# Can anterior chamber depth values assist in the diagnosis of angle closure disease spectrum?

Jack Phu[1,2], Ryan Seong[2], Aaron Tse[2], Michael Kalloniatis[1,2]
[1] Centre for Eye Health, University of New South Wales, Kensington NSW 2052 Australia
[2] School of Optometry and Vision Science, University of New South Wales, Kensington NSW 2052 Australia

Correspondence: Ryan Seong: r.seong@student.unsw.edu.au
& Aaron Tse: a.c.tse@student.unsw.edu.au

## Introduction

- Glaucoma is a leading cause of blindness, with primary angle closure glaucoma being responsible for nearly half the cases of glaucoma-related blindness.[1]
- With many clinicians not being confident in performing gonioscopy[2], it is important to implement effective, non-invasive techniques to supplement the gold standard of gonioscopy in detecting those at risk or in early stages of angle closure disease to prevent irreversible blindness

## Aims

- To investigate anterior chamber depth measurements obtained using Pentacam Scheimpflug imaging for detecting angle closure spectrum disease
- To identify any clusters or patterns of anterior chamber depth which can be used to phenotype the type of angle closure for effective patient management

## Methods

### *Ethics statement*

- Patients have provided written consent for their de-identified records to be accessed and used for research purposes. The study was approved by the Human Research Ethics Committee at the University of New South Wales and adhered to the tenets of the declaration of Helsinki.

### *Patient cohorts*

- Consecutive patients seen at the Centre for Eye Health (CFEH) referred for anterior chamber angle assessment were assessed.[3]
- Patients were separated into one of three diagnostic groups based on the most posterior structures visible on gonioscopy: open angles (at least posterior trabecular meshwork visible in all quadrants), primary angle closure suspect or worse (PACS+), or narrow and non-occludable (NNO). In total, 202 open angle patients, 142 NNO, 32 PACS+ patients were examined.

### *Data extraction*

- Anterior chamber depth data was extracted from the Oculus Pentacam software (Figure 1), and clinical data were extracted from the medical records.

### *Statistical analysis*

- Receiver operating characteristic (ROC) curves were analysed to determine the ability for anterior chamber parameters in separating between diagnostic groups.

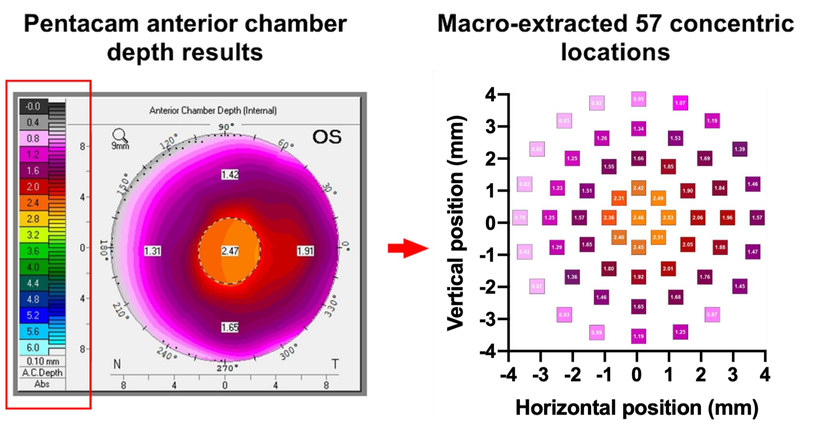


***Figure 1: Example of clinical data extracted from Pentacam results to obtain anterior chamber depth values at 57 test locations.***

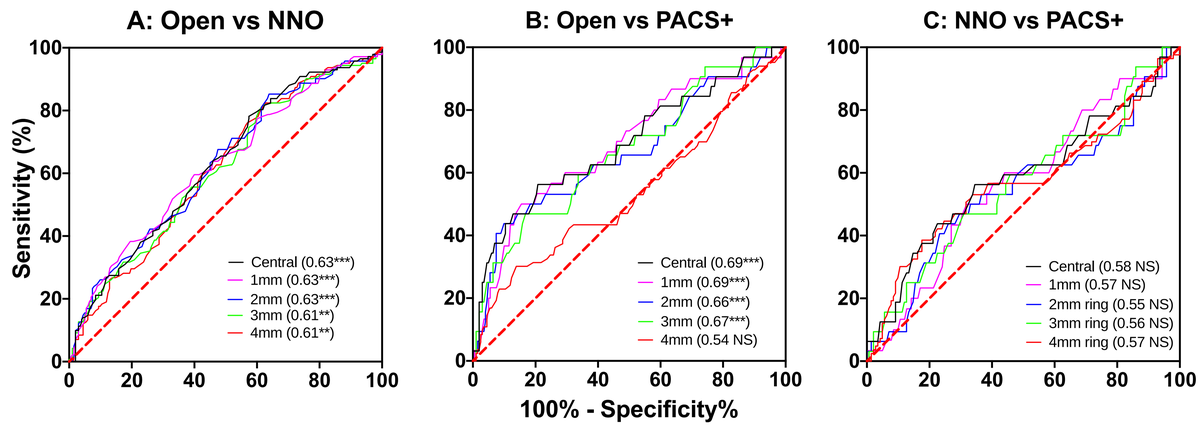


***Figure 2: Receiver operating characteristic (ROC) curves for comparisons between pairs of diagnostic groups. The areas under the ROC curves are shown in brackets. The diagonal line indicates the line of no discrimination.***

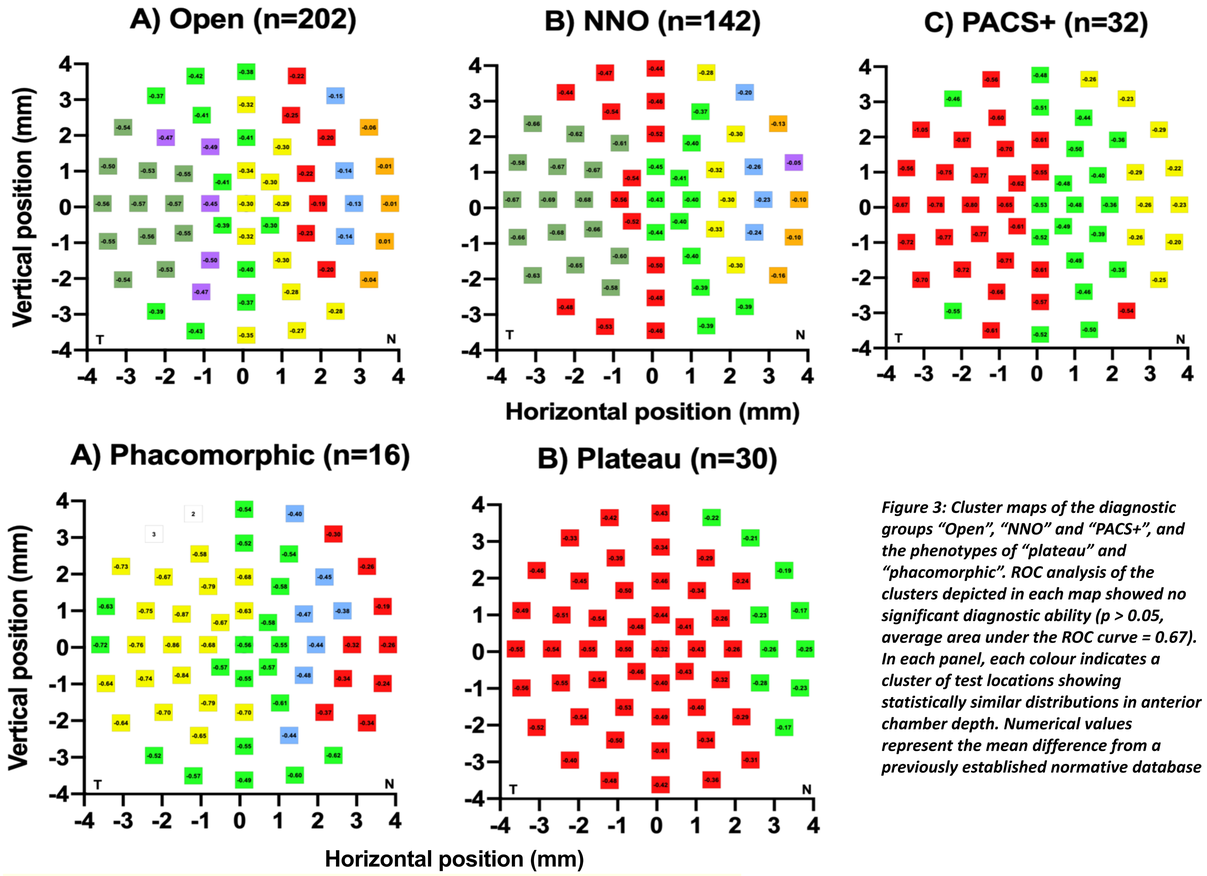


***Figure 3: Cluster maps of the diagnostic groups "Open", "NNO" and "PACS+", and the phenotypes of "plateau" and "phacomorphic". ROC analysis of the clusters depicted in each map showed no significant diagnostic ability (p > 0.05, average area under the ROC curve = 0.67). In each panel, each colour indicates a cluster of test locations showing statistically similar distributions in anterior chamber depth. Numerical values represent the mean difference from a previously established normative database***

## Results

### *Patient characteristics*

- The mean age of the cohort was 57 (range: 22-79). The most common ethnicity was Caucasian (n=217). There were more females (n=255) than males (n=121) in the cohort.

### *ROC analysis*

- There was modest ability of the central, 1mm, 2mm and 3mm ring anterior chamber depth (ACD) values in distinguishing between open vs NNO, and open vs PACS+. The 4mm ring had diagnostic value in distinguishing between open vs NNO only.
- Whilst central and peripheral rings display similar ROC curves, the diagnostic ability for both central and peripheral ACD values was poor in distinguishing between NNO and PACS+ compared to gonioscopy.

### *Cluster analysis*

- Categorising test locations which share similar distributions from age-normal values were categorised into clusters.
- Cluster analysis revealed a nasal-temporal bias across the anterior chamber, symmetrical about the horizontal axis for all groups, compared to a reference normative database.[4]
- ROC analysis of the clusters within each group revealed a moderate diagnostic ability which was not statistically significant ($p>0.05$).

## Conclusions

- Scheimpflug imaging demonstrates a modest ability in the diagnosis of angle closure disease compared to gonioscopy.
- There was no significant difference between the diagnostic ability of central ACD values and peripheral ACD values.
- Arranging the test locations into clusters based on ACD values reveals a nasal-temporal asymmetry and a superior-inferior symmetry in all groups, with a depressed temporal angle relative to the nasal angle.
- Clusters of plateau iris and phacomorphic groups reveal distinct pathological patterns.

## Acknowledgements

The authors thank the clinicians and technicians at the Centre for Eye Health for assistance in collecting the clinical data, and Janelle Tong for technical assistance. Guide Dogs NSW/ACT provides salary support for JP and MK. The funding body had no role in the conception or conduct of the study. This project was supported in part by a Beta Sigma Kappa Fellowship to JP.

## References

1. QUIGLEY, H. & BROMAN, A. (2006). The number of people with glaucoma worldwide in 2010 and 2020. British Journal Of Ophthalmology, 90(3), 262-267. doi: 10.1136/bjo.2005.081224
2. JAMOUS, K. F., KALLONIATIS, M., HAYEN, A., MITCHELL, P., STAPLETON, F. J. & ZANGERL, B. 2014. Application of clinical techniques relevant for glaucoma assessment by optometrists: concordance with guidelines. Ophthalmic and Physiological Optics, 34, 580-591.
3. PHU J, HENNESSY MP, SPARGO M, DANCE S, KALLONIATIS M. 2020. A collaborative care pathway for patients with suspect angle closure glaucoma spectrum disease. Clin Exp Optom 103(2):212-219.
4. PHU J, TONG J, ZANGERL B, LE JL, KALLONIATIS M. 2020. Cluster analysis reveals patterns of age-related change in anterior chamber depth for gender and ethnicity: clinical implications. Ophthalmic and Physiological Optics, 40(5):632-49.