

Immediate effects of diamond burr debridement in patients with spontaneous chronic corneal epithelial defect; histopathology evaluation

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Introduction

Spontaneous chronic corneal epithelial defect (SCCED) is a relatively common ulcerative keratitis in middle-aged canine patients (1). A study by Stanley et al described the healing percentage of SCCED patients after being treated by one of the following treatments: cotton bud debridement, grid keratotomy or superficial keratectomy. Their results showed a treatment success of approximately 63%, 85% and 100% respectively, 10-15 days after treatment (2). Alger Diamond Burr debridement (DBD) was described as a treatment for SCCEDs with a reported success rate of 92%, 10-15 days post-treatment (3).

The use of diamond burring is reported to spare the stroma in canine cadaver eyes (4). However, there are no studies that report the effects of DBD in corneas with naturally occurring SCCEDs to date. The purpose of this prospective, multicentric study was to evaluate the immediate effects of the DBD on the canine cornea of patients diagnosed with SCCED. The study was approved by the Ethics and Welfare Committee of the Royal Veterinary College (RVC).

Material and Methods

Clients whose dogs were diagnosed with SCCEDs at either Davies Veterinary Specialists or the Royal Veterinary College were offered to choose from the reported treatment options. Clients that opted for a superficial keratectomy were informed of the DBD study and were given the option to be included in it. A specific consent form was read and signed if clients approved. The patients were anaesthetised and routinely prepared to undergo a superficial keratectomy under the surgical microscope. A gentle cotton debridement was performed to assess the ulcer's extension area. Then, the ulcerated area was marked peripherally and halved in two similar areas with a controlled-depth corneal knife. One of the areas was burred with the Alger Diamond Burr (3.5mm medium grit) for at least 40 seconds up to 60 seconds and the other half area was left un-burred. Then, a superficial keratectomy was performed. Once the corneal tissue was resected the corneal samples were separately placed in formalin tubes. The pathologist assessing the samples remained masked to the treatment used through labelling of the tubes as "A" for the non-burred samples and "B" for the burred samples. Light microscopy evaluation was performed using Hematoxylin & Eosin (H&E), Periodic acid-Schiff (PAS), and Masson's trichrome stains. The following parameters were analyzed for each sample (A and B): nature and degree of the leukocytic infiltrate, presence of a superficial hyaline acellular zone (HAZ), thickness of this zone (if present), degree of keratocyte-spindle cell proliferation and presence of stromal vascularisation. The thickness of the HAZ was measured in 5 randomly selected fields (Image J software, NIH, USA) and averaged for each sample. With the PAS and Masson stains the staining properties of the HAZ were evaluated.

Statistical analysis of the averaged HAZ thickness between non-burred and burred fragments were performed using a Student's paired t-test after having checked for normal distribution of the data. The significance was set at $P < 0.05$.

Results

Nine dogs were recruited, resulting in 9 burred and 9 non-burred corneal samples. All non-burred corneal samples had a superficial stromal HAZ, with a mean \pm standard deviation thickness of $4,309 \pm 1,348 \mu\text{m}$. Seven of the burred corneal samples had an intermittent HAZ and 2 did not show an obvious HAZ, with a mean thickness of $1,062 \pm 0,664 \mu\text{m}$. There was a significant difference between the HAZ thickness of burred and non-burred corneal samples ($P < 0,0001$) (Figure 1). The HAZ was PAS-positive in all of the non-burred corneas, whereas the PAS was intermittently positive in 6 burred corneas and negative in the remaining 3. When present, the HAZ stained strongly blue with Masson's, indicating the presence of collagen. All 9 non-burred corneal samples showed a strong blue staining of the HAZ, whereas only 2 of the burred corneas showed strong blue staining with Masson's stain. The remaining burred corneal samples showed either intermittent blue stain with Masson's (3 samples) or no staining (3 samples). The inflammatory infiltrate was neutrophilic in 16 corneal samples, and predominantly lympho-plasmacytic in 2 samples from the same dog. Four of the samples showed stromal vascularisation. Keratocyte infiltration was seen in all the corneal samples although the degree of infiltration varied between samples.

Discussion

The results of this study show that the DBD applied between 40-60 seconds on a naturally occurring SCCED can significantly reduce the thickness of the HAZ. This irregular, acellular zone in the exposed corneal stroma has been theorised to be responsible for the poor attachment of the corneal epithelium in SCCEDs, and a reduction of its thickness may be responsible for improving the healing rates reported with DBD this technique (1).

There are many factors to take into account when evaluating DBD, such as contact-pressure variability between the probe and the cornea, the type of burr used and the intraocular pressure of the affected eye, all of which might have an effect on the success rate.

Since the HAZ has been theorised to be associated to the non-healing nature of SCCEDs, the authors of the current study propose that a higher application of pressure during burring and/or a longer DBD time might increase the effectiveness of healing rates in SCCEDs using the above protocol.

Footnote:

Figure 1: Reduction of the thickness of the hyaline acellular zone in the study population.

References:

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