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Role of Anterior Segment Optical Coherence Tomography in Risk Stratification of Intumescent Cataracts: from Morphological Analysis to Personalized Surgery

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Abstract **Review Article**

Intumescent cataracts represent a high-risk surgical condition due to increased intralenticular pressure and fragile capsular structures. Preoperative evaluation is often limited by the absence of red reflex and poor visualization of lens morphology. Anterior segment optical coherence tomography (AS-OCT) provides detailed in vivo imaging of lens architecture, enabling identification of key features such as capsular convexity, intralenticular clefts, cortical liquefaction, and compartmentalization. Based on these findings, a morphological classification can be established, allowing indirect assessment of intralenticular pressure and stratification of capsular risk. This approach facilitates prediction of intraoperative behavior and guides surgical strategy. AS-OCT thus represents a major step toward personalized cataract surgery, transforming management from an unpredictable to a predictive model.

Keywords: Anterior segment OCT, intumescent cataract, capsular risk, intralenticular pressure, personalized surgery.

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INTRODUCTION

Intumescent cataracts, also known as white or hypermature cataracts, are characterized by cortical liquefaction associated with a dense nucleus and increased intralenticular pressure (page 2). This leads to anterior capsular bulging and significant capsular and zonular fragility, making these cataracts particularly high-risk from a surgical perspective.

One of the main intraoperative complications is uncontrolled capsulorhexis due to sudden decompression, resulting in radial tears known as the Argentine flag sign (page 3).

Clinical examination alone is often insufficient. The absence of red reflex and the inability to assess intralenticular pressure limit preoperative evaluation (page 4).

Anterior segment OCT has emerged as a valuable imaging modality in this context. It allows detailed morphological analysis of the lens despite opacity. Key features identifiable on AS-OCT include anterior capsular convexity, intralenticular clefts, areas of cortical liquefaction with ground-glass appearance, compartmentalization, and cortical fiber organization (page 5).

These features provide indirect insight into intralenticular pressure. Capsular convexity and cortical compartmentalization are strong indicators of increased pressure, which correlates with a higher risk of capsular rupture.

Based on these observations, a morphological classification can be proposed. Four main types can be distinguished according to OCT findings, each associated with a specific pressure profile and surgical risk.

Type I cataracts present lamellar fibers without capsular convexity and are associated with low pressure and low surgical risk. Type II cataracts show anterior capsular convexity and intralenticular fissures, reflecting high pressure and high capsular risk. Type III cataracts are characterized by liquefied cortex with potential fluid release, corresponding to moderate risk. Type IV cataracts exhibit homogeneous liquefaction with variable pressure but unpredictable intraoperative behavior (pages 6–9).

Table: AS-OCT-Based Classification of Intumescent Cataracts and Surgical Implications

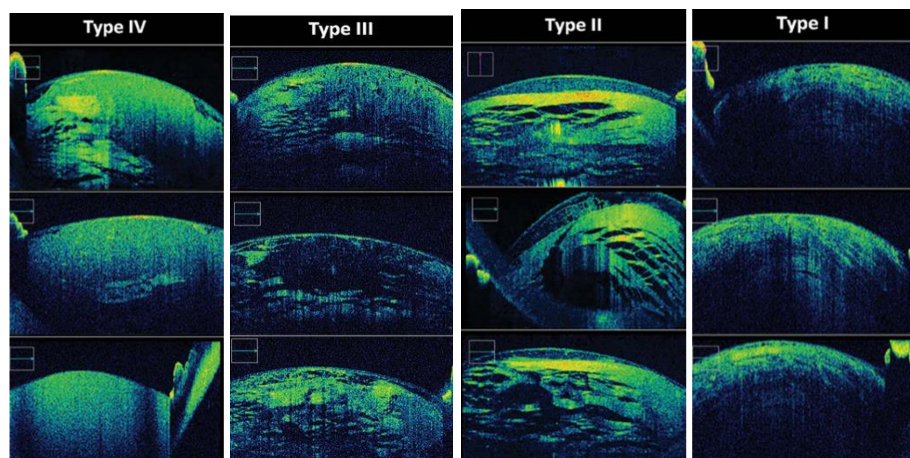
Type	AS-OCT Morphological Features	Intralenticular Pressure (Indirect Assessment)	Capsular Risk Level	Intraoperative Behavior	Recommended Surgical Strategy
Type I	- Lamellar cortical fibers- Absence of anterior capsular convexity- Preserved internal lens architecture- No intralenticular clefts or fluid pockets	Low pressure Stable lens volume No significant capsular tension	Low	Stable anterior capsule Controlled capsulorhexis No sudden decompression	Standard continuous curvilinear capsulorhexis (CCC) No decompression required Routine phacoemulsification
Type II	- Marked anterior capsular convexity- Presence of intralenticular clefts/fissures- Early cortical liquefaction- Signs of cortical compartmentalization	High pressure Increased capsular tension Risk of sudden fluid release	High	Sudden radial extension of capsulorhexis High risk of Argentine flag sign Uncontrolled tearing	Initial small capsulorhexis (mini-rhexis) Controlled decompression (needle aspiration) Gradual enlargement of capsulorhexis
Type III	- Extensive cortical liquefaction- Visible fluid pockets- Partial spontaneous fluid release- Disorganized cortical fibers	High but partially decompressed Moderate residual pressure	Moderate	Partial decompression during surgery Less abrupt but still unpredictable capsular behavior	Initial aspiration of liquefied cortex Careful capsulorhexis after decompression Avoid excessive manipulation
Type IV	- Homogeneous lens liquefaction- Loss of normal lens architecture- Diffuse “ground-glass” appearance- Thin and fragile capsule- Possible anterior chamber shallowing	Variable pressure May be high or already decompressed Unpredictable dynamics	Variable (often high)	Highly unpredictable behavior Risk of capsular collapse or tear Zonular weakness possible	Controlled decompression Two-step capsulorhexis (mini + enlargement) Use of high-viscosity OVD Gentle, low-fluidics phaco technique

This classification enables effective risk stratification and guides surgical decision-making. A direct capsulorhexis may be performed in low-risk cases, whereas high-risk cases require decompression techniques and modified surgical approaches.

The integration of AS-OCT into preoperative evaluation allows surgeons to anticipate intraoperative challenges and adapt their strategy accordingly. This represents a paradigm shift from empirical surgery to predictive and personalized management.

From a pathophysiological perspective, the correlation between OCT morphology and intralenticular pressure is supported by previous studies showing that cortical liquefaction leads to osmotic imbalance and increased lens volume, resulting in capsular tension and risk of rupture.

AS-OCT therefore provides not only structural but also functional information, bridging the gap between anatomy and surgical behavior.



CONCLUSION

Anterior segment OCT plays a crucial role in the evaluation of intumescent cataracts. By enabling morphological classification and indirect pressure assessment, it allows preoperative risk stratification and surgical anticipation. This approach transforms cataract surgery from an unpredictable procedure into a personalized and predictive intervention.

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REFERENCES

1. Titiyal, J. S., Kaur, M., Shaikh, F., Goel, S., & Bageshwar, L. M. S. (2020). Real-time intraoperative dynamics of white cataract-intraoperative optical coherence tomography-guided classification and management. *Journal of Cataract & Refractive Surgery*, 46(4), 598-605.
2. LoBue, S. A., Bellucci, R., Camposampiero, D., Salvetat, M. L., & Bruni, E. (2024). Preventing the Argentinian flag sign and managing anterior capsular tears: A review. *Indian Journal of Ophthalmology*, 72(2), 166-174.
3. Figueiredo, C. G., Figueiredo, J., & Figueiredo, G. B. (2012). Brazilian technique for prevention of the Argentinean flag sign in white cataract. *Journal of Cataract & Refractive Surgery*, 38(9), 1531-1536.
4. Porwal, A. C., Singh, S., Raje, D., & Sharma, N. (2021). Role of preoperative Nd:YAG laser anterior capsulotomy in mature intumescent cataracts. *Asia-Pacific Journal of Ophthalmology*, 10(5), 473-477.
5. Dhingra, D., Balyan, M., Malhotra, C., Rohilla, V., & Jain, A. K. (2018). A multipronged approach to prevent Argentinian flag sign in intumescent cataracts. *Indian Journal of Ophthalmology*, 66(9), 1304-1306.
6. Conrad-Hengerer, I., Hengerer, F. H., Joachim, S. C., & Dick, H. B. (2014). Femtosecond laser-assisted cataract surgery in intumescent white cataracts. *Journal of Cataract & Refractive Surgery*, 40(1), 44-50.
7. Schultz, T., Joachim, S. C., Szuler, M., Stellbogen, M., & Dick, H. B. (2014). Laser-assisted mini-capsulotomy: A new technique for intumescent white cataracts. *Journal of Refractive Surgery*, 30(11), 742-745.
8. Chee, S. P., Bacsal, K., Jap, A., Seet, B., Cheng, C. L., & Chan, N. S. (2019). Femtosecond laser-assisted cataract surgery for the white cataract. *British Journal of Ophthalmology*, 103(4), 544-550.