Commentary: Deep anterior lamellar keratoplasty: The challenges and solutions

Anterior lamellar corneal surgery was first described in the mid-19th century. The technique, however, failed to popularize, and full-thickness corneal grafting remained the preferred procedure for the next 100 years. Thereafter, the advent of guided trephines and refinements in lamellar corneal dissection techniques heralded the modern era of anterior lamellar keratoplasty. Deep anterior lamellar keratoplasty (DALK) is an established technique for treating corneal stromal pathologies with a healthy endothelium, such as keratoconus, dystrophies, or scars.[1] In this issue, an article by Fogla *et al.* describes the preferred surgical techniques and outcomes of DALK among keratoplasty surgeons in India. The survey reports that DALK constitutes >25% of the keratoplasty cases in only about one fourth of the participants.[2] In spite of its numerous advantages over penetrating keratoplasty (PK), including a much lower graft rejection rate, better reversal after rejection, and earlier suture removal, the uptake of DALK among keratoplasty surgeons has been relatively slow owing to its steep learning curve, technical complexity, and longer operative times compared with PK. Stromal dissection for barring the Descemet membrane (DM) remains the most challenging component of DALK. Among the various methods described for barring the DM, Anwar's big-bubble technique has emerged as the most popular owing to its advantages such as shorter operative times, fewer intraoperative complications, and better visual outcomes. The formation of a big bubble, though desirable, may not be successfully achieved in all cases. Its reported success rate ranges from 35% to 95% and may be adversely affected by numerous factors, including female sex, presence of posterior stromal scar, thin pachymetry (<250 microns), smaller trephine size, and a relatively superficial placement of the needle or cannula within the stroma during air injection.[3,4] The classical technique of layer-by-layer removal of stroma while time taking, continues to remain popular, especially as a rescue measure in cases with a failed big-bubble formation such as advanced keratoconus cases with healed hydrops or excessively thin corneas.

Over the past two decades, our understanding of the corneal surgical anatomy has been furthered by the characterization of the pre-Descemet or Dua's layer. The importance of identifying the type of big bubble created intraoperatively has been emphasized due to its implications on surgical outcomes. A Type 2 bubble, situated between the pre-Descemet layer and DM, is more susceptible to perforation, with up to 86% of the cases requiring conversion to PK.[5] Cases with deep corneal scars and thin corneas have been associated with a higher rate of Type 2 big-bubble formation. In lieu of the high risk of intraoperative DM perforation with Type 2 big bubble, a layer-by-layer dissection of the stroma up to the predescemetic layer may be a safer option in such cases while attempting to bare the DM.[5] While some authors have refuted the presence of a distinctive pre-Descemet layer, the existence of the three types of big bubble and its clinical implications remains widely acknowledged and accepted.[6] Modern intraoperative optical coherence tomography systems have emerged as a valuable tool to assess corneal residual stromal bed during a layer-by-layer dissection, to delineate the level of cleavage or the type of big bubble created, and for detecting a double anterior chamber during surgery.[7]

Recently, femtosecond laser (FS) has been employed for performing highly customized corneal trephination in DALK. Although it has certain theoretical advantages such as better wound configuration and earlier suture removal enabled by faster wound healing, the clinical superiority and cost-effectiveness of FS-DALK over manual DALK are yet to be established in well-controlled studies.[8] The applicability of the FS laser technology is also limited in cases with corneal scars, severe corneal thinning, or dense opacities. Such cases still comprise a significant proportion of cases in our country, which may explain the relatively low utilization of the technology among DALK surgeons in India.

Corneal ectasia, which has been the classical indication for DALK, continues to remain the most common indication for the procedure in our country.[2] The recent therapeutic advancements for treating the disease, such as corneal collagen cross-linking and contact lens technology have, however, led to a decline in the number of keratoconus cases requiring DALK for advanced progressive disease and visual rehabilitation, respectively. Continued advances in the field are expected to further reduce the number of patients who would require the DALK in the coming future.

Although DALK requires less rigid criteria for donor tissue quality, a factor that is particularly advantageous in a resource-poor country like ours, the technical complexity of the procedure, its poor reproducibility, and the potential

for conversion to full-thickness keratoplasty have prevented its effective transition to a first-choice procedure for treating stromal pathologies. Although various techniques have been described to reduce the operative time, increase the technical ease, and improve the safety of DALK, none of the methods have shown an absolute superiority over the others.[6,8]

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