Cornea

Rudy MMA Nuijts

MANY patients who have undergone keratoplasty procedures have poor functional vision despite a clear graft because of high degrees of regular and irregular astigmatism. The management of such cases is an evolving science, said Rudy MMA Nuijts MD PhD, University Hospital Maastricht, The Netherlands.

Speaking at the Cornea Day of the 11th Winter Refractive Meeting of the ESCRS, Dr Nuijts noted that in his own practice 36 per cent of keratoplasty patients have high astigmatism and most series show mean cylinders of 4.0 D to 5.0 D and significant anisometropia. In about two thirds of cases, the astigmatism has an irregular topographic pattern, while in the remaining cases it has a regular pattern, he said.

The causes of post-keratoplasty astigmatism include size and shape differences between the donor corneal button and the trephined aperture in the recipient’s eye, as well as eccentric placement of the graft, and irregular scarring at graft-host junction. “All of these factors can cause asymmetric forces in the cornea resulting in shape alterations. It is easy to imagine that an eccentric graft with extensive vascularisation at the margin pre-operatively and large differences in thickness may result in significant postop astigmatism,” Dr Nuijts added.

Tolerance of residual ametropia depends on such factors as the status of the fellow eye and the age and expectations. However, most patients will not tolerate more than 3.0 D to 4.0 D of anisometropia and/or astigmatism, he pointed out.

Offering optical options

The treatment options for post-keratoplasty astigmatism and anisometropia include simple optical approaches, like glasses and contact lenses, and surgical approaches, which range from arcuate keratotomy to corneal refractive surgery and the implantation of IOLs.

In general, 20-40 per cent of patients need contact lenses after penetrating keratoplasty procedures and this figure may rise to 40-50 per cent in eyes with keratoconus, he noted. He added that in his practice the mainstay for treating post-keratoplasty visual problems remains the fitting of a rigid gas-permeable tetracurve contact lens with a large 12.0mm diameter. He usually waits seven months after the keratoplasty to fit the lenses, using topography, so that they will be aligned with the wound edges of the graft, he explained. “This may result in a nice fit with a good clearance between the lens and the cornea and adequate fluorescein pattern,” he added.

Dr Nuijts noted that he has had good results with the lenses. In a series of 36 eyes of 33 patients with post-keratoplasty anisometropia and/or astigmatism for whom he fitted the lenses, the mean LogMAR BCVA improved approximately three lines from 0.36 to 0.11.

In addition, during a follow-up period of six to 36 months, patients reported that they wore their lenses for an average of 13.6 hours a day. The only complication was an adverse suture reaction in one patient. Another patient was excluded from the analysis due to poor motivation.

Scleral contact lenses are also gaining popularity as a treatment for post-keratoplasty eyes, he said. Resting on the external sclera, the lenses are composed of a gas-permeable fluorosilicone acrylate copolymer with Dk of 85x10-11. They have a large 27.0mm diameter and a thickness of 13mm. In the most ideal case they will provide a clearance of about 0.5mm between the cornea and the back of the scleral lens.

In a recent Dutch study by Visser and associates, 56 patients fitted with scleral contact lenses after penetrating keratoplasty had a median BCVA of 0.48 after a follow-up of at least three months. There were also minimal side effects, which consisted primarily of lens related limbal hyperaemia in 20.8 per cent.

Despite the good results that can be achieved with contact lenses, many patients cannot tolerate them. Contact lens intolerance can result from ocular problems including corneal topographic abnormalities, dry eye and blepharitis. Other causes include occupations that expose a patient to high amounts of dust, wind or water, and poor manual dexterity due to age, tremor, arthritis or poor vision. In addition, some patients are insufficiently motivated to handle the somewhat rigorous hygiene regimen the lenses require.

Corneal relaxing incisions and wedge resections are often the first surgical option to consider, he suggested. Relaxing incisions flatten the steep corneal meridian while wedge resections, or compression sutures, steepen the flat meridian. Both approaches result in a coupling effect such that flattening of the steep meridian will steepen the flat meridian and vice versa, he said.

In general, incisional techniques can correct 4.0 to 5.0 D of astigmatism, and the astigmatic effect is proportional to the magnitude of the pre-operative cylinder, he noted, adding: “The reduction in cylinder achieved with incisional techniques varies from 50-60 per cent, however, they have minimal effect on the spherical equivalent and they are sometimes unpredictable and the nomograms for congenital astigmatism do not apply.”

Surface ablations improving

Surface ablations like PRK or LASEK are other options for the correction of post-keratoplasty astigmatism and the results with these techniques seem to be improving, he said.

In several of the early series of patients who underwent PRK for post-keratoplasty astigmatism with broad beam lasers only a small proportion achieved BCVA of 20/40 or better and in some series 30-40 per cent lost more than two lines of BCVA. In addition hase grade II and III occurred in 25 per cent to 50 per cent of eyes.

Since that time, however, there have been advances in surface ablation with modern high frequency small flying spot excimer laser platforms that preserve corneal clarity better. In addition, there are new techniques like topography-guided customised ablation, which improves the accuracy of the ablation, and LASEK, which may reduce haze. Moreover, surgeons now have at their disposal pharmacologic modulators of wound healing such as mitomycin-C, for use in cases at a high risk of haze.

In 2001, Jesper O. Hjortdal MD and his associates published a study (Acta Ophthalmologica Scandinavica, 2001) in which they used topography-guided PRK with the TOSCA 2.0mm flying spot system (MEL 70 laser, CZ Meditec) in 16 eyes of 16 patients with post-keratoplasty astigmatism.

They reported that the mean BCVA improved from 0.28 to 0.45 at 12 months (p<0.05). In addition, BCVA improved in six eyes by a logMAR step of more than 0.1, and the RMS of corneal wavefront aberrations decreased from 3.35 to 1.51 (p<0.05). Regular astigmatism decreased significantly, although coma and spherical aberration did not.

However, four eyes (25 per cent) developed grade III haze and required additional corneal surgery, Dr Nuijts noted.

Another study published that same year (Alessio et al, Ophthalmology, 2001) produced better results using topography-guided PRK with the CIPFA system (Laser Scan laser, Lasersight), which has a 0.8mm flying spot. The study involved 10 eyes of 10 patients with irregular astigmatism following penetrating keratoplasty. None of the eyes received mitomycin-C, he noted.

After a mean follow-up of 8.4 months, all eyes had gained lines of BCVA and in 80 per cent the spherical equivalent was within 1.0 D of intended correction. In addition, the mean cylinder decreased by 84 per cent from a pre-operative value of 8.5 D (range: 4.0 to 24.0 D) to a postoperative value of 1.3 D (range: 4.0 to 0.0 D). Furthermore, there were no complications, including haze in any eyes.

Mitomycin-C and LASEK

Mitomycin-C has proven useful for preventing haze in highly myopic patients undergoing primary PRK or LASEK and may also improve results in post-keratoplasty eyes undergoing such procedures, Dr Nuijts said. However, questions remain regarding its toxicity and safety, he pointed out.
LASIK after penetrating keratoplasty

LASIK has several theoretical advantages over PRK for the treatment of post-keratoplasty astigmatism. It provides more rapid visual rehabilitation, decreased stromal scarring and minimal regression. It can also treat greater ranges of refractive error.

The main drawbacks of LASIK for this indication are that it may induce wound dehiscence, and flap complications, like buttonholes and thin flaps, in eyes with high keratometry readings. It also increases the risk of recurrence of keratoconus.

Several published series show that the reduction of cylinder following LASIK for post-keratoplasty astigmatism varies between 60-70 per cent. However, they also show a high incidence in flap complications and in many series LASIK retreatments were necessary.

“The current recommendations regarding LASIK after penetrating keratoplasty are to wait at least one year after the graft procedure keratoplasty and at least three months after suture removal. In addition, it is important to insure that there is good wound apposition, without over-ride or under-ride, and adequate endothelial cell counts to avoid interface fluid pockets,” he added.

Regarding the long-term effects of LASIK for post-keratoplasty astigmatism, evidence in the literature is sparse, Dr Nuijts said. A prospective study carried out by Jorge Alio MD and associates compared a one-step LASIK procedure with a two-step procedure in 22 eyes with post keratoplasty astigmatism (JCRS November 2004). It showed significantly greater changes in cylinder in the two-step group although there was no significant difference between the two groups in terms of visual outcome, Dr Nuijts noted.

Lenticular approaches

Another approach is to leave the cornea alone as much as possible and instead modify refraction with phakic IOLs or, in patients with cataracts, toric IOLs implanted in the capsular bag.

Dr Nuijts noted that in his and his associates have achieved good results with the Artisan anterior chamber toric IOL (Ophtec) in a series of 35 eyes with post-keratoplasty astigmatism, although there was a worrying amount of endothelial cell loss over the long term. He noted that implantation of the anterior chamber lenses brought about an 86 per cent mean reduction of cylinder and refraction remained stable throughout three years of follow-up. In addition, BCVA was 20/40 or better in 77 per cent of cases. Moreover, on a scale from one to 10 the mean satisfaction score was “eight”, compared to “two” pre-operatively. However, endothelial cell counts fell from 1160/cm² to 760/cm² after two years.

“We know that after penetrating keratoplasty endothelial cell loss can reach 67 per cent at 10 years, so presently it is unknown whether this figure we found follows the natural course after penetrating keratoplasty or if there is an additional loss after lens placement,” he commented.

In eyes with post-keratoplasty astigmatism that also have cataracts, the MicroSil Toric IOL (Humanoptics) can be a useful option, Dr Nuijts noted. The foldable silicone lens has a spherical anterior and prolrate surface and can correct from -3.0 D to +31.0 D of sphere and from 2.0 D to -12.0 D of cylinder. Z-haptic protects against rotation. In a study in which 11 eyes that underwent implantation of the lens for post-keratoplasty astigmatism and cataaract, the mean UCVA improved from 0.1 to 0.25 and the mean BCVA improved from 0.25 to 0.6. Furthermore, the refractive cylinder decreased from 7.0 D to 1.63 D (p=0.001) after surgery (Vestenz et al, Ophthalmology, 2005).

Furthermore, there were no cases of rejection or graft failures and endothelial cell loss remained stable at around 1300 cm². However, there was a deviation from the target axis of 4.1° after a mean follow-up time of 3.5 months.

Dr Nuijts noted that when all else fails there is always the option of performing a repeat keratoplasty, however, most studies published to date indicate that although vision improves significantly while the sutures are in place, it returns to pre-operative levels once the final suture is removed.

“The future will of course be lamellar keratoplasty and it has now been shown that posterior lamellar keratoplasty causes a reduction in astigmatism although the effect of anterior lamellar keratoplasty procedures on astigmatism has to be determined,” he concluded.

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