Effect of cataract or glaucoma surgery on frequency doubling technology perimetry in patients with glaucoma

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SUMMARY

We studied the effect of cataract or glaucoma surgery on visual field determined by frequency doubling technology (FDT) in patients with glaucoma before and after surgery. Patients with glaucoma were examined with FDT before and after 31 cataract surgeries or 31 glaucoma surgeries. Mean deviation significantly improved after cataract surgery in 30 eyes (surgical cataract group) or after glaucoma surgery in 31 eyes (surgical glaucoma group) that underwent surgery, but not in eyes that never underwent surgery (control groups). Intraocular pressure also decreased postoperatively in both surgical groups. Change of mean deviation (index for diffuse visual field loss) significantly correlated with percent reduction of intraocular pressure in the surgical glaucoma group without hypotony, but not in the surgical cataract group. No significant differences were found in pattern standard deviation in either group. Cataract surgery or glaucoma surgery improved visual field loss, as determined by FDT in patients with glaucoma. Glaucoma surgery improved visual field due to intraocular pressure reduction.

Key words: Cataract surgery, glaucoma surgery, FDP, improvement

I. Introduction

Frequency doubling technology (FDT, Humphrey-Zeiss and Welch Allyn, Dublin, CA, USA) has been developed to screen for glaucoma[1]. As determined by FDT, cataract can worsen visual field [2-4]. Cataract surgery improves visual field, especially mean deviation on the Humphrey field analyzer (HFA, Humphrey-Zeiss, Dublin, CA, USA) [4-7]. Reduction of intraocular pressure led to improvement as determined with FDT [8]. We studied visual field evaluated by FDT in patients with glaucoma before and after cataract surgery or glaucoma surgery to assess the effect of cataract removal and intraocular pressure on FDT.

II. Materials and Methods

Thirty-one consecutive patients (19 men and 12 women) with glaucoma and cataract had undergone FDT at least once before this study.
to remove the learning effect\cite{9,10}. Their ages ranged from 50 to 87 years (mean: 68.6 years). Twenty-six had open angle glaucoma and 5 had primary angle closure glaucoma. Those with angle closure glaucoma had undergone laser iridotomy before the study.

Thirty-one eyes in 31 patients who underwent cataract surgery (surgical cataract group) and 22 fellow eyes that never underwent cataract surgery (control cataract group) were included. Four fellow eyes in the surgical group were excluded because they could not see the fixation point, and 5 eyes underwent cataract surgery during the same period. The 31 eyes in the surgical group never received pilocarpine at examination, and the size of the pupil was more than 3 mm at examination. Cataract surgery was performed by the same surgeon (NF); it included a phacoemulsification procedure with a small incision (less than 4 mm) and implantation of a soft intraocular lens (acrylic lens with a 5.5-mm optic diameter) in the capsular bag.

Thirty-one eyes of 31 patients (20 men and 11 women) who underwent glaucoma surgery (surgical glaucoma group) and 22 fellow eyes in the same patients that never underwent glaucoma surgery in the fellow eyes (control glaucoma group) were included. Four of 31 fellow eyes in the surgical group were excluded because they could not see the fixation point and 5 eyes underwent glaucoma surgery during the same period. Patient ages ranged from 23 to 75 years (mean: 52 years). None had previously undergone glaucoma surgery or laser treatment. All had experienced threshold tests of FDT at least once. All had 0.5 or better visual acuity. One surgeon (NF) had performed a trabeculectomy with a mitomycin adjunct in all patients. The 31 eyes in the surgical group never received pilocarpine at examination, and the size of the pupil was more than 3 mm at examination.

Patients were examined in both eyes with threshold c-20 of FDT under far correction within 1 month before and within 3 months after surgery. Intraocular pressure was measured by applanation tonometry after FDT testing. Mean deviation (MD), pattern standard deviation (PSD), and intraocular pressure at examination were compared before and after surgery with paired t test. Visual acuity was compared before and after cataract surgery with paired t test. The correlation between change of MD and percent reduction of intraocular pressure was analyzed with simple regression analysis. All results of less than 20\% of fixation loss, 33\% of false positive, and 33\% of false negative were adopted. If unreliable, FDT was reexamined. The research followed institutional guidelines and the tenets of the World Medical Association Declaration of Helsinki. We obtained written informed consent from each patient before their entry in this study.

III. Results

Thirty-one cataract surgeries were performed without complication. Thirty reliable results in the surgical group and 22 reliable results in the control group were included. Only 1 result in the surgical cataract group was excluded because it exceeded false negative results twice. Postoperative MD significantly ($P<0.0001$) improved after cataract surgery (from $-9.8$ dB to $-6.9$ dB, Fig. 1). Also visual acuity significantly ($P<0.0001$) improved after cataract surgery, and intraocular pressure at examination significantly ($P=0.0064$) decreased after cataract surgery. The reduction of intraocular pressure was 1.8 mmHg (from 16.7 mmHg to 14.9 mmHg). No significant differences in terms of PSD ($P=0.1804$) were found in the surgical cataract group before and after surgery. Only 2 patients showed a deteriorated MD after cataract surgery. The change of MD was not significantly correlated with % intraocular pressure reduction (Fig. 2).
Figure 1: Mean deviation (MD) improved after cataract surgery in all but two cases in the surgical cataract group.

Figure 3: Mean deviation (MD) improved after glaucoma surgery in all but four cases in the surgical glaucoma group.

Figure 2: No significant correlation between mean deviation (MD) change and reduction of intraocular pressure was found in the surgical cataract group.

Figure 4: Slight significant correlation between mean deviation (MD) change and reduction of intraocular pressure was found in the surgical glaucoma group without hypotony.

Thirty-one reliable results in the surgical glaucoma group and 22 reliable results in the control glaucoma group were included. Postoperative MD significantly ($P<0.0001$) improved after cataract surgery (from $-11.9$ dB to $-10.6$ dB, Fig. 3). Also intraocular pressure at examination significantly ($P<0.0001$) decreased after glaucoma surgery. The reduction was 14.4 mmHg (from 27.9 mmHg to 13.5 mmHg). No significant differences in terms of PSD ($P=0.9558$) were found in the surgical group before and after surgery. Four patients showed a deteriorated MD after trabeculectomy. Two of those 4 patients showed low intraocular pressure (3 and 7 mmHg) after filtering surgery. The change of MD was not significantly ($P=0.4536$) correlated with percent intraocular pressure reduction in 31 patients. When 5 eyes with an intraocular pressure of 8 or less mmHg were excluded, the change of MD was significantly ($P=0.0489$) correlated with percent reduction of intraocular pressure (Fig. 4).

No significant differences in terms of MD ($P=0.9810$), intraocular pressure at examination ($P=0.3155$), or PSD ($P=0.2146$) were found in the control glaucoma group before and after glaucoma surgery.
IV. Discussion

MD determined with FDT significantly improved after cataract or glaucoma surgery. This improvement was only found in the surgical groups, while no change of MD was found in the control groups. Learning effect could be dismissed in the control groups. FDT threshold was determined, based on contrast sensitivity and cataract-induced deterioration of contrast sensitivity [11, 12]. Cataract then would deteriorate MD with FDT in patients with cataract without glaucoma, which meant diffuse loss [3, 4]. Kogure et al [2] reported that the FDT showed a significant decrease in sensitivity with decreasing retinal illumination, which was induced by neutral density filter or miosis. Retinal illumination should, therefore, be taken into account when evaluating FDT results. Glaucoma surgery also improved MD. A possible mechanism might be reversible change with FDT. We reported 1 case with MD change in response to intraocular pressure [8]. The reduction of intraocular pressure led to an improvement of MD. The change of MD correlated with the reduction of intraocular pressure in the present patients without hypotony after glaucoma surgery. The patients with hypotony after glaucoma surgery showed deteriorated MD. Hypotony retinopathy or cataract progression could deteriorate visual field.

We did not compare the results of HFA with those of FDT in this study. Similar results would have been obtained from HFA, according to previous reports [5-7].

In conclusion, visual field determined by FDT in patients with glaucoma and cataract improved after cataract surgery or glaucoma surgery.

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References

