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Corneal topographical study of the effect of lacrimal punctum occlusion on corneal surface regularity in dry eye patients

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PURPOSE. *To compare topographic indices of surface regularity in dry eye patients and in normal subjects (controls) and to investigate the short-term effect of lacrimal punctal plugs on these indices in dry eye patients.*

METHODS. *The surface regularity index (SRI) and surface asymmetry index (SAI) of the TMS-2 corneal topographic modelling system were used to evaluate corneal surface regularity in 20 eyes of 10 dry eye patients before and after the insertion of Herrick silicon lacrimal plugs (Lacrimedics, Rialto, CA, USA) and in 24 eyes of 12 normal subjects as controls.*

RESULTS. *SRI and SAI were significantly lower in controls than dry eye patients (p=0.00). Median SRI was 1.72 in dry eye patients before punctal occlusion and 0.525 in the control group. Median SAI was 1.305 in dry eye patients and 0.240 in controls. After lacrimal punctal occlusion, Schirmer test results and fluorescein breakup time increased in nine patients and remained the same in one patient. After occlusion, the SRI decreased in 9 eyes, and increased in 11 (p=0.970); SAI decreased in 13 eyes and increased in 7 (p=0.135).*

CONCLUSIONS. *No significant change in topographic indices of corneal surface irregularity could be detected in severe dry eye patients with lacrimal punctal plugs in the short-term follow-up. (Eur J Ophthalmol 2001; 11: 116-9)*

KEY WORDS. *Dry eye, Corneal topography, Lacrimal plug*

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INTRODUCTION

"Dry eye", the most common condition affecting the ocular surface, is a symptom complex of all those conditions which led on to abnormalities of tear film flow and/or stability (1, 2). Tear film dysfunction designates any tear film abnormality and includes disorders of the aqueous, mucin and lipid components of the tear film (3). While patients with mild tear film instability complain of foreign body sensation, itching and grittiness, those with a severe form such as Sjögren's syndrome, causing a marked reduction in aqueous tear production, may experience constant and disabling eye irritation and develop ocular surface epitheliopathy, keratinization, vascularization and sight-threatening corneal ulceration (4).

Patients with mild and moderate dry eye can be treated successfully with topical artificial tears, but severe keratoconjunctivitis sicca and underlying collagen vascular disease require punctal occlusion to prevent the drainage of natural and artificial tears, thus relieving the symptoms (5,6).

We questioned whether, besides improving subjective symptoms, lacrimal plugs also smooth the corneal surface in dry eye patients. The aim of this study was therefore to compare topographic indices of surface regularity, measured with the TMS-2 corneal topographic modelling system in dry eye patients and in normal subjects as controls and to investigate the effect of lacrimal punctal plugs on these indices in dry eye patients.

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METHODS

The study group consisted of 20 eyes of 10 dry eye patients (2 male, 8 female) and the control group included 24 eyes of 12 normal individuals (6 male, 6 female). Four of these patients had primary Sjögren's syndrome and 6 had secondary Sjögren's syndrome. We used the criteria of Knapp (7) for permanent canalicular occlusion: patients who remain symptomatic for more than three months with maximum medical therapy, have scant tear film and Jones test of basal secretion of 5 mm or less. Normal controls had a Schirmer 1 test result higher than 20 mm, no history of contact lens use, no ocular irritation, no corneal fluorescein staining and no abnormal ocular surface finding on biomicroscopy.

All the patients and the control group had slit lamp examination, visual acuity testing, Schirmer and fluorescein breakup time measurements. Corneal topography was done by the same physician with the TMS-2 corneal topography instrument (Tomey Technology, Cambridge, MA). After the corneal topographic analysis a temporary collagen plug was inserted into the lower punctum on the same day and left there for 48 to 72 hours, in order to check how the patients tolerated it and whether they benefited. All patients reported relief of symptoms. We observed no complications related to the collagen plug, such as epiphora, pruritus, irritation, protrusion or canaliculitis. At 48 to 72 hours after insertion of the temporary plug, a Herrick 0.4 mm (7 patients) or 0.5 mm (3 patients) (Lacrimedics, Rialto, CA, USA) silicon lacrimal plug was inserted into the lower canaliculi under topical anesthesia.

Symptoms and clinical findings associated with ocular surface disease were followed for two months. Slit lamp examination, visual acuity testing, Schirmer and fluorescein breakup time measurements were repeated at the two-month visit, when corneal topography analysis was also repeated.

We measured quantitative parameters related to corneal surface power asymmetry (Surface asymmetry index [SAI]) and surface regularity within the central area of the cornea (Surface regularity index [SRI]) as predictors of the optical performance of the corneal surface. The SRI is determined by summing local fluctations in power along 256 equally spaced hemimeridians on the 10 central mires. This index approaches zero for a normally smooth corneal surface and increases directly with irregular astigmatism (8). SAI was determined from the centrally weighted summation of differences in corneal power between corresponding points 180 degrees/ apart on the photokeratoscope mires over 128 equally spaced meridians (9). SAI approaches zero for a perfectly radially symmetrical surface and increases as the contour becomes more asymmetric (8).

The Mann Whitney U test and Student's t-test were used to compare indices in the two groups and the Wilcoxon signed ranks test for analysis of the effect of lacrimal punctal plugs in dry eyes.

RESULTS

SRI and SAI were significantly lower in the control group than in dry eye patients (p=0.00) (Tab. I). After lacrimal punctal occlusion (LPO), Schirmer levels and fluorescein breakup time increased in nine patients and remained the same in one patient. Biomicroscopic examination at two months showed a significant decrease in mucous filaments and punctate epithelial defects.

After LPO, SRI decreased in 9 eyes, and increased in 11 (p=0.970). SAI decreased in 13 eyes and increased in 7 (p=0.135) (Tab. II). The effect of LPO on corneal

TABLE I - MEDIAN TOPOGRAPHIC INDICES OF HEALTHY SUBJECTS AND DRY EYE PATIENTS BEFORE LACRIMAL PLUG OCCLUSION

Indices	SRI	SAI
Normal eyes	0.525	0.240
Dry eye patients	1.720	1.305
p	0.00	0.00

SRI: Surface regularity index, SAI: Surface asymmetry index

TABLE II - MEDIAN TOPOGRAPHIC INDICES OF DRY EYE PATIENTS BEFORE AND AFTER LACRIMAL PLUG OCCLUSION

Indices	SRI	SAI
Before LPO	1.72	1.30
After LPO	1.805	1.225
p	0.970	0.135

LPO: Lacrimal punctum occlusion, SRI: Surface regularity index, SAI: Surface asymmetry index

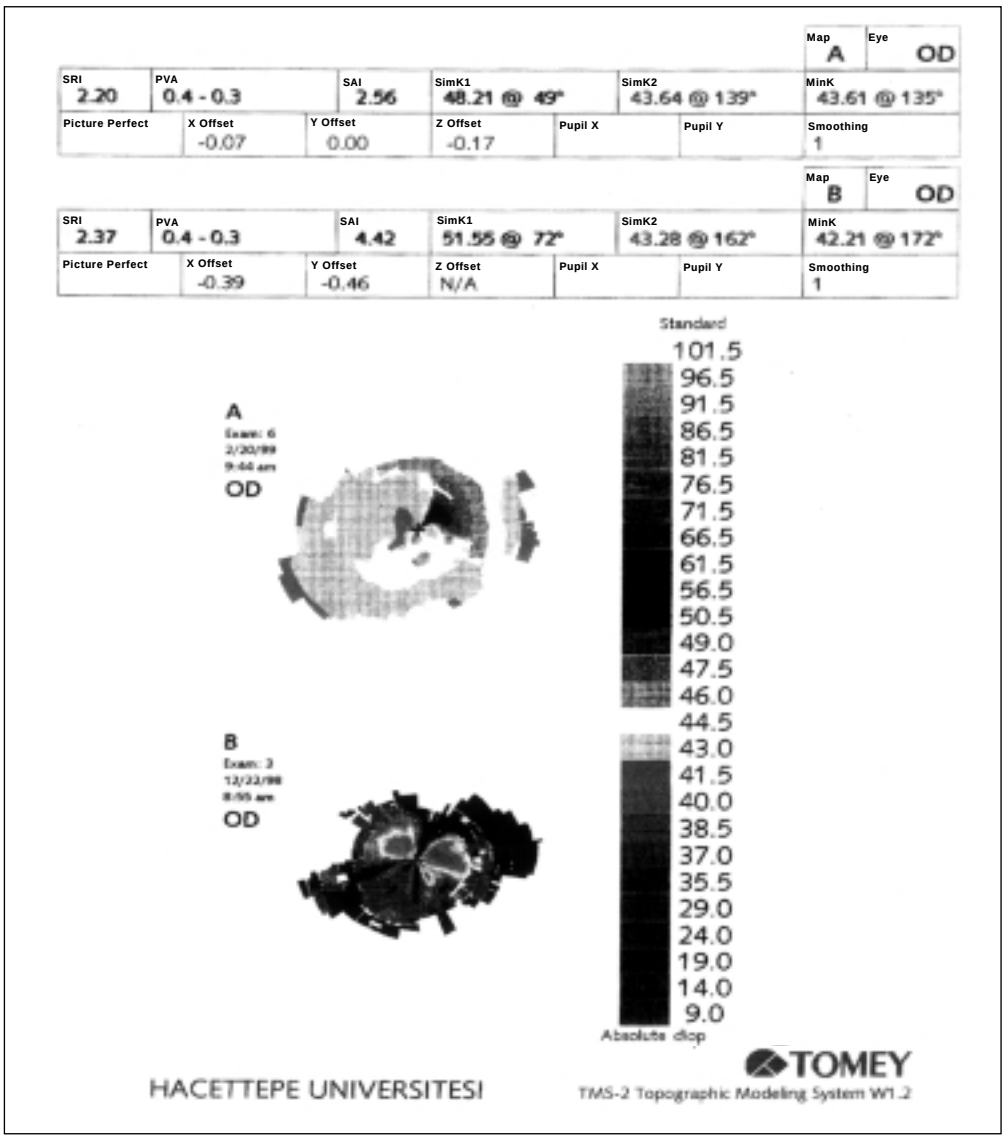

Fig. 1 - *TMS-2 corneal topographic maps and surface regularity indices.*
***A**. Corneal topographic map and surface regularity indices of a patient in the study group; two months after lacrimal punctum occlusion.*
***B**. Corneal topographic map and surface regularity indices of the same patient before lacrimal puctum occlusion.*

topography of a patient in the study group can be seen in Figure 1.

Nine patients had an improvement in symptoms and needed less topical artificial tears and none of the patients reported discomfort attributable to the plugs.

DISCUSSION

Tear film abnormality is a common problem. Although the mainstay of the treatment of dry eye is artificial tear solutions, LPO can aid retention of naturally produced and artificial tears in patients whose symptoms are not relieved by frequent use of artificial tears (10-12). Improvement in symptoms and decreased ocular surface signs after this treatment have been documented (12-14).

The common pathogenic pathway that unites the different causes of tear deficiency is the effect on the ocular surface. All tear deficiency states produce some degree of damage to the ocular surface, leading to epithelial disruption. We used corneal topographical analysis, a non-invasive technique, in normal subjects and in dry eye patients to show the corneal surface irregularities that produce the main symptoms and to compare these quantitative parameters in dry eye patients before and after treatment with lacrimal punctal plugs to show the improvement in corneal surface

irregularities. To the best of our knowledge, this is the first study to use corneal topographic analysis to follow up treatment results with lacrimal punctum plugs in dry eye patients.

Our study used the quantitative indices of the TMS-2 corneal topographic modelling system, namely the SAI and the SRI, to assess the regularity of the corneal surface in dry eyes and the effect of LPO. Both indices were significantly elevated in dry eye patients. This is consistent with the results reported by Liu et al (15). After LPO the SRI decreased in 9 eyes, and increased in 11, which was statistically insignificant (p=0.970). SAI decreased in 13 eyes and increased in 7 eyes but this change was not statistically significant (p=0.135).

Liu et al (15) reported that the topographic indices SRI and SAI could be used as objective diagnostic indices for dry eye, and for evaluating the effect of artificial tears on corneal surface regularity. They found that SRI, SAI and mean astigmatism all decreased significantly and potential visual acuity (PVA) improved in dry eyes after instillation of artificial tears.

Despite the improvement in symptoms and clinical findings, we could not demonstrate any significant change in corneal surface regularity after LPO, with corneal topographic analysis. The difference between these results and the previous study might possibly be due to differences in the characteristics of our study group which consisted of severe dry eye patients with serious corneal surface abnormalities. The two-month follow-up after LPO might be too short to note a real improvement in corneal changes because of the severity of the dry eye state and ocular surface abnormalities. In addition, most of our patients stopped or reduced their use of artificial tears, because of the false impression that no medication was necessary after LPO. The small sample and relatively short follow-up might also have influenced the results.

In conclusion, no significant change in topographic indices of corneal surface irregularity could be detected in severe dry eye patients with lacrimal punctal plugs in the short-term follow-up.

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