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The Use of Soft Contact Bandage Lenses for Corneal Ulcer in Dogs and Cats: A Review

Nattapat Pratumjorn[1], Natapol Pumipuntu[1,2], Ratchanon Kusolsongkhrokul[3], and Athip Lorsirigool[4,5*]

[1] *Faculty of Veterinary Sciences, Mahasarakham University, Maha Sarakham 44000, Thailand*
[2] *One Health Research Unit, Faculty of Veterinary Sciences, Mahasarakham University, Maha Sarakham, 44000, Thailand*
[3] *Pak Chong Animal Hospital, Nakhon Ratchasima, 30130, Thailand*
[4] *TerdThai Love Pet Clinic, Bangkok 10600, Thailand*
[5] *Department of Forensic Science, Faculty of Science and Technology, Suan Sunandha Rajabhat University, Bangkok 10300, Thailand*
*Corresponding author's Email: jlorsirigool@hotmail.com

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ABSTRACT

A corneal ulcer is the characteristic of the destruction of the corneal epithelium layer and loss of the stroma layer at various depths. At present time, soft bandage contact lenses are used in many countries for corneal ulcers in dogs and cats to protect their cornea, increase contact time with topical eyes solutions, and support corneal reepithelialization. This article aimed to review information on the use of soft contact bandage lenses to treat corneal ulcers in dogs and cats interms of their efficacy and precaution. The results of the present review have revealed that soft contact bandage lenses are used to protect the cornea, enhance contact time with topical eye treatments, reduce median healing time, and provide comfort in dogs and cats with corneal ulcers. In the case of serious infections and dry eyes, soft contact bandage lenses are not recommended.

Keywords: Corneal ulcer, Incidence, Soft contact bandage lenses, Treatment

INTRODUCTION

The cornea is the front part of the eyes covering the iris, pupil, and anterior chamber (Farghali et al., 2021). A corneal ulcer is characterized by damage to the corneal epithelium layer (superficial corneal ulcer) and loss of the stroma layer at various depths (deep corneal ulcer) (Kartashov et al., 2019). The severity of a corneal ulcer depends on the size, depth, edema, the appearance of keratomalacia, and present hypopyon or hyphae at the anterior chamber (Ekapopphan et al., 2018). There are various risk factors for corneal ulcers in dogs and cats, including congenital abnormalities, the anatomical structure of the eyes (some breeds risk of dry eyes, such as Pug and Shih-Tzu), trauma (fighting, accidents), infections (herpes virus, parasites), and systemic diseases such as diabetes mellitus and infectious canine hepatitis (Croix et al., 2001; Good et al., 2003; Sykes, 2014; Kartashov et al., 2019; Patel et al., 2020).

Diagnosis of corneal ulcer

Methods for diagnosis of corneal ulcer begin with taking into account the history of the patient and general physical examinations. Pets with corneal ulcers often squint with the painful eye and experience tearing, redness, and increased corneal opacity (Patel et al., 2020; Kim et al., 2021). A complete ophthalmic examination should be performed on both eyes, including the Schirmer tear test (STT) to measure the level of tears, intraocular pressure to measure the fluid pressure of the eyes, a fluorescein dye test to detect the injury to the cornea, and menace response-pupillary light reflex-dazzle reflex, and slit-lamp examination to recognize the neuromuscular system and inside the eye (Kartashov et al., 2019; Kim et al., 2021). A fluorescein dye positive test means fluorescein stain will be maintained in the stroma layer and appear to be green color, indicating corneal epithelium layer devastation, in which case checks should be made to determine the size, depth, and infiltration of white blood cells or red blood cells to evaluate the severity (Patel et al., 2020). Moreover, matrix metalloproteinases (MMPs) are endopeptidases found in almost every eye tissue (Kaya et al., 2021). Matrix metalloproteinases, particularly collagenases, are essential for maintaining corneal integrity and clarity (Kaya et al., 2021). It was suggested that an imbalance in collagenase levels could trigger the keratolytic process, which would destroy the basement membrane structure and cause corneal ulcers (Kaya et al., 2021). Dry eyes, trauma, and infection are examples of conditions that cause MMPs imbalance (Kaya et al., 2021).

Incidence, causative factor, and microbial isolation

There have been reports of the incidence of corneal ulcers in dogs in India, which mainly involve Pug, Pomeranian, mongrel, and brachycephalic dog breeds (Patel et al., 2020). Additionally, corneal ulcers have been reported in cats in

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Russia, mostly involving British and Scottish cat breeds (Kartashov et al., 2019). Moreover, previous reports suggested that brachycephalic cats are predisposed to developing non-healing corneal ulcers (Croix et al., 2001). This sore have been reported in both dogs and cats, specially the younger ones and males (Kartashov et al., 2019; Patel et al., 2020). Some of the causative factors of corneal ulcers reported in dogs include traumatic injury, keratoconjunctivitis sicca, entropion, chemical injury, and distichiasis (Bossuyt, 2016; Patel et al., 2020). For cats, the dermoid, crystalline keratopathy, traumatic injury, entropion, and feline herpesvirus 1 (FHV-1) have been reported as causative factors (Moore, 2005; Bossuyt, 2016; Kartashov et al., 2019). Ekapopphan et al. (2018) surveyed bacteria isolated from corneal ulcers of dogs in Thailand, in which the most commonly found were *Staphylococcus spp*., *Pseudomonas aeruginosa*, *Enterobacteriaciae*, *Streptococcus spp*., *Aeromonas spp*., and *Acinetobacter lwoffii*. Hewitt et al. (2020) studied bacteria isolated from corneal ulcers of dogs in the United States, among which *Staphylococcus pseudintermedius*, *Streptococcus canis*, and *Pseudomonas aeruginosa* were the most common ones. In cats, *Staphylococcus spp*., *Streptococcus spp*., *Corynebacterium spp*., *Escherichia coli*, *Proteus spp*., *Pseudomonas aeruginosa*, and *Klebsiella spp.* have been reported as bacteria isolated from corneal ulcers (Moore, 2005). In addition, other microorganisms, including *Candida spp*., have been reportedly detected in corneal ulcers in dogs (Ekapopphan et al., 2018)

Treatment of corneal ulcers

Treatment of corneal ulcers depends on the progress of the lesion. Superficial corneal ulcer treatment typically utilizes topical eye drops and systemic drugs (Williams et al., 2017). Meanwhile, severe deep corneal ulcer cases are often unresponsive or respond slowly to topical or systemic drugs, and therefore, require surgery (Jaksz and Busse, 2017). At present, the treatment method for corneal ulcers in dogs and cats has been developed to reduce surgical treatment methods while providing results that have similar or better healing outcomes, such as using soft contact bandage lenses (Grinninger et al., 2015; Bossuyt, 2016; Kim et al., 2021). This article gathers information on the use of soft contact bandage lenses to treat corneal ulcers in dogs and cats.

Surgical treatment

Severe deep corneal ulcers, such as descemetocele, corneal dystrophy, ulcerative keratitis, indolent corneal ulcer, and chronic corneal ulcer may require surgical management (Mezzadri et al., 2021). The surgical methods include debridement epithelium, conjunctival pedicle graft, grid or punctate keratotomy, third eyelid flap, superficial keratectomy, and temporary tarsorrhaphy (Croix et al., 2001; Pandey et al., 2018).

Non-surgical treatment

Several reports of nonsurgical treatment include the use of topical eye drops with triple antibiotic (neomycin-polymyxin-bacitracin) prophylactic antibiotic therapy in dogs with superficial corneal ulcers (Hewitt et al., 2020), a combination of chloramphenicol and ciprofloxacin in suspected infected corneal ulcers (Hewitt et al., 2020), and pain control with non-steroidal anti-inflammatory drugs)NSAIDs(or systemic opioids (Jaksz and Busse, 2017). Uveitis cases should use atropine for mydriatic to reduce accompanying painful ciliary muscle spasms (Jaksz and Busse, 2017). Autologous serum, ethylenediaminetetraacetic acid, and acetylcysteine are used in keratomalacia to inhibit proteolytic enzymes (Jaksz and Busse, 2017). In dogs with keratoconjunctivitis sicca, a cross-linked thiolated carboxymethylated hyaluronic acid (xCMHA-S) hydrogel was utilized to close nonhealing stromal ulcers (Williams et al., 2017). Injection of autologous platelet-rich plasma into the conjunctiva of dogs and cats with corneal ulcers was found to be efficient, yet the procedure is time-consuming (Farghali et al., 2021). At present, bandage contact lenses are used in many countries in cases of corneal ulcers in dogs and cats, including Georgia, Germany, Korea, the Netherlands, the United Kingdom, and the United States (Grinninger et al., 2015; Bossuyt, 2016; Braus et al., 2018; Sukjong et al., 2018; Diehl et al., 2019; Kim et al., 2021). Bandage contact lenses have been reported to have properties that promote healing, deliver medicine, and maintain hydration (Sukjong et al., 2018). Previous studies report that the use of soft bandage contact lenses in corneal ulcers in dogs decreases healing time, compared with dogs not treated with soft bandages (Wooff and Norman, 2015).

Contact bandage lenses

Contact lenses have been used in humans since 1887 (Loh and Agarwal, 2010). Different types of contact lenses include hard lenses (firm, reduce oxygen flow to the cornea) and soft lenses (soft, made of hydrogel, and permit oxygen to the cornea, Loh and Agarwal, 2010). Soft contact lenses are used as bandages to preserve the cornea, improve contact duration with topical eye treatments that enhance the cornea-drug interaction over time, and encourage corneal reepithelialization (Sukjong et al., 2018, Figure 1). In veterinary uses, soft contact bandage lenses designed for both humans and animals have been adopted (Diehl et al., 2019). In 2018, both types of lenses were recommended for canine eyes (Braus et al., 2018). Each product brand has a different design component inside the contact lens (Table 1). Before using soft contact bandage lenses, the animal should be tested via STT to measure dry eye conditions, observe purulent discharge, and check cases with suspected bacterial keratitis since some previous reports do not recommend the use of lenses in such instances (Bossuyt, 2016).

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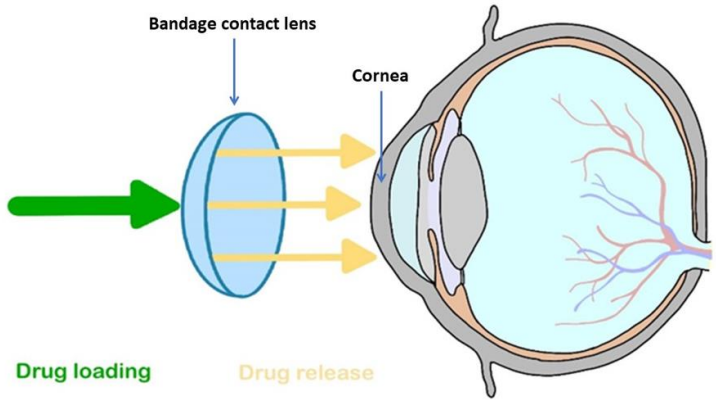

Figure 1. The soft contact bandage lenses help to protect the cornea, increase contact time with topical eyes solutions and increase the cornea-drug interaction for a long time.

Table 1. Soft contact bandage lenses used in animals and human

Trade name	Materials	Designed for species	References
SofLens® (Bausch & Lomb)	Hydroxyethyl methacrylate and ethylene glycol dimethacrylate	Human	Schmidt et al. (1977)
Softcon® (Lombart)	Hydroxyethyl methacrylate and polyvinyl pyrrolidone	Human	Schmidt et al. (1977)
PureVision®2 (Bausch & Lomb)	Silicone vinyl carbamate, N-vinylpyrrolidone, a siloxane crosslinker, and a vinyl alanine	Human	Braus et al. (2018)
Acrivet® (Bausch & Lomb)	2–hydroxyethyl methacrylate and vinylpyrrolidone	Veterinary (Dog)	Braus et al. (2018); Wooff and Norman (2015)
HydroBlues™18 (Keragenix)	Hydrophilic polymers	Veterinary (Dog)	Diehl et al. (2019)
AnimaLens™HRT 78 (Keragenix)	Hydrophilic polymers	Veterinary (Dog)	Diehl et al. (2019)
Acuvue® Oasys™ with Hydraclear™ Plus (Johnson and Johnson)	Silicone hydrogel senofilc	Human	Diehl et al. (2019)

Table 2. Treatment of corneal ulcers by using soft contact bandage lenses in dogs and cats

Abnormality	Methods	Average or median of healing times (days)	Complications	References
Spontaneous chronic corneal epithelial defects (Dog)	debridement + SCBL	14	Blepharospasm	Grinninger et al. (2015)
Spontaneous chronic corneal epithelial defects (Dog)	linear grid keratotomy + SCBL	7	Not found	Wooff and Norman (2015)
Acute bullous keratopathy (Cat)	SCBL	44	Not found	Sukjong et al. (2018)
Symblepharon (Cat)	superficial keratectomy + SCBL	22	Not found	Kim et al. (2021)
Superficial corneal ulcer (Dog)	SCBL	10.6	Blepharospasm, premature loss of the contact lens	Bossuyt (2016)
Superficial corneal ulcer (Cat)	SCBL	10	Blepharospasm, premature loss of the contact lens	Bossuyt (2016)

SCBL: Soft contact bandage lenses

Use of soft contact bandage lenses for dogs and cats with corneal ulcers

The size of the contact bandage lens should be measured using the Jameson caliper or based on recommendations from the product to get an appropriate size for the eyes of the animal (Wooff and Norman, 2015). Using an inappropriately sized bandage lens could result in dislocation of the lens (Bossuyt, 2016). Wooff et al. (2015) studied the use of soft contact bandage lenses in combination with linear grid keratotomy (LGK) in Boxer dog breed with spontaneous chronic corneal epithelial defects (SCCEDs). Wooff and Norman (2015) found a significant reduction in median healing time, compared with LGK alone. Meanwhile, Bossuyt et al. (2016) studied the use of soft contact

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bandage lenses in corneal ulcers in Lhasa apso, Pug, Boxer, Shih Tzu, mixed dog breeds, and domestic shorthair cats, with the lenses found to provide comfort and protection in the primary healing phase until the ulcer had healed, which occurred faster than without a contact lens. Additionally, Braus et al. (2018) recommended using soft contact bandage lenses in the Beagle dog breed for around 14 days although cytology indicated a mild inflammatory reaction. Kim et al. (2021) reported the use of superficial keratectomy and soft contact lens with partial temporary tarsorrhaphy in symblepharon in the Persian cat breed. The result found no reappearance of symblepharon when rechecked 347 days post-operation. Additional studies involving the use of soft contact bandage lenses in dogs and cats with corneal ulcers are presented in Table 2.

CONCLUSION

The use of soft contact bandage lenses in corneal ulcers in dogs and cats helps to protect the cornea, increase contact time with topical eyes solutions, decrease median healing time, and provide comfort. However, soft contact bandage lenses are not recommended in cases of dry eye conditions and severe infections. Furthermore, soft contact bandage lenses have been found to improve treatment responses when used in combination with other surgical procedures.

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Authors' contribution

Nattapat Pratumjorn, Natapol Pumipuntu, and Ratchanon Kusolsongkhrokul collected data. Athip Lorsirigool wrote the final draft of the manuscript and performed the submission. All authors read and approved the final revised manuscript.

Competing interests

The authors declared that they have no conflict of interest.

Ethical consideration

All authors check plagiarism, fabrication and/or falsification, double publication and/or submission, and redundancy already.

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