Surgical Technique

Stop sign for correct tissue plane identification in small incision lenticule extraction

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We describe the "stop sign" which allows correct anterior and posterior lenticular plane delineation in Small Incision Lenticule Extraction (SMILE). This sign describes the resistance noted at the junction between the dissected and undissected halves of both the planes, interfering with subsequent lateral movement of the instrument. The resistance is demonstrated at both the anterior and posterior lenticular plane. This allows ideal dissection of the lenticule from the overlying cap and underlying stroma, thereby reducing the complications arising from incorrect tissue dissection.

Key words: Lenticule delineation, small incision lenticule extraction, SMILE complications

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Femtosecond laser assisted flap creation for Laser In-Situ Keratomileusis (LASIK) was described first in 2001.[1] Roughly a decade later, the evolution of refractive surgery witnessed the advent of Small Incision Lenticule Extraction (SMILE).[2] SMILE entails the creation of four sequential femtosecond cuts to fashion an intrastromal lenticule, which is subsequently separated from the surrounding stromal surface and removed via a 2-5mm corneal side cut. Although there is an increasing evidence of benefits of SMILE secondary to a smaller incision including superior corneal biomechanics and lesser corneal denervation,[3,4] a greater surgical skill is required and increased risk of complications is associated.

Correct delineation and subsequent dissection of the lenticular edge remains the most challenging surgical step.[5] Unintended posterior plane dissection and attempts at subsequent lenticule retrieval are associated with complications including cap incision tear or avulsion, residual lenticular fragment and creation of a false passage. We describe a technique for correct tissue plane identification in SMILE.

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Following adequate centration, suction is initiated and the femtosecond pass creates four sequential cuts to fashion an intrastromal lenticule. A sharp tipped instrument is subsequently used to open the corneal side cut, and the anterior [Fig. 1a] and posterior [Fig. 1b] lenticular planes are delineated in the right and left half, respectively. In case the correct plane has been achieved, a point of resistance is noted at the junction between the dissected and undissected halves of both planes, interfering with subsequent lateral movement of the instrument or the stop sign. This can be demonstrated at both the anterior and posterior lenticular plane i.e., during left to right movement in the posterior plane [Fig. 1c] and right to left separation in the anterior plane [Fig. 1d], confirming ideal delineation [Video 1]. Following delineation, the lenticule is dissected from the overlying cap and the underlying stroma. It is subsequently extracted via a 3mm corneal side cut incision using micro forceps.

Fig. 2 demonstrates an incorrect separation wherein the posterior lenticule surface has been delineated in both attempts [Fig. 2a and b], and the lack of subsequent resistance allows the instrument to move laterally into the area of previous delineation [Fig. 2c]. This continuity between the areas of tissue separation demonstrates a posterior lenticule delineation, with subsequent adherence of the lenticule to the overlying cap and dissection difficulties.

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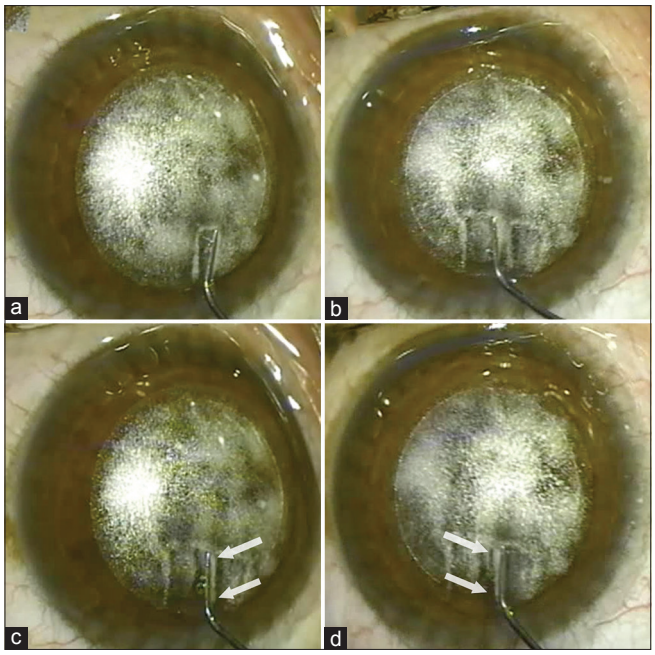

Figure 1: Anterior plane delineated on the right side (a) followed by posterior separation on the left (b). Stop sign at junction of dissected and undissected halves between the two planes. This provides resistance to lateral movement of instrument (left to right) in the posterior (c, arrows) and (right to left) anterior plane (d, arrows)

Discussion

SMILE is a minimally invasive procedure, which entails the creation of an intrastromal lenticule and its subsequent extraction through a small corneal incision. Differentiating the planes of the lenticule allows anterior dissection prior to posterior separation, enabling a safe lenticule removal. Incorrect plane separation with subsequent adherence of the lenticule to the stromal cap is associated with increased tissue manipulation and complications including side cut tear or avulsion, lenticule fragmentation or even retained lenticule in certain situations.

Various techniques have been described to identify the correct plane in SMILE. Jacob and coworkers describe the white ring sign, wherein the reflected edge of the lenticule side cut and its relative position to the instrument serves as a visual guide.[6] Dissection of the posterior surface of the lenticule edge first has been described allowing clear demarcation of the remaining half of each layer.[7] However, these techniques have their limitations in cases where the visualisation may be suboptimal secondary to inadequate opaque bubble layer (OBL) or in thin lenticules, wherein the edge may not have adequate thickness.

Other methods including the continuous curvilinear lenticulerrhexis and lenticoschisis may be associated with ripping of the lenticule especially in low ammetropia with thin lenticules.[8,9] Moreover, the procedure is not recommended in cases of dense OBL or uneven laser scanning leading to suboptimal tissue dissection. The utilisation of microscope-integrated intraoperative optical coherence guided SMILE is limited by the cost and availability of equipment. In addition, the lag involved in shifting the patient between the machines allows time for the photo disruptive cavitation bubbles to escape, making subsequent dissection difficult.[10]

We describe a technique to accurately delineate the tissue planes by noting a resistance at the junction between the dissected and undissected halves of both planes or the stop sign. This technique is independent of the nature of the opaque bubble layer and thickness of the lenticule procured. Moreover, no additional instrumentation or surgical expertise is required.

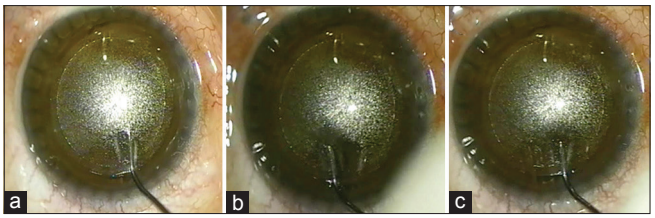

Figure 2: Posterior delineation on both sides (a and b), with subsequent absence of stop sign allowing (left to right) lateral movement (c)

Conclusion

In conclusion, the stop sign refers to the resistance offered between the dissected and undissected halves of the two surgical planes, and allows safe and efficient separation of anterior and posterior lenticular planes.

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Conflicts of interest

There are no conflicts of interest.

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