$ ). According to the owner questionnaires therapy was carried out as prescribed by all owners.

## DISCUSSION

SCCED can be a frustrating problem for affected cases, their owners and veterinarians, because the response to treatment is so variable. Debridement is the most commonly performed procedure because removal of the loose epithelium is an essential step in the healing process (Kirschner 1990, Ledbetter *et al.* 2013). Even though debridement offers an acceptable rate of healing, superficial keratectomy is known to have the highest success rate and the shortest healing time (Kirschner 1990, Chandler *et al.* 2010, Ledbetter *et al.* 2013). However, disadvantages associated with the latter treatment include the need for sedation or general anaesthesia, increased costs for the owner and an increased risk of visible corneal scar formation (Kirschner 1990, Chandler *et al.* 2010, Ledbetter *et al.* 2013). Previous reports that evaluated the effectiveness of soft contact lenses in the management of SCCEDs have shown encouraging results (Morgan *et al.* 1984, Kirschner 1990, Morgan & Abrams 1994, Espejo & Gomez de Iturriaga 2010, Chandler *et al.* 2010, Martinez *et al.* 2010, Gosling *et al.* 2013). The mechanism by which the soft contact lenses facilitate healing is unclear. Proposed mechanisms include the pressure applied to the corneal epithelium by the contact lens and the protection of migrating corneal epithelial cells (Kirschner 1990, Chandler *et al.* 2010, Gosling *et al.* 2013). The advantages of a BCL include topical rather than general anaesthesia or sedation, the lesion can be directly examined, the treated eye is visual (depending on degree of corneal pathology) and there is good tolerance (Schmidt *et al.* 1977, Morgan *et al.* 1984).

In this study, the ulcer had healed at the first recheck in 100% of eyes with BCLs, as compared to 40% of the eyes treated with the standard therapy only. This success rate is higher than those reported in previous studies. One other report suggested that the use of soft contact lens had a positive influence on healing time in 72% of the cases with recurrent corneal erosions. According to these authors, improper fitting was the reason for failure in the other animals (Schmidt *et al.* 1977). In another study, insertion of a soft contact lens resulted in healing in 75% of the eyes concerned if the retention time of the contact lens was 10 days or longer (Morgan *et al.* 1984). An additional study suggested that the healing response of corneal erosions treated with contact lenses was considerably low (61.5%), even though the retention

time of the contact lens had been between 14 and 21 days (Morgan & Abrams 1994). A significantly shorter healing time and higher retention rate were reported in a more recent study (Gosling *et al.* 2013). The BCL retention rate was 95% throughout that study period of 52 days. The corneal ulcer healed in 92.5% of the patients after a mean time of 15.5 days.

Improved comfort in the present study ( $4\pm 4$  days in the treated group as compared to  $33\pm 20$  days in the control group) was in accordance with three previous studies (Schmidt *et al.* 1977, Morgan *et al.* 1984, Morgan & Abrams 1994). Assessment of the results of owner questionnaires indicated that blepharospasm was seen only for  $4\pm 4$  days in the study group whereas blepharospasm was seen up to  $33\pm 20$  days in the control group. No positive effect was found regarding the duration of lacrimation. In group 1 lacrimation was recorded by the owners for  $7\pm 6$  days and in group 2 for  $4\pm 5$  days.

Similar to previous reports (Kirschner *et al.* 1989, Morgan & Abrams 1994, Stanley *et al.* 1998, Bentley & Murphy 2004, Chandler *et al.* 2010, Ledbetter *et al.* 2013), the dogs included in the present study had an average age of 8.1 years and both sexes were equally affected.

From the nine available lens sizes, the D2 and D4 sizes were most commonly used. This can be explained by the fact that Jack Russell terriers and medium-sized crossbreed dogs were the most commonly affected breeds in this study. In contrast to other studies (Gelatt & Samuelson 1982, Kirschner *et al.* 1989, Kirschner 1990, Morgan & Abrams 1994, Stanley *et al.* 1998, Gosling *et al.* 2013, Ledbetter *et al.* 2013) only one boxer was involved in this study. This may be due to the fact that dogs with an abnormal lid anatomy (e.g. macroblepharon, entropion, ectropion or distichiasis) were excluded from the study.

In conclusion, the results in the limited number of dogs in the present study suggest that BCLs offer an effective adjunctive, non-invasive treatment modality for SCCEDs. Contact lenses are easy to place, offer minimal risk to the eye and are associated with reduced healing times and improved comfort. Case selection and proper fitting and application are, however, essential. Future studies are warranted to evaluate the BCL tolerance and the interaction and compatibility between soft contact lenses and ophthalmic drugs.

## Acknowledgements

Supported in part by Acrivet Veterinary Division of S&V Technologies AG (Acrivet Pat D1-9 contact lenses).

## Conflict of interest

None of the authors of this article has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

## Reference

- Bentley, E., Murphy, C. J. (2004) Thermal cautery of the cornea for treatment of spontaneous chronic corneal epithelial defects in dogs and horses. *Journal of American Veterinarian Medical Association* **224**, 250-253
- Bromberg, N. M. (2002) Cyanoacrylate tissue adhesive for treatment of refractory corneal ulceration. *Veterinary Ophthalmology* **5**, 55-60
- Chandler, H. L., Gemensky-Metzler, A. J., Bras, I. D., *et al.* (2010) In vivo effects of adjunctive tetracycline treatment on refractory corneal ulcers in dogs. *Journal of American Veterinarian Medical Association* **237**, 378-386
- Espejo V., Gomez de Iturriaga I. (2010) The use of bandage lenses in indolent corneal ulcers. A review of 40 clinical cases (2007-2010). Proceedings of the European Society of Veterinary Ophthalmologists. Dublin, Ireland, May 13 to 16, 2010. p 349
- Gelatt, K. N., Samuelson, D. A. (1982) Recurrent corneal erosions and epithelial dystrophy in the Boxer dog. *Journal of the American Animal Hospital Association* **18**, 453-460
- Gosling, A. A., Labelle, A. L., Breaux, C. B. (2013) Management of spontaneous chronic corneal epithelial defects (SCCEDs) in dogs with diamond burr debridement and placement of bandage contact lens. *Veterinary Ophthalmology* **16**, 83-88
- Kindler, S., Schiesler, A. (2012) Diamond burr superficial keratotomy and superficial linear keratotomy for the treatment of spontaneous chronic corneal epithelial defects (SCCEDs). Proceedings of the European College of Veterinary Ophthalmologists. Trieste, Italy, May 24 to 27, 2012, p E1
- Kirschner, S. E., Niyo, Y., Betts, D. M. (1989) Idiopathic persistent corneal erosion: clinical and pathological findings in 18 dogs. *Journal of the American Animal Hospital Association* **25**, 84-90
- Kirschner, S. E. (1990) Persistent corneal ulcers. What to do when ulcers won't heal. *Veterinary Clinics of North America: Small Animal Practice* **20**, 627-642
- Ledbetter, E. C. & Gilger, B. C. *et al.* (2013) *Diseases and surgery of the canine cornea and sclera*. In: *Veterinary Ophthalmology*. 5th ed. Eds K. N. Gelatt. Blackwell Publishing, Gainesville, FL, USA. pp976-1049
- Martinez, E. *et al.* (2010) Clinical usefulness of hydrophilic bandage lenses. Proceedings of the European Society of Veterinary Ophthalmologists. Dublin, Ireland, May 13 to 16, 2010. p 349
- Morgan, R. V. *et al.* (1984) An evaluation of soft contact lens usage in the dog and cat. *Journal of the American Animal Hospital Association* **20**, 885-888
- Morgan, R. V., Abrams K. L. (1994) A comparison of six different therapies for persistent corneal erosions in dogs and cats. *Veterinary Comparative Ophthalmology* **4**, 38-43
- Schmidt, G. M., *et al.* (1977) The use of hydrophilic contact lenses in corneal diseases of the dog and cat: a preliminary report. *Journal of Small Animal Practice* **18**, 773-777
- Stanley, R. G., Hardman, C., Johnson, B. W. (1998) Results of grid keratotomy, superficial keratectomy and debridement for the management of persistent corneal erosions in 92 dogs. *Veterinary Ophthalmology* **1**, 233-238