

Short Communication

Significance of the Reliability Coefficient in Frequency Doubling Technology Perimetry-Based Mass Screening

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- FDT perimetry
- Reproducibility
- Retest

Abstract

Objective: During mass screening for glaucoma using frequency doubling technology (FDT) perimetry, the case showing that reliability coefficients such as 'false positive' (FP) or 'fixation errors' (FE) (or both) in the FDT test are low is frequently observed. We therefore assessed the significance of the reliability coefficient in the FDT test under a population-based setting.

Subject and methods: Anautomated FDT perimetry test (Screening mode C-20-1) was performed in 20787 subjects [mean (\pm standard deviation) age: 49.0 (\pm 18.0) years]. Retest was done when FP, FE, and/or any grade of visual field abnormalities (VFA) was detected. Subjects with reproducible results between the first and second tests were screened by ophthalmologists on the bases of a fundus examination in order to further consult a complete ophthalmic examination.

Results: Of the 20787 subjects, 3315 (15.9%) showed FP or FE with 1/3 but no VFA, and 1535 (7.3%) with FP > 1/3 or FE > 1/3 but no VFA in the first examination. Retest of 3315 subjects with FP or FE with 1/3 was performed, of which 2772 (83.6%) were normal, and finally, 64 (1.9%) were screened out as abnormal. In the retest of 1535 subjects with FP > 1/3 or FE > 1/3, 1090 (71.0%) subjects were normal in the second test, and finally, 117 (7.6%) were screened out as abnormal. On complete ophthalmological evaluation, 27 subjects with FP or FE with 1/3 were negative for glaucoma, while only one out of the 54 subjects with FP or FE with > 1/3 was diagnosed as having glaucoma.

Conclusion: During mass screening with FDT perimetry, FP or FE was frequently (> 10%) observed in the first test. The retest was particularly important, and more than 70% were normal in the second test. Even in subjects with reproducible results of low reliability coefficients on FDT perimetry, those without VFAs, had a low risk of glaucoma.

ABBREVIATIONS

FDT: Frequency Doubling Technology

INTRODUCTION

Glaucoma is a relatively common ocular disease characterized by optic neuropathy [1]. Its diagnosis is based on findings of both typical structural and functional defects (optic disc damage and visual field loss) in at least one eye [1]. Within an aging society, glaucoma-induced visual field defects are an important determinant of the quality of life (QOL) [2], and their prevention

is an important public health concern [3]. Characteristics of glaucoma depend on race [4]; in the Japanese population, the dominant form of this condition is primary open angle glaucoma (POAG). In particular, normal tension glaucoma (NTG) accounts for over 90% of the cases of POAG in Japan [5].

Glaucoma mass screening is an important public health intervention as up to 80% of all glaucoma cases in Japan do not receive medical treatment [5]. Frequency doubling technology (FDT) premetric test is a convenient, feasible, fast, and reliable method for population-based screening for visual field loss [6].

We had earlier demonstrated the efficacy of screening based on FDT, with a > 70% positive predictive value for glaucoma, including that for “glaucoma risk” in the workplace [7].

When FDT is used for mass screening, a screening mode (C-20-1or 5, N-30-1or 5) is proper owing to time constraints. Glaucoma screening algorithms typically employ the use of a combination of a number of fields involved and visual field abnormality (VFA) grade [8]. The reported sensitivity of these algorithms has varied between 55% and 90%, but with a high specificity of > 90% [8-11].

Use of the screening mode is associated with false positives (FP) and fixation errors (FE). According to the manufactory manual of FDT, a reliability of up to 1/3 in both FE and FP is acceptable. However, the reliability is particularly low for mass screening among elderly persons [12,13]; moreover, clear cut-off levels for the purposes of mass screening have not been reported. A number of cases showing that reliability coefficients: FP or FE (or both) were low were frequently observed [14-16] in population-based mass screening. However, the need for ophthalmological consultation, given the low reliability of the FDT test, is not clear. In the present study, we sought to clarify the significance of reliability coefficients in the FDT test in a population-based setting.

MATERIALS AND METHODS

The study protocol was approved by the ethics review boards of incorporated medical institution Ganka-Koseikai. Subjects were participants in health checkups performed in Omiya City Clinic. This health checkup included mass screening for glaucoma using FDT perimetry (Zeiss, screening mode C-20-1), fundus examination by fundus photography (CR-2Plus AF, Canon, Inc. Tokyo, Japan), and measurement of ocular pressure (Full Auto Tonometer TX-F, Canon, Inc, Tokyo, Japan). The results of the FDT test consisted of three parameters: FP, FE, and VFA with three grades on 17 spots. FP shows the frequency that an examiner responds to a false signal on three occasions. FE is determined by the fixation of the eye by a signal in three times.

Initially, an FDT test was performed in both eyes. If FP, FE, or VFA of any grade on 17 spots were detected, a retest was done, and the reproducibility was observed. For subjects with reproducible results, ophthalmologists determined whether a further complete ophthalmic evaluation was needed on the basis of the results of fundus examination by fundus photograph and ocular pressure measurement.

RESULTS

Of 20935 subjects who underwent the FDT test, 148 were excluded because of a documented history of glaucoma or other ophthalmic disorders. A total of 20787 subjects with a mean (\pm standard deviation) age of 49.0 years (\pm 18.0 years) were included.

The results are shown (Figure 1). Of the 20787 subjects, 3315 (15.9%) showed FP or FE with 1/3; 1535 (7.3%) showed FE > 1/3 or FP > 1/3; and 2299 (11.1%) showed VFA. The retest was performed in 3315 subjects with FP or FE with 1/3, following which 2772 (83.6%) subjects were found to be normal. Finally, 64 (1.9%) subjects were screened out as abnormal.

In the retest of 1535 subjects with FE > 1/3 or FP > 1/3, 1090 (71.0%) subjects were found to be normal, and finally, 117 (7.6%) were screened out as abnormal. Of the 2299 subjects with VFA, 1250 (54.4%) were found normal in the retest. Overall, 19219 (92.5%) subjects were classified as normal and 1230 including 64 (0.3%) because of FP or FE with 1/3, 117 (0.56%) because of FE > 1/3 or FP > 1/3, and 1049 (5.0%) because of VFA were identified for further ophthalmic examination.

Complete ophthalmic examination was performed. Out of the 27 subjects who had FP or FE with 1/3, none was diagnosed as having glaucoma, and two other diseases were found. Out of the 52 subjects with FE > 1/3 or FP > 1/3, one was diagnosed as having glaucoma and 3 had other diseases. Of the 657 subjects with VFA, 328 (49.2%) were diagnosed as having glaucoma or as glaucoma suspects; and 146 (22.2 %) were diagnosed as having other diseases including cataract, severe myopia, and fundus hemorrhage; and 183 (27.9%) were diagnosed as normal.

DISCUSSION

The decision to refer subjects, who are screened positive on FDT-based mass screening, for further ophthalmological consultation, is not straightforward given the low reliability coefficients of the FDT results. Likewise, some definitive criteria are necessary to label such subjects as normal. Approximately 5% subjects in this study that had no VFA, tested positive with FP or FE (or both) in the FDT test on two occasions. This finding underscores the dilemma faced during mass screening by FDT. In this study, the subjects with low reliability coefficients were further screened out on the basis of intraocular pressure measurement and fundus examination by fundus photograph. Of the 545 subjects with FP or FE with 1/3 who showed reproducible result on two occasions, only 64 (11.7%) were needed to undergo a complete ophthalmological evaluation on the basis of fundus photographic examination. Out of these 27 subjects, no one was finally diagnosed as having glaucoma. In addition, of the 445 (26.2%) subjects with FP or FE with > 1/3 who showed reproducible result on two occasions, 117 were needed to undergo a complete ophthalmological evaluation. Out of these 52 subjects, only one was finally diagnosed as having glaucoma. These results suggest a low risk of glaucoma in subjects who showed the low reliability coefficients but no VFA.

Of the three parameters tested on the FDT test, FP and FE tested negative in the retest in 70% of those who tested positive in the first test. Further, 50% of the subjects who showed VFA in the FDT test were found to be negative in the second test. These results clearly indicate that reproducibility of FDT results is particularly important in population-based settings to reduce false positive cases. Our results are consistent with those reported from a population based study [7] and a hospital-based case-control study [17].

Of the 657 subjects in whom VFA were detected, 34.7% (= positive predictive value) were glaucomatous. This value is relatively low as compared to that in our previous report on general workers. This may be attributable to the higher mean age of this study population (49.0year) compared to that in our previous study (40.8 year) [7]. Elder subjects are likely to have other co-existing ophthalmic diseases, which reduces the positive predictive value for glaucoma [18].

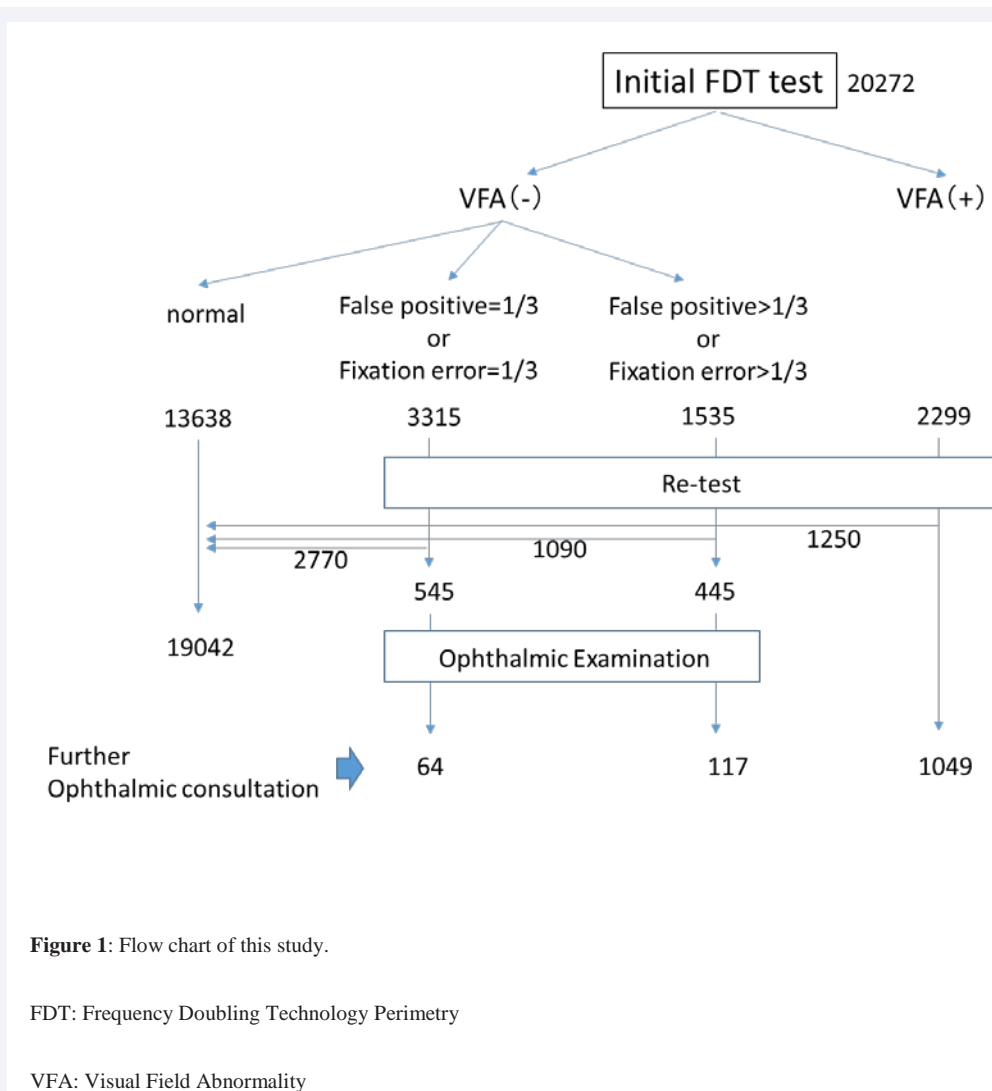


Figure 1 Flow chart of this study.
FDT: Frequency Doubling Technology Perimetry; VFA: Visual Field Abnormality

CONCLUSION

In conclusion, subjects screened VFA positive or the low reliability coefficients: FP or FE (or both) on FDT-based mass screening require retesting. Up to 35% of patients showing VFA on repeat FDT tests may be glaucomatous. On the other hand, subjects showing low reliability but no VFA on repeat FDT tests have a low risk of glaucoma.

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