

## Frequent Eye Rubbing Followed by Partial Abrasion of Inner Retinal Layers

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### ABSTRACT

**Purpose:** Mechanical irritation can contribute to the pathogenesis of various eye diseases. The release of inflammatory mediators due to eye rubbing may alter the corneal collagen leading to corneal ectasis. Eye rubbing may never cause eye pressure spikes, but lowering intraocular pressure. In this study, we aimed to uncover the eye rubbing effects on retina by retinal imaging analyses using optical coherence tomography (OCT).

**Study Design:** Case-control Study.

**Methods:** This comparative case series enrolled 131 patients (262 eyes, age: 65.4±18.9 years) who confessed to compulsive and frequent eye rubbing, and showed inner retinal layer abrasion on OCT. Comparative studies were conducted using 116 patients (232 eyes, age: 67.0 ± 13.3 years) with primary glaucoma (PG) meeting the diagnostic criteria as positive controls; and 94 healthy subjects (118 eyes, age: 56.4 ± 18.8 years) as negative controls. OCT observations and statistical analysis included 128-256 sequential macular images followed by 3D images, and significance maps of the retinal ganglion cell layer (RGCL), and the retinal nerve fiber layer (RNFL). Mann-Whitney U-test, and  $\chi^2$  test were performed.

**Results:** OCT images showed partial abrasion of inner retinal layers extending from the internal limiting membrane to the RNFL, or to the RGCL due to eye rubbing. RGCL and RNFL were significantly thin in frequent eye rubbing and PG patients compared to healthy controls.

**Conclusion:** Mechanical irritation such as frequent eye rubbing can cause to shake the vitreous, lead inner retinal layer abrasions, and thinning of the RGCL and RNFL.

### Keywords

Frequent eye rubbing, Partial abrasion of retina, Optical coherence tomography (OCT), Glaucoma, Retinal ganglion cell layer.

### Introduction

Some patients with glaucoma, retinitis pigmentosa and other eye disorders with low visual acuity such as excessive myopia; are prone to frequent eye rubbing or massaging in an attempt to improve their eyesight. Patients with pollen allergy or allergic conjunctivitis have itchy eyes that causes them to vigorously and

frequently rub their eyes. Sharma N, et al. [1] reported that the release of inflammatory mediators due to eye rubbing may alter the corneal collagen and lead to corneal ectasis.

McMonnies CW [2] demonstrated that eye rubbing may cause eye pressure spikes; and those that are large, long lasting or more frequent may contribute to the progression of pressure-related eye diseases. Thus, mechanical irritation may contribute to the pathogenesis of various eye diseases.

In this study, we aimed to uncover the eye rubbing effects on retina by retinal imaging analyses using optical coherence tomography (OCT).

## Methods

### Subjects

Four groups were enrolled for comparison of measured parameters. The frequent eye rubbing group (FER) included 262 eyes of 131 patients (men: 90, women: 41) with an average age [standard deviation, SD] of 65.4 [18.9] years. All FER patients confessed to frequent and habitual eye rubbing, and showed inner retinal layer abrasion on OCT. The primary glaucoma group (PG) included 232 eyes of 116 patients (men: 55, women: 61) with an average age of 67.0 [13.3] years meeting the diagnostic criteria of; (1) positive glaucomatous cupping, (2) receiving therapy for normal tension glaucoma, and (3) no significant diurnal fluctuations of intra ocular pressure (IOP). The FER-PG group included 132 eyes of 66 frequent eye rubbing glaucoma patients (men: 26, women: 40) with an average age of 62.6 [13.6] years as positive controls. The healthy group included 118 eyes of 94 healthy controls (men: 10, women: 16) with an average age of 56.4 [18.8] years as negative controls.

### Imaging

OCT scanning was performed by using the 3D OCT-2000 (Topcon, Tokyo, Japan). Scanning was performed by a single individual for all study subjects. The observations by a single ophthalmologist included 128 or 256 sequential 2-dimensional images in the macular region, followed by 3-dimensional image acquisition. Retinal ganglion cell layer thickness (RGCL) and retinal nerve fiber layer thickness (RNFL) were measured by an inbuilt software. In the macula, RGCL extended from the ganglion cell layer to the inner plexiform layer (IPL), and RNFL thickness was the distance from the inner limiting membrane to RNFL. In this study, the significance map with more than three red tiles in 128 images were reckoned abnormal results. The red tile by an inbuilt software means less than 1 percentile abnormality under matching the age, gender, race standard values.

### Statistical analyses

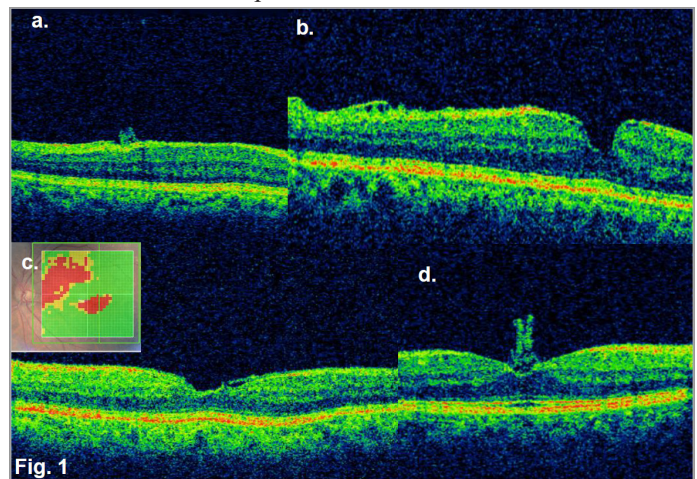
The Mann–Whitney U-test and  $\chi^2$  test were performed. The  $\chi^2$  test was used to examine the differences in RGCL or RNFL thinning among the groups. The significance maps of RGCL, and RNFL were evaluated statistically. All data are presented as mean [SD] unless otherwise specified. P value <0.05 was considered to be statistically significant.

### Ethical considerations

Examinations were conducted with patients' approval within the scope of routine examinations. All procedures were in accordance with the ethical standards of the respective committees (institutional and national) on human experimentation and with the 1964 Declaration of Helsinki and later versions. The institutional review board (IRB)/ Ethics Committee of Kanazawa Hospital has ruled that approval was not required for this retrospective study.

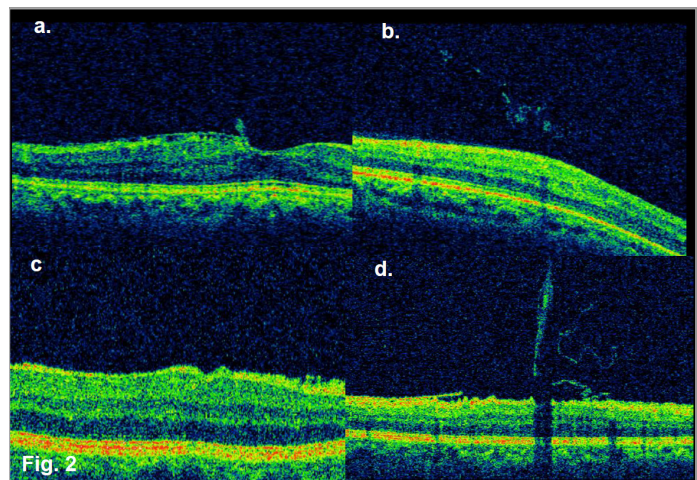
## Results

There were no significant differences in the average age among all four groups. Figures 1, 2, 3 and 4. shows the OCT images of partial retinal abrasion in FER patients.



**Figure 1:** Optical coherence tomography showing partial retinal abrasion in patients with frequent eye rubbing (FER).

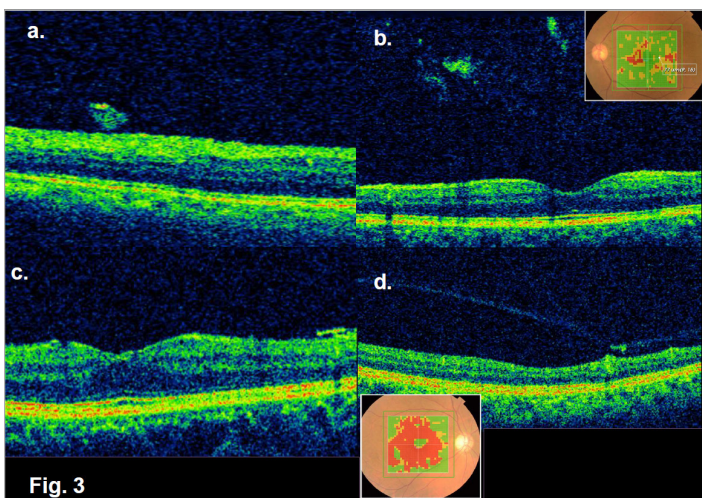
(a) a 71-year-old FER woman, (b) a 89-year-old FER woman, (c) a 57-year-old FER woman and retinal ganglion cell layer image, (d) a 77-year-old FER woman.



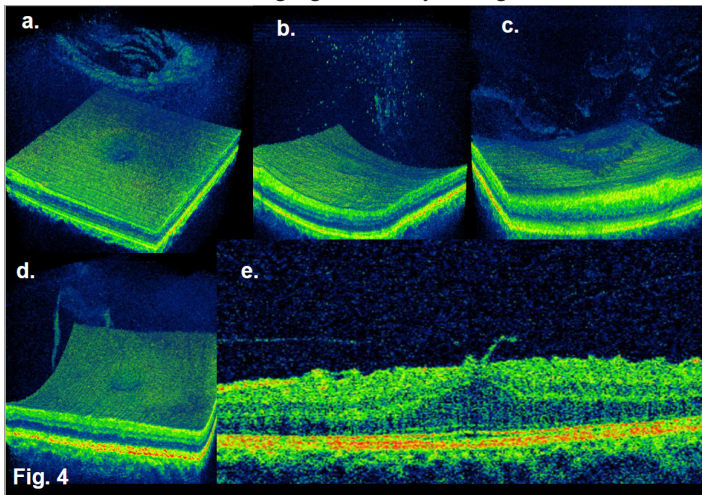
**Figure 2:** Optical coherence tomography showing partial retinal abrasion in patients with frequent eye rubbing (FER).

(a) a 50-year-old FER woman, (b) a 50-year-old FER woman, (c) a 80-year-old FER woman, (d) a 72-year-old FER man.

The average macular GCL thickness was 59.5 [1.7]  $\mu\text{m}$  in FER subjects, 51.7 [1.6]  $\mu\text{m}$  in FER-PG, 59.0 [1.1]  $\mu\text{m}$  in PG, which were in significantly (p value less than 0.0002, respectively) thinner than that healthies 66.1 [0.8]  $\mu\text{m}$ . The average macular RGCL thickness in FER-PG was significantly (p<0.0001) thinner than that in PG. The average macular RNFL thickness was 30.3 [2.3]  $\mu\text{m}$  in FER subjects, 22.9 [2.3]  $\mu\text{m}$  in FER-PG, 33.3 [1.3]  $\mu\text{m}$  in PG, which were in significantly (p value less than 0.0008, respectively) thinner than that healthies 40.0[1.0]  $\mu\text{m}$ . The average macular RNFL thickness in FER-PG was significantly (p<0.0001) thinner than that in PG.



**Figure 3:** Optical coherence tomography showing partial retinal abrasion in patients with frequent eye rubbing (FER). (a) a 74-year-old FER man, (b) a 73-year-old FER man and his retinal ganglion cell layer image, (c) a 56-year-old FER woman, (d) a 65-year-old FER woman and her retinal ganglion cell layer image.



**Figure 4:** Optical coherence tomography showing partial retinal abrasion in patients with frequent eye rubbing (FER). (a) a 23-year-old woman, (b) a 71-year-old FER man, (c) a 53-year-old FER man, (d) a 50-year-old FER woman, (e) a 72-year-old FER woman.

The  $\chi^2$  test performed to detect differences in macular RGCL and RNFL thinning between the groups, showed presence of RGCL or RNFL thinning in FER, FER-PG, and PG groups, whereas there was no RGCL or RNFL thinning in the healthy controls (Table 1a, b). The RGCL or RNFL thickness are altered depending on the age, gender, and race, it may be less meaningful to compare the thickness values themselves. In this reason, we tried to compare each thickness by  $\chi^2$  test using the presence or not of significance map disorders as a varienc.

**Table 1:** Macular retinal ganglion cell layer (RGCL) and retinal nerve fiber layer (RNFL) thinning between study groups analysed using  $\chi^2$  test. FER: Frequent eye rubbing; FER-PG: Frequent eye rubbing-primary glaucoma; PG: Primary glaucoma (Table 1a, b).

	Thinning	No thinning
Control	-13.665	13.665*
FER	3.653*	-3.653
FER-PG	4.044*	-4.044
PG	8.411*	-8.411

**a.** Post hoc cell contribution: disorder, RGCL.

	Thinning	No thinning
Control	-14.782	14.782*
FER	4.290*	-4.290
FER-PG	4.749*	-4.749
PG	8.695*	-8.695

**b.** post hoc cell contribution: disorder, RNFL.

## Discussion

Sharma RS, et al. [1] and other authors [2-5] have emphasised the association of eye rubbing in the pathogenesis of keratoconus. Balasubramanian SA, et al. [6] reported that eye rubbing for 60 seconds increased the tear levels of matrix metalloproteinase (MMP)-13, interleukin (IL)-6 and tumour necrosis factor (TNF)- $\alpha$  in healthy subjects. Cytokines, such as soluble IL-2 receptor (sIL-2R), IL-2, IL-4, IL-6 and IL-2, are possible inducers of glaucomatous optic neuropathy. These inflammatory cytokines induce apoptosis in the RGCL and RNFL thinning.

Masket S, et al. [7] reported that with the application of 1.0 oz of external force, the mean IOP rose from 17.49 mmHg at baseline to 43.44 mmHg following pressure application. Routine ophthalmic eye massage is performed to reduce IOP before old cataract surgery, for central retinal artery occlusion to dislodge the clot or embolus, or for maintaining the filtering bleb after glaucoma surgery. However, Goto H, et al. [8] reported that repeated blunt mechanical stimulation may produce cataract in atopic dermatitis patients.

In this study, the FER patients had predisposing conditions such as atopic conjunctivitis, pollen allergy, or meibomianitis that caused them to rub their eye frequently and vigorously. OCT showed partial abrasion of inner retinal layers, and thinning of the RGCL and RNFL in patients due to FER. The presence of strong vitreo-macular adhesions in these patients may further exacerbate the retinal tears. In glaucoma patients, FER may lead to prompt progression of visual field defects, and a more severe RGCL and RNFL thinning compared to those with glaucoma and no eye rubbing. It is expected that the future studies about relationship between perifoveal visual field defect in glaucomas and RGCL & RNFL thinning pattern in FER patients.

This study suggest that mechanical irritation such as FER can cause to shake the vitreous vigorously, lead inner retinal layer abrasions with resulting RGCL and RNFL thinning.

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