A DESCRIPTION OF BLEND ELECTROLYSIS FOR TREATMENT OF CANINE DISTICHIASIS; 78 CASES (2012 – 2017)

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Purpose: To describe a population of dogs treated with blend electrolysis for distichiasis at The Royal Veterinary College and report complications seen.

Methods: Part 1: Records were reviewed from 2012-2017 and the population of 78 dogs with distichiasis treated using blend electrolysis (Sterex SX-B blend epilator) analysed. Part 2: Eighteen dogs treated with blend electrolysis were re-examined prospectively by an ECVO diplomate.

Results: Part 1: Brachycephalic breeds accounted for 62%. English Bulldog was the most common breed (42%). In this population, 88% of dogs were successfully treated with one treatment of electrolysis (successful treatment defined as resolution of clinical signs). Forty-five dogs had recurrent distichia on follow-up, mostly fine distichia without clinical discomfort. Twelve percent required repeat electrolysis. Complications were infrequent: five dogs had scarring or hypopigmentation of the eyelid margin.

Part 2: Eighteen dogs were re-examined. Ten had distichia recurrence, six had eyelid scarring and five had depigmentation associated with electrolysis. Two dogs had occasional clinical signs thought to be related to distichiasis. All owners perceived their dog's ocular comfort to be improved following blend electrolysis.

Conclusions: Brachycephalic breeds, most notably English Bulldogs, are overrepresented in this population. Blend electrolysis appears an effective treatment for resolution of clinical signs.

Key words: Distichiasis, Blend electrolysis, Electrolysis.

Introduction

Distichia are single or multiple hairs arising from the eyelid margin which is normally hairless. Single or multiple eyelids may be affected. Distichia arise from ectopic hair follicles in the distal tarsal plate and emerge through the openings of meibomian glands or less commonly the openings of the glands of Zeiss or Moll (1-3). Distichia cause varying degrees of disease. Soft, fine distichia and those not in contact with the cornea may cause no clinical discomfort and may be found incidentally during ophthalmic examination. Hairs contacting the cornea can cause irritation, blepharospasm, increased blinking, epiphora and corneal lesions such as ulceration, pigment deposition and corneal vascularisation (4).

Distichiasis in dogs is a common problem with a reported prevalence of 1:133 (2). Distichiasis is thought to be inherited and is usually present from a young age, however the mode of inheritance is unknown. Breed predispositions have been described in the American Cocker Spaniel, English Cocker Spaniel, Welsh Springer Spaniel, Cavalier King Charles Spaniel, Flat Coat Retriever, Boxer, English Bulldog, Havanese, Shetland Sheepdog, Shih Tzu, Pekingese, Tibetan Terrier, Dachshund, Poodle and Jack Russell Terrier (4-6). Female cocker spaniels have been shown to be more likely to have distichiasis than males, however no sex predisposition has been described in any other breeds (4, 5). Distichiasis has also been reported, although uncommonly, in the horse, cat and ferret (7-9). In human patients, congenital distichiasis is rare. Distichiasis is more commonly acquired later in life secondary to chronic irritation or inflammation (10). In animals, distichiasis may also occur in old age secondary to metaplasia of the tarsal glands caused by chronic inflammation (4, 11).

When distichia are causing clinical signs of irritation, treatment should be recommended. Multiple methods for removal of distichiasis have been described. Manual epilation of the distichia using round-tip epilation forceps can provide temporary relief, however hairs regrow and the plucking needs to be repeated every 4-5 weeks according to the hair cycle (4). This technique may prove useful to confirm that clinical signs of ocular irritation are caused by the distichiasis. Permanent removal of distichia is most desirable and there are various techniques, both surgical and non-surgical, used to do this which destroy, remove or re-direct the hair follicle. Non-surgical options include electrolysis, cryotherapy and trans-conjunctival thermal electrocautery (4, 9). Surgical techniques include wedge resection, partial tarsal plate excision, palpebral conjunctival resection and lid splitting (11, 12). Choice of technique depends on location and extent of distichiasis along with surgeon experience. Surgical resection is useful for single hairs, or a group of hairs in a small area. Electrolysis targets one hair follicle at a time, therefore, can be time consuming if many hairs are present. Cryotherapy targets a larger

area of the eyelid margin, therefore may be useful when many hairs are present along the eyelid margin. All techniques require general anaesthesia, adequate magnification and illumination in order to visualise the hair and hair follicle opening.

Electrolysis is either galvanic (electrical energy) or thermal diathermy (heat energy). Blend electrolysis is a technique which combines both electrical and thermal energy allowing use of lower currents. The addition of thermal energy is also advantageous as it decreases the treatment time necessary; from 30-60 seconds per cycle with galvanic electrolysis alone to 15-30 seconds with blend electrolysis (13, 14). Blend electrolysis is considered to be a more effective and more rapid than other methods of electrosurgical epilation, and is reported to be less painful in humans (14, 15).

Complications of distichia removal procedures include distichia recurrence, eyelid swelling, eyelid margin fibrosis, focal eyelid margin depigmentation and occasionally cicatricial entropion (12). The prevalence of complications has not been documented for electrolysis. Cryotherapy causes swelling of the eyelids and conjunctiva for approximately 48 hours. Loss of pigment in the treated area has been demonstrated following cryotherapy, re-pigmentation is said to occur after 6-8 weeks (16). Recurrence of distichia is thought to occur in 10-46% over all removal techniques (11, 12); recurrence rate has not been reported for each method of removal individually.

To the authors' knowledge this is the first description of blend electrolysis for treatment of distichiasis in the veterinary literature.

Methods:

Part 1: Hospital records were reviewed for the years 2012-2017, and the population of dogs with distichiasis treated using blend electrolysis analysed.

The following information was extracted from the medical records: breed, sex, age at time of procedure, presenting clinical signs, number of electrolysis procedures, concurrent ocular disease, concurrent ocular procedures and post-operative ophthalmic examination findings. Dogs that had been treated at any point with cryotherapy or surgical removal of distichiasis were excluded in order to evaluate complications following electrolysis only.

Prior to the procedure, each eye was aseptically prepared with dilute (1:50) povidone iodine solution. Electrolysis was performed using a Sterex SX-B blend epilator with a F41 short two-piece insulated epilating needle. The fine epilating needle (electrode) was inserted into the

meibomian gland opening beside the hair shaft 3-4mm. The electrode supplied a 3-5 mA current which destroys the germinal cells of the hair follicle. Recommended protocol is to apply a low current of 2-3 mA for 15-30 seconds. Applying a current of greater than 5mA is not advised as it can create scar tissue. The footplate was depressed and the needle gently rotated until a bubble of meibomian fluid appeared on the eyelid margin. This was repeated twice, and then the cilia was then epilated gently using cilia forceps. If the hair was still firmly attached, the electrolysis procedure was repeated until the hair became loose and could be removed without resistance. The procedure was carried out by an ECVO diplomate or resident in training.

Part 2: Eighteen dogs were re-examined prospectively. Time since electrolysis procedure varied, ranging from 10 to 67 months (median 32 months). The owners were questioned on subjective measures of ocular comfort (comfort, tearing, blepharospasm, blink rate, rubbing). Each dog had an ophthalmic examination performed by an ECVO diplomate. A full ophthalmic examination was performed using a slit-lamp biomicroscope. Schirmer 1 tear test (STT-1), tear film break-up time (TFBUT) and fluorescein tests were performed. Ethical approval was granted by The Royal Veterinary College Clinical Research Ethical Review Board (URN 20171729-2).

The effect of distichiasis and scarring on STT-1 and TFBUT was analysed using a generalised estimating equation with exchangeable working correlation metrics to account for repeated observations from different eyes of the same dog. Eighteen dogs were examined in part 2 of the study. All eighteen dogs were included in description of distichia recurrence, scarring and depigmentation. Three dogs were excluded from statistical analysis for having concurrent ocular disease (ectopic cilium n=1, keratoconjunctivitis sicca n=1, entropion n=1), one dog had only one eye and one dog did not allow TFBUT to be performed (n=15 dogs; STT n=29 eyes, TFBUT n=27 eyes). Statistical analysis was performed using computerised statistical software SPSS (IBM® SPSS Statistics, version 24; 2015).

Results:

Part 1: Twenty two breeds were included in the population; English Bulldog (n=33), Pug (n=8), French Bulldog (n=5) Boxer (n=5), Shih-tzu (n=3), Shetland sheepdog (n=3), Cocker Spaniel (n=3), cross-breed (n=3) Border Terrier (n=2) and one each of the following breeds; Chihuahua, Dachshund, Toy Poodle, Springer Spaniel, Eurasier, Portuguese Water Dog, Jack Russell Terrier, Curly Coat Retriever, Bernese mountain dog, Staffordshire bull terrier,

Cockerpoo, Cavalier King Charles Spaniel, Weimaraner. There were 30 female dogs (10 entire and 20 neutered) and 48 male dogs (27 entire and 21 neutered). Age of dogs treated ranged from 4 months to 10 years, with most dogs treated at one year or below (median 23.5 months). 60 dogs (77%) were treated with electrolysis at the same time as another surgical procedure requiring general anaesthesia, 18 dogs (23%) were anaesthetised for the sole purpose of distichiasis removal by blend electrolysis. All dogs exhibited discomfort upon initial presentation.

Concurrent ocular abnormalities were present in 44/78 (56%) dogs (table 1), most commonly abnormalities of eyelid conformation. 52/78 (67%) dogs had another surgical procedure performed at the same time as electrolysis, to address concurrent ocular abnormalities, most commonly correction of eyelid conformational abnormalities (table 2).

Table 1: Concurrent ocular abnormalities seen in dogs treated with electrolysis.

Concurrent ocular pathology	**Number (%)**
Entropion	20 (26%)
Entropion + euryblepharon	14 (18%)
Ectopic cilia	7 (9%)
Eyelid mass	4 (5%)
Prolapsed gland of nictitating membrane	4 (5%)
Keratoconjunctivitis sicca (KCS)	3 (4%)
Cataract	3 (4%)
Euryblepharon	2 (3%)

Table 2: Concurrent surgical procedures performed at the same time as electrolysis.

Concurrent procedures	**Number (%)**
Canthoplasty	15 (19%)
Entropion correction	12 (15%)

Wedge resection	10 (13%)
Ectopic cillia excision	7 (9%)
Corneal ulcer repair	7 (9%)
Prolapsed gland of nictitating membrane repositioning	4 (5%)
Phacoemulsification	3 (4%)
Lacrimal puncta enlargement	2 (3%)

Successful treatment of distichiasis was defined as resolution of clinical signs of ocular discomfort. Nine dogs were lost to follow up. Of the 69 dogs for which follow up was available, 88% (61/69) of dogs were successfully managed with one treatment of electrolysis, 12% dogs (8/69) required repeat electrolysis; 7/69 dogs (10%) required two treatments and 1/78 dog (2%) required three treatments.

Complications reported on clinical records at follow-up appointments were noted, follow-up appointments ranged from 1 week to 6 weeks after blend electrolysis. Forty-five dogs (65%) had recurrence of distichia on re-examination. In eight of these dogs, the distichia were causing a clinical problem, these were the dogs which required repeat electrolysis. Thirty-seven of the 45 dogs with documented distichia regrowth had recurrence of fine distichia, which were not causing discomfort. Five dogs (7%) had scarring or depigmentation of the eyelid margin noted on re-examination, one dog developed an eyelid laceration post-operatively caused by self-trauma.

Part 2: All 78 patients were invited back to the hospital for re-examination. Eighteen out of 78 dogs were examined (table 3). Time since electrolysis procedure varied, ranging from 10 to 67 months (median 32 months). Thirteen (72%) dogs had been treated once with electrolysis and five (28%) dogs had required two electrolysis treatments. All owners of dogs examined prospectively perceived an improvement in their dog's ocular comfort following blend electrolysis.

Ten (55.6%) dogs had distichia recurrence at re-examination. Two dogs (11%) had occasional clinical signs which may have been related to the distichiasis. Of the two dogs with clinical signs, one dog (patient 2) was reported to have mild epiphora and occasional blepharospasm, this dog had three distichia in each eye on examination and had increased STT-1 readings of

30mm/minute in the right eye and 26mm/minute in the left eye. The second dog (patient 4) had occasional episodes of mild epiphora, blepharospasm and facial rubbing; this dog had four hairs arising from the right upper eyelid. Scarring was seen as an indentation of the eyelid margin and was seen in six dogs (33%) (Figure 1). Depigmentation of the eyelid margin was seen in five dogs (27%) (Figure 2). Scarring and depigmentation were seen in dogs that had received both one and two treatments with electrolysis, and scarring was not always associated with depigmentation.

Three dogs were excluded from statistical analysis due to concurrent ocular disease (patients 1, 9 and 15). One dog had unilateral ocular discomfort, presumed to be caused by an ectopic cilium noticed on examination rather than recurrence of distichiasis. One dog had developed bilateral ocular discomfort, despite having one distichia recur in the upper right lid, the discomfort was most likely to be due to concurrent entropion. One dog developed keratoconjunctivitis sicca (KCS) which was diagnosed three years following blend electrolysis, and despite treatment with Optimmune™ was still occasionally uncomfortable; there was no recurrence of distichia therefore discomfort was presumed to be due to KCS. No significant difference was found in STT-1 (n=29 eyes) or TFBUT (n=27 eyes) whether scarring or hairs were present or not ($p>0.05$).

Table 3: Summary of cases examined prospectively in part 2 of the study

Patient number	Breed	Number of electrolysis procedures	Follow up time since procedure (months)	Number of distichia	Scarring	Depigmentation	Clinical signs	Concurrent ocular disease	Schirmer 1 tear test readings (mm/min)	Tear film break up time (seconds)
1	English Bulldog	1	30	1	-	-	Epiphora	entropion	OD 24 OS 30	OD 5 OS 1
2	Boxer	1	10	7	-	-	Mild epiphora and occasional blepharospasm	-	OD 30 OS 26	OD 12 OS 13
3	Shetland sheepdog	1	19	4	-	Area of depigmentation OD	-		OD 15 OS: 15	OD 9 OS 9

4	Jack Russel Terrier	1	22	6	Two areas of scarring OD and one OS	-	Occasional mild epiphora, and facial rubbing		OD 22 OS 30	OD 10 OS 11
5	Cocker spaniel	1	22	1	Two areas of scarring	One area of depigmentation	-		OD 19 OS 22	OD 7 OS 7
6	Pug	1	24	1	One area of scarring	-	-		OD 29 OS 29	Not performed due to temperament
7	English Bulldog	2	17	1	-	-	-		OD 18 OS 16	OD 5 OS 6
8	English Bulldog	1	37	1	-	-	-		OD 23 OS 20	OD 6 OS 6
9	Cross breed	2	14	3	Two areas of scarring	-	Blepharospasm and epiphora	Ectopic cillia	OD 34 OS 35	OD 4 OS12
10	Border terrier	1	48	0	-	-	-		OD 25 OS 25	OD 9 OS 11
11	English Bulldog	2	60	0	-	Depigmentation OD	-		OD 16 OD 9	OD 3 OS 4
12	Shih-tzu	1	56	0	-	-	-	OS enucleated	OD 20	OD 16
13	Shetland sheepdog	1	39	0	-	-	-		OD 20 OS 20	OD 9 OS 8
14	English Bulldog	2	35	3	Two areas of scarring in each eye	-	-		OD 30 OS 20	OD 8 OS 10
15	English Bulldog	1	51	0	-	-	Blepharospasm and mucoid discharge consistent with recent diagnosis of KCS	Keratoconjunctivitis sicca	OD 5 OS 5	OD 1 OS 1
16	Shih-tzu	1	67	0	-	Multiple areas of depigmentation in both eyes	-		OD 22 OS 22	OD 10 OS 11
17	Curly coat retriever	2	55	0	Two areas of scarring OD	One area of depigmentation OD	-		OD 21 OS 19	OD 24 OS 18
18	English Bulldog	1	25	0	-	-	-		OD 24 OS 23	OD 11 OS 14

Discussion

Breed predisposition in the population of dogs treated for distichiasis with blend electrolysis is similar to that reported in previous studies (1, 2, 4). There are more males in this population, whereas previous publications have found that more females are affected with distichiasis (5, 8). Recurrence of distichiasis (56%) is higher than previously reported, we postulate that this is because previous studies have reported recurrence of distichia that are causing a clinical problem, whereas this study includes both recurrence of distichia causing clinical problem but also fine distichia that are not causing any clinical signs. Most dogs in this study with recurrent distichia were asymptomatic, and recurrence of distichiasis with clinical signs (13% [2/15 dogs in part 2]) is similar to that reported in literature (8, 11). There is a higher prevalence of scarring and depigmentation on prospective examination (60%; 33% scarring and 27% depigmentation)

than was noted at follow-up appointments on retrospective records (7%). We postulate that this is due to under-reporting on clinical notes as most scarring and depigmentation is mild and not causing clinical signs. Scarring, depigmentation and eyelid distortion are mentioned as complications of electroepilation in the literature but have not been quantified for any method of distichiasis treatment (1, 4, 8). Reinstein et. al. report depigmentation resolves with time following trans-conjunctival electrocautery to remove distichiasis (8). Follow up of cases in part two of this study revealed that depigmentation remained in five dogs, however this was thought to be cosmetic and not causing any clinical signs of ocular discomfort.

Another reported disadvantage of electroepilation is focal destruction of the meibomian gland (17). It is possible that destruction of meibomian glands may cause a qualitative tear film deficiency, particularly if a large number of distichia are electroepilated, due to damage of the meibomian glands during treatment leading to decreased secretion of the oily lipid layer of the tear film from damaged meibomian glands, and therefore increased evaporation of the aqueous portion of the tears. Patients with extensive distichia requiring electrolysis at more sites along the eyelid margin are likely to have a higher risk of developing a qualitative tear film deficiency than those with few distichia at the time of treatment, as there is potential for more of the meibomian glands to become damaged. It is not possible to quantify this in this study as the number of distichia treated were not always present on retrospective records. The stability of the tear film can be assessed using the tear film break-up time. This study did not show a significant difference in tear film break-up time whether scars or recurrent distichia were present following blend electrolysis or not, although this may be a result of small sample size rather than true lack of significance. It was not possible to compare tear film break-up time before and after blend electrolysis due to lack of pre-operative measurement or between dogs that had undergone blend electrolysis with dogs that had not been treated with blend electrolysis due to the lack of a control group.

Limitations of this study include small sample size and its retrospective nature. Retrospective case recruitment does not allow controlling for concurrent ocular disease, concurrent surgical procedures or variable topical and oral medications; all of which could influence clinical outcome. Variations in these factors may influence success and complication rate. A number of dogs in part one of the study had concurrent ocular disease that was potentially painful, and therefore the resolution of discomfort may have been attributable to concurrent treatment rather than removal of the distichiasis by blend electrolysis. This could falsely increase the success rate calculated.

Retrospective medical records did not always describe exact location of distichiasis; therefore, it is not possible to comment on whether distichia recurrence was at the previously treated site or at a new, untreated site on the eyelid margin. This would be a difficult problem to overcome but could be approached by numbering the meibomian glands and using the numbering system to describe where distichia erupt, or by using photographic records. Retrospective medical records did not always state the exact number of hairs treated; it is possible that animals with more hairs treated had a greater opportunity for recurrence. Retrospective surgery reports also did not explain whether there were any hairs which required more than two cycles of electrolysis applications before the hair could be epilated, which could potentially result in more tissue damage and therefore more scarring. Time of re-examination was not uniform, due to other ocular problems and owner time constraints, this may impact results as those animals re-examined 1-3 weeks following the procedure may be less likely to have distichia recurrence, when those examined at 4-6 weeks following blend electrolysis may be more likely to have distichia recurrence owing to the natural hair growth cycle. Blend electrolysis was performed by different surgeons which may impact both success and rate of scarring. It has been suggested that electroepilation performed improperly (either misplacing the probe or applying too much current for too long time period) may lead to scarring (17). It is possible that blend electrolysis performed by an experienced surgeon may have a higher success rate and lower incidence of scarring, however this has not been proven.

Statistical analysis was limited by small sample size, it is possible that significant differences may have been seen if the sample size was larger.

There is currently no published material on blend electrolysis, or comparisons between different methods of distichiasis removal in veterinary patients. This study provides inaugural information on blend electrolysis in veterinary patients and will hopefully be a platform for future research in methods of distichiasis removal. Future prospective studies where location of distichia are accurately described, either with drawings or photographs would be useful when assessing the outcome of electrolysis. Comparison of more than one method of distichiasis treatment would also be beneficial, in order to determine best possible treatment.

Conclusion

Brachycephalic breeds, most notably English Bulldogs, are overrepresented in this population. Blend electrolysis appears an effective treatment for resolution of clinical signs and complication rate is low.

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