Effect of Upper Eyelid Surgery on Corneal Topography

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Objective: To compare the effects of different upper eyelid procedures on corneal topography.

Methods: Eighty-two eyes of 43 patients with various degrees of dermatochalasis or ptosis underwent computed corneal topography before surgery and at 3 months after surgery. Patients were divided into groups depending on the extent of surgery. In addition, the thickness of the central cornea was correlated with the change in astigmatism.

Results: There were mean changes in total astigmatism of 0.25 diopter (D) after ptosis surgery (P = .02) and 0.21 D after blepharoplasty with reduction of large fat pads (P = .04) compared with 0.09 D in patients after skin-only blepharoplasty. In addition, there was a correlation between corneal thickness and change in astigmatism of more than 0.2 cylinders after ptosis surgery (P < .05). Postoperative astigmatic axis changes were not systematic.

Conclusions: We found a statistically significant correlation between the severity of upper eyelid abnormality and topographical corneal changes after surgery. These findings emphasize the importance of advising patients, especially those with ptosis and severe dermatochalasis, that upper eyelid repositioning procedures may induce vision changes.

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Dermatochalasis is an age-related change in the eyelids and manifests as excessive folds of skin sometimes with underlying protrusion of fat through the orbital septum of the upper eyelids. Acquired ptosis refers to a thinning of the levator aponeurosis. Posis surgery and blepharoplasty are the most commonly performed procedures of the upper eyelid by oculoplastic surgeons. Blurred vision has long been recognized as a potential complication of these procedures. Several studies evaluated the effect of upper eyelid surgery on corneal topography. Most patients who underwent blepharoplasty and ptosis repair had refractive changes measurable by corneal keratometry. However, in view of the rising popularity of blepharoplasty, we investigated whether different surgical strategies involving minor to major resection of tissue, or other factors such as corneal thickness, correlate with severity of corneal topographic change.

METHODS

Patients were recruited from the oculoplastic division of the Department of Ophthalmology, Cantonal Hospital St Gallen, St Gallen, Switzerland, during 16 months from August 1, 2005, to December 1, 2006. The study was approved by the hospital ethics committee. Exclusion criteria were prior intraocular, refractive, or eyelid surgery, as well as existence of corneal surface-altering diseases such as pterygium, keratoconus, or contact lens wearing. Accurate measurement of the upper eyelid position was completed in all patients with the eyebrow fixed in repose position. Margin reflex distance, defined as the distance from the central light reflex on the cornea to the upper eyelid margin in primary position, was assessed, and a distance of less than 2 mm was generally considered ptosis necessitating surgery.

Corneal topography was recorded using a computed topography system (Orbscan II; Bausch & Lomb, Rochester, NY). The system measures anterior and posterior corneal elevation and surface curvature by using a scanning slit mechanism. Anterior surface elevation maps of the topography system can be considered accurate representations of corneal shape and are reproducible. The central corneal thickness was calculated by measuring the distance between the anterior and posterior surfaces of the cornea.

Patients were asked to blink twice to smooth the corneal surface to give a reproducible measurement. Some corneal topographies were recorded twice, and measurements of topographic variables were reproducible. The initial measurement was performed at variable time points before surgery and were repeated at 3 months after surgery following completed wound healing. The analysis of the corneal topographies included simulated keratometry in the 3- and 5-mm zones. The values of the 3-mm zone correspond to Javal-Schiotz keratometry values. A relevant change in astigmatism was defined as a change in cylinder power of at least
were seen at 3 months after surgery. Sutures were removed 6 to 8 days after surgery, and patients
tral, and sometimes the lateral compartment were resected. In entire fat pad blepharoplasty, the medial, the cen-
compartments have been described in the upper eyelid: a central compartment, which is usually deep yellow; a pale yellow
medial compartment; and a lateral third accessory compartment, which is usually deep yellow; a pale yellow
axial, Degrees

<table>
<thead>
<tr>
<th>Group</th>
<th>Cylinder, D</th>
<th>Axis, Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td>All groups (N = 82)</td>
<td>-0.92</td>
<td>-0.93</td>
</tr>
<tr>
<td>Ptosis surgery (n = 24)</td>
<td>-1.08</td>
<td>-1.16</td>
</tr>
<tr>
<td>Skin-only blepharoplasty (n = 17)</td>
<td>-0.79</td>
<td>-0.82</td>
</tr>
<tr>
<td>Blepharoplasty with reduction of the medial fat pad (n = 19)</td>
<td>-0.87</td>
<td>-0.83</td>
</tr>
<tr>
<td>Blepharoplasty with reduction of the entire fat pad (n = 22)</td>
<td>-0.87</td>
<td>-0.84</td>
</tr>
</tbody>
</table>

Abbreviation: D, diopter.

Data are given as means.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Eyes With Relevant Cylinder Power Change/Axis Change</th>
<th>Median Change, D</th>
<th>Maximum Decrease, D</th>
<th>Maximum Increase, D</th>
<th>Mean ± SD/Median Corneal Thickness, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eyes With Change/Eyes Without Change</td>
<td></td>
<td></td>
<td></td>
<td>Eyes With Change/Eyes Without Change</td>
</tr>
<tr>
<td>Skin-only blepharoplasty (n = 17)</td>
<td>2/0</td>
<td>0.25</td>
<td>0.20</td>
<td>0.30</td>
<td>526 ± 44/526</td>
</tr>
<tr>
<td>Blepharoplasty with reduction of the medial fat pad (n = 19)</td>
<td>7/0</td>
<td>0.30</td>
<td>0.80</td>
<td>0.40</td>
<td>532 ± 37/534</td>
</tr>
<tr>
<td>Blepharoplasty with reduction of the entire fat pad (n = 22)</td>
<td>11/4</td>
<td>0.30</td>
<td>0.80</td>
<td>0.60</td>
<td>543 ± 40/540</td>
</tr>
<tr>
<td>Ptosis surgery (n = 24)</td>
<td>15/8</td>
<td>0.30</td>
<td>0.70</td>
<td>1.10</td>
<td>539 ± 42/550</td>
</tr>
</tbody>
</table>

Abbreviation: D, diopter.

0.2 diopter (D) or a relevant rotation of axis, defined as a change of more than 10° if the underlying amount of astigmatism was
0.2 D or more may be noted by patients, whereas smaller changes usually do not affect visual acuity.

With-the-rule astigmatism was defined by axes in the range of $0^\circ \pm 20^\circ$ and against-the-rule astigmatism by axes in the range
of $90^\circ \pm 20^\circ$. Axes falling outside of these ranges were defined as oblique astigmatism. Pachymetry was obtained using the com-
puterized topography system by measuring the thinnest central area.

Patients were divided into the following 4 groups based on the type of surgery performed: skin-only blepharoplasty (SOB),
blepharoplasty with reduction of the medial fat pad (BMFP),
blepharoplasty with reduction of the entire fat pad (BEFP), and
transcutaneous levator advancement ptosis surgery. All pro-
cedures were performed transcutaneously using a 0.2-mm carbon
dioxide laser.

The amount of fat to be resected in upper eyelid surgery was
determined before surgery with the patient in downgaze and
with medial and lateral ranges of motion. The following 3 fat
compartments have been described in the upper eyelid: a cen-
tral compartment, which is usually deep yellow; a pale yellow
medial compartment; and a lateral third accessory compart-
ment, which is a frequent finding during upper eyelid blepha-
roplasty.8,9 In entire fat pad blepharoplasty, the medial, the cen-
tral, and sometimes the lateral compartment were resected.
Sutures were removed 6 to 8 days after surgery, and patients
were seen at 3 months after surgery.

RESULTS

Forty-three patients were included in the study. Measure-
ments included 24 eyes of 13 patients with involutional ptosis
and 38 eyes of 30 patients with dermatochalasis. Of the
38 eyes of 30 patients with dermatochalasis, 17 were from
the SOB group, 19 from the BMFP group, and 22 from the
BEFP group. The study group comprised 34 women and
9 men (mean age, 59 years [age range, 38-82 years]).

The preoperative and postoperative mean cylinders are
summarized in Table 1. The changes in cylinder values and
cylinder axis shifts were calculated and were statistically
analyzed using 1-way analysis of variance or t test. The mean
overall change in simulated keratometry in the 3-mm
zone at 3 months after surgery was 0.19 D, with a mean±SD
of 0.09±0.08 D in the SOB group, 0.15±0.20 D in the BMFP
group, 0.21±0.20 D in the BEFP group, and 0.25±0.25 D
in the ptosis surgery group. We found statistically signifi-
cant astigmatic changes in the ptosis surgery and the BEFP
groups (P < .05 for both) compared with the SOB group.

An analysis of relevant axis changes showed that astig-
matism changed in 7 of 17 eyes (41%) in the SOB group,
in 11 of 19 eyes (57%) in the BMFP group, in 15 of 22 eyes
(68%) in the BEFP group, and in 21 of 24 eyes (88%) in
the ptosis group. If looking at the amount of astigmatism
only, there was a change of 0.2 D or more in 2 of 17 eyes
(12%) in the SOB group, in 7 of 19 eyes (37%) in the BMFP
group, in 11 of 22 eyes (50%) in the BEFP group, and in
15 of 24 eyes (63%) in the ptosis surgery group (Table 2).
In the SOB and BMFP groups, no concomitant axis change
was noted, whereas in the BEFP and ptosis surgery groups,
the axis rotated more than 10° in 4 of 11 (36%) and 8 of
15 (53%) eyes, respectively. These data were reexamined
for the effect of corneal thickness on cylinder power changes
following surgery. Corneal thickness was statistically equal
among all groups. The mean thickness of corneas with as-
tigmatic change of more than 0.2 cylinder was compared
with the mean thickness of corneas with astigmatic change

0.2 diopter (D) or a relevant rotation of axis, defined as a change of more than 10° if the underlying amount of astigmatism was at least 0.2 D. Our experience shows that refractive changes of 0.2 D or more may be noted by patients, whereas smaller changes usually do not affect visual acuity.
of 0.2 cylinder or less. A correlation between corneal thickness and change in astigmatism of more than 0.2 cylinders was found only after ptosis surgery ($P < .05$). In addition, an analysis of corneal topography maps showed a statistically significant increase in astigmatism from the center to the 5-mm zone in all groups. When comparing the 5-mm-diameter-zone mean keratometric values, mean diopteric changes of 0.72 D after ptosis surgery and 0.29 D after blepharoplasty were measured.

Only 1 patient explicitly reported blurred vision at 3 months after surgery. This patient showed an astigmatic change of 1.0 D after ptosis surgery. In all groups, rotation in with-the-rule direction was equally as frequent as rotation in against-the-rule direction.

Studies$^{2,4,10}$ have investigated the effect of eyelids on corneal shape, mainly in congenital ptosis. Gullstrand$^{11}$ reasoned that corneal astigmatism was changed by the pressure of the eyelids in with-the-rule direction, attributing this to a thinning of the cornea by the eyelids. When the cornea is flattened peripherally, the central cornea becomes steeper in with-the-rule direction. In addition, various upper and lower eyelid conditions, including hemangiomas, gold weight implants, chalazia, epibulbar dermoids, and involutional ectropion, have been reported to affect corneal shape.$^{12-14}$ As far as we know, astigmatic change after blepharoplasty has been investigated only marginally. Brown et al$^{10}$ prospectively evaluated corneal shape changes in 22 patients who underwent upper eyelid surgery. In total, 18 corneas of 9 patients undergoing blepharoplasty and 24 corneas of 13 patients undergoing ptosis surgery were measured by keratometry. At 3 months after ptosis repair, the mean diopteric change as measured by keratometry was approximately 0.60 D, and almost 30% of these patients showed transient astigmatic changes greater than 1.00 D. At 3 months after blepharoplasty, the mean dioptric change as measured by keratometry and by corneal videokeratography was approximately 0.55 D, with 11% of patients showing astigmatic changes greater than 1.00 D. The number of measured eyes was small and blepharoplasty was analyzed as a whole, without differentiating skin-only or additional fat pad reduction. We found a smaller mean diopteric change of 0.19 D after upper eyelid surgery, with mean changes of 0.16 D in the blepharoplasty group and 0.25 D in the ptosis group. Rotation of axis was not systematic and was not predictable. Only 1 of our patients demonstrated a change of more than 1.00 D. This change in refraction was clinically relevant as the patient had noted blurred vision at 3 months after surgery.

The results of the present study suggest that alteration of the eyelid pressure on the cornea may change the corneal shape and its refractive characteristics. Considering the growing number of blepharoplasties performed, it is important to be aware of these potential changes in corneal optical function. These findings may be relevant in patients planning to undergo cataract or refractive surgery and upper eyelid surgery. It is well known that cataract surgery can induce further levator detachment; therefore, ptosis surgery should be performed at least 3 months after cataract surgery. However, considering our results, we suggest that blepharoplasty (in contrast to ptosis repair, especially when large fat pads are to be resected) should be performed at least 3 months before cataract surgery or refractive procedures. This sequence allows assessment of the correct lens power after corneal shape change.

In summary, corneal topographic change detected in the present study correlated with the degree of the upper eyelid abnormality and may affect corneal optical function. Our findings provide strong evidence that altered eyelid pressure after ptosis surgery and blepharoplasty with large fat pad reduction may induce notable corneal shape change. Our data suggest that corneal thickness affects the degree of corneal shape change only when there is substantial alteration of eyelid pressure on the cornea, as is the case with ptosis surgery. Corneal topographic changes after blepharoplasty without reduction of large amounts of fat were small and are unlikely to affect visual acuity.

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REFERENCES