

Introduction

- The limbus is an important area anatomically, physiologically, and clinically.
- Functions: Nourish peripheral cornea, provide outflow for aqueous, and assist in corneal epithelial regeneration (1).
- Scientific literature offers little information on a precise definition of its structures and dimensions (Figure 1; Table 1).
- Recent technological and surgical advancements in the fields of contact lenses and cataract and glaucoma surgeries have created the need for a better understanding.

Corneo-limbal Dimensions according to General Ocular Anatomy Texts				
References	General Description	Unit	Usability/Definition of Limbal	Relationship between Corneal and Trabecular Meshwork
Baker and Whyte (1980) System of ophthalmology, No. 2	13.1 to 24.6 mm	mm		
Journal of ophthalmology, No. 2	range of corneal curvature	mm		
			N/A	Measurement of corneal dimensions is required to provide the basis of the meshwork and thus just one of the measurements required for the study

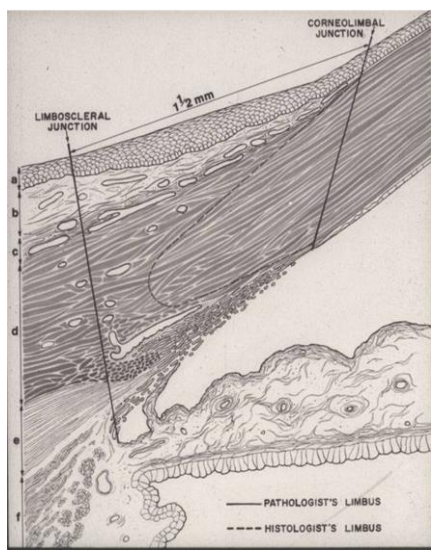


Figure 1. Classic diagram from Hogan, Alvarado, Wedell (1971)

This diagram has routinely been reproduced, sometimes mildly modified in subsequent anatomy texts. It has become the accepted understanding of limbal dimensions and structural relations.

[illegible]

* - denotes that the diagram presented in the text was an adaptation/copy taken from Histology of the Human Eye (Hogan, Alvarado, and Wedell)

Purpose

The purpose of this study was to define the limbus morphologically, to develop a methodology to accurately measure the width of the limbus, and to determine the relationships between the limbal components.

Methods

- Whole human eyes (n=3) obtained from a US eye bank were dissected along the equatorial meridian (Figure 2)
- After placement in a 2.5% glutaraldehyde fixative within 48 hours of death, smaller pieces of tissue suitable for electron microscopy were prepared following an established histological protocol.
- Scanning electron microscopy (SEM), transmission electron microscopy (TEM), light microscopy (LM), and serial block face (TESCAN) microscopy were used to identify and measure the limits of the limbus using ImageJ software.

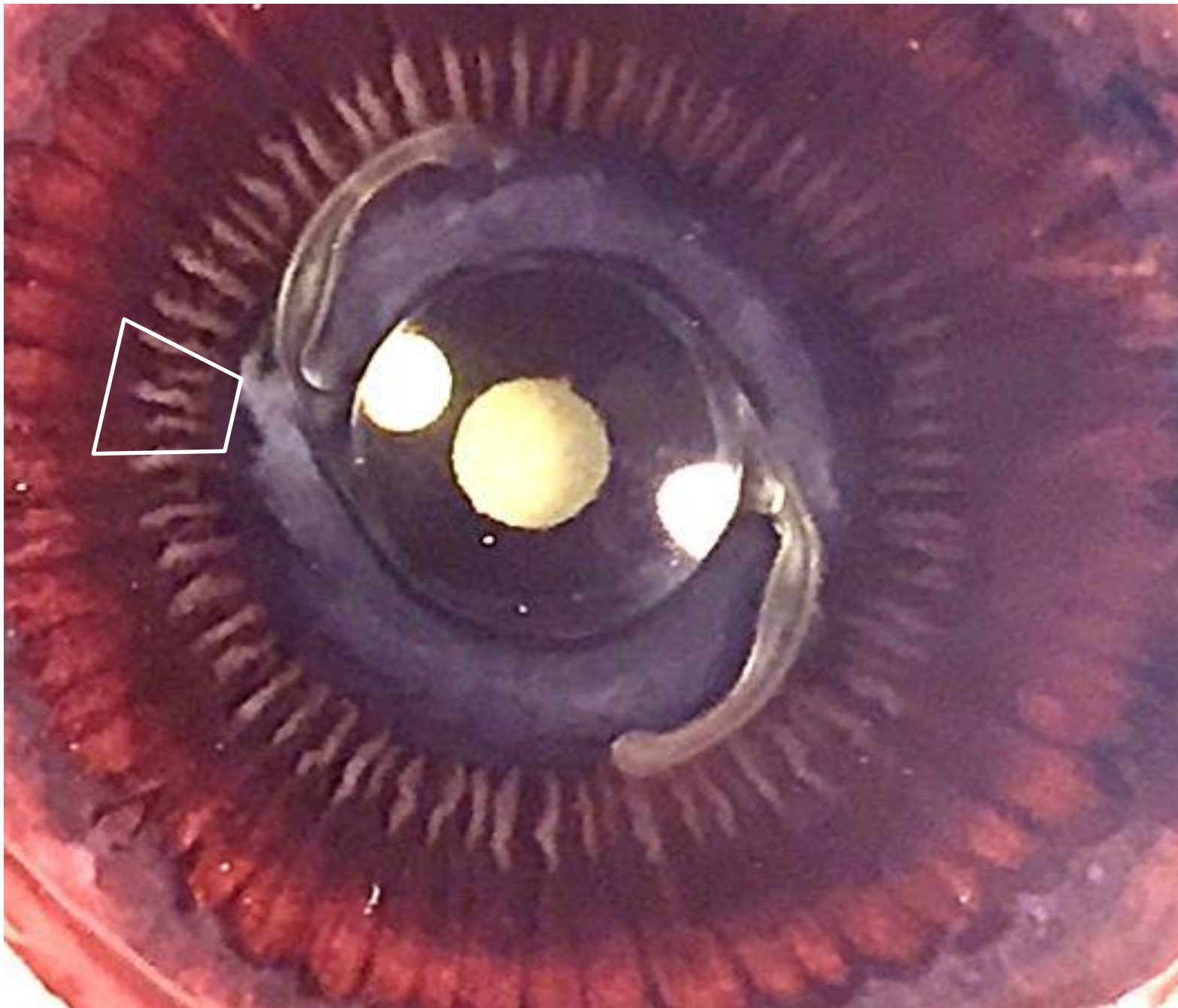


Figure 2. Posterior view of the anterior segment dissected from an 84 year old woman.

The pie-shaped outline indicates from where samples of tissue with intact uveal and outer coats were collected. This illustration also visualizes the perfect implantation of an IOL (Alcon SN60WF) .

Results

- Limbal dimensions are not exactly the same when measured along the anterior and posterior surfaces.
- The scleral spur is truly a part of the scleral anatomy, although it maintains a close relationship with the limbal trabeculae.
- Imaging indicated that the angle recess is strictly a uveal feature and should not be a reference point for the peripheral extreme of limbus

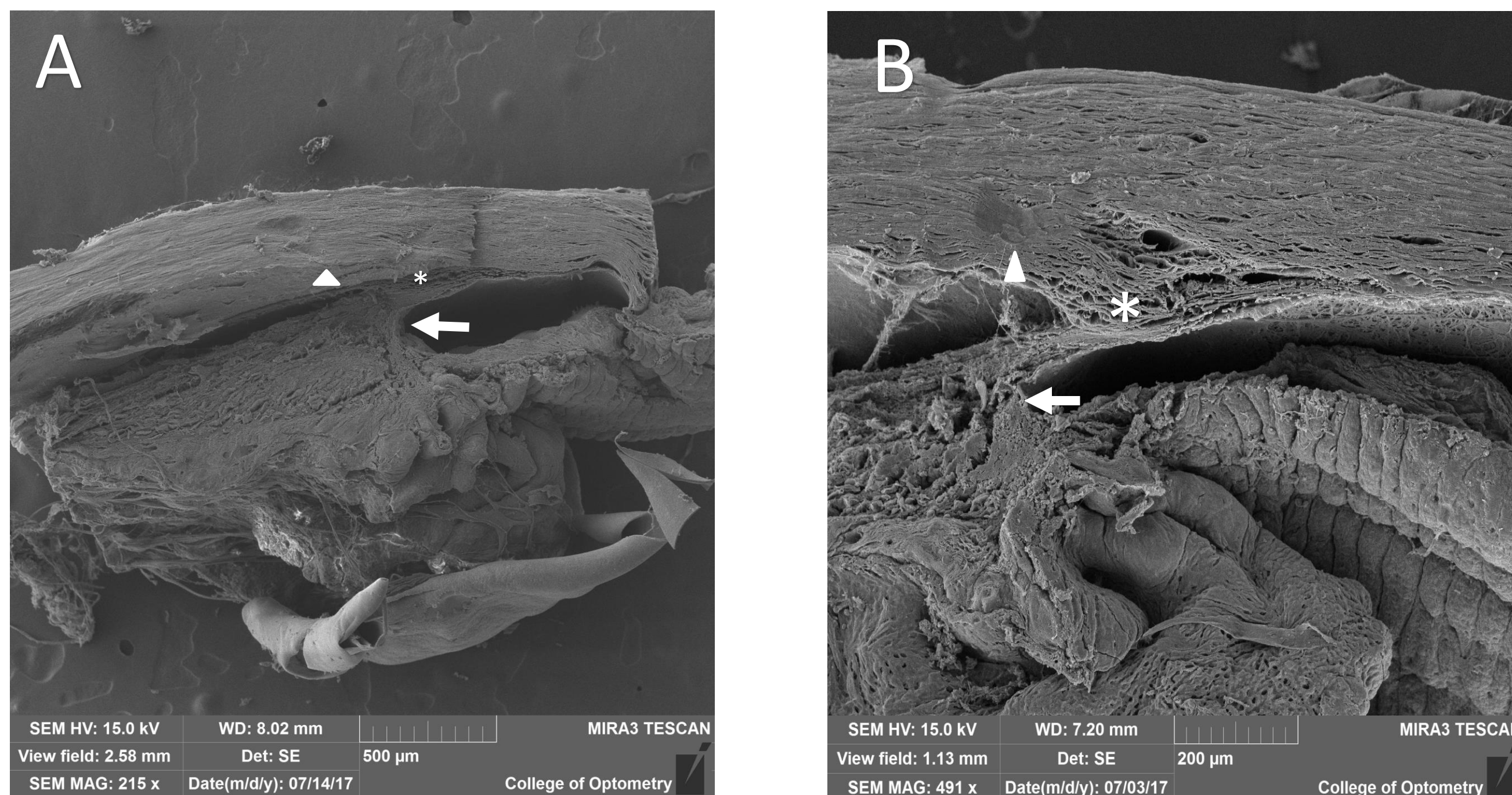


Figure 3. SEM of filtration angle (A low magnification, B high magnification).

- 1) Scleral spur – triangle
- 2) Trabecular meshes – asterisk
- 3) Angle recess - arrow

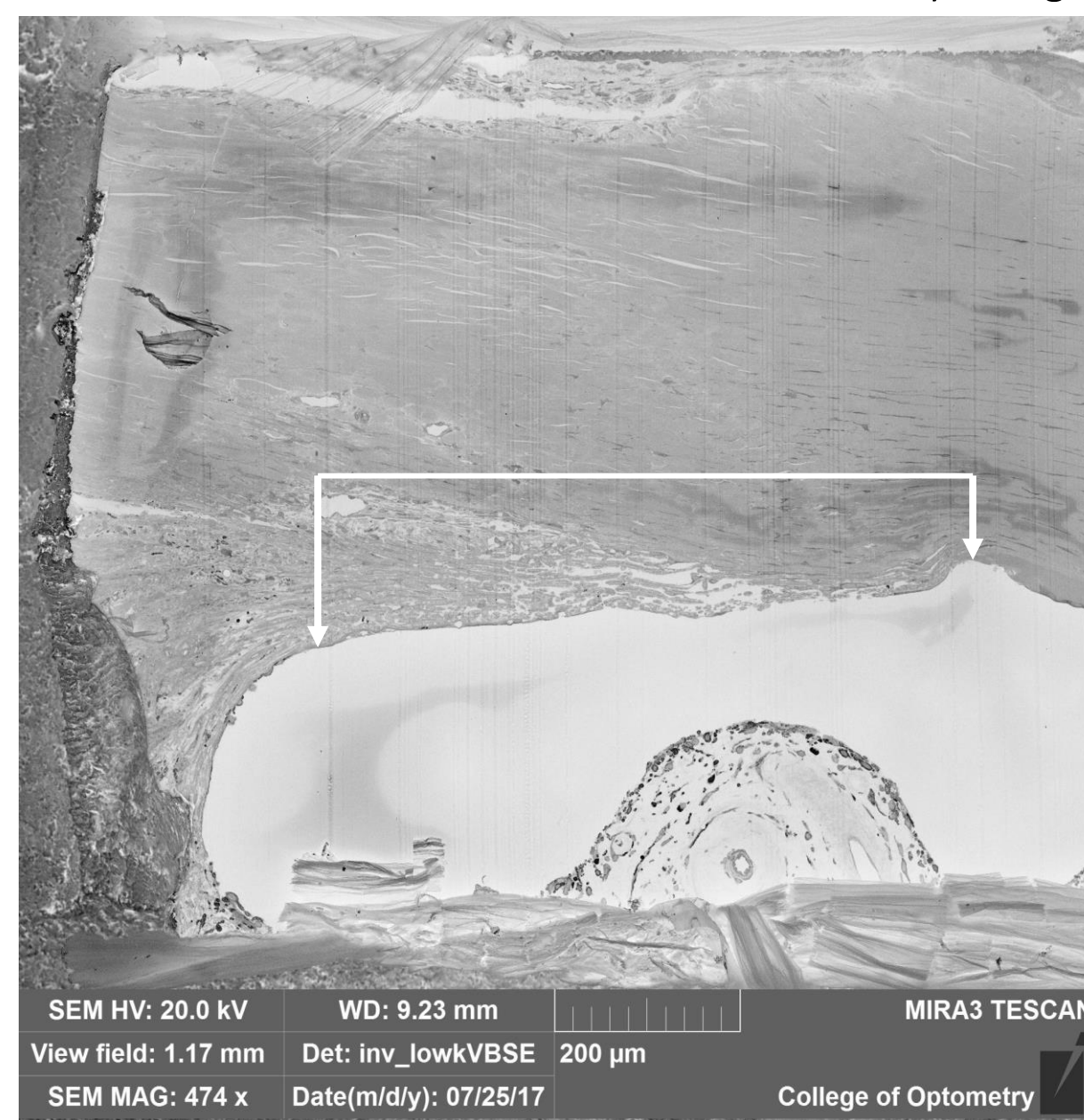


Figure 4. TESCAN of filtration angle

ImageJ software measurement from the peripheral wall of canal of Schlemm to the transition zone of posterior limiting lamina (PLL) into trabecular meshes indicated a 690 μm width of posterior limbus.

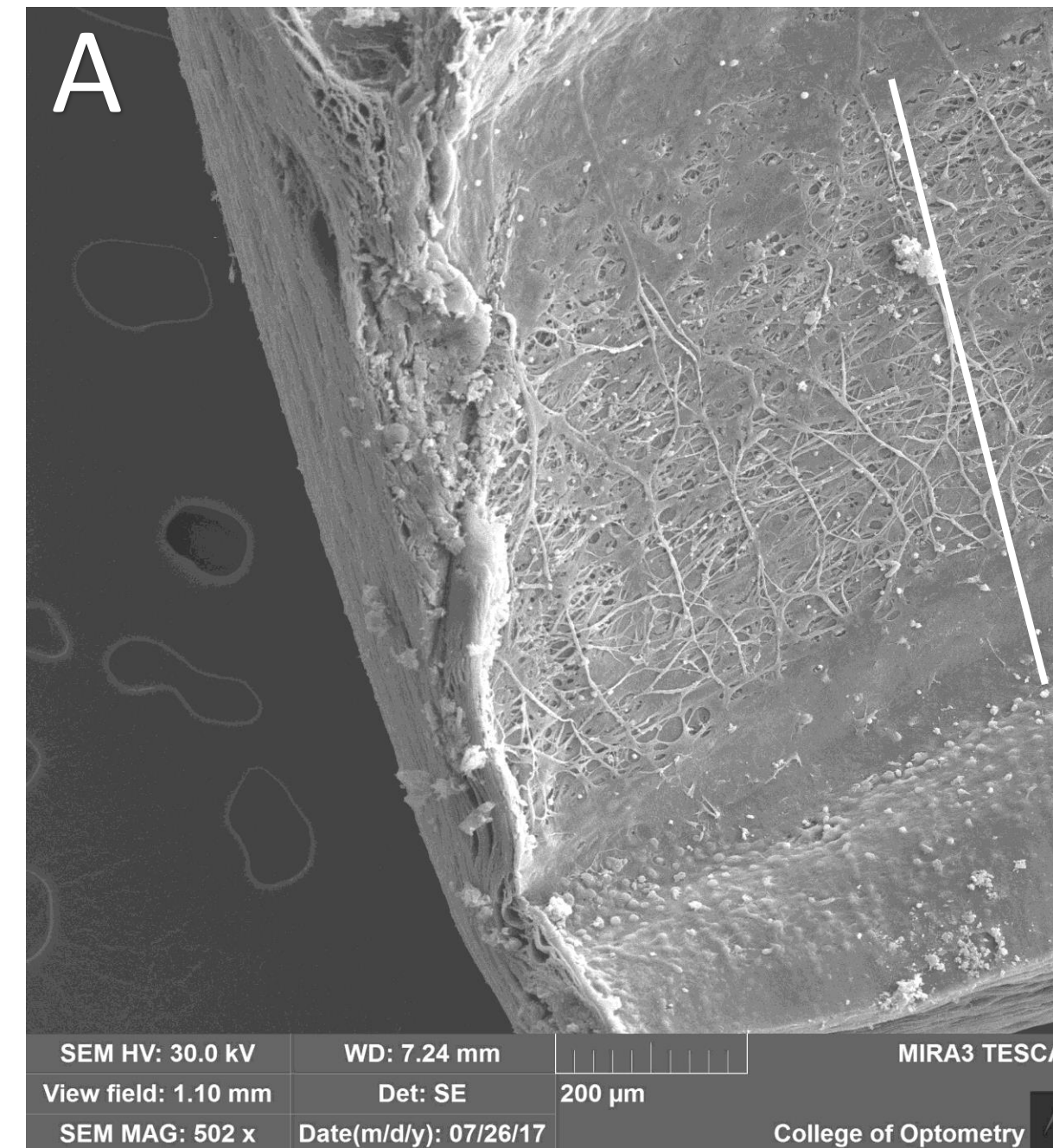


Figure 6. Near full width of trabecular meshwork (A low magnification, B high magnification).

The uveal and corneo-scleral meshwork can be distinguished by their chord-like and sheet-like appearances respectively. SEM. ImageJ software revealed that this width was 695 μm

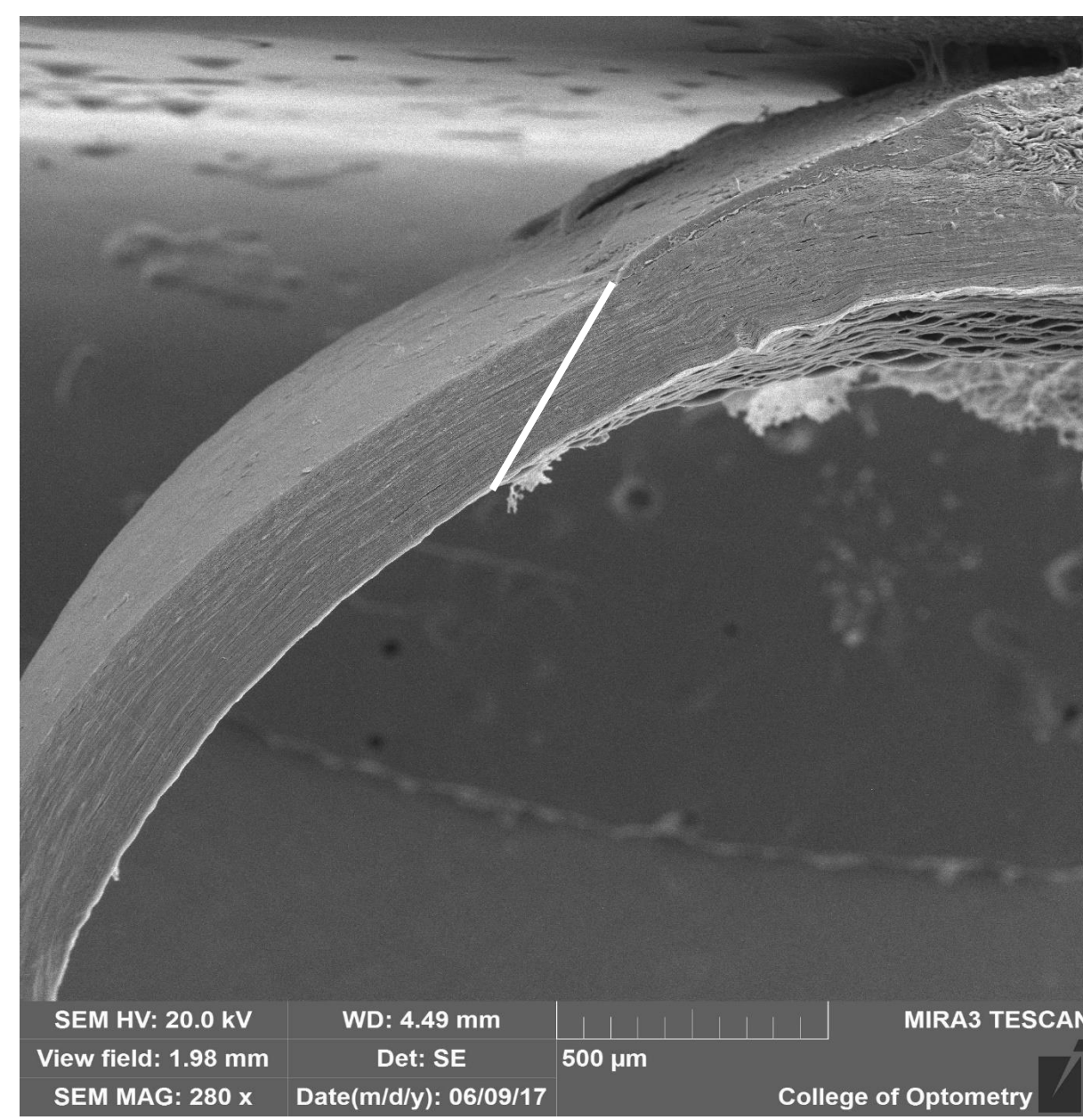
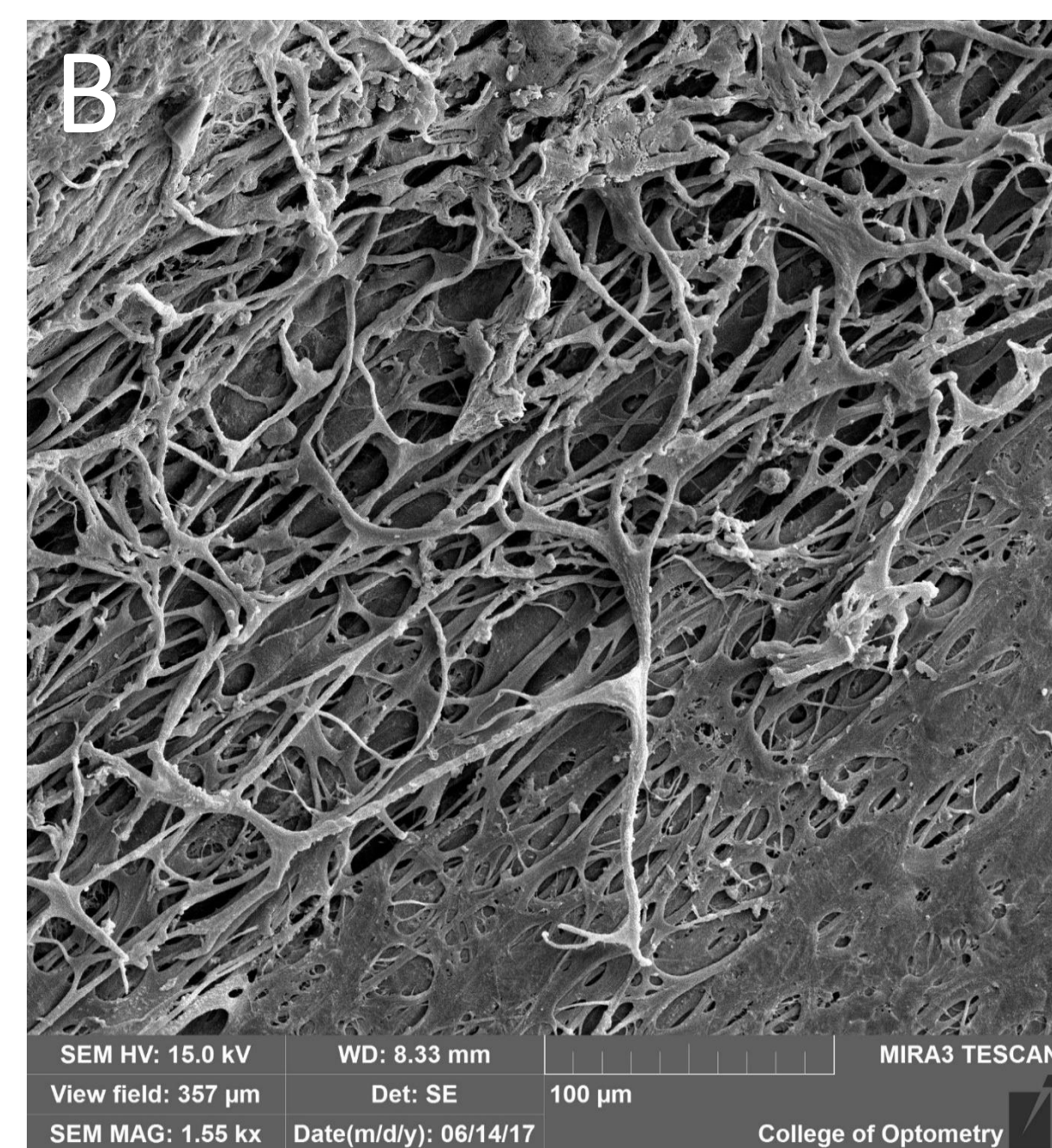


Figure 5. Central limits of limbus.

The peripheral terminations of the corneal anterior limiting lamina (ALL) and PLL are connected with a line marking cornea (C) to the left and limbus (L) to the right. SEM.



Discussion and Conclusions

- The Hogan, Alvarado, and Wedell (1971) diagram (Figure 1) and its reproductions (3-10), on which we have based much of our understanding of the region, have inaccuracies.
 - Typically, the canal of Schlemm is wrongly illustrated to occupy a smaller part of the superior and lateral extreme of the trabecular meshes. However, its lumen size has been shown to vary between specimens and is IOP dependent (11). Our observations indicated that it occupies a larger area of the external face of trabeculum than previously suggested.
 - The scleral spur is part of the outer coat and is peripheral to limbus.
 - Angle recess is part of the uveal coat and separate from the trabecular meshes
- The termination of the ALL and PLL are reasonable anatomical reference points for the anterior extremes of limbus, as has been shown in previous literature (3).
- Peripheral limbal extremes are more ambiguous and proved to be more difficult to define
- Corneo-limbal diagonal dimensions are not likely to be the same for measurements along the anterior and posterior surfaces.
- Future measurements of limbus should not include scleral spur and angle recess.
- In scleral lens practice and glaucoma/cataract surgeries, this crucial area has a great need for further research into its structural arrangement and dimensions.

References

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