Morphologic Stages of Full-Thickness Macular Hole Assessed with Spectral Domain Optical Coherence Tomography

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Introduction: The sequential stages of full-thickness macular hole has never been described in vivo in humans using imaging. The purpose of this study is to describe the sequential morphological changes following full-thickness macular hole (FTMH) formation, utilizing a novel, objective staging system based on optical coherence tomography (OCT), and to determine its association with baseline visual acuity (VA) and duration of symptoms.

Methods: Retrospective multicenter study. Primary FTMH referred to St. Michael's Hospital, Toronto Canada, and Retina Consultants of Texas, Texas, Houston, USA, from 2009 to 2022 were included. Multimodal imaging of 1000 patients were initially assessed. To be eligible for this study patients had to have at least two preoperative SD-OCT scans and no other retinal pathology. The electronic medical charts were reviewed. The staging was based on the assessment of outer retinal morphology on successive SD-OCT central foveal scans. Univariable and multivariable logistic and linear regression analyses were conducted to evaluate the association between baseline MH stage and baseline VA and duration of symptoms. Results were considered statistically significant if the P value < 0.05.

Results: 52 eyes were included. The mean age(SD) was 65.4 (8.4) years. 67.3% (35/52) were female. The mean presenting logMAR (SD) VA was 1.03 (0.41). Outer retinal changes following FTMH occurred in 4 stages: 1) separation of the neurosensory retina from the RPE with well-defined interdigitation zone (IDZ), ellipsoid zone (EZ), and external limiting membrane (ELM) (4/52, 7.7%); 2) Hydration: thickening of photoreceptor inner (IS) and outer segments (OS) (27 /52;51.9 %) ; 3) patchy (moth-eaten)photoreceptor loss (16/52;30.8 %); 4) severe or complete loss of ISs and OSs and /or bare ELM (5/52, 9.6%).

When assessing follow-up preoperative OCT, none of the Stage 1 FTMHs remained at the same stage. 28.9 %(15/52) of eyes were in Stage 2; 34.6 % (18 /52) in Stage 3 and 36.5% (19 /52) were in Stage 4.

The progression time (days, SD) from Stage 1 to Stage 2 was 21(0), Stage 2 to Stage 3 was 284 (216.7), and Stage 3 to 4, was 482 (543.4). There was a statistically significant association between increasing stage and longer duration of symptoms (p=0.032) and, most importantly, between increasing stage and worse VA at baseline (p<0.001),β= 0.22 (95%CI = 0.11-0.33) after adjusting for sex, age and lens status.

Conclusions: This novel staging system describes the sequential morphologic changes in FTMH with SD-OCT over time. The baseline morphological stage of FTMH was associated with the duration of symptoms and baseline visual acuity. This objective staging system provides a potential novel imaging biomarker for FTMH.