Meibography
&
Tear film lipid layer

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Meibomian gland examination

• MGs morphology and function may be evaluated in vivo by:
  • SL
  • MG expression
  • Meibometry
  • Contact meiboscopy
  • Non contact infrared meibography
  • Laser scanning confocal microscopy
Meibomian glands and tear film lipid layer

- Meibomian lipids are the main component of the superficial lipid layer of the TF, essential for the maintenance of ocular surface health and integrity.

- LL examination may add important data to better assess MGs function and TF stability.
Non contact infrared meibography has been first described by Reiko Arita in 2008 to show the effects of ageing in a normal population.

At the 2011 ACVO meeting Masanori Endo presented a poster on “Non contact infrared meibography in dogs and cats” by using a portable probe.

At the 2015 4th COSDW in Tokyo, NCIM has been considered.

NCIM by hand held meibographs

- MGA-VET: hand held meibograph wi-fi connected to an iPad
NCIM by hand held meibographs

- OSA-VET: hand held Ocular Surface Analyser cable connected to a computer
Feasibility

- The animal cooperative temper and the owner’s compliance are essential requirements
- No need of specific restraint for dogs and cats if the owner and/or an assistant hold the head
- Short training period
Most horses have been sedated with detomidine (10μg/Kg) and butorphanol (10 μg/Kg) and an auriculopalpebral nerve block has been carried out.

All exams were performed when clinical signs of deep sedation were evident by placing the animal’s head on a support.
Meibography allows to examine MGs arrangement within the eyelid....

...and the location of their ductal openings along the so called grey line.
In a normal eyelid 30-40 MGs and their openings may be shown.

A normal MG is approximately linear and 3-4 mm in length.
• Meibography is easily performed also in cooperative cats
• MGs number, more or less regular arrangement and size are easily examined

• In most cases the four eyelid examination lasts few minutes.
Meibography is easily performed also in horses

The iPad connected meibograph is more practical to examine horses in the field

- it’s not cable connected to a computer
- can be angled as needed, while the holder of the OSA system, in contact with the horse’s head, may limit the angle of view while examining the upper eyelid
Since the animal is not annoyed by a visible light, it’s possible to examine a cooperative horse without sedation.
• MGs share strong similarities with the hair follicles of the cilia in embryologic development and structure

• If germ cells fail to differentiate completely to MGs, they become pilosebaceous units instead
Meibomian gland dysfunction (MGD)

• **MGD is a chronic, diffuse abnormality of the meibomian glands, commonly characterized by terminal duct obstruction and/or qualitative/quantitative changes in the glandular secretion**
  
  *This may result in alteration of the tear film, symptoms of eye irritation, clinically apparent inflammation, and ocular surface disease*

• Epidemiology in humans
  
  • Population-Based Studies: prevalence varies widely, from 3.5% to almost 70%, it’s higher in reports arising from Asian populations**
  
  • Clinic-Based Studies: from 20% in UK to approximately 60% in Japan
  
  • MGD is considered a main cause of evaporative DED

** Knop E et al. The International workshop of Meibomian gland dysfunction: report of the subcommittee on anatomy, physiology and pathophysiology of the Meibomian gland. IOVS 52,4,1938-1978, 2011

Source: https://www.dryeyeandmgd.com
Meibomian gland dysfunction

• In dogs: Corinna Eule’s study on Blepharitis and MGs. All criteria defined for MGD in humans were present in 37.5% of histopathological samples *

• In dogs: MGD studied and described by Yasunary Kitamura, Akihiko Saito and Maehara Seiya **

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Anatomical changes occur in all studied species as a consequence of:

- ageing
- ductal opening hyperkeratinization
- increased meibum viscosity
- inflammatory mediators
- bacterial lipid-degrading enzymes
- hormonal changes
- topical or systemic medications
Meibomian gland dysfunction

- MGD was diagnosed in 39 over 68 dogs I examined by NCIM for a history of long lasting OSD (57%)
- MGD was present in 7 over 13 KCS dogs (54%)
CLINICAL SIGNS

• Continuous blinking:
  • 25 incomplete / 6 complete / min

• Red and wet eyes
CLINICAL HISTORY
• Granulomatous sebaceous adenitis
• Uncommon skin disease found in some breeds of dogs (rarely in cats, rabbits and horses)
• Inflammatory response against the dog's sebaceous glands → destruction of the glands (probably immuno-mediated)
Palù: meibomian gland dysfunction

MGs atrophy, shortening, dropout
Meibomian gland dysfunction

- In some cases of MGD the eyelid mucocutaneous junction may move posteriorly with retroplacement of ductal openings.
- The mucosa may also spread forward, so that the orifices appear to lie in mucosal tissue.
Meibomian gland dysfunction

• MG expression can be performed as an indicator of MG function
• Expression may demonstrate the terminal ductule plugged with inspissated secretion

Normal: clear to light yellow

Abnormal: whitish-gray to yellow

Semisolid plug of toothpastelike consistency
Meibomian gland dysfunction

- Scattered orifices may be capped by a dome of oil with a tough surface
MGs scoring systems: meiboscore

- On selected images I checked for meiboscore: ratio of meibomian gland area to total analysis area
- Meiboscore evaluates only areas of MGs dropout
Palù, granulomatous sebaceous adenitis and MGD
MGs scoring systems: meibograde

• Meibograde is a more accurate scoring systems based on described MGs histopathologic changes: distortion, shortening, dropout

• A score of 0 through 3 is assigned to each of the three categories

• A meibograde from 0 through 9 per eyelid is obtained by summing the scores
• Meibomian lipids are the main component of the superficial TF LL
• MGD alters the TF LL, increases aqueous phase evaporation and decreases TF stability
• LL composition, probably more than LL thickness, is highly correlated with TF thinning rate caused by evaporation
The TF LL can be visually examined by observing interference patterns generated by light reflected from its front surface (air-lipid boundary) and the lower surface (lipid-aqueous boundary).
Principles of Thin Film Interferometry

- Light striking a thin film is partially reflected (ray 1) and partially refracted at the top surface (A).
- The refracted ray is partially reflected at the bottom surface (B) and emerges as ray 2.
- The coloured interference fringes are caused by the specular reflection at A and B and the phase difference between ray 1 and 2.
- Colour intensity and distribution vary according to the thickness of the film and the indices of refraction of the various media.
Principles of Thin Film Interferometry
TF LL interferometry

- Polarized light biomicroscopy in dogs & cats by Carrington
  - 16 different interference colours
  - 3 principal variants of surface lipid morphology (dogs) (wave, islet and granitiform)

Polarized light biomicroscopic observations on the pre-corneal tear film. 1. The normal tear film of the dog

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Polarized light biomicroscopic observations on the pre-corneal tear film. 2. Keratoconjunctivitis sicca in the dog


Polarized light biomicroscopic observations on the pre-corneal tear film. 3. The normal tear film of the cat

TF LL patterns

• LL thickness is evaluated by looking at LL patterns (colour & texture)
• Three main patterns:
  • faintly visible homogeneous meshwork pattern (≈15-30 nm)
  • compact meshwork pattern, grey waves (≈30-60 nm)
  • meshwork with waves and interference fringes (≈60-150 nm)
• TF evaporation does not necessarily correlate with thickness of the TF LL*
• LL thickness is just a parameter to be considered
• Contaminants and clumping of lipid-mucins may increase LL evaporation

*King-Smith PE et al. Tear Film Breakup and Structure Studied by Simultaneous Video Recording of Fluorescence and Tear Film Lipid Layer Images. IOVS, July 2013, Vol. 54, No. 7, 4901
• TFE may be impacted by more than lipid layer thickness, may be a function of LL composition
• Bacterial lipases may break down esters into component acids and alcohols, causing a defective TFLL structure with increased evaporation*

*King-Smith PE et al. Tear Film Breakup and Structure Studied by Simultaneous Video Recording of Fluorescence and Tear Film Lipid Layer Images JOVS, 54, 7, 4900-4909, July 2013
TF LL thickness
Patterns grading scale
NIBUT grid

In most cases continuous eye and third eyelid movements prevent NIBUT evaluation.
Placido disc – OS topography