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EDITORIAL

Intraocular lens implantation in the absence of capsular support: scleral fixation

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Although routine phacoemulsification with simultaneous implantation of a foldable intraocular lens (IOL) in the capsular bag remains the gold standard in uneventful cataract surgery [1], events such as surgical complications or previous trauma may render zonular and/or capsular support insufficient or even absent, thus leaving the operating surgeon faced with an important decision regarding the type of IOL and mode of fixation. Moreover, increasing age as well as a number of ocular pathologies such as pseudoexfoliation or systemic conditions such Marfan syndrome or homocystinuria may lead to late in-the-bag IOL dislocation, necessitating secondary fixation of a pre-existing IOL or IOL exchange. For over a decade the available choices in the absence of capsular support included angle-supported anterior chamber (AC) IOLs and scleral-sutured posterior chamber (PC) IOLs through a large corneal or limbal incision. Although flexible open-loop AC IOLs have an improved safety record [2] compared to previous closed-loop models, most surgeons nowadays prefer either scleral- or iris-supported IOLs due to their near-normal anatomical correction and safer profile regarding corneal endothelium.

Scleral-sutured, glued or intracanal-fixated IOLs placed in the posterior chamber further from the cornea and all AC structures, appear to have a higher safety profile compared with a properly implanted iris-fixated IOL (angle-supported, iris-sutured or iris-claw IOs) with lower risk of corneal endothelial loss, pupillary distortion, iris or angle damage, chronic iritis and secondary glaucoma [3]. This makes a scleral-fixated (SF) posterior chamber IOL the ideal choice in the presence of previous iris trauma, iris defects such as in acquired or congenital aniridia, glaucomatous eyes with or without the presence of a drainage device and eyes with a compromised corneal endothelium. Where there is history of iritis and/or CMO, the placement of an angle- supported or iris-fixated AC-IOL, with varying degrees of associated iris chaffing and blood-ocular barrier breakdown, may lead to a significantly worse prognosis compared to a SF- IOL [4–6]. The implantation of a posterior chamber (PC) IOL in the sulcus is a lot more advantageous compared to an iris-fixated or anterior-chamber (AC) IOL in regard to both safety and optical quality. In terms of safety the presence of a stable PC-IOL forms a barrier preventing the migration of inflammatory cytokines and mediators as well as prolapse of vitreous strands in the anterior chamber, thus reducing the risk of CMO [7]. Furthermore, it preserves the integrity of the AC, preventing eventual damage to corneal endothelium, as well as the iris stroma, and angle structures reducing the risk of inflammation, pressure elevation and/or formation of peripheral anterior synechiae. Regarding optical quality, PC-IOLs are placed closer to the nodal point of the eye ensuring better visual quality compared to any iris-fixated technique, considering the fact that fellow eyes will most likely receive or might already have been implanted with a PC- IOL as well.

Not infrequently, poor zonular support occurs in the setting of already established or impending corneal decompensation. The presence of a PC-IOL ensures a deeper chamber, enabling surgical manoeuvres as well as the introduction, manipulation and the long-term preservation even of the most demanding endothelial grafts like PDEK and DMEK. On the contrary, endothelial grafting in the presence of any iris- or angle-supported IOL is not only technically more demanding but the proximity of the IOL to the graft increases the risk for secondary or even primary graft failure.

A relatively common complication of all scleral-fixating techniques is intraoperative and early post-operative haemorrhage as a result of conjunctival manipulation, placement of sclerotomies and/or needles through the well vascularised pars plicata and the formation of scleral flaps. However, it can be up to a degree prevented by careful planning and meticulous surgical technique. Maintaining the eye well-pressurised during the procedure and ensuring tight wounds is of paramount importance. Careful haemostasis of the scleral bed of the flaps in cases of glued PC-IOL reduces the possibility of intra- and early post-operative vitreous haemorrhage and/or hyphema (Fig. 1).

Late postoperative AC and vitreous haemorrhage, especially in poorly positioned IOLs, may be attributed to continuous chaffing of uveal tissues leading to Uveitis-Glaucoma-Hyphema (UGH) syndrome and most likely CMO. These uncommon complications in secondary PC-IOL fixation (11.6% and 14.3%, respectively) [8] are encountered more frequently in secondary iris-fixation and AC IOLs [9]. Considering that two major risk factors for the occurrence of UGH-syndrome are floppy iris syndrome and traumatic aphakia, the placement of a SFPC-IOL is largely preferred in the setting of concurrent traumatic iris defects, as these would not only make the insertion of any iris-fixated or angle supported IOL without prior iris reconstructive surgery impossible or at least unstable, but they would further increase the risk for late postoperative haemorrhage, inflammation and IOP spikes.

Scleral suture fixation in the absence of capsular support has been criticised for the risk of IOL tilt, decentration and even subluxation especially where IOLs were suspended by two sutures. However, newer techniques of PC scleral fixation such as the four-flanged technique by Sergio Canabrava [10], the double-needle Yamane technique [11], the implantation of a Carlevale IOL [12] (Fig. 1b, c) and more importantly the glued-IOL described by A. Agarwal [13], allow for a more stable and predictable placement with a much larger area of fixation, where a part of the IOL haptics acts as an anchor, making IOL decentration and tilt a lot less likely [14]. With regard to iris-fixated IOLs, one may argue that they have been shown to have a high track record of stability and lack or very low levels of tilt. Nevertheless, this appears to be largely iris-dependent and may not be the case in eyes with traumatic aphakia, floppy iris and stromal atrophy. The flaccid iris in those cases lacks tone, reducing the stability of the iris-claw IOLs and

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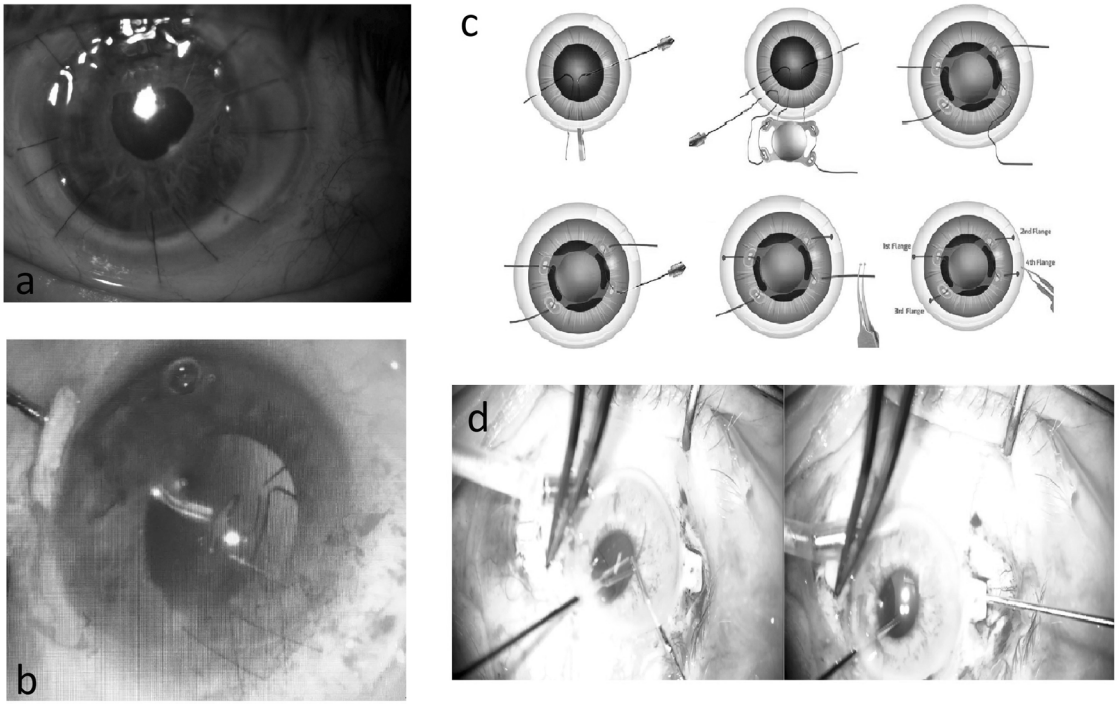

Fig. 1 Scleral fixation intraocular lens implantation examples. a Scleral fixation intraocular lens in situ – notice long suture ends used to prevent conjunctival perforation. **b** Carlevale intraocular lens insertion. **c** Four-flanged technique for intraocular lens fixation. **d** Three-piece intraocular lens insertion through scleral flaps.

Table 1. Advantages of scleral fixation.

1. Lower risk for corneal endothelial stress during performance of AC manoeuvers.
2. Lower risk of pupillary distortion, iris or angle damage and chronic iritis.
3. Lower risk for Uveitis-Glaucoma-Hyphema syndrome.
4. Advantageous in cases of iris defects, trauma or iritis.
5. Implanted closer to the nodal point of the eye.
6. Enables future endothelial grafting.
7. New sutureless techniques devoid of suture-related complications and provide stable fixation.
8. Easy to fit through small incisions.
9. Transconjunctival techniques further reduce conjunctival manipulation.

risking an immediate or late dislocation in the vitreous cavity with detrimental consequences in case of attempted retropupillary iris fixation. In fact one recent study has shown a disenclavation rate of retropupillary fixated iris-claw IOLs of 9.7% and an older one of 14%, respectively [15, 16].

Intraocular lenses designed for scleral fixation are foldable and easy to fit through a small incision, thus their insertion does not require the large corneal or limbal wound needed in the case of iris-claw or angle supported AC-IOL, maintaining the structural integrity of the eye and reducing the risk of a post-operative wound leak, endophthalmitis and astigmatism. Moreover, the risk for a suprachoroidal haemorrhage should be considered and large incisions should be avoided in high-risk patients. The advent of newer techniques such as the Yamane [11] and the trocar-assisted scleral fixation [17] minimise the need for conjunctival opening and other manipulations that should be avoided in glaucomatous patients in the favour of future need for filtration surgery or conjunctival cicatricial pathologies like ocular cicatricial pemphigoid.

In conclusion, scleral fixation of IOLs in the posterior chamber, although technically demanding, allows the preservation of a near-normal ocular architecture with very good visual outcomes (Table 1). Eyes with lack of zonular and/or capsular support tend to have multiple comorbidities making the preservation of cornel endothelium and the reduction of iris inflammation with resultant CMO that scleral fixation of PCIOL offer, a top priority.

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REFERENCES

1. Olson RJ, Braga-Mele R, Chen SH, Miller KM, Pineda R 2nd, Tweeten JP, et al. Cataract in the Adult Eye Preferred Practice Pattern®. Ophthalmology. 2017;124: P1–119.
2. Auffarth GU, Wesendahl TA, Brown SJ, Apple DJ. Are there acceptable anterior chamber intraocular lenses for clinical use in the 1990s? An analysis of 4104 explanted anterior chamber intraocular lenses. Ophthalmology. 1994;101:1913–22.

3. Kumar B, Muni I. Scleral fixation of intraocular lenses. [Updated 2021 Jul 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan.
4. Kumar DA, Agarwal A, Ali WRK. Uveitis and deficient lens capsules: effect of glued intraocular lens on the visual outcome and the reactivation of inflammation. Indian J Ophthalmol. 2019;67:1610–6.
5. Todorich B, Thanos A, Yonekawa Y, Thomas BJ, Abbey AM, Faia LJ. Transconjunctival sutureless intrascleral fixation of secondary intraocular lenses in patients with uveitis. Ocul Immunol Inflamm. 2018;26:456–60.
6. Zeh WG, Price FW. Iris fixation of posterior chamber intraocular lenses. J Cataract Refract Surg. 2000;26:1028–34.
7. Güell JL, Barrera A, Manero F. A review of suturing techniques for posterior chamber lenses. Curr Opin Ophthalmol. 2004;15:44–50.
8. Kansal V, Onasanya O, Colleaux K, Rawlings N. Outcomes of using sutureless, scleral-fixated posterior chamber intraocular lenses. Semin Ophthalmol. 2019;34:488–96.
9. Zemba M, Camburu G. Uveitis-Glaucoma-Hyphaema Syndrome. General review. Rom J Ophthalmol. 2017;61:11–7.
10. Canabrava S, Canêdo Domingos Lima AC, Ribeiro G. Four-flanged intrascleral intraocular lens fixation technique: no flaps, no knots, no glue. Cornea. 2020;39:527–8.
11. Yamane S, Sato S, Maruyama-Inoue M, Kadonosono K. Flanged intrascleral intraocular lens fixation with double-needle technique. Ophthalmology. 2017;124:1136–42.
12. Veronese C, Maiolo C, Armstrong GW, Primavera L, Torrazza C, Della Mora L, et al. New surgical approach for sutureless scleral fixation. Eur J Ophthalmol. 2020;30:612–5.
13. Agarwal A, Kumar DA, Jacob S, Baid C, Agarwal A, Srinivasan S. Fibrin glue-assisted sutureless posterior chamber intraocular lens implantation in eyes with deficient posterior capsules. J Cataract Refract Surg. 2008;34:1433–8.
14. Kumar DA, Agarwal A, Prakash G, Jacob S, Saravanan Y, Agarwal A. Evaluation of intraocular lens tilt with anterior segment optical coherence tomography. Am J Ophthalmol. 2011;151:406–12.e2.
15. Choi EY, Lee CH, Kang HG, Han JY, Byeon SH, Kim SS, et al. Long-term surgical outcomes of primary retropupillary iris claw intraocular lens implantation for the treatment of intraocular lens dislocation. Sci Rep. 2021;11:726.
16. Gonnermann J, Klamann MK, Maier AK, Rjasanow J, Joussen AM, Bertelmann E, et al. Visual outcome and complications after posterior iris-claw aphakic intraocular lens implantation. J Cataract Refract Surg. 2012;38:2139–43.
17. Totan Y, Karadag R. Trocar-assisted sutureless intrascleral posterior chamber foldable intra-ocular lens fixation. Eye (Lond). 2012;26:788–91.

AUTHOR CONTRIBUTIONS

MT was responsible for the conception and designing of the work, acquisition and analysis of data/references and drafting the work. He was involved in revising it critically and the final approval of the version to be published. GV was responsible for the designing of the work, analysis of data and drafting the work. He was involved in revising it critically and the final approval of the version to be published. IA contributed to the acquisition, analysis of data/references and drafting the work and tables. He was involved in revising it critically and the final approval of the version to be published. MM was involved in revising the work critically for important intellectual content and the final approval of the version to be published, also providing feedback on the content. SJ was involved in revising the work critically for important intellectual content and the final approval of the version to be published, also providing feedback on the content.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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