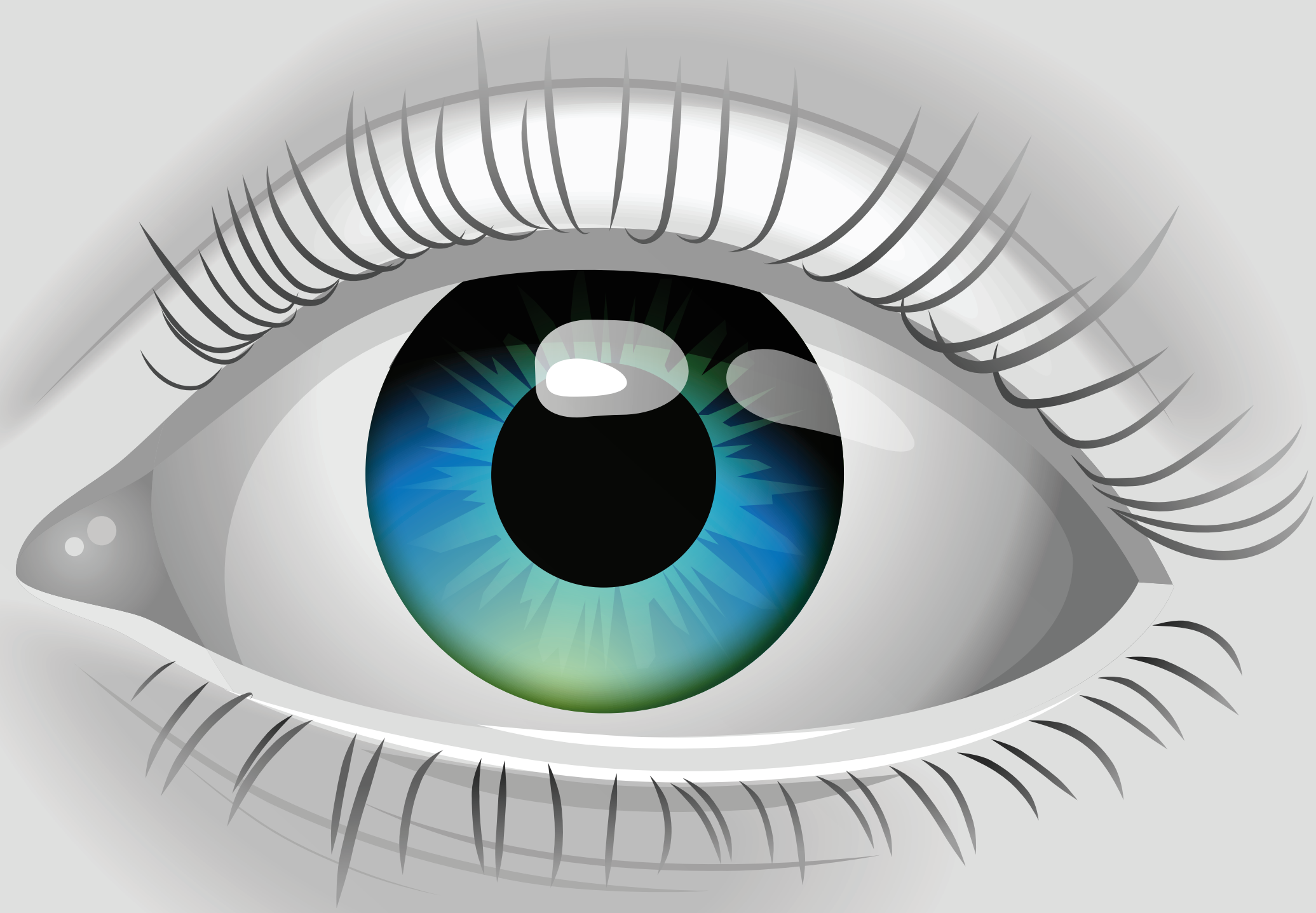


ENHANCEMENT OF CLINICAL OBSERVATION OF *DEMODEX FOLLICULORUM*

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INTRODUCTION

- Demodex folliculorum* is associated with blepharitis.¹
- These mites are microscopic (<400µm) making them difficult to identify with a standard slit lamp (SL).
- It is possible to view the mites using the Mastrota technique,² which involves rotating the eyelash to reveal *D. folliculorum* at the base of the lash
- An ideal viewing system would provide a magnified upright image (approx. 400-600x) of the eyelash base, with low optical distortion.
- The purpose of this investigation was to explore existing optical instruments to enhance the viewing of *D. folliculorum* in a clinical setting.**

METHODS

Four categories of optical instruments were experimented with:

- SL modifications
- Condensing lenses (e.g. 90D, 78D, 66D, 30D, 20D)
- Head mounted magnifiers
- Digital devices

The optical properties assessed were

- Magnification/field of view
- Distortion
- Working distance (WD)
- Viewing stability
- Depth of field

Filters, dyes, and different wavelengths of light, along with their practicality were also evaluated.

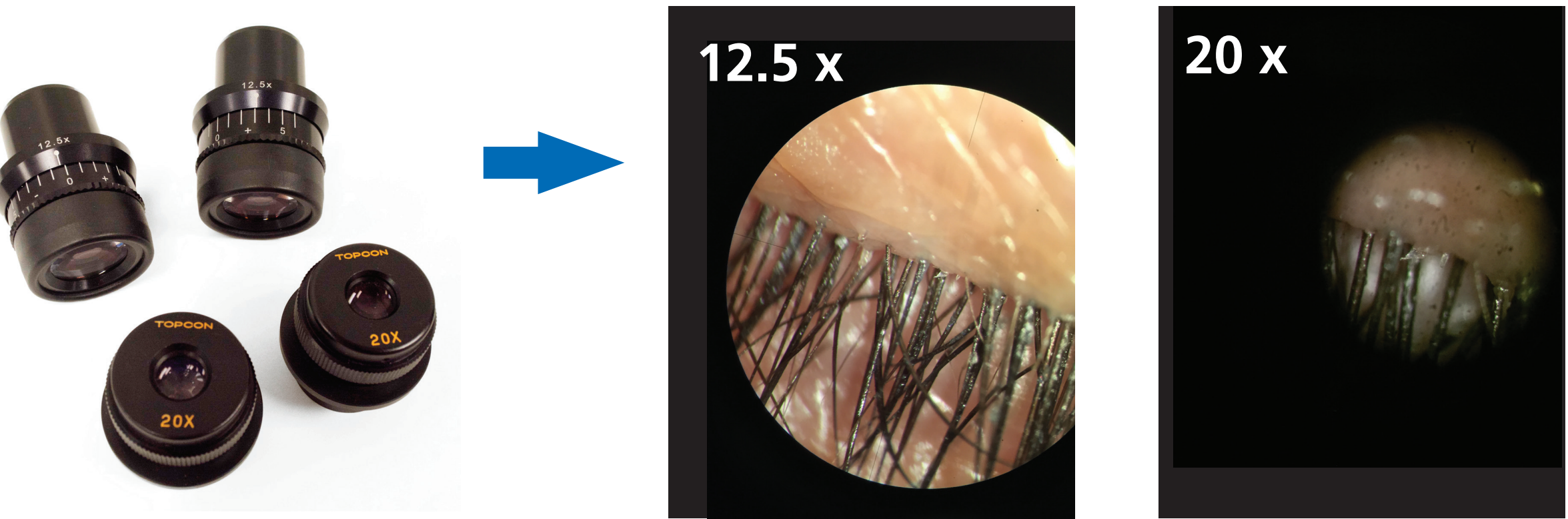
RESULTS

- SL modifications are a viable option, since the optics are optimized and the patient is stabilized.
- Magnification can be changed by toggling different objectives and oculars (as in higher end slit lamps)

Slit Lamp Modifications

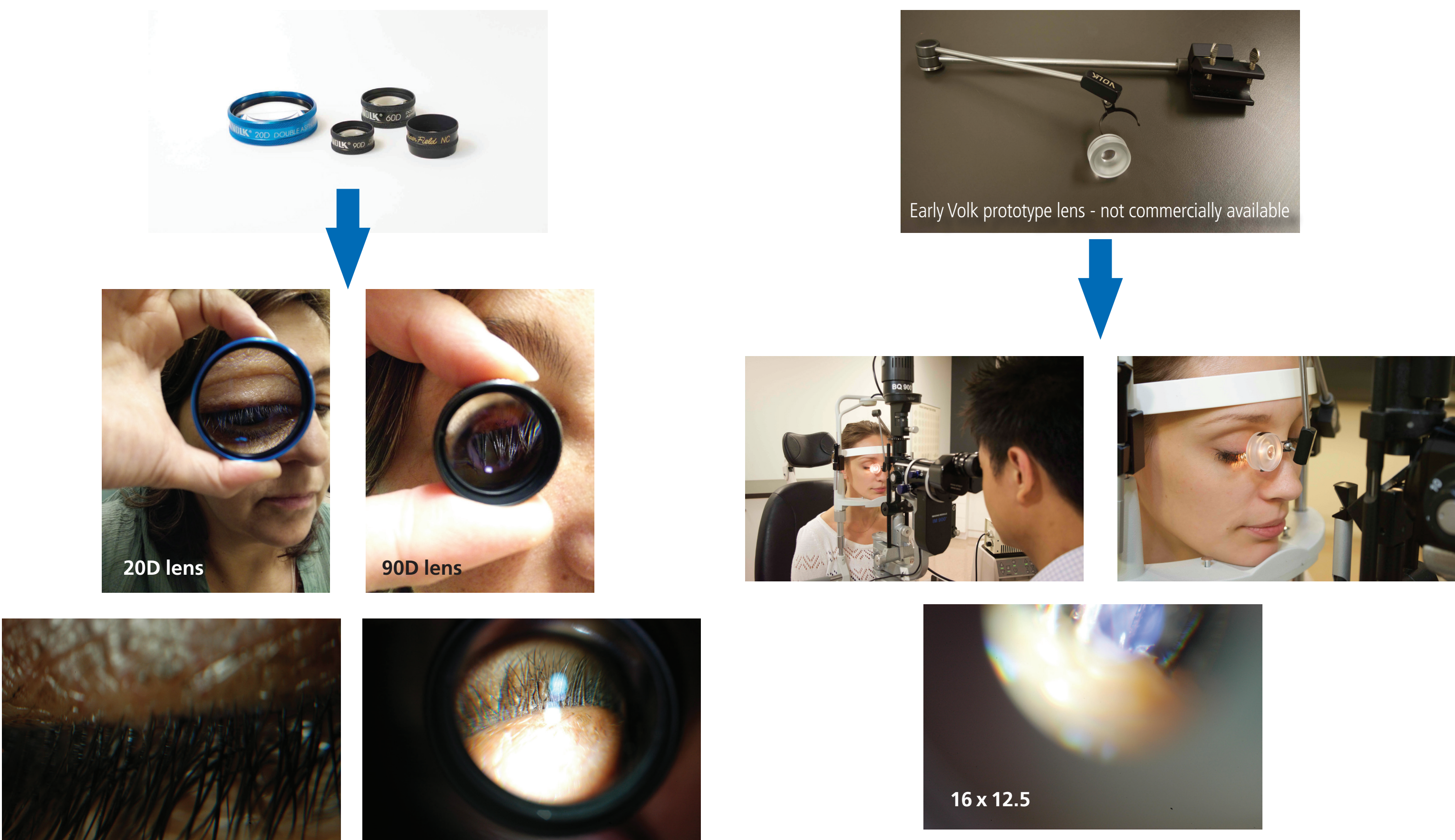


Effect of changing oculars



Condensing lenses

- Condensing lenses were able to achieve the desired magnification, but at the cost of distortion, image inversion and stability.
- Existing condensing lenses were not designed for viewing lid margin structures



Head mounted magnifiers

- Head mounted magnifiers (e.g. 8x binoculars) offer freedom of movement, but WD is restrictive and invasive and did not provide sufficient magnification

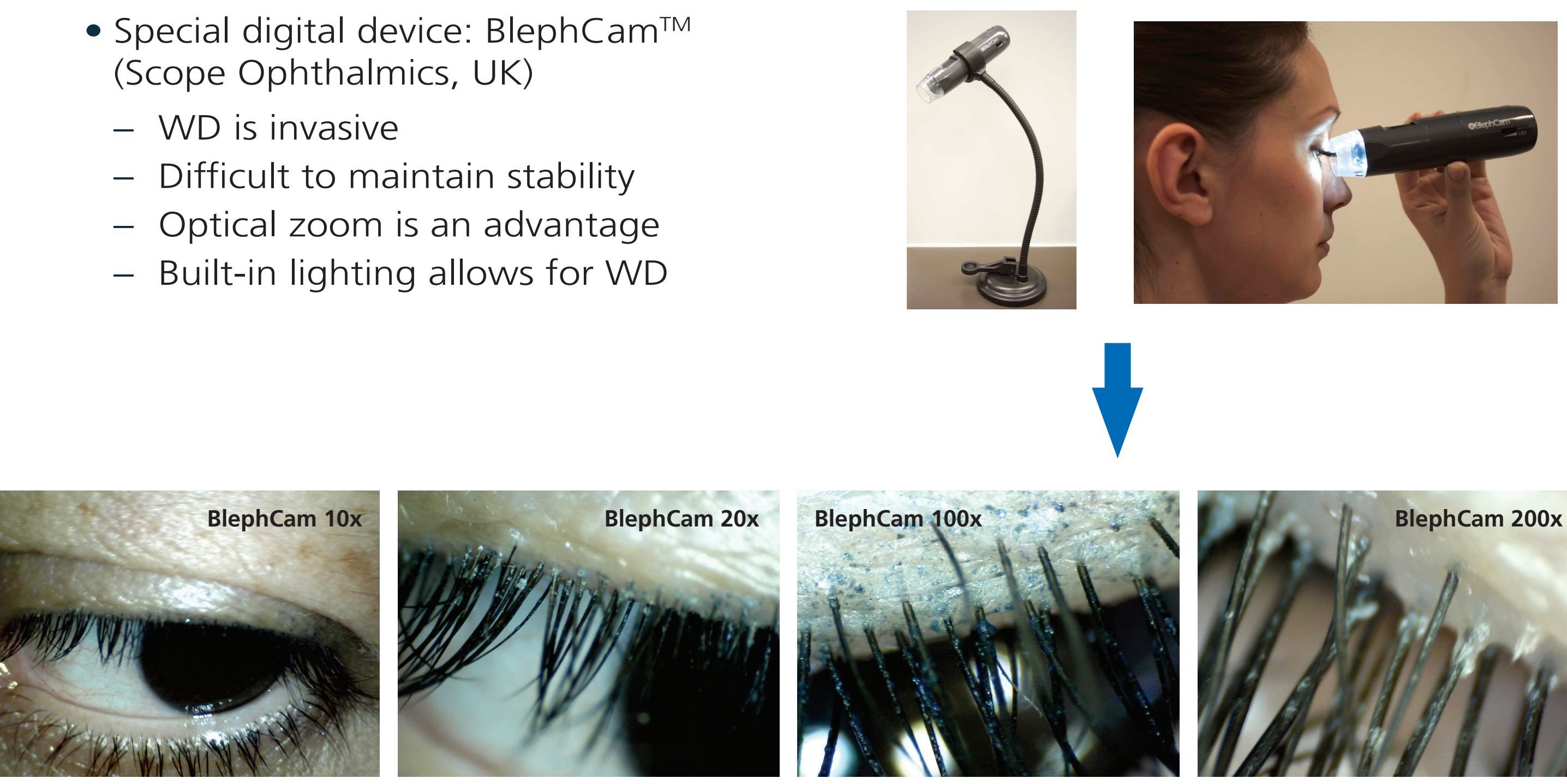


Digital devices

- Digital devices (smartphones/tablets) were user-friendly and accessible, however optics and stability are limitations.
- Adaptors exist to improve stability
- Digital magnification (zooming in photos) is a feature inherent with digital devices which allows better appreciation of details (mite tails)



- Special digital device: BlephCam™ (Scope Ophthalmics, UK)
- WD is invasive
- Difficult to maintain stability
- Optical zoom is an advantage
- Built-in lighting allows for WD



Others

- Presently, no ophthalmic dyes or filters have effectively enhanced the visualization of the mite.
- Optical coherence tomography and confocal microscopy has successfully viewed *D. folliculorum* in vivo.^{3,4}

	Slit lamp modifications	Condensing lenses	Head mounted devices	Digital devices	Advanced imaging technologies
Magnification capability	+++	++	-	- (+++ BlephCam™)	+++
Low image distortion	+++	-	-	-	+++
Working distance	+++	+++	-	+++ (+++ BlephCam™)	+ (OCT) - (confocal)
Viewing stability	+++	-	++	-	-
Depth of field	-	-	-	-	-

DISCUSSION

Slit lamp is a feasible platform for viewing of *D. folliculorum*

- Existing instrument in practice and clinical routine
- Ability to change oculars for increased magnification
- Ability to accommodate different condensing lenses
- Can combine it with digital photography
- For the most part – patient is stable, image is stable
- Lighting can be controlled (techniques, direction and intensity)

Condensing lenses

- Very poor stability and lighting
- Distortion issues with existing lenses
- Existing lenses not meant for lid viewing
- Early VOLK prototype lens addresses some issues
 - Works with a steady mount to promote stability
 - Designed for lid structure
 - Dual aspheric lens
 - Focal length 9mm
 - Nominal working distance 5mm
 - Virtual magnified image of 5.75x

Head mounted magnifiers

- Freedom of movement
- Not enough magnification
- May require invasive working distance

Digital devices

- Ability to capture images make digital devices very attractive as chair side educational tools
- Advancing camera technology may allow for improved ability to capture images on smartphone devices in the future

CONCLUSION

- The main challenge to viewing the base of the eyelash is obtaining sufficiently high magnification with minimal distortion and good stability.
- The slit lamp remains the best platform for the development of an optical system for viewing *D. folliculorum* in a clinical setting

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