Combining multiple parameters of Optical Coherence Topography using the “Random Forest” decision tree method improves the diagnosis of glaucomatous visual field damage
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**Purpose:** To develop a classifier to discriminate glaucomatous patients and normative subjects based on optical coherence tomography (OCT) measurements using the machine learning method known as the “Random Forest” (RF) algorithm.

**Methods:** Spectral domain OCT (Topcon 3D OCT-1000 and 2000) and perimetry (Humphrey Field Analyzer, 24-2 SITA standard) measurements were conducted in 124 eyes of 124 patients with open angle glaucoma (60.1 ± 13.1 years old) and 86 eyes of 86 normative subjects (52.6 ± 15.6 years old). The RF method was then used to discriminate glaucoma and normal subjects using 223 different OCT parameters consisted of macular retinal nerve fiber layer (m-RNFL) thickness, ganglion cell layer and inner plexiform layer (GCL+IPL) and circumpapillary RNFL (cp-RNFL). The area under the receiver operating characteristic curve (AROC) was then derived using the probability of glaucoma as suggested by the proportion of votes in the RF classifier, in leave-one-out cross validation. For comparison, AROCs were derived based on the raw values of 223 single OCT parameters.

**Results:** The AROC associated with the OCT parameters were: total m-RNFL (93.4%), superior half m-RNFL (80.2%), inferior half m-RNFL (91.4%), total GCL+IPL (89.4%), superior half GCL+IPL (79.4%), inferior half GCL+IPL (91.8%), total cp-RNFL (92.8%), superior quadrant cp-RNFL (73.6%) and inferior quadrant cp-RNFL (82.6%), respectively. Among 223 OCT parameters, the largest AROC (94.3%) was obtained with the m-RNFL in an inferior temporal sector. The AROC from the Random Forest classifier (98.6%) was significantly larger than any AROCs associated with single OCT parameters (p < 0.001). In the ROC, the sensitivities were 98.8 / 80.1 % (RF / best single OCT parameter) at the specificity of 90%, and 92.9 / 65.5 % (RF / best single OCT parameter) at the specificity of 95%, respectively.

**Conclusions:** Evaluating multiple OCT measurements using the RF method provides an accurate diagnosis of glaucoma.