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Reliability of manual vascular segmentation for retinal fractal dimension using peek

retinatm (Article) [\(Open Access\)](#)Esa, N.R.^a, Saidi, S.N.H.^b, Azemin, M.Z.C.^c, Shukri, N.A.M.^c, Ahmad, N.^c, Yusof, F.^c^aBachelor of Optometry (Hons.), Kulliyah of Allied Health Sciences, International Islamic University Malaysia, Malaysia^bCandidate of Bachelor of Optometry (Hons), Kulliyah of Allied Health Sciences, International Islamic University Malaysia, Malaysia^cKulliyah of Allied Health Sciences, International Islamic University Malaysia, Malaysia

Abstract

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Fractal dimension (Df) has been identified as indirect measure in quantifying the complexity of retinal vessel network which is useful for early detection of vascular changes. Reliability studies of Df measurement on retinal vasculature, has been conducted on retinal images processed by using semi-automated software which only permits image with 45° field of view (FOV). Smartphone-assisted fundus camera retinal image has a maximum 30° FOV which warrant manual processing in measuring the Df. Retinal blood vessels need to be manually segmented to produce binary images for retinal vasculatures Df measurement. Therefore, this study was conducted to determine the intragrader and intergrader reliability of manual segmentation of the retinal vasculature Df measurement from retinal images taken using a smartphone-assisted fundus camera. Forty-five retinal images were captured using the Portable Eye Examination Kit Retina (Peek Retina™, Peek Vision Ltd, UK). Suitable image for Df analysis were selected based on gradable retinal image criteria which included; i) good image focus, ii) centered position of optic nerve head (ONH) and iii) significant blood vessel visibility. The images were cropped 0.5 disc diameters away from disc margin and resized to 500x500 pixels using GNU Image Manipulation Program Version 2.8.18 (GIMP, The GIMP Team, United States). Retinal vessels were manually traced by using layering capabilities for blood vessel segmentation. Df values of segmented blood vessels were measured by using Image J (National Institutes of Health, USA) and its plugin software, FracLac Version 2.5. Intragrader and intergrader reliability was determined by comparing the Df values between; two readings measured one week apart by a grader and readings from two different graders, respectively, using intraclass correlation coefficient (ICC) and Bland-Altman graphical plots. Intragrader agreement for retinal Df showed good reliability with ICC of 0.899 (95% CI: 0.814-0.945). Bland Altman analysis indicated good agreement between Df values at different grading time (mean difference 0.0050; 95% CI:-0.0001-0.0101). Intergrader reliability for retinal Df was high with ICC of 0.814 (95% CI: 0.459-0.919). Bland Altman plot revealed good intergrader agreement for retinal Df between two graders with a bias value of 0.0158 (95% CI: 0.0092-0.0223). In conclusion, manual segmentation of retinal image captured by smartphone-assisted fundus camera has good reliability (0.75 < ICC < 0.9) for Df analysis to study the morphology of retinal vasculatures. © Blue Eyes Intelligence Engineering & Sciences Publication.

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