

# Use of punctal occlusion in the treatment of canine keratoconjunctivitis sicca

**Twenty eyes of 10 dogs with keratoconjunctivitis sicca (KCS) were treated by occlusion of the ventral nasolacrimal punctum with a silicone punctal plug in order to increase the volume of the remaining tear lake. Punctal size was measured using a commercially available punctal gauge and the appropriate sized plug was inserted under local anaesthesia. Seven dogs showed an increase in Schirmer tear test I (STT) value. STT values immediately prior to plug placement were  $2.3 \pm 1.7$  mm/minute. STT values with punctal occlusion were  $6.1 \pm 4.1$  mm/minute, giving a mean increase of  $3.8 \pm 2.7$  mm/minute ( $P < 0.001$ ). In 14 eyes of eight dogs, the increase in STT values was accompanied by a clinical improvement in the appearance of the ocular surface. In the three dogs with no increase in STT values, the use of punctal plugs reduced the frequency of artificial tear replacement therapy required to maintain a healthy ocular surface. These results show that use of punctal plugs in dogs with KCS may be appropriate where other lacrimomimetic medications have been unsuccessful.**

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## INTRODUCTION

The treatment of canine keratoconjunctivitis sicca (KCS) was revolutionised by the introduction of topical cyclosporine as a lacrimogenic agent (Kaswan and others 1990). However, around 5 per cent of cases are resistant to the therapeutic effects of cyclosporine (D. L. Williams, personal observations), these generally being animals with neurogenic KCS or those cases of chronic KCS with a Schirmer tear test I (STT) value of 0 mm/minute. These cases require long-term tear replacement medication with an artificial tear solution such as hypromellose, polyvinyl alcohol or a carbomer-based lubricant (eg, Viscotears; Ciba Vision).

In humans, there is a relatively high incidence of KCS in older women suffering symptoms of dry eye as a manifestation of Sjögren's syndrome, an autoimmune disease characterised by rheumatoid arthri-

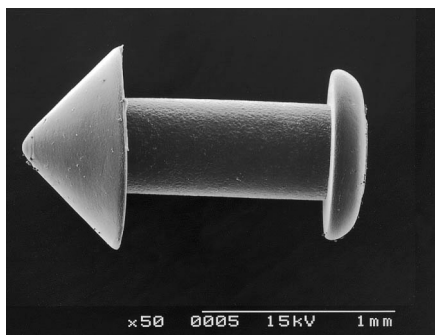
tis as well as polyexocrinopathy resulting in xerostomia and KCS. In these cases, while tear replacement is the standard treatment, an alternative measure is to prevent tear escape through the nasolacrimal duct. Punctal occlusion with removable silicone punctal plugs has been used for some time in cases where tear production has not fallen to zero, as determined by the STT (Adams 1978, Willis and others 1987).

No reports of the use of silicone punctal plugs in canine KCS have been published to date. This study therefore sought to determine whether punctal plugs used for human punctal occlusion would be appropriate for use in dogs, to define appropriate cases where punctal occlusion would be beneficial, and to assess, through STT measurements, whether punctal occlusion was beneficial in the treatment of canine KCS.

## MATERIALS AND METHODS

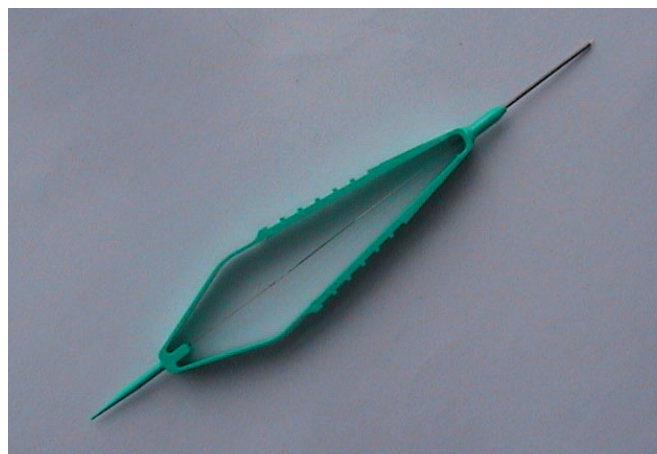
Two types of medical silicone punctal plugs (Oasis; Glendora, CA) (EagleVision; Optimed/Innova UK, Petshore) were used, with shaft diameters ranging from 0.4 mm to 0.8 mm. These plugs have a head portion designed to lie on the eyelid outside the punctum and a shaft designed to lie within the punctum (Fig 1) and are preloaded on a disposable inserter (Fig 2). Before inserting the plug, the correct size must be ascertained using a dedicated punctal size gauge available with the plugs (Oasis). In this study, the punctal diameter was measured using a punctal gauge in 100 dogs of various breeds and sizes while under general anaesthesia during routine surgery. The punctal gauge is used to dilate the punctal opening prior to placement of the plug, which is performed using topical anaesthetic (0.5 per cent proxymetacaine).

Punctal plugs were used in 20 eyes of 10 dogs with bilateral KCS. STT values were recorded in the dogs before punctal occlusion, and again following punctal



**FIG 1. Silicone punctal plug**

**FIG 2. Disposable inserter for the punctal plug**



occlusion, using the same make and batch number of STT strips (Schering-Plough Animal Health) as employed in the first measurement.

Cases with tear production giving pre-treatment STT readings of between 0 and 6 mm/minute were included in the study. Causes of KCS varied from presumed autoimmune gland destruction (cases 1, 2, 4, 6, 9 and 10), lacrimotoxic KCS following systemic sulphonamide treatment (cases 3 and 5) and presumed neurogenic KCS with dry eye and nostril (cases 8 and

9). Six eyes of four dogs were unresponsive or poorly responsive to topical 0.2 per cent cyclosporine ointment (Optimmune; Schering-Plough) while, in the remaining six dogs, limited owner compliance with topical cyclosporine treatment led to the clinical decision to use punctal plugs. In cases where no response to topical cyclosporine was noted or where owner compliance led to cessation of drug use,

topical cyclosporine medication was discontinued prior to plug placement. In cases where some response was noted, drug use was continued.

Ophthalmological assessments with slit lamp biomicroscopy, and direct and indirect ophthalmoscopy were performed at initial examination and on two or three subsequent occasions in each case. STT values were measured at least 10 days prior to plug placement, immediately prior to plug placement and then at between two and six weeks after plug placement. Clinical evaluation of ocular surface health assessed blepharospasm, mucoid ocular discharge, conjunctival hyperaemia, superficial corneal vascularisation and pigmentation and assigned an overall score of between 0 and 5. Improvement in ocular surface health was scored between 0 and 3 by comparison of clinical scores before and after punctal plug placement.

Statistical analysis of STT values used a repeated measures analysis of variance (ANOVA) and Scheffe's multiple comparison test with a significance level of  $P=0.05$ .

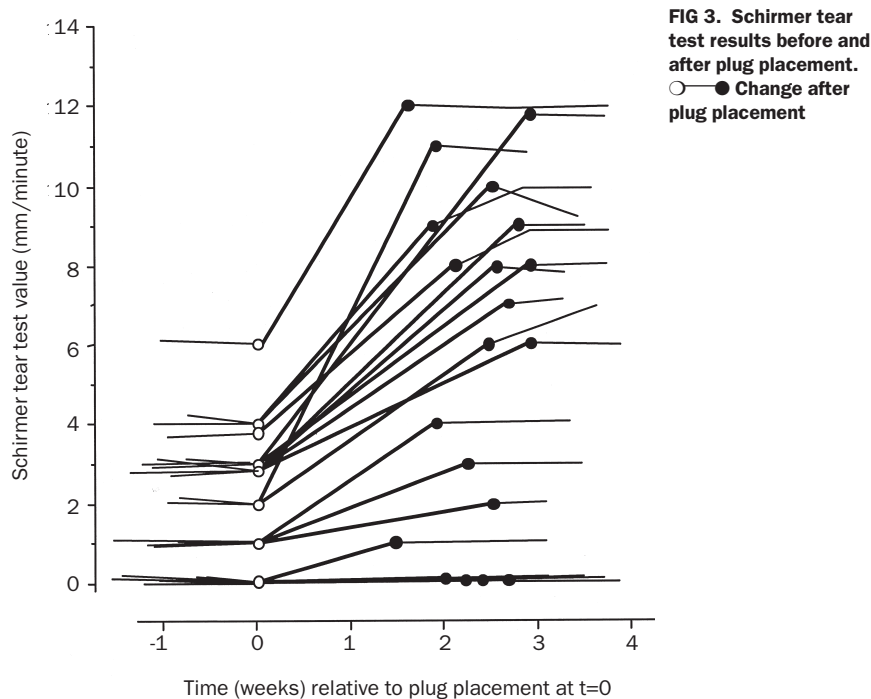
<b>Table 1. Range of ventral nasolacrimal punctal diameters (number [percentage]) in dogs of different weights</b>						
Bodyweight	<0.5 mm	0.5 mm	0.6 mm	0.7 mm	0.8 mm	>0.8 mm
<10 kg (n=25)	0 (0)	4 (16)	15 (60)	4 (16)	2 (8)	0 (0)
10-20 kg (n=26)	0 (0)	1 (4)	9 (34)	13 (50)	2 (8)	1 (4)
20-30 kg (n=25)	0 (0)	0 (0)	1 (4)	16 (64)	3 (12)	5 (20)
>30 kg (n=24)	0 (0)	0 (0)	0 (0)	9 (37.5)	9 (37.5)	6 (25)

<b>Table 2. Signalment, Schirmer tear test I (STT) values and clinical improvement after punctal plug placement in dogs in the study</b>					
Case	Signalment	Plug size (mm)	Initial STT (mm) (left eye/ right eye)	STT with plug (mm) (left eye/ right eye)	Clinical improvement
1	Crossbred, FN, 7 y	0.7	6/3	12/8	+++/>
2	West Highland white terrier, FN, 8 y	0.7	4/2	10/6	+++/>
3	Boston terrier, ME, 12 y	0.6	3/3	7/12	+++/>
4	Crossbred terrier, FE, 10 y	0.8	3/4	8/9	+++/>
5	Jack Russell terrier, FN, 7 y	0.6	1/1	3/4	+/>
6	West Highland white terrier, FN, 14 y	0.7	2/3	11/9	+++/>
7	Staffordshire bull terrier, ME, 8 y	0.8	1/3	2/6	-/>
8	Cavalier King Charles spaniel, FE, 7 m	0.7	4/0	8/1	+/>
9	Crossbred, ME, 1 y	0.8	0/0	0/0	-/>
10	West Highland white terrier, FN, 15 y	0.6	0/0	0/0	-/>

FN Female neutered, FE Female entire, ME Male entire, y Years, m Months

## RESULTS

The majority of dogs (89.5 per cent) had a ventral nasolacrimal punctal diameter of between 0.6 and 0.8 mm. Punctal diameters were identical in both eyes in all dogs.



A proportion of larger dogs (25 per cent of dogs over 30 kg, 12 per cent of all dogs) had puncta larger than 0.8 mm and punctal plugs of this size were loosely fitting in the punctum. Table 1 documents the range of ventral nasolacrimal punctal diameters in relation to bodyweight.

Case details of the 10 dogs included in the study are given in Table 2, together with their STT values before punctal plug insertion and at the first re-examination between two and six weeks following plug placement. STT values are shown graphically in Fig 3. In most dogs, punctal placement required local anaesthesia (0.5 per cent proxymetacaine), restraint of the head by an assistant, focal illumination and magnification (2.5 ×) provided by a head loupe.

Mean STT values for all eyes immediately prior to plug placement were  $2.3 \pm 1.7$  mm/minute and had not changed significantly over the 10 days prior to plug placement ( $P=0.23$ ). Mean STT values in all eyes following punctal occlusion were  $6.1 \pm 4.1$  mm/minute, resulting in a mean

increase of  $3.8 \pm 2.7$  mm/minute. The STT values did not change significantly during the four-week period after plug placement ( $P=0.54$ ), as shown in Fig 3. Sixteen eyes showed increased STT values following punctal plug placement. In 14 eyes, this increase was greater than 2 mm/minute. In all eyes where an increase was seen, an improvement in ocular surface health was noted, as demonstrated by reduction in blepharospasm and reduction in ocular discharge (Table 2).

In two eyes, the increase was from 0 mm/minute to 1 mm/minute (case 8, left eye) and from 1 mm/minute to 2 mm/minute (case 7, right eye), neither of these being significantly different from pretreatment values. Four eyes with STT values of 0 mm/minute (cases 9 and 10) did not show any increase in STT values following punctal plug placement. In the six eyes where no increase or an increase of less than 2 mm/minute was noted, clinical improvement did not occur with punctal plug use alone. Punctal occlusion did appear to optimise the effects of topical

tear replacement, although this was not possible to quantify. Owners reported that a reduction in the frequency of use of polyvinyl alcohol-based or hypromellose-based tear replacements was possible while maintaining ocular comfort, as determined by a reduction in blepharospasm and ocular discharge.

## DISCUSSION

Topical cyclosporine is an important component in the medical management of canine KCS, with studies reporting an increase in tear production of between 24 and 36 per cent (Kaswan and others 1990, Sansom and others 1995). In a small but significant number of dogs, however, tear production is not increased appreciably by topical cyclosporine therapy; cases of congenital and neurogenic KCS appear to be particularly unresponsive to cyclosporine (D. L. Williams, personal observations). In 5 per cent of other cases seen by the author, topical cyclosporine is inappropriate for a variety of reasons, ranging from drug-induced ocular irritation in a small number of animals to cost factors associated with life-long treatment in other cases. This proportion of cases is necessarily skewed by the setting in which the animal is seen. A larger proportion of animals are unresponsive in a second-opinion clinic since responsive cases are not referred for further evaluation; meanwhile, in a first-opinion clinic in a relatively poor area, a larger number of animals are presented in which cyclosporine treatment is not appropriate from a financial perspective. Animals presented in this study comprised both second opinion cases referred for cyclosporine unresponsiveness and animals in which medication was too costly for life-long treatment. In both of these situations a permanent method of increasing the volume of the ocular surface tear lake would be a valuable adjunct to frequent tear replacement medication.

Punctal plugs have been used in human ophthalmology for some years as an

adjunct treatment for KCS. Patients with an STT value of less than 6 mm/minute are reported to benefit from an increase in tear lake volume even in the face of no increase in tear production (Willis and others 1987). Occlusion of the ventral punctum alone allows drainage of excess tears through the dorsal nasolacrimal punctum and prevents epiphora. The majority of patients experience an improvement in ocular comfort with a decrease in the requirement for tear supplementation with permanent plug placement (Willis and others 1987).

In this study, 14 out of 20 eyes showed an increase in STT value. The mean increase in STT value over all eyes was  $3.8 \pm 2.7$  mm/minute, giving an average percentage increase of  $60.5 \pm 37$  per cent. The average increase in STT value for eyes in which the STT value increased was  $4.3 \pm 2.5$  mm/minute giving a percentage increase in the STT reading of  $175 \pm 110$  per cent. In cases in which punctal plug placement was an appropriate treatment, the technique produced extremely beneficial results. However, in the five eyes with no tear production, as demonstrated by an STT value of zero prior to punctal plug placement, little or no increase in the STT value was seen and no clinical improvement was noted. This is understandable given that punctal plug placement does not increase tear production but, rather, maintains tears produced in the tear lake. Dogs with a low or zero STT result are thus unlikely to benefit, given that there will be no or little tear lake to retain in the conjunctival sac. Hence, a key factor in achieving success with this therapy is patient selection.

It might be argued that the STT does not measure the volume of the tear lake but, instead, tear production, and thus the values presented here are not appropriate for evaluation of punctal plug placement. In fact, the test, by necessity, measures a combination of the initial tear lake volume and tear production (Holly and Laukatis 1984, Williams and Evans 2001). Therefore, the test is of value in

determining changes in tear lake volume even where tear production is not increased.

The techniques of measuring punctal size and insertion of the plug require practice to achieve optimal results. There is a limited range of plug sizes; however, the predilection of small-breed dogs to the development of KCS means that the available range of punctal plug diameters is appropriate for the majority of cases.

Some complications have been reported following punctal plug placement in humans, with distal plug migration necessitating surgical removal of the plug (Soparkar and others 1997). In a small minority of human patients plug placement resulted in ocular discomfort. In this small study no animals experienced complications such as ocular discomfort or more severe problems such as plug extrusion or distal migration.

Punctal plugs can be used permanently or as a short-term measure to provide an initial assessment of the value of punctal occlusion in an individual dog. Other methods of punctal occlusion include permanent closure of the ventral punctum by use of a thermal probe. It may be appropriate to produce permanent punctal occlusion in this manner in dogs where use of a punctal plug has proven successful, but such techniques have yet to be reported in canine patients.

As well as use of punctal plugs to maintain a natural ocular surface tear lake, previous reports have suggested that punctal occlusion can optimise tear replacement therapy in humans with KCS. Indeed, plug placement may act as a valuable adjunct to topical application of medications for conditions such as glaucoma (Bartlett and others 1996). Such uses of punctal plugs in the dog have yet to be investigated.

### Conclusions

This study indicates that punctal plug placement may be a valuable adjunct treatment in canine KCS. Plug placement can

be difficult and large breeds of dog may have ventral nasolacrimal puncta which are too large for plug placement to provide adequate punctal occlusion. Dogs in which no tear production occurs, as determined by STT values of zero, are also unlikely to be suitable candidates for this treatment. However, for those in which some tear production occurs, punctal plug placement can increase the volume of the ocular surface tear lake, resulting in significant clinical improvement even without increased tear production.

### Acknowledgements

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