Optical coherence tomography (OCT) is a method of acquiring and processing optical signals that is known to have excellent reproducibility and therefore plays an important role in the detection and monitoring of glaucoma and retinal disease [1-3]. As with other imaging modalities, the quality of OCT images is essential to clinical analysis. Signal strength (SS) and the placement of an exact center are used as criteria to assess the quality of an OCT image.

In previous versions of OCT software, the signal to noise ratio (SNR) was the only parameter for quality. The SNR parameter gave only a general indication of the strength of the acquired signal within a given scan. In current OCT software, SS is used for image quality control. Signal strength is an advanced parameter that combines SNR and the uniformity of the signal within a scan. The scale of SS ranges from 1 to 10, with 1 representing poor image quality and 10 representing excellent image quality [4]. According to current manufacturer recommendations, SS of 6 or greater is significant for meaningful analysis.

A number of factors, including pupil size, lens opacity and corneal drying, have been reported to influence the SS and the measurement of retinal nerve fiber layer (RNFL) thickness in patients [4-9]. These factors cannot be corrected in some patients, and can compromise the image quality of OCT scans. When an image has low SS due to the above factors, other tools can be used to diagnose glaucoma for patient care. Examples of other diagnostic tools include the...
Humphrey visual field analyzer and fundus photography. These tools, however, also have low reliability in many cases. For situations of low image reliability due to uncorrectable patient factors, reference data for OCT is not yet published. Recently, advanced OCT has been developed that offers improved visual quality [10]. Because the Stratus OCT is still widely used, however, information for more accurate interpretation of OCT images is needed [11]. In an effort to help improve interpretation of OCT images, this study investigates the variability of OCT scans by varying SS, a critical parameter for the quality of scans.

Materials and Methods

This cross-sectional, observational study was done from December 2007 to August 2008 after approval from the institutional review board and ethics committee of the Kangbuk Samsung Hospital in Seoul, Korea. This prospective study was performed after approval from the subjects were recruited from the outpatient glaucoma service of the Kangbuk Samsung Hospital. This study evaluated 688 eyes in 688 participants. All of the subjects underwent a full medical and ocular history. The detailed ocular examination included visual acuity, intraocular pressure measurement using the Goldman applanation tonometer, and slit lamp and fundus examinations. A digital fundus camera was used to take red-free fundus photographs of the retina and stereo disc photographs (Visucam; Carl Zeiss Meditec, Dublin, CA, USA). Detailed fundus examination and OCT scans were performed under mydriasis. In addition, other subjects with glaucoma were those with diagnoses of open angle glaucoma defined as optic disc abnormalities, and RNFL defects with or without visual field loss. Glaucoma hemifield test results within 99% of normal limits, and glaucoma hemifield test results within 99% of normal limits. Included among subjects with glaucoma were those with diagnoses of open angle glaucoma defined as optic disc abnormalities, and RNFL defects with or without visual field loss. Glaucomatous optic disc abnormality was defined as having one of several features, including neuroretinal rim thinning, notching, or excavation. Optic disc abnormalities were detected in the stereo disc photographs. Defects of the RNFL were detected in the red-free digital fundus photographs. Other inclusion criteria for both normal and glaucomatous subjects were, 1) the subject was 18 years or older, 2) the subject had best-corrected visual acuity of 20/40 or better, 3) the subject had no history of ocular or neurological disease or surgery that might produce test results or vision changes confounding recognition of test results due solely to glaucoma, 4) the subject had no history of amblyopia, 5) the subject had the mental and physical capacity to perform the tests, and 6) willingness to participate as a subject in the study.

Optic coherence tomography technique

Twice in the same day, subjects were scanned with the Stratus OCT (software ver. 4.0.1, Carl Zeiss Meditec). The OCT scans were performed on each subject by a single technician through a dilated pupil with Fast RNFL thickness protocols using internal fixation. An operator applied artificial tears (Hyalein; Santen Pharmaceuticals, Osaka, Japan) to each patient before scanning. A scan was successfully obtained if the fundus image was sufficiently visible to distinguish the optic disc and the scanning circle, and if there were no obvious movement artifacts with missing data at the acquired scan pattern. Images with poor scan quality (error messages and obvious segmentation errors), decentration, poor focus or low analysis confidence were excluded. For subjects who had both eyes scanned, one eye was randomly selected for analysis. In addition, cases having the same signal strength in repeated OCT scans were selected for analysis. When the signal strength was different in repeated OCT scans despite the scans being of good quality, we evaluated one additional OCT scan and selected scans with the same signal strength for analysis. Cases with different signal strength among three OCT scans were excluded from analysis. The RNFL thickness measurements from initial and repeat scans were compared and subsequently correlated with the differences in SS.

The analysis algorithm reports 17 RNFL thickness values, as follows. Mean RNFL thickness around the entire circumference, average thickness within the four quadrants (temporal, superior, nasal, and inferior), and average thickness in each of 12 clock-hour sectors, where clock hours 1 to 5 represent the nasal clock hours, and clock hours 7 to 11 represent the temporal ones. Left optic disc areas were considered to be the mirror images of right optic disc areas. In all tables, the measured areas of the nasal region were named clockwise from 12 to 6. The measured areas of the temporal region were named from 6 to 12.

Statistical analysis

Statistical analyses were performed using PASW statistics ver. 17.0 (SPSS Inc., Chicago, IL, USA). Parameters, including average RNFL thickness and mean clock hour RNFL thicknesses, were automatically generated in the analysis report. These measurements were aligned based on right eye orientation. The superior clock hour was designated as 12 o’clock, and the others were assigned accordingly. The clock hours were assigned clockwise in the right eye and counterclockwise in the left eye. The four