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Surgical Technique

Blue Ring Technique for Clearer Visualization of Incision Line During Corneal Transplantation

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Abstract

Objectives: A novel surgical technique that improves visualization of wound margins during deep anterior lamellar keratoplasty (DALK) and challenging cases of penetrating keratoplasty (PK) is described.

Methods: The standard keratoplasty technique was modified to allow better visualization of wound margins. After trephination of the cornea, the wound is opened with the help of an anterior chamber cannula, the margins are stained with trypan blue, and then washed with balanced salt solution. Only the stroma that is incised will be stained with the dye, while the healthy corneal epithelium remains unstained. The corneal button is removed by following the blue ring. Next, the corneal graft tissues are sutured to the recipient bed. At this step, the colored line allows for better visualization of the margins and the depth of the sutures.

Results: This technique is useful in all cases of DALK and PK. It is especially helpful in cases with corneal scars, which can lead to incomplete trephination. In such cases, the surgeon can easily follow the blue ring while making a manual incision. This technique both allows the surgeon to save time during these relatively complex surgeries and allows for the formation of a nice, round recipient bed.

Conclusion: This technique has the potential to increase surgical comfort and reduce irregularities in the recipient bed that have the potential to cause irregular astigmatism.

Keywords: Blue ring, corneal transplantation, deep anterior lamellar keratoplasty, penetrating keratoplasty, trypan blue.

Introduction

Deep lamellar keratoplasty is increasingly preferred for the treatment of corneal stromal pathologies, including keratoconus, corneal stromal dystrophies, and corneal scarring (1). It is preferred over penetrating keratoplasty (PK) because it is an extraocular procedure and it has a smaller chance of graft rejection and complications related to open-sky condition (2). Identification of the incision line in the stromal bed during deep anterior lamellar keratoplasty (DALK) is not always easy, because the corneal stroma loses its transparency after the big bubble formation. Difficulties in the visualization of the incision line may lead to nicks on the recipient bed during manual excision of the recipient central corneal stroma. Irregularities in the recipient bed margins may prevent proper apposition of the donor button and recipient bed, potentially leading to surface irregularity and postkeratoplasty astigmatism.

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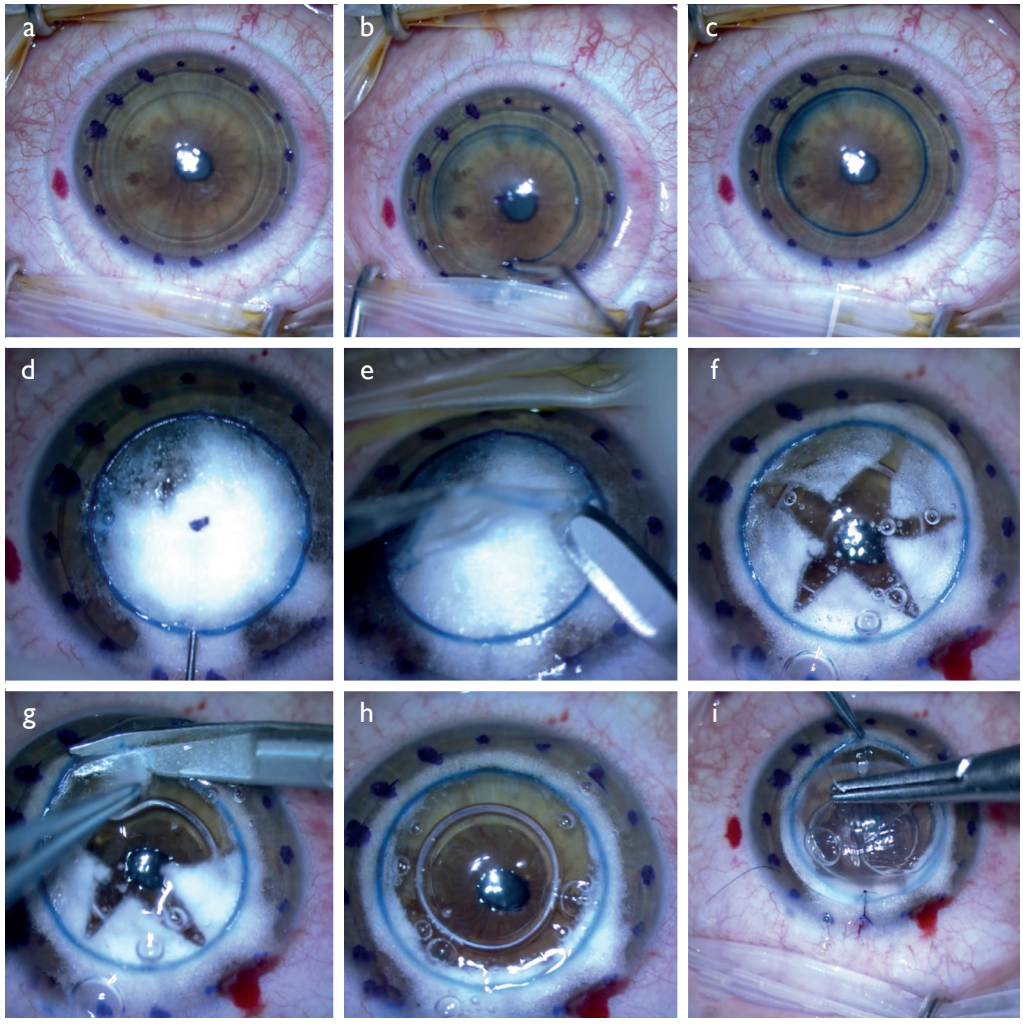

Figure 1. Clinical images from deep anterior lamellar keratoplasty surgery using the blue ring technique. **(a)** Cornea is trephined and ready for staining; **(b)** Incision line is stained with trypan blue with the help of an anterior chamber cannula; **(c)** Blue ring is formed after washing the incision line; **(d)** Corneal stroma becomes whitish in color; **(e)** Removal of the anterior stroma is performed after staining; **(f)** Posterior stroma and incision line can be easily identified; **(g)** Removal of the posterior stoma is easier with better visualization of the stained incision line; **(h)** Descemet membrane and prepared recipient bed with clearly stained margins; **(i)** Staining of the stromal margin aids better apposition of recipient bed and graft button by improving the depth perception of the surgeon.

We modified the standard DALK procedure to allow better visualization of the incision line. After partial thickness trephination of the cornea (Fig. 1a), trypan blue is applied 360° into the incision line with the help of an anterior chamber cannula (Fig. 1b), and is washed immediately afterwards. Only the thin stromal incision is stained with the dye, while the remaining cornea remains translucent (Fig. 1c). Later, the big bubble is formed with the standard procedure and the corneal stroma becomes whitish in color (Fig. 1d). At this stage, the margins of the recipient bed can be easily identified and the central stroma can be excised precisely by following the blue ring staining on the incision line (Fig. 1e and 1f). The blue stained stromal incision line also allows the surgeon to get a better perception of depth during suturing, and therefore aids better apposition of the graft button and recipient bed (Fig. 1h and 1i).

This technique is also very useful when trephination is incomplete, especially in corneas with intense stromal scarring or a preexisting corneal perforation (where the vacuum cannot be applied properly). In these cases with incomplete trephination, the blue ring technique allows for better visualization of the incision margins in both DALK and penetrating keratoplasty cases. We have routinely performed our surgeries with this method for the last 2 years and did not experience any adverse event associated with this procedure. Blue staining spontaneously disappeared 1 or 2 days after the

surgery in all cases. We believe that this technique has the potential to increase surgical comfort and success at all stages of surgery in DALK and challenging PK cases.

Disclosures

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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