Calculating graft size and position in rotational corneal autografting: A simplified approach

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In eyes with eccentric corneal opacities partially involving the pupillary area, using a rotational corneal autograft, can help restore vision without the immunological complications associated with allografts. In this report, we describe a simple intraoperative method for determining trephine size and placement for rotational corneal autografting. This surgical approach helps in the planning and execution of rotational corneal autografting, to obtain good outcomes.

Key words: Corneal autograft, graft rejection, rotational autograft

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Rotational corneal autografts are infrequently performed, but offer important advantages in patients with central corneal scars. Recent studies indicate that endothelial cell loss after this procedure is lower than after homologous penetrating keratoplasty.[1,2] Although astigmatism continues to be a problem due to the eccentric nature of corneal trephination in rotational keratoplasty, the important immunological advantages of this procedure make it an attractive option in indicated patients.

However, for the procedure to result in visual benefits, it is essential that the central corneal opacity is shifted out of the entrance pupil of the eye. Formulae have been described that help assess the suitability of the procedure and choose the size of the trephine to be used.[3,4] The use of digital photographs and imaging software to assess the suitability of the procedure has also been described.[5] A possible drawback of techniques that use photographs is that the two-dimensional images do not take into account the curvature of the cornea and this may result in errors in calculation.

Despite the preoperative assessment, it is important to ensure intraoperatively that these calculations produce the desired effect. In this context, it is important not just to choose an appropriate trephine size, but also to ensure that the trephine is appropriately positioned on the cornea. We described a simple method that helped in ensuring that the rotational corneal autograft would produce the desired result - this was performed in the operation theater prior to corneal trephination.

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Materials and Methods

A paracentral corneal opacity involving the pupil is shown in Fig. 1A. The anatomical center of the cornea is measured using calipers and is inked with a marking pen (mark 1). Assuming a postsurgical functional pupil size of 3 mm and adding 0.5 mm for suture placement (to preserve the clear zone for the entrance pupil), a second mark is made in the opacity 2.0 mm from the first mark (mark 2), which denotes the minimum area of clear cornea that is desired postoperatively in the opaque area [Fig. 1B]. The third mark (mark 3) is made 1.5 mm from mark 1, 180° away from mark 2 that indicates the other margin of the entrance pupil and the rotated corneal opacity should not cross this point. The distance from mark 2 to the central edge of the corneal opacity is measured and in this example, is 3.5 mm. A fourth mark (mark 4) is made in line with and 4 mm away from mark 3 [Fig. 1C]. This indicates the location of the edge of the rotated opacity and in this case in order to further move the opacity from the pupillary margin, 0.5 mm has been added to the measured distance of 3.5 mm. This determination is also aided by the preference to stay 0.5-1 mm away from the limbus.

The distance from mark 4 to mark 2 provides the trephine size required - in this case, 7.5 mm. Hence, the trephine can be correctly positioned, if its edges touch marks 4 and 2 and is centered on a mark midway between these points. Fig. 1D shows the effect of rotation of the calculated corneal graft. The points 2 and 4 depict the margins of the rotated graft. Within the graft, the points 1 and 3 are now interposed, thus enabling rotation of the clear peripheral cornea to overlie the pupillary area.

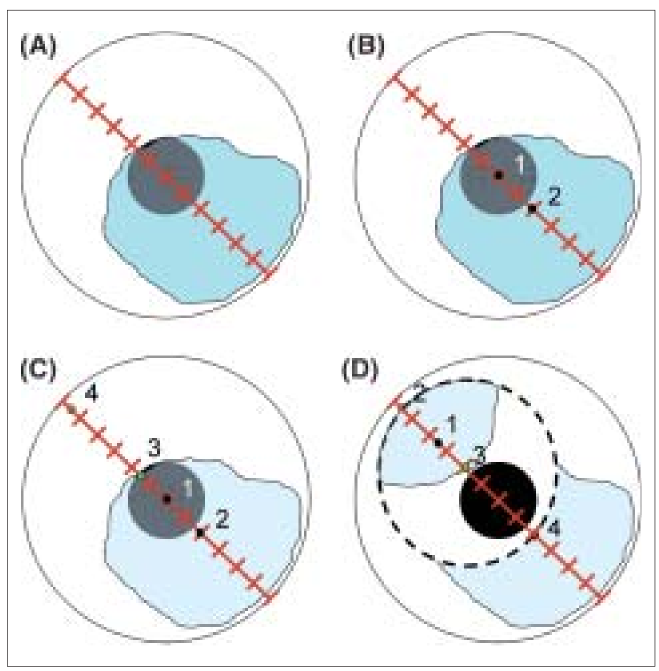

Figure 1: (A) Schematic of cornea with opacity involving pupillary area - the red line shows graduations on a 1-mm scale, (B) The center of the cornea is marked (1) and a point 2.0 mm away from the center, is marked (2) in the opacity, (C) A third mark (3) is made 1.5 mm away from the central mark, in line with the second mark; a fourth mark (4) is made 4.0 mm away from the third, (D) Depiction of rotation of calculated corneal graft

In Fig. 2, a similar paracentral opacity is shown, which however involves less of the pupillary area. In this eye, since more peripheral cornea is available for rotation, mark 2 is made 2.5 mm away from the center. This allows the use of an 8-mm trephine with at least 4 mm of central clear cornea.

In Fig. 3, a central corneal opacity is shown; by following the principles in Example 1 and placing mark 4 at the limbus, a central 3 mm clear area is obtained.

In Fig. 4, a larger central opacity is shown and in this case, even if the trephine is positioned at the limbus, the resultant clear central area does not cover the pupil and hence in this case, a rotational autograft is best avoided.

Discussion

Using this approach has helped us plan corneal rotational grafts precisely, with good outcomes. We have used this technique in 20 eyes over the past 10 years. Endothelial counts were not performed in all eyes, but none of the eyes have had a corneal endothelial failure after the surgical procedure. The visual outcomes have been varied and this depends on the preoperative amblyopic status of the eye, associated intraocular changes in the lens and retina and the astigmatic error after the procedure.

It allows intraoperative confirmation of the feasibility of this surgical procedure and takes into account the corneal curvature and allows accurate placement of an appropriately sized trephine. In comparison with other procedures described in the literature, this is a simpler approach that does not need access to digitized photographs or computer software, although those methods also work well. Importantly, it helps identify cases in which this procedure is unlikely to result in good outcomes, in which a penetrating graft may be performed as a primary procedure.

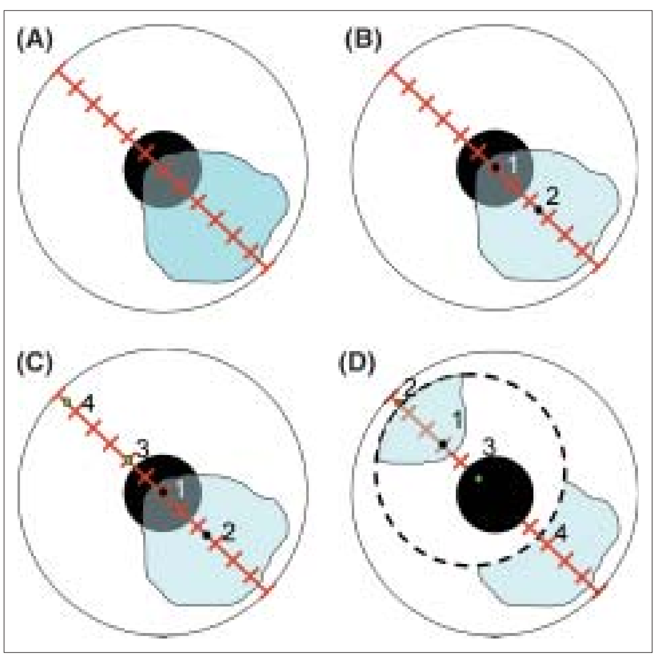

Figure 2: (A) Schematic of cornea with opacity involving pupillary area - the red line shows graduations on a 1-mm scale, (B) The center of the cornea is marked and a point 2.5 mm away from the center, is marked in the opacity, (C) A third mark is made 2.0 mm away from the central mark, in line with the second mark; a fourth mark is made 3.5 mm away from the third, (D) Depiction of rotation of calculated corneal graft

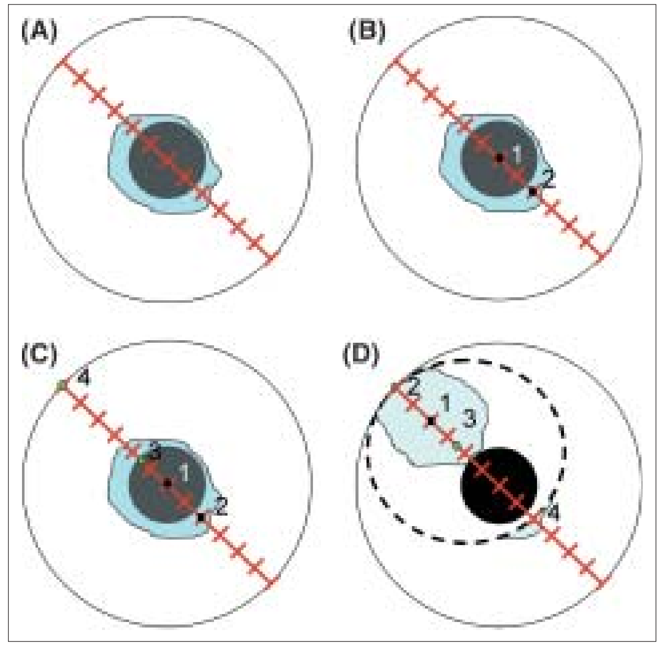

Figure 3: (A) Schematic of cornea with opacity involving pupillary area - the red line shows graduations on a 1-mm scale, (B) The center of the cornea is marked and a point 2.0 mm away from the center, is marked in the opacity, (C) A third mark is made 1.5 mm away from the central mark, in line with the second mark; a fourth mark is made 4.5 mm away from the third, (D) Depiction of rotation of calculated corneal graft

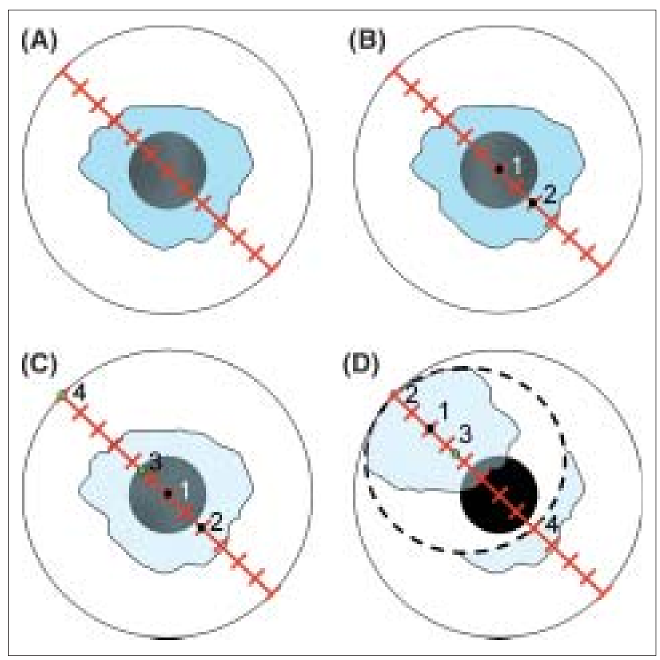

Figure 4: (A) Schematic of cornea with opacity involving pupillary area - the red line shows graduations on a 1-mm scale, (B) The center of the cornea is marked and a point 2.0 mm away from the center, is marked in the opacity, (C) A third mark is made 1.5 mm away from the central mark, in line with the second mark; a fourth mark is made 4.5 mm away from the third, (D) Depiction of rotation of calculated corneal graft

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