# Vision Matters

## A Focus on Keratoconjunctivitis Sicca (KCS)

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# Keratoconjunctivitis sicca (KCS):

**Ocular conditions account for about ten percent of canine consultations in first opinion practice[1]; this means if twenty dogs come into your surgery in a day, two of them are likely to be presenting with an eye condition.**

With owners increasingly doing their own research before visiting their vet, it is vital to have in-depth knowledge of commonly seen conditions. This report focuses on keratoconjunctivitis sicca (KCS), also known as dry eye, a condition where early recognition can have a significant impact on prognosis.

**5%**

Dry eye affects nearly 5% of all dogs[2]

**20%**

...and up to 20% of predisposed breeds[3]

**46%**

46% of dog owners in a recent survey were not aware that their pet could suffer from dry eye[4]

**Look out for useful hints and tips from Chris Dixon BVSc CertVOphthal MRCVS throughout this report:**

**Chris Dixon** is an ophthalmologist at Veterinary Vision, an ophthalmology referral practice in Cumbria. Chris graduated from the University of Bristol and spent several years in mixed practice, before deciding to focus on ophthalmology; he was awarded a certificate in ophthalmology in 2011. Chris has a particular interest in ocular micro-surgery and topographical analysis of the cornea.

Case study photography courtesy of **Veterinary Vision**



# The normal tear film explained

The normal tear film (also called the precorneal tear film) consists of three major components:

- **Mucous layer** – produced by conjunctival goblet cells, and also by the epithelial cells of the cornea and conjunctiva
- **Aqueous layer** – produced by the lacrimal and nictitans glands
- **Lipid layer** – produced by meibomian glands in the eyelid margin

> Recent research into tear film dynamics suggests that the three component layers are not well defined, and that there is a possible fourth layer of glycocalyx that extends from the corneal epithelium.[5,6]
>
> The aqueous layer of the tear film is 98.2% water and 1.8% solids, including immunoglobulins (IgA, IgG, IgM), lysozyme, lactoferrin, transferrin, ceruloplasmin and glycoproteins.[7,8]
>
> Without a normal aqueous layer, the corneal surface is at risk from bacterial infection, hypoxia, toxic tissue metabolite accumulation and excessive degradation.

The tear film plays a vital role in maintaining ocular health:

- Lubricates the cornea, eyelids and conjunctiva
- Provides oxygen and nutrients (e.g. glucose and electrolytes) to the cornea; vital due to its avascular nature
- Removes metabolic by-products (carbon dioxide and lactic acid)
- Aids removal of irritants
- Allows white blood cells to access the cornea and conjunctiva
- Plays a role in local immune defence of ocular surface

All three components are vital for ocular health. Immune-mediated KCS results in a reduction of the aqueous component only.

# Aetiology of KCS:

**Immune-mediated**
- Most common cause
- Affects the lacrimal and nictitans glands
- More common in certain breeds

**Systemic diseases**
- For example:
- Hypothyroidism[9]
- Diabetes mellitus[9]
- Hyperadrenocorticism[9]

**Drug induced**
- Sulphonamides
- Topical and systemic atropine
- Following sedation/GA (reduces tear production for at least 24 hours)[10]

**Congenital**
- Hypoplasia or aplasia of the lacrimal gland
- Usually unilateral
- Dogs present with severe corneal dryness
- Usually in miniature breeds
- Uncommon

**Iatrogenic**
- Removal of nictitans gland or third eyelid

**Neurogenic**
- Loss of parasympathetic innervation to the lacrimal gland (CN VII)
- Loss of sensory innervation to the ocular surface (CN V)
- Idiopathic or as a result of inner ear disease/trauma/neoplasia

**Infectious causes**
- E.g. Distemper

**Other**
- Prolapsed nictitans gland
- Trauma to the orbit affecting the tear glands

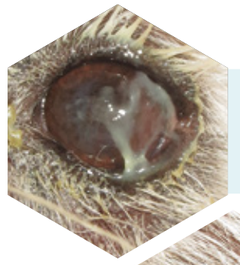


# Clinical signs of KCS:

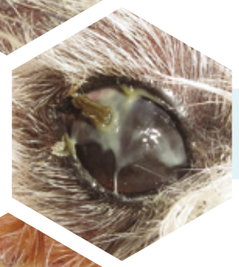
## Acute:

**KCS can present acutely, but this is less common than a chronic presentation**

- **Very painful**
- **+/- Corneal ulceration – likely to rapidly deteriorate if left untreated (may lead to stromal malacia or globe rupture)**



Acute onset, conjunctival hyperaemia, mucopurulent discharge and periocular crusting

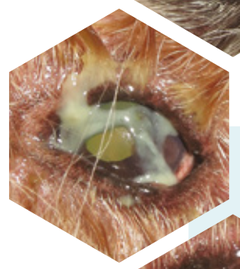


Acute onset, mucopurulent discharge

## Chronic – Early Stages:

**KCS usually presents as a chronic condition**

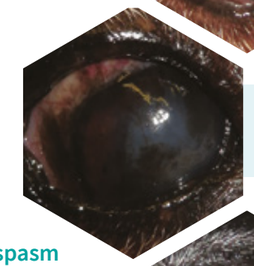
- **Often subtle signs initially**
- **Conjunctival hyperaemia**
- **Intermittent mucoid/ mucopurulent discharge**



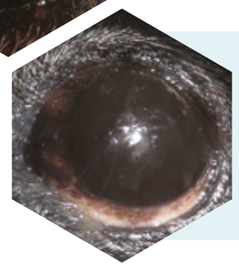
Low grade, uncontrolled chronic KCS. In the first picture, conjunctival hyperaemia is evident along with a mucoid discharge. In the second of the two, neovascularisation of the cornea can be seen.

## Chronic – Later Stages:

- **Worsening conjunctival hyperaemia**
- **+/-Corneal ulceration- often small and may rapidly worsen**
- **Pain – photophobia and blepharospasm**
- **Increasing, persistent mucopurulent discharge**
- **Corneal vascularisation and pigmentation**



Densely pigmented cornea, likely to have diminished visual acuity.



Chronic, uncontrolled KCS. Corneal pigmentation and scarring. Note that the camera flash reflection is not sharp, which is indicative of an irregular corneal surface.

> "KCS can commonly be misdiagnosed as bacterial conjunctivitis due to the persistent mucopurulent ocular discharge."

# Diagnosis:

**KCS is diagnosed by performing a Schirmer Tear Test (STT); there are two types: STT-1 and STT-2.**

## STT-1:

- Most commonly performed
- No local anaesthetic used
- Measures reflex and basal tear production

## STT-2:

- Local anaesthetic used
- Measures basal tear production only
- Performed in order to eliminate the reflex tear component, which can be useful in painful eyes

> STT-1 readings should be interpreted in conjunction with the clinical appearance, and readings may be falsely high in painful eyes. Always compare the STT-1 readings between the eyes and consider performing an STT-2 to eliminate the reflex tear component.

## Case Example:

Consider a dog with KCS that has a superficial ulcer in one eye. This eye may have an increase in reflex tearing due to the pain caused by the ulcer.

Despite having KCS, an STT-1 result from this eye may show a normal or borderline reading, as an increase in reflex tears contributes to a falsely high result.

By performing an STT-2 in this patient, the reflex tear component is eliminated. STT-2 readings are usually half that of STT-1 readings.

## Performing a Schirmer Tear Test

To perform an STT-1:

- Bend the STT strip at the notch whilst still in the packet (if the strips are touched on the corneal contact area they will not be sterile and the grease from fingers may compromise the result)
- Place the short section of the bent strip into the lateral half of the lower eyelid
- Ensure there is contact with the corneal surface to cause reflex tear production
- Measure for a full minute

> To perform an STT-2:
>
> - Apply a drop of topical local anaesthetic to the eye (e.g. 0.5% Proxymetacaine)
> - After approximately one minute, gently dry the conjunctival sac with a sterile cotton bud or bacteriology swab
> - The STT paper strip can then be applied for one minute
>
> It is important to perform any STT over 60 seconds, as it has been shown that the paper strips do not absorb the tears in a linear fashion.[11] Timing over 15 or 30 seconds may therefore provide false results.

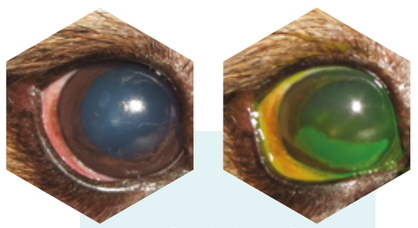
## Interpreting STT results

| STT-1 Reading | Interpretation |
|---|---|
| <5mm/min | Severe KCS – commence treatment |
| 6-10mm/min | Mild/Moderate KCS – commence treatment |
| 11-14mm/min | Interpret alongside clinical signs – re-test in 3 weeks (or sooner if necessary) |
| 15mm/min | Normal tear film quantity |

## Key Points to Consider

Always perform the test on both eyes, even when there is unilateral disease:

- A sore eye may have a normal reading, as a result of ocular pain and increased tearing, whilst the other eye may have a low reading suggestive of underlying KCS. Equally an ulcerated eye with a borderline reading would be of concern as a much higher result would be expected due to reflex tearing.
- Any red or ulcerated eye should have an STT performed (unless deep ulceration is present and the integrity of the cornea is fragile).
- In any case where KCS is suspected it is important to assess both eyes for evidence of corneal ulceration; especially where discharge is present, which may obscure an underlying ulcer. Discharge should be removed very gently to avoid exacerbating a pre-existing ulcer.
- If you suspect KCS, but obtain a normal STT reading, advise the owner to have a repeat check in a few weeks.
- Predisposed breeds should have regular STTs carried out – at vaccinations and check ups.



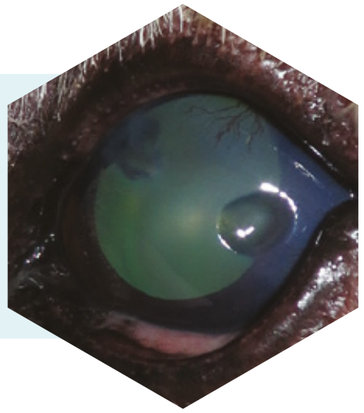
Superficial ulcer of the ventral cornea. The flash reflection on the cornea is not sharp, indicating that the cornea is dry in the unstained image. This dog had superficial corneal ulceration secondary to KCS.

> STT-2 readings are usually half the STT-1 readings and a normal dog will record 7mm/min. Both eyes should be tested so that an accurate comparison can be made.
>
> Tear film quantity has been found to vary during daylight hours (<2mm/min), and reaches peak production at night.[12]
>
> The application of most topical medications prior to assessment may falsely increase STT readings, but lower readings can also occur if the dog has been prescribed topical atropine. It is therefore important to document baseline STT-1 readings prior to the use of atropine.

# Treatment:

**In addition to treating the underlying condition, it is really important to look for and treat any secondary complications, e.g. bacterial infections or corneal ulceration.**

Infected mid-stromal ulcer secondary to KCS. It is crucial to assess dogs with KCS for the presence of ulceration so that management can be initiated early; this case has progressed to a stage where urgent referral/ intensive treatment is needed.



> "All cases with a suspected secondary bacterial infection should be treated with a topical antimicrobial preparation. An ocular swab may provide additional information if submitted for pathogen culture prior to topical medical therapy."

## Treatment options

Treatment should be based on aetiology. As most cases of KCS are immune-mediated (although the exact prevalence remains unknown) the treatment options below focus on immune-mediated KCS. The majority of cases are managed medically, and require treatment for life.

### Cyclosporine:

- **0.2% cyclosporine is indicated for the treatment of immune-mediated KCS**
- **An increase in tear production is expected within ten days, but may not be maximal until six weeks from commencement of therapy**
- **The majority of dogs require lifelong treatment**

> "It has been recommended that carrying out an STT three hours following the application of topical cyclosporine, provides the most accurate assessment of response to therapy.[13]"

> "It has been shown that around 87% of dogs respond to cyclosporine therapy if their STT reading is over 2mm/min at the time of diagnosis, whereas only around 50% of dogs are likely to respond when their initial STT reading is under 2mm/min.[13]"

> "Following the diagnosis of KCS, I normally repeat STT-1 assessment after three weeks of cyclosporine therapy, although it may take six weeks for the therapy to achieve maximal effect. It is important to regularly examine uncontrolled KCS cases as they remain at a high risk of ulcerative corneal disease."

### Artificial Tears/Tear Supplements

- **Only supplemental and should not be viewed as a replacement for treatment targeting the underlying cause**
- **Essential component in the management of KCS to keep eyes lubricated**
- **Should be used in addition to cyclosporine; this is especially important at the start of therapy due to the time it takes for cyclosporine to have an effect on tear production**
- **Majority of cases will benefit from long-term use of artificial tears, in addition to cyclosporine, to keep the eyes as comfortable as possible**
- **Vary in composition, viscosity and application frequency**

> "When considering a tear replacement therapy for a patient, I will always use a long-acting product, as it is often not practical to apply topical therapy at a high frequency. However, severe cases may require intensive therapy with these products in the short-term. Tear replacement products should be used as an adjunctive therapy, and are not a substitute for medical management aimed at treating the underlying cause of KCS."

## What are the options?

Artificial tears can be broadly split into four groups:

1. Hypromellose based products (such as Tears Naturale®; Alcon) tend to require very frequent application, often once every 1-2 hours.
2. Carbomer based products (such as Viscotears®; Alcon and Lubrithal™; Dechra) have increased viscosity compared to hypromellose products, but usually require application around every 4-6 hours.
3. Paraffin based products (such as Lacri-Lube®; Allergan) are often very useful during general anaesthesia, due to their thick consistency.
4. **Hyaluronic acid (HA) based products; HA is a naturally occurring molecule that plays a crucial role in maintaining tissue hydration.[14] Recently a modified version of HA was brought to the market by Bayer Animal Health, called Remend™ Dry Eye Lubricant Drops. Remend™ is preservative-free, and has the benefit to owners that it can be applied just twice daily.**

# Ongoing management:

**Once KCS has been diagnosed and treatment commenced, STTs should be performed every 2-3 months to monitor progress. The interval between STTs can be increased once the condition is stable.**

> If an STT result is low despite cyclosporine and lubricants for 12 weeks, consideration may need to be given to using an off-label preparation, or consider referral.

**Owner education as to the lifelong nature of the disease is vitally important for successful ongoing disease management.**

A recent survey showed that

**70%**

of vets believed that owners not understanding the lifelong nature of the condition is one of the main barriers to compliance when managing cases of KCS.[15]

## Tear replacement therapy- compliance is key

In a recent survey[15]...

Nearly **75%** of vets rated owner compliance in treating dry eye as average or below.

When thinking specifically about tear replacement therapy:

**82%** of vets felt that the leading barrier to compliance was owners not having the time to administer therapy frequently enough.

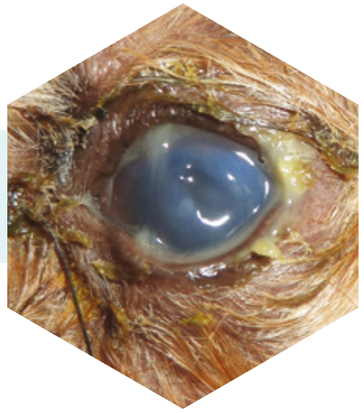
The long-lasting lubrication provided by Remend™ Dry Eye Lubricant Drops makes it a useful option to aid the management of dry eyes in dogs, where twice daily application may encourage owner compliance.



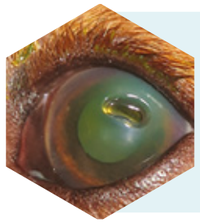

## When to refer?

- If there are severe secondary complications such as deep corneal ulceration
- Cases that are refractory to medical treatment after 12 weeks
- Cases that may require surgery, such as parotid duct transposition (PDT)

> Unfortunately deep stromal ulceration and keratomalacia (melting ulcer) can develop with uncontrolled KCS (see photo) and can lead to corneal rupture. These cases can often be effectively treated with intensive medical and surgical management, and I would recommend that you urgently seek ophthalmological advice or referral.



Keratomalacia in chronic KCS case



Acute KCS case with secondary bacterial infection and descemetocoele formation. Requires urgent referral/intensive treatment

> Cases that are refractory to medical management may be considered for parotid duct transposition (PDT) surgery. The operation is designed to allow the flow of saliva onto the surface of the eye, preventing desiccation. Although saliva has a similar osmolarity and pH compared to tears, it contains higher concentrations of minerals. In my experience the deposition of crystals on the ocular surface and eyelids can be a common feature following PDT surgery, and can be difficult to remedy. Despite the high complication rate associated with PDT surgery, a study has shown a 92% success rate, judged by an ophthalmologist and owner satisfaction survey.[16]

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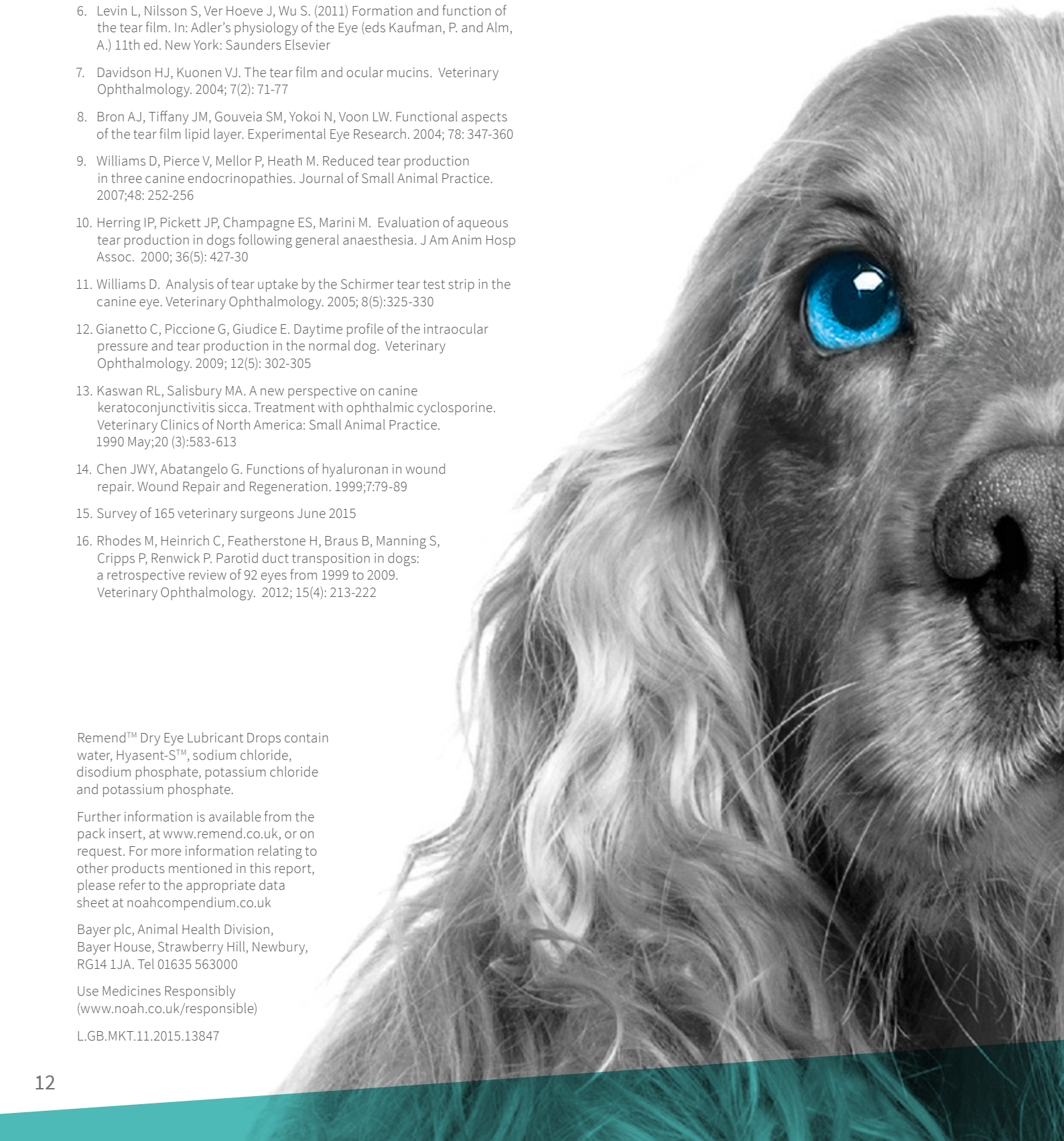

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