recall. To better reflect the performance of AutoML, its predictions were compared with ground truth labels to receive a □-score of 0.947 which shows a high agreement with human gradings.

**Conclusions:** Being coding-free and having low hardware requirements makes AutoML an ideal alternative to CDL for source-limited regions and clinicians to perform automated ASOCT image quality control for facilitating image analysis.

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## Classification of Visual Field Abnormalities in Highly Myopic Eyes without Pathologic Change

*First Author: Fengbin **LIN***
*Co-Author(s): Shida **CHEN**, Xiulan **ZHANG***

**Purpose:** To develop a classification system of visual field (VF) abnormalities in highly myopic eyes with and without glaucoma.

**Methods:** The study included 1893 VF tests from 1302 eyes (825 individuals) who underwent VF testing (Humphrey 24-2 SITA) and a detailed ophthalmic examination. A comprehensive set of VF defect patterns was defined via observation of the 1893 VF reports, literature review, and consensus meetings. The classification system comprised 4 major types of VF patterns, including normal-type, glaucoma-like defects, high myopia-related defects, and combined defects. A subset (n = 1000) of the VFs was used to evaluate the interobserver and intraobserver agreement and weighted k values of the classification system by 2 trained readers. The prevalence of various VF patterns and their associated factors were determined.

**Results:** We found that normal-type, glaucoma-like defects, high myopia-related defects, and combined defects accounted for 74.1%, 10.8%, 15.0%, and 0.1% of all unique VF tests, respectively. The interobserver and intraobserver agreements were >89%, and the corresponding k values were 0.86 or more between readers. Both glaucoma-like and high myopia-related VF defects were associated with older age ($P < 0.001$) and longer axial length ($P < 0.05$). Longer axial length showed a stronger effect on the prevalence of glaucoma-like VF defects than on the prevalence of high myopia-related VF defects ($P = 0.036$).

**Conclusions:** We propose a new and reproducible classification system of VF abnormalities for nonpathological high myopia. Applying a comprehensive classification system will facilitate communication and comparison of findings among studies.

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## Deep Learning-based System for Assessing Conjunctival Injection and Subconjunctival Hemorrhage in Red Eye

*First Author: Pak Wing **CHIU***
*Co-Author(s): Edmund Y **LAM**, Allie **LEE**, Yuxing **LI**, Vincent **TAM**, Yanmin **ZHU***

**Purpose:** Conjunctivitis presenting with conjunctival injection (CI) and subconjunctival hemorrhage (SCH) are common conjunctival causes of red eye. Conventional clinical diagnosis is incoherent due to interobserver variability. We proposed an automatic monitoring system utilizing deep learning models to classify between normal eye, CI, and SCH.

**Methods:** External eye images (CI, SCH, and normal) were collected from the public Sclera Blood Vessels, Periocular and Iris (SBVPI) dataset and Hong Kong Lo Fong Shiu Po Eye Centre. Images were pre-processed by resizing, contrast enhancement, and white-balancing adjustment. Images were augmented to increase the dataset's diversity up to a total of 2440 images. The dataset was split as training-validation-test of 8:1:1. The sclera was segmented and trained for prediction by a customized SU-Net model. YOLOv5 and TransUNet models were combined to classify these eye conditions. Differences of SCH-area proportion in SCH and vessels thickness in CI were quantified.

**Results:** SU-Net predicted sclera region with an accuracy score of 0.992, intersection over union of 0.977, and F1 score of 0.982. YOLOv5 model achieved an accuracy of 98.3% in classifying the eye conditions. Accuracy score of quantifying SCH-area proportion was 0.962 when comparing with manually annotated ground truth. It could classify vessel thickness of < or > 6 pixels. To further characterize SCH by location, there was no significant difference between superior/inferior (52.6% vs 31.6%, p = 0.317) and temporal/nasal areas (47.4% vs 52.6%, p = 0.819) due to currently limited subjects (n = 19).

**Conclusions:** Our deep learning-based system could identify CI and SCH with high accuracy. Changes in SCH-area proportion could be quantified for monitoring recovery.

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## Developing a Privacy-preserving Deep Learning Model for Glaucoma Detection: A Multi-Center Study with Federated Learning

*First Author: Emma Anran **RAN***
*Co-Author(s): Carol **CHEUNG**, Pheng Ann **HENG**, Clement **THAM**, Xi **WANG***

**Purpose:** Deep learning (DL) is promising to detect glaucoma. However, patients' privacy and data security are major concerns when pooling all data for model development. We developed a privacy-preserving DL model using the federated learning (FL) paradigm to detect glaucoma from three-dimensional (3D) optical coherence tomography (OCT) images.

**Methods:** This is a multi-center study. The FL paradigm consisted of a "central server" and 7 eye centers in Hong Kong, the United States, and Singapore. Each center first trained a model locally with its own OCT optic disc volumetric dataset and then uploaded its model parameters to the central server. The central server used FedProx algorithm to aggregate all centers' model parameters. Subsequently, the aggregated parameters were redistributed to each center for its local model optimization. We experimented with different networks. Lastly, we tested the FL model on 2 prospectively collected unseen datasets.

**Results:** We used 9,326 volumetric OCT scans from 2,785 subjects. The FL model performed consistently well with different networks in 7 centers (accuracies 78.3-98.5%, 75.9-97.0%, and 78.3-97.5%, respectively) and stably in the 2 unseen datasets (accuracies 84.8-87.8% and 84.8-87.7%, respectively). The FL model achieved non-inferior performance in classifying glaucoma compared to the traditional model trained by pooling data and significantly outperformed the individual models trained by single dataset.

**Conclusions:** The 3D FL model could leverage all the datasets and achieve generalizable performance, without data exchanges across centers. This study demonstrated an OCT-based FL paradigm for glaucoma identification with ensured patient privacy and data security, charting another course toward the real-world transition of AI in ophthalmology.

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## Early Rate of Change in Circumpapillary Vessel Density is Associated with Normal Tension Glaucoma Progression: An Optical Coherence Tomography Angiography Longitudinal Study

*First Author: Ruyue **SHEN***
*Co-Author(s): Poemen **CHAN**, Anni Annie **LING**, Timothy Pak Ho **LIN**, Clement **THAM***

**Purpose:** To prospectively evaluate the early rate of changes in circumpapillary vessel density (cpVD) as measured by optical coherence tomography angiography (OCTA) in normal tension glaucoma (NTG) eyes, and its relationship to the subsequent risk of glaucoma progression.

**Methods:** Two hundred eight-five eyes from 198 NTG patients with a minimum 24-month follow-up were included. A swept-source OCT (Triton DRI-OCT, Topcon, Japan) was used to acquire OCTA images of the 3 mm × 3 mm peripapillary region. An automated customized