Relaxing incisions out the graft for postkeratoplasty astigmatism

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Introduction

In 1977 Troutman proposed "relaxing incisions" as a technique to relax intrastromal or cicatricial tensions producing a steepening effect (1,2,3). Troutman's original technique provided for symmetric arcuate 60° - 90° incisions, centred in the steepest meridian and placed in the wound.

This original technique underwent some modifications regarding either the incision shape, depth or location. Ruiz suggested to perform its trapezoidal keratotomy also in postkeratoplasty astigmatism and various surgeons (4,5) tried this technique, but is was commonly held that the procedure was powerful but with poor predictability (6,7). Lindstrom (8) proposed transverse incisions performed in the wound or in the graft.

Both computerized and fluorescein keratoscopies have offered data on either the symmetry or the asymmetry of the steepest meridian or sector. For this reason, Troutman's "relaxing incisions" have become "selective" in relation to the type of deformation (9,10).

A second modification of the procedure is linked to incision depth. Troutman suggested an incision depth of 80 - 90%. Lindstrom increased incision depth with successive redeepenings during the same surgical intervention, or in the following days when at check-up the correcting effect appears insufficient (8).

"Relaxing incisions" also change in relation to their site; in the graft, the wound or else outside the graft in the patient's cornea? Troutman's original technique provided for symmetric 90° incisions made at wound level. The majority of authors reported cases of incisions made in the wound or inside the graft (11,12,13,14,15,16), sometimes with Ruiz's trapezoidal incisions.

Results are extremely variable and a comparaison is impossible due to procedure (17) and follow-up variability. The mean correction with simple incisions, either arcuate, transverse or trapezoidal, ranges between 3 to 8 diopters. In our opinion, with the technique of the incision in the wound it is not easy to determine the right incision depth due to both the variation in the scar thickness and the difficulty in obtaining precise pachymetric readings because of the different echoes deriving from acoustic transmission irregularities.

Material and Methods

On these grounds, microperforations are a likely complication so that some surgeons prefer to use a bent insulin needle for a gradual detachment of the graft of the patient's cornea down to almost the Descemet's membrane.

We experimented this technique in 8 cases with disappointing results in terms of both correction and predictability, and in all cases secondary surgery was necessary. Yet, it should be kept in mind that this site is adequate only when a scar retracting at the junction level is evident.

Apart from this procedure, the cases of relaxing incisions operated by the Authors were 75, of which 5 had incisions in the wound, 2 in the graft, while all the other cases had incisions in the host cornea. In this series of 68 cases, 50 underwent

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simple relaxing incisions and 18 with compression sutures.

We prefer to perform relaxing incisions in the patient's cornea about 0.2 - 0.3 mm close to the wound. Because of the yielding tissue, in keratoconus the incision produces a remarkable corneal effect, so that it is possible to correct high astigmatism even with incisions placed at about 3.5 or 4.25 mm from the centre. This is due to the fact that most grafts for keratoconus have a diameter of 7.5 - 8.5 mm.

If doubled, this distance from the centre equals the so-called Optical Zone. If performed for congenital astigmatism, arcuate incisions would produce an extremely limited effect (about 1 to 1.5 Dpts.), while in astigmatism following trasplant for keratoconus, it is possible to obtain corrections up to 8-9 Dpts.

We feel that this difference is related to the keratoconic tissue, which shows a greater tendency to bulge even if the incision is made farther from the centre. These incisions often show a dehiscence with epithelialization of the incision, which, however, does not interfere with vision due to its peripheral location. Moreover, being the thickness of the patient's cornea more regular than that of the wound, it is possible to obtain pachymetric readings and, consequently, to adjust incision depth. We set the diamond tip at about 0.04 - 0.05 below the lowest pachymetric reading.

Instead of redeepening the incision in the following days when the effect appears insufficient, we prefer to widen the incision, depending on keratoscopic indications. Keratoscopy is also used for a correct surgical planning in terms of incision site and width. Sometimes we performed a single incision in only one sector, while in other instances asymmetric incisions were made.

From what has been said, in this series an index regarding the type of astigmatism, and perhaps its pathogenesis too, may be derived also from the number of procedures performed with either symmetric or asymmetric incisions. Table 1 indicates the number of either symmetric or asymmetric incisions.

Table 1
Type of relaxing incisions in 68 cases

Type	Symmetric	Asymmetric	Isolated
Number	25	34	9

These data show the morphological irregularity of these corneas and how keratoscopy helps in correcting those forms of astigmatisms that are otherwise impossible to correct in a precise manner. Incision width is also suggested by the keratoscopic map with a variability of 40° to 90°. In any case, the characteristic of these relaxing incisions lies in their poor predictability.

Results

The results of simple wound opening is shown in Table 2.

Table 2
Results of astigmatism correction after keratoplasty by wound opening in 8 cases

	CORRECTION
AVERAGE	1,14
MAXIMUM	3,75
MINIMUM	-6,00
ST. DEV.	3,35

The technique used in the 8 cases not only revealed its extremely poor efficacy, but it also underlined the risk that over a certain limit, difficult to assess, the wound may bulge and cause an incontrollable overcorrection. In one case with an overcorrection up to 14 Diopters a second suture was necessary. Conversely, an indication for this technique may be the correction of low astigmatism causing aniseiconia and problems in binocular vision. In all other cases, relaxing incisions should be performed with a diamond knife.

The other cases were operated either with relaxing incisions performed out the graft or together with compression sutures.

Table 3

Results on 50 cases of post-keratoplasty astigmatism correction with simple relaxing incision outside the graft (in absolute keratometric values)

	PREOP	POSTOP	CORRECTION
AVERAGE	7.71	2.31	5.40
MAXIMUM	14.00	6.00	10.00
MINIMUM	3.5	0.25	1.25
ST. DEV..	1.95	1.26	2.03

The follow-up of mean 32.10 months, with range from 63.33 to 2.47.

After a few cases, which grew into over-correction at one month postoperatively and had to be resutured, we now prefer to perform narrower incisions and to increase their depth after one or two weeks if the patient is undercorrected. In Table 4, the number of secondary surgeries indicates the poor predictability of the procedure in these cases.

Table 4

Under and overcorrections with incision dehiscenses in 50 cases of stitchless relaxing incisions

Cases	Undercorrected	Overcorrected	Total
	42	8	50

In 7 out of 8 overcorrected cases it was necessary to apply more stitches due to incision dehiscence, and only 1 case was corrected with two more small incisions in the 90° meridian. We deem preferable to perform secondary surgery for overcorrection by widening the incisions or else with new incisions rather than suturing dehiscent incisions since the former procedure grants better results. Another reason for this is that, incising the patient's cornea and dealing mostly with keratoconus, the morphological stabilization is slower, and the full correcting effect may show even after one month.

The correcting results of the series with compression sutures is shown is Table 5.

A comparaison with the mean results obtained from the series of patients operated with only relaxing incisions shows how adding compressive stitches to relaxing incisions increases the average effect only by over one diopter.

Table 5

Corrective results of 18 cases operated with relaxing incisions outside the graft combined with either symmetric or asymmetric compressive stitches

	PREOP	POSTOP	CORRECTION
AVERAGE	9.46	3.19	6.38
MAXIMUM	12.25	5.5	10
MINIMUM	6.5	0	2
ST.DEV.	1.74	1.51	2.12

In some of the first cases, one compressive stitch was applied in each sector, so that one can logically think that greater number of compressive stitches would have yielded a greater effect as indeed we have seen in the subsequent cases.

The technique of combining compressive stitches to relaxing incisions is extremely useful to modulate successively the corrective effect by selective removal. Once the desidered correction is obtained, following the removal of one or two stitches, the others are left in situ up to even 8 - 10 months so as to allow the relaxing incision to heal in the desired fashion.

In conclusion, if planned, non perforating incisions-out the graft, either single or double, symmetric or asymmetric-may grant a good correction in cases up to 8 diopters, although with an evident sectorial depression the correction could be greater. When a greater correction is necessary, the so-called "compressive stitches" should be applied

To sum up, we perform only relaxing incisions with astigmatism below 8 diopters, while we apply compressive stitches in the orthogonal meridian with an astigmatism exceeding that value. Thus, we feel that separate compressive stitches used after the plastic phase may be given only by using non-elastic and non-degradable thread that is not so thin as to cut the tissue.

The visual results of the two series of patients - incisions alone and incisions combined with compressive stitches - show that the two techniques not only reduced the amount of astigmatism, but also improved its regularity in the 68 cases.

Table 6

Improvement of corrected visual acuities (in tenths) of the two series of patients operated with relaxing incisions (No. 50) and with compressive stitches (No. 18) as obtained preo - and post-operatively

	PREOP	POSTOP	IMPR.
AVERAGE	4.55	7.70	3.15
MAXIMUM	10	10	0
MINIMUM	1	4	3
ST.DEV.	2.03	1	0.36

The only serious complication reported with this technique was a corneal decompensation following a negative immunologic reaction in one case in which the endothelial density had not been assessed pre-operatively. Such density later turned out to be critical (540 cell/mm^2). In this case the refractive result was excellent. This teaches us that an endothelial microscopy examination is necessary prior to any surgical approach in transplants and that it is wiser to perform relaxing incisions in the graft than in the patient's cornea when the latter is vascularized.

Conclusion

In conclusion, in the surgical treatment of the postkeratoplasty astigmatism we obtained very good results with relaxing incisions performed in the host cornea as well as with those performed in in either the wound or the graft.

Among the advantages we noticed with these incisions are: less danger of microperforations than with incisions performed in the wound, a greater correction effect in keratoconus than with incision incisions performed in the graft and a grater possibility to control the effect.

Besides, this procedure is atraumatic for the graft since it is performed outside the wound. The only contraindication is a neovascularised host cornea.

References

1. TROUTMAN RC.: Surgical correction of high corneal astigmatic errors after successfull keratoplasty. A preliminary report. Advances in Ophthalmology 1972, 27-170.

2. TROUTMAN R.C.: Microsurgery of the anterior segment of the eye. Vol. 2, 286 Ed. Mosby 1977.

3. TROUTMAN R.: Microsurgery of the anterior segment of the eye. Mosby. 1974 Vol. 2, 23.

4. MERCK PM, WILLIAMS PA, LINDSTROM RL. Trapezoidal keratotomy. A vector analysis. Ophthalmology 1886, 93, 719.

5. LAVERY G.W., LINDSTROM R.L.: Clinical results of the Ruiz astigmatic keratotomy - J. Refract Surg, 1985, 1, 70-74.

6. BUZARD K.A., HAIGHT D., TROUTMAN R: Ruiz procedure for postkeratoplasty astigmatism. J. Refr. Surg. 1987, 3, 40.

7. KAUFMAN H.E.: Corneal Transplant and Visual Disability. Refr. & Corneal Surgery - 1989, 5, 213.

8. LINDSTROM R.L., LAVERY G.W.: Correction of Post-Keratoplasty Astigmatism. In Sanders D.R., Hofman R.F. "Refractive Surgery" Ed. Slack - 1985, 167.

9. MERLIN U.: Il problema dell'astigmatismo nel trapianto di cornea. Atti LXVI Congr. SOI 1986, 245.

10. FRANGIEH G.T., KWITKO S. MCDONNEL P.J.: Prospective corneal topographic analysis in surgery for keratoplasty astigmatism. Arch. Ophthalm. 1991, 109, 506.

11. KRACHMER J.H., FENZL R.E.: Surgical correction of high postkeratoplasty astigmatism: relaxing incisions vs wedge resection. Arch. Ophthalm. 1980, 98, 1400.

12. SUGAR J., KIRK A.K.: Relaxing keratotomy for postkeratoplasty high astigmatism - Ophthal. Surg. 1983, 14, 156.

13. LAVERY G.W., LINDSTROM R.L., HOFER L.A. DOUGHMAN D.J.: The surgical managment of corneal astigmatism after penetrating keratoplasty -Ophthal Surg, 1985, 16, 165-169.

14. KRACHMER J.H., CHING S.S.T.: Relaxing corneal incisions for postkeratoplasty astigmatism - Int Ophthalmol.Clin. 1983, 23, 153.

15. MANDEL M.R., SHAPIRO M.B., KRACHMER J.H.: Relaxing incisions with augmentation sutures for correction of postkeratoplasty astigmatism. Am. J. Ophthalm. 1987, 103, 441.

16. ARFFA R.C., Results of graded relaxing incision technique for postkeratoplasty astigmatism. Ophthalmic Surg. 1988, 19, 624.

17. BINDER P.S., WARING III G.O.: Keratotomy for astigmatism. In "Refractive Keratotomy" Ed. Mosby 1992, 1174.