Long-term stability of keratometric astigmatism after limbal relaxing incisions

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PURPOSE: To study the keratometric stability of limbal relaxing incisions (LRIs) performed during cataract surgery.

SETTING: Princess Royal University Hospital, Kent, United Kingdom.

DESIGN: Retrospective case series.

METHODS: Medical notes of patients who had small-incision cataract surgery combined with LRIs between November 2006 and December 2010 were reviewed. Keratometric astigmatism was measured using Scheimpflug pachymetry (Pentacam). Surgically induced astigmatism (SIA) was calculated using the Astig Plot application.

RESULTS: Twenty eyes of 20 patients were evaluated. The median keratometric astigmatism preoperatively and 2 weeks, 10 weeks, and 3 years postoperatively was 2.1 diopters (D) (interquartile range [IQR], 1.7 to 2.4 D), 1.3 D (IQR, 0.9 to 2.1 D), 1.2 D (IQR, 0.5 to 1.7 D), and 1.0 D (IQR, 0.7 to 1.4 D), respectively. There were no significant differences in keratometric astigmatism between 2 weeks and 10 weeks postoperatively ($P=.35$) or between 10 weeks and 3 years postoperatively ($P=.72$). The median SIA 2 weeks, 10 weeks, and 3 years postoperatively was 2.2 D (IQR, 1.6 to 4.1 D), 2.1 D (IQR, 1.2 to 2.7 D), and 1.8 D (IQR, 1.2 to 2.5 D), respectively. There was a statistically significant difference in SIA between 2 weeks and 10 weeks postoperatively ($P=.002$) but not between 10 weeks and 3 years postoperatively ($P=.72$).

CONCLUSION: The keratometric effects of LRIs were stable from 10 weeks to 3 years postoperatively.

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The correction of preexisting keratometric astigmatism is important for achieving spectacle independence after cataract surgery. Several approaches have been described, including limbal relaxing incisions (LRIs), clear corneal incisions (CCIs) along the steep meridian, opposite CCIs, astigmatic keratotomy (AK), and toric intraocular lens (IOL) implantation.[1,2] The exact method selected for each patient is often dependent on a combination of factors, such as the magnitude of preexisting keratometric astigmatism, cost, and availability of specialty resources such as toric IOLs.[1–3]

Limbal relaxing incisions performed in conjunction with cataract surgery have been shown to be effective in reducing moderate amounts of preexisting keratometric astigmatism, albeit with a tendency toward undercorrection.[4–7] For correction of higher degrees of astigmatism, a combination of an LRI and toric IOL implantation during bimanual phacoemulsification has been shown to be promising.[8]

Apart from being effective, LRIs are a popular method for reducing existing keratometric astigmatism in cataract surgery because they are simple to perform

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and low in cost. Furthermore, compared with other methods such as AK, LRIs are more forgiving because exact on-axis incision placements are not as critical.[3]

Several randomized controlled studies have compared LRIs with other methods of astigmatic correction during cataract surgery. Compared with on-axis incisions, LRIs have been found to be more effective in reducing keratometric astigmatism of 1.50 diopters (D) or more at the time of cataract surgery.[6] However, compared with toric IOLs, LRIs were less effective and predictable,[9] especially for correcting astigmatism of more than 2.25 D.[10]

At present, the stability of the keratometric correction produced by LRIs is not fully understood. Some studies found the effects of LRIs regress over time,[4,7,9,11,12] while others found the effects to be stable.[5,6,13–16] Furthermore, in general, published studies of LRIs in cataract surgery had a mean follow-up of 1 year or less with the exception of 2, which had a mean follow-up of 17 months[4] and 3 years.[12] In both studies, the authors describe a mild regression of the effects of LRIs.

This retrospective study aimed to determine the stability of LRIs over a mean follow-up of 2.9 years ± 0.9 (SD).

PATIENTS AND METHODS

The medical notes of patients who had small-incision cataract surgery combined with LRIs at Princess Royal University Hospital, South London Healthcare Trust, NHS, United Kingdom, between November 2006 and December 2010 were reviewed retrospectively. If the patient had cataract surgery and LRIs in both eyes during this period, only the first eye to have surgery was included in the study.

Limbal relaxing incisions were offered to patients who were listed for routine cataract surgery and had at least 1.2 D of preexisting keratometric astigmatism. Exclusion criteria included previous corneal surgery, irregular astigmatism, significant dry eyes, and thin corneas.

The same surgeon (L.I.) performed all surgeries. The LRIs were created before phacoemulsification was performed. The length and number of LRIs were decided based on a modified Gills nomogram.[11]

The incisions were created along the steep corneal meridian just within the limbal vessels using a guarded diamond knife set at 600 µm depth. Phacoemulsification and foldable IOL implantation were then performed through a CCI of 2.75 to 3.00 mm. These incisions were made along the steep corneal meridian when possible. If that was technically difficult, temporal CCIs were created.

In cases in which the LRI incisions were paired and the corneal incision was planned along the steep meridian, the surgeon first created the LRI and then used this incision to enter the anterior chamber with a 2.75 mm or 3.00 mm keratome.

Postoperative medications included dexamethasone 0.1% and chloramphenicol 0.5% eyedrops 4 times a day. Both were tapered over 4 weeks.

Patients were invited for clinic reviews at various times after surgery as follows: 2 weeks (mean 13 ± 3 days), 10 weeks (mean 10 ± 4 weeks), and 3 years mean (2.9 ± 0.9 years). Only patients who attended all follow-up visits were included in the analysis.

Keratometric astigmatism was measured using Scheimpflug pachymetry (Pentacam, Oculus Surgical, Inc.). Surgically induced astigmatism (SIA) was calculated using the Astig Plot application of the Eye Pro 2012 program (EB Eye).

The 2-tailed Wilcoxon signed-rank test (version 22.0, SPSS, Inc.) was used for statistical analysis unless otherwise specified.

RESULTS

Of the 36 patients (46 eyes) who had cataract surgery and LRIs between November 2006 and December 2010, 20 (25 eyes) had postoperative data from all required visits and thus comprised the study cohort. Of these 20 patients, 5 had bilateral surgery. Table 1 shows the patients' demographics and the incision types. Table 2 shows the keratometric astigmatism over time.

There were no statistically significant differences in age ($P=.84$) or preoperative keratometric astigmatism ($P=.58$) between the 20 patients who had complete postoperative follow-up data for analysis and the 16 patients who did not have complete postoperative follow-up data (Mann-Whitney *U* test, version 22.0, SPSS, Inc.).

Keratometric Astigmatism Over Time

Study Cohort The median keratometric astigmatism preoperatively and 2 weeks, 10 weeks, and 3 years postoperatively was 2.1 D (interquartile range [IQR], 1.7 to 2.4 D), 1.3 D (IQR, 0.9 to 2.1 D), 1.2 D (IQR, 0.5 to 1.7 D), and 1.0 D (IQR 0.7 to 1.4 D), respectively (Figure 1). The keratometric astigmatism at all postoperative timepoints was statistically significantly lower

Table 1. Patient demographics.

Parameter	Value
Patients (n)	20
Eyes (n)	20
Sex (n)	
Male	8
Female	12
Age at surgery (y)	
Median	79
IQR	73, 83
Preop astigmatism	
Median (D)	2.1
IQR (D)	1.7, 2.4
WTR (n)	10
ATR (n)	10
Incision type (n)	
On-axis	14
Temporal	6
Single: paired	9:11

ATR = against the rule; IQR = interquartile range; WTR = with the rule