Associations of Retinal Layer Thickness and Optic Disc Parameters with Inflammatory Bowel Disease: A Cross-Sectional Analysis

Rohan Misra[1][2], David Merle[1][2], Siegfried Wagner[1][3], Yukon Zhou[1][2], Dominic Williamson[1][2], Robbert Struyven[1][2], Alastair Denniston[4], Pearse Keane[1][3]

[1] UCL Insitute of Ophthalmology, London, UK [2] Moorfields Eye Hospital, London, UK [3] NIHR Moorfields Biomedical Research Centre, London, UK [4] College of Medicine and Health, University of Birmingham

Background

- Imbalance in gut microbiota (dysbiosis) can impair physiological functions and is associated with systemic diseases.
- Dysbiosis often precedes increased intestinal permeability (leaky gut) where barrier dysfunction allows microbial products and toxins to enter the bloodstream, eliciting systemic inflammation.[1]
- Numerous clinical studies have identified correlations between dysbiosis and various retinal diseases, including age-related macular degeneration and diabetic retinopathy.[2][3][4]
- Inflammatory bowel disease (IBD) such as Crohn's disease (CD) and ulcerative colitis (UC) are associated with dysbiosis and inflammatory ocular diseases.[5]
- IBDs are also associated with retinal aberrations (increased drusen counts) and retinal vascular alterations.[5]

Primary objective

To explore associations between IBD subtypes (Crohn's Disease, Ulcerative Colitis, and other IBD) and retinal vascular parameters and retinal layer thicknesses

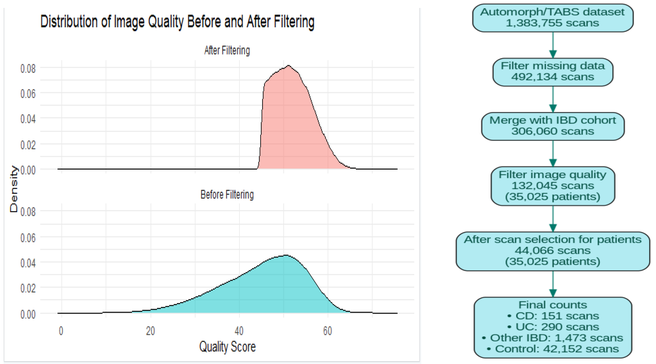


Figure 1. Distribution of image quality after filtering and flowchart of data handling

Methods

- Cross-sectional analysis of data from the 'AlzEye' study, a retrospective cohort of 154,830 patients, aged ≥ 40 years, who had retinal imaging at Moorfields Eye Hospital, between 2008 and 2018.[6]
- Retinal vascular parameters were extracted from macula-centered color fundus photographs (CFP) using 'Automorph', a deep-learning algorithm; retinal layer thicknesses were extracted from optical coherence tomography (OCT) scans using the Topcon Advanced Boundary Segmentation algorithm (TABS).
- The final dataset of IBD patients was curated based on image quality and missing features.
- Mixed-effects linear regression model was fitted to determine associations between image-derived parameters and IBD (CD, UC and other IBD types).
- Model adjusted for the following confounding variables: age, sex, hypertension, diabetes mellitus and socioeconomic status.
- Sub-group analyses performed to compare different IBD subtypes (CD, UC and other).

Results

Crohn's Disease vs Control:

- Optic disc smaller (height ↓0.26 SD; width ↓0.21 SD) and optic cup reduced (height ↓0.25 SD; width ↓0.21 SD).
- Retinal microvasculature expanded: artery density ↑0.23 SD, overall vessel density ↑0.19 SD, fractal dimension ↑0.21 SD, tortuosity ↑0.20 SD.

Ulcerative Colitis vs Control:

- Mild arterial changes only: vessel density ↑0.15 SD; fractal dimension ↑0.14 SD.
- No significant optic nerve head or retinal layer alterations.

Other IBD vs Control:

- Outer retina (EZ/OSP/IZ) thinning (↓0.17 SD) with inner NFL thickening (↑0.11 SD) and modest MZ ↑0.07 SD.
- Retinal vasculature changes: overall vessel density ↓0.06 SD, fractal dimension ↓0.12 SD (both arteries & veins), arterial density ↓0.10 SD.

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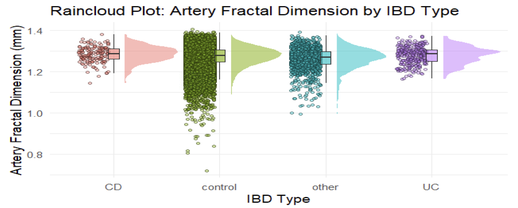


Figure 2. Raincloud plot for artery fractal dimension across all subgroups. This demonstrates the distribution of all data points and box plots showing median, interquartile ranges and potential outliers in each group. Raw data points are also included to show individual values.

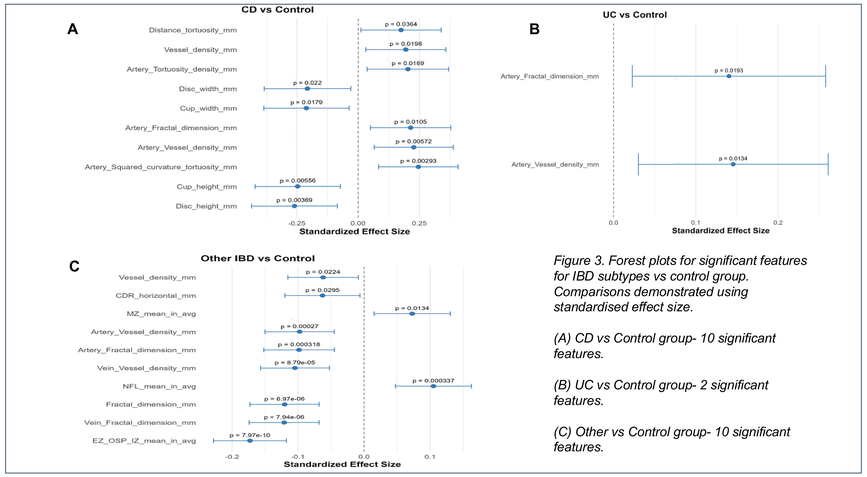


Figure 3. Forest plots for significant features for IBD subtypes vs control group. Comparisons demonstrated using standardised effect size.

(A) CD vs Control group- 10 significant features.

(B) UC vs Control group- 2 significant features.

(C) Other vs Control group- 10 significant features.

Conclusion and Future Directions

- Retinal imaging reveals demonstrable subtype-specific vascular and structural changes in IBD. Structural changes predominate in CD, while outer retinal thinning and generalised vascular changes characterise other IBD types. UC appears minimally impacted with mild vascular alterations, emphasising variability among subtypes.
- Further research can help to assess their clinical relevance and use as supplementary outcome measures for monitoring disease progression and therapeutic response.

Contact: rohan.misra1@nhs.net