

Commentary: Capsule staining and its aftermath

Since the introduction of capsulorhexis by Gimbel and Neuhann,^[1] various surgical strategies to stain the anterior capsule with varied dyes have been put forward in pursuit of enhancing its visibility in white and dense cataracts. Apart from staining the anterior capsule, the dyes have been demonstrated to prevent posterior capsular opacification through a significant decrease in density and viability of the lens epithelial cells^[2] and they have also been employed in posterior capsulorhexis.^[3]

Trypan blue was initially employed to examine the endothelium of donor cornea and Gerrit Melles first proposed its application for anterior capsular staining.^[4] In the experimental and clinical stage evaluation of the effect of capsular staining dyes *in vivo*, various stains have been employed like trypan blue, indocyanine green, fluorescein sodium, Gentian violet, brilliant blue etc. However, trypan blue has gained maximum acceptance in clinical practice for staining the anterior capsule.

The capsule-staining dyes have been found to alter the elasticity and stiffness of the capsular bag that probably has substantial clinical significance as it can affect the surgical outcomes. Studies on the effect of capsular staining reveal that stained capsules lose their elasticity with enhancement of stiffness that is hypothesized to be due to collagen crosslinking induced by a photosensitizing action of the staining agent.^[2,5] Surprisingly, no biochemical changes were seen in the absence of light. Hence, it was conceptualized that light has a role in altering the properties of lens capsule. The downside of this aspect is that all surgeons need a surgical microscope and the light emanating from it probably promotes the crosslinking effect on the lens capsule. To decrease the aftermath of capsular staining dyes, the minimum possible concentration of the staining dye should be employed. Currently, Trypan blue is used at 0.06% concentration but it has been suggested that the lowest effective concentration should be used and Trypan blue concentrations as low as 0.0125% has also been demonstrated to stain the anterior capsule satisfactorily.

Dick *et al.*^[6] attributed trypan blue staining to directly alter the biomechanical properties of lens capsule due to marked reduction in elasticity and an increase in stiffness. Dye-enhanced surgeries should therefore be observed and followed up closely to detect any subtle or obvious changes that may serve as an indicator for surgical repercussions in the immediate or late postoperative period. In the study by Dick *et al.*,^[6] the anterior capsule was exposed to trypan blue for 10 seconds whereas in the current study^[7] the capsules were exposed for 1 minute to various dyes that included trypan blue, brilliant blue, and indocyanine green. A change in biomechanical properties was observed in both the studies irrespective of the duration of exposure and the method employed to measure the biomechanical property. Therefore, surgeons should probably consider applying the staining dyes for a duration that is just optimal to stain the capsule.

It has been contemplated that post usage of capsule-staining dyes, the incidence of capsular tears could increase leading to a higher incidence of intraoperative complications. Although it remains to be seen that dyes are mostly used in challenging

cases to enhance capsule visualization and whether the inadvertent complications related to capsular flaps are due to lost elasticity or are due to mismanagement or the complicated nature of the case itself at the first instance.

Envisioning a broader picture, would it be justified to enhance the visualization of the capsule in pursuit of achieving a complete capsulorhexis and losing on to the strength and elasticity that would be extremely critical in complex case scenarios? The question still remains unanswered and further studies are warranted.

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