

Effect of Grid Keratotomy on Indolent Corneal Ulcers in Dogs

Jae-sang Ahn, Se-eun Kim, Young-woo Park, Jeong-taek Ahn, Yesran Lee,
Eui-ri Lee, Kangmoon Seo and Man-bok Jeong¹

Department of Veterinary Surgery and Ophthalmology, College of Veterinary Medicine,
Seoul National University, Seoul 151-741, Korea

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Abstract : A total of 29 eyes (25 dogs: one eye, 2 dogs: both eyes) with indolent corneal ulcer were treated with grid keratotomy from January 2008 to March 2010. The corneal lesions were reevaluated at 7-14 day intervals. The treatments had been repeated until fluorescein dye was not retained on the cornea and the epithelium did not appear to be loosely attached to the stromal layer. The healing rate of the corneal ulcers was 86.2%. The mean healing time (mean \pm SD) was 15.9 ± 9.2 days, ranged from 7 to 39 days. The lesions of remaining 4 eyes had deteriorated or not improved for more than 6 weeks. In those cases, 3rd eyelid flap following grid keratotomy was applied. After 2 weeks, all of the eyes healed by the treatment. The results in this study suggest that grid keratotomy could be an excellent choice as an initial treatment for superficial corneal ulcers in dogs. In the cases of recurrence or to promote healing of the lesions, however, 3rd eyelid flap following grid keratotomy is recommended.

Key words : indolent ulcer, grid keratotomy, 3rd eyelid flap, dog.

Introduction

Corneal ulcers are occurred when the epithelium is damaged and underlying stroma is exposed. Corneal ulcers are classified by the depth (superficial, deep, stromal, descemetocoele), causes (bacterial, fungal, immune-mediated, trauma, etc.), and ease of healing (simple, complicated, refractory, progressive) (8,13,15). Indolent ulcer is chronic epithelial erosion that fails to re-epithelize the stromal layer, characterized by superficial, non-infectious, complicated, refractory, and non-progressive (1,13,15). Because corneal epithelium is entirely substituted in 1-2 weeks normally, indolent ulcer should be suspected when superficial ulcer is not healed within 1-2 weeks (1,3,18).

Currently, 3rd eyelid flap has been used generally for the treatment of non-healing corneal ulcers. Third eyelid flap has advantages such as reduction of frictional irritation, desiccation, and probability of further damage to the cornea. Therefore, it could promote healing of the corneal lesions (8,13,22). However, 3rd eyelid flap could impede penetration of medications, prevent from monitoring of the lesions and require general anesthesia in most patients (13). Moreover, previous studies have described that 3rd eyelid flap alone do not provide beneficial effect on the healing of non-healing corneal ulcers (16,19).

Stanley *et al.* (18) have described that grid keratotomy is highly successful in the treatment of persistent corneal ero-

sions. This technique is simple, low-cost, and effective procedure (15,18). Furthermore, general anesthesia is not required to perform the treatment and monitoring of the lesions is possible postoperatively.

The purpose of this study is to review the results of the therapeutic effects of grid keratotomy for the treatment of indolent corneal ulcers in dogs. To evaluate efficacy of grid keratotomy, success rate, mean healing time, and mean treatment time were detected.

Materials and Methods

The medical records of the patients who were referred to Veterinary Medical Teaching Hospital of Seoul National University from January 2008 to March 2010 for management of indolent corneal ulcers were retrospectively reviewed. Indolent ulcers were diagnosed if fluttering of epithelial lip when the cornea was flushed using squeezing bottle containing Hartmann's solution and positive fluorescein test were identified. To treat the lesion, cornea was prepared with 0.2% povidone iodine solution followed by application of 0.5% proparacaine hydrochloride ophthalmic solution (Alcaine[®], S.A. Alcon-Couvreur N.V., Puurs, Belgium). After 1 minute, epithelial debridement was performed using dry, sterile cotton-tipped applicators until all the loose epithelium was removed (Fig 1). Subsequently, grid-patterned linear keratotomy was made at 1 mm intervals on the exposed stroma with a 26-gauge hypodermic needle and extended 1 mm beyond the area. The keratotomy was made not to exceed the 1/3 of corneal thickness. The patients were reevaluated at 7-14 days interval. On the exam-

¹Corresponding author.
E-mail : vetsx04@snu.ac.kr

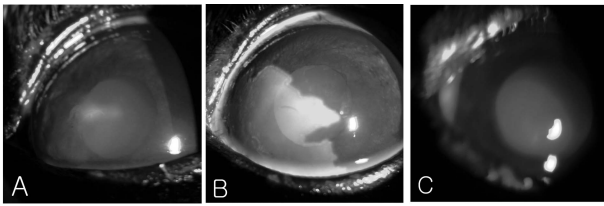


Fig 1. Indolent ulcer in a 11-year-old, neutered female, Miniature Pinscher. Fluorescein dye staining was performed before (A) and after (B) epithelial debridement. The lesion regressed after 2 weeks (C).

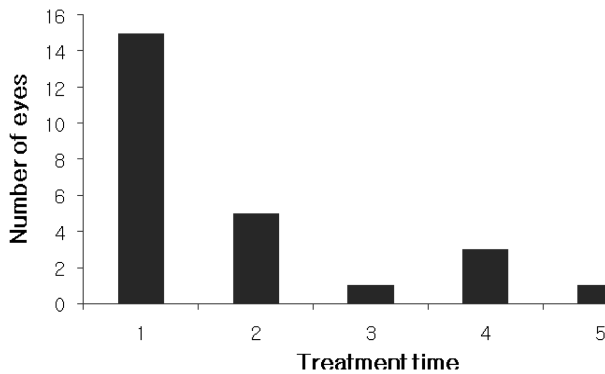


Fig 2. Treatment times of grid keratotomy in group that corneal ulcer resolved without 3rd eyelid flap.

ination, the treatment was performed again when the fluorescein dye was retained or loosely attached epithelium was detected. If the lesion was worsened or not regressed within 6 weeks from initial treatment, the treatment was repeated again and the cornea was protected with 3rd eyelid flap under general anesthesia with propofol (ProvetTM 1%, Claris Lifesciences, Vasana, India; 6-10 mg/kg, IV). Two weeks later, 3rd eyelid flap was removed and the eye was examined to determine corneal healing. Successful treatment was defined as no recurrence at least 1 month.

Results

Twenty seven patients, unilaterally in 25 dogs and bilaterally in 2 dogs, were included in this study. Shih Tzus ($n = 6$) were the most prevalent breed and Malteses and Cocker Spaniels ($n = 4$) were followed. The mean age of the patients was 9.6 ± 4.0 years, ranged from 1 to 18 years. Most of the patients (85.1%) were older than 5 years. There were 10 spayed females, 7 castrated males, 6 intact females, and 4 intact males. Each eye had a corneal ulceration with retention of fluorescein dye and loosely attached epithelium which was easily removed by epithelial debridement using sterile cotton-tipped applicator.

Twenty five eyes (86.2%) were healed after keratotomy. Among the eyes, 15 eyes received the treatment once and the other eyes required additional treatments, which was 1.8 ± 1.2 times on the average (Fig 2). Mean healing time was

15.9 ± 9.2 days, ranged from 2 to 39 days. The corneal ulcers of remaining 4 eyes were not resolved within 6 weeks or exacerbated during the treatments. Therefore, 3rd eyelid flap was performed following epithelial debridement and keratotomy under general anesthesia. At 2 weeks after 3rd eyelid flap, corneal ulcers were resolved in all eyes.

Discussion

Indolent ulcer is one of the most complicated ocular diseases in veterinary medicine. Initially, superficial trauma is likely to induce indolent ulcer (1,6,8). However, various factors such as keratoconjunctivitis sicca, adnexal disease, neurotropic keratitis, exposure keratitis, and primary corneal diseases (e.g. calcific keratopathy, lipid keratopathy, corneal edema) could be associated with this condition in dogs (15). There is apparent predisposition in boxers even though any breed could be affected in this disease (1,2,8,11). Middle-aged to older dogs are most commonly affected (1,2,11,17).

On ophthalmic examination, non-adherent epithelium (epithelial lip) and extension of fluorescein stain below the epithelial lip (halo formation) are specific features of indolent ulcer (1,15,17). Microscopically, loss of corneal basement membrane and acellular hyalinized zone formation on the superficial stromal layer are typical findings (1,2). Because corneal basement membrane takes a role of reservoir for growth factors and various cytoactive molecules and modulates behaviors of epithelial cells, loss of basement membrane impedes epithelial attachment to the underlying stroma (1). Superficial stromal hyalinized zone serves as barrier to reassembly of adhesion and inhibits attachment of epithelial layer to the exposed stroma (1,2,15). Therefore, treatments that alter the stroma as like grid or punctuate keratotomy, superficial keratectomy, and thermal cauterization can achieve high success rate for the treatment of indolent ulcer (1,2,15,18).

A number of treatments have been suggested including medications and surgical procedures (1,2,4,7,9,11,12,14,15,18,20,21). Among these treatments, grid keratotomy is easy to perform, low-cost, and effective therapy to treat non-healing corneal ulcer (15,18). Possibility of monitoring the lesion that would enable adequate therapeutic intervention to be applied to prevent exacerbation of the corneal ulcers also is additional benefit of the grid keratotomy procedure. Third eyelid flap may impede drug penetration, disable from monitoring of the cornea and require general anesthesia in most patients (13). Previous studies have described that 3rd eyelid flap alone have little effect on the healing of indolent corneal ulcers because 3rd eyelid flap is not related to alteration of abnormal superficial stromal layer (16,18,19). However, 3rd eyelid flap reduces frictional irritation caused by blinking and prevents desiccation of the cornea (13). It could also relieve pain and prevent additional damage to the cornea (8,22). In these reasons, 3rd eyelid flap could promote healing of indolent corneal ulcers if combined with procedures that alter the abnormal stromal layer, such as grid keratotomy.

Previous study (18) reported healing time of grid keratotomy under topical anesthesia and grid keratotomy followed by 3rd eyelid flap under general anesthesia as a treatment of indolent ulcers. In the keratotomy plus 3rd eyelid group, the corneal ulcers regressed earlier and necessitated fewer treatment number than the keratotomy-only group. The authors described that general anesthesia enabled the surgeon to perform the grid keratotomy with more even depth and distribution and the 3rd eyelid flap only minimized postoperative problems such as ocular pain or infection. Even though therapeutic effect of 3rd eyelid flap alone on indolent ulcer is questionable because of its inability to altering abnormal stromal layer, 3rd eyelid flap could accelerate the healing of the lesion by reason of benefits of 3rd eyelid flap mentioned above. Additionally, grid keratotomy could be performed evenly enough by topical anesthesia and restraint in all cases in our study.

Corneal ulcers in this study were regressed after grid keratotomy alone in 86.2% of eyes. This suggests that grid keratotomy could destroy acellular hyalinized zone efficiently and expose underlying normal stroma assisting growing epithelial cells to adhere to the stromal layer. Corneal ulcers of 4 eyes that had not respond to grid keratotomy resolved after grid keratotomy with 3rd eyelid flaps for 2 weeks. This result also supported the idea that 3rd eyelid flap could promote and supplement therapeutic effect of grid keratotomy on indolent ulcers. Even though the lesion resolved without 3rd eyelid flap, 10 out of 25 eyes required additional grid keratotomy and 4 eyes more than 3 times (Fig 2). Moreover, each grid keratotomy procedure induces considerable ocular pain for several days. Therefore, to accelerate the corneal healing and relieve patients' discomfort, 3rd eyelid flap could be applied in early stage of the disease.

Focusing on skull conformation, brachycephalic breeds (21/27: 6 Shih-Tzues, 4 Malteses, 3 Yorkshire Terriers, 2 Pugs, 2 Pekingeses, 2 Miniature Pinschers, 1 Miniature Poodle, and 1 Pomeranian) were outnumbered by mesocephalic breeds (6/27, 4 Cocker Spaniel, 1 Golden Retriever, and 1 mixed breed). Kafarnik *et. al.* (10) have described that, even though it was not statistically significant, the corneal nerve fiber density in brachycephalic dogs was lower than that in mesocephalic dogs. Because neurotrophic keratitis in human is associated with hypoesthetic or anesthetic cornea, and alteration of corneal innervations have been documented in dogs with recurrent corneal erosion, decreased corneal nerve fiber density in brachycephalic breeds could be related with recurrent corneal epithelial defects (5,17).

Mean age of the patients (9.63 ± 4.02 years, range: 1-18 years) in this study was similar with the results of previous studies (1,2,11,17). Therefore, age of the patients should be considered for prognosis of indolent ulcer after treatment.

Conclusion

Grid keratotomy could be a simple and excellent procedure to treat indolent ulcers in dogs. In case of recurrence or to

promote healing of the lesions, it is recommended to perform 3rd eyelid flap following grid keratotomy.

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개에서 만성 각막 상피 결손증 치료법으로서의 각막 격자 절개법

안재상 · 김세은 · 박영우 · 안정택 · 이예스란 · 이의리 · 서강문 · 정만복¹

서울대학교 수의과대학

요 약 : 2008년 1월부터 2010년 3월까지 만성 각막 상피 결손증으로 서울대학교 부속 동물병원에 내원한 환자 27마리 (25두: 단안, 2두: 양안)를 대상으로 점안마취 하에 격자 각막 절개법을 적용하였다. 처치 후 7-14일 간격으로 재진 하였으며, 형광염색 시 음성이고, 각막 표면이 안정화될 때까지 반복 처치 하였다. 이중 86.2%에 해당하는 25안에서 각막 궤양이 치유되었으며, 평균 치유기간은 15.92 ± 9.19 일 (7-39일)이었다. 병변이 악화되거나 각막 절개법을 최초로 시행 후 6주가 지나도 병변이 치유되지 않는 4안의 경우, 전신마취 하에 각막 절개법 및 제 3 안검 플랩을 적용하였으며, 2주 후 플랩을 제거했을 때, 병변이 모두 치유된 것을 확인하였다. 따라서, 각막 절개법은 만성 각막 상피 결손 증에 유용한 치료법이라고 사료되며, 반복적인 처치에도 재발하거나 시술의 성공률을 높이기 위해서는 각막절개법과 제 3 안검 플랩을 함께 실시할 것이 추천된다.

주요어 : 만성 각막 상피 결손증, 각막절개법, 개