ARCHIVES OF THE MEDICINE AND CASE REPORTS
hmpublisher.com/index.php/amcr · Vol. 7 No. 4 (2026) · pp.350-369
e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

CASE REPORT

Green-Laser-Flanged Intrascleral Fixation of a Secondary Intraocular Lens in Aphakia with Reduced Endothelial Reserve: Rapid Visual Rehabilitation, a +1.00 Dioptre Prediction Error, and a Minimum Reporting Data Set

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ARTICLE INFO

Article history
Received: June 30, 2026
Revised: July 30, 2026
Accepted: August 20, 2026
Available Online: August 29, 2026
Published: August 31, 2026
Keywords
Aphakia; Corneal endothelial cell ; Intrascleral haptic fixation; Refractive prediction error; Yamane technique
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DOI
https://doi.org/10.37275/amcr.v7i4.929

ABSTRACT

Background: Aphakia without capsular support is decided largely by the state of the corneal endothelium.
Objective: To present the result with a structured audit of the record and a numbered minimum data set for reporting laser-flanged intrascleral fixation.
Methods: A 60-year-old man was referred twelve months after left phacoemulsification complicated by posterior capsule rupture, with no lens implanted. Best-corrected acuity with a +10.00 D aphakic spectacle was 20/200 (1.00 logMAR), uncorrected acuity was counting fingers at one metre, intraocular pressure was 15 mmHg, vitreous was present in the anterior chamber, and endothelial cell density was about 1200 cells/mm^2. Pars plana vitrectomy was combined with double-needle intrascleral fixation of a three-piece polyvinylidene-fluoride-haptic lens through 27-gauge tunnels 2.0 mm behind the limbus; the haptics were flanged with a 532 nm green laser, and surgery took 30 minutes.
Results: Uncorrected acuity was 20/60 on day one, 20/40 at one week and 20/30 at one month, when best-corrected acuity reached 20/20 with +0.75 -0.50 and anterior segment tomography showed an optic tilt of about 2°; the result was stable at three months.
Conclusion: A full logarithmic unit of best-corrected acuity was recovered, yet the achieved spherical equivalent of +0.50 D against a -0.50 D target represents a +1.00 D hyperopic prediction error, and no post-operative endothelial measurement, biometric input or laser parameter was recorded.

All authors have reviewed and approved the final version of the manuscript.

1. Introduction

Cataract surgery is among the most reliably successful operations in medicine, and precisely because it is, its residual failures are concentrated in a small number of eyes that then require disproportionate effort to rehabilitate. Posterior capsule rupture is the pivotal intraoperative event. In a consecutive series of 25,224 phacoemulsification procedures performed at a single tertiary centre between 2017 and 2022, posterior capsule rupture occurred in 351 eyes, reported as an overall rate of 1.3% (351/25,224 recomputes to 1.4%), and the eyes in which it occurred still reached a mean best-corrected acuity of 0.51 ± 0.56 logMAR at one year from a pre-operative 1.31 ± 0.84 logMAR, but with corneal oedema in 195 of those 351 eyes (55.6%) and raised intraocular pressure in 117 (33.3%) early after surgery.[1] Where in the operation the capsule gives way determines what can be salvaged. Among 1,042 complicated cataract operations at Moorfields Eye Hospital, rupture occurred during phacoemulsification in 621 eyes (60%), during irrigation-aspiration in 248 (24%), during lens implantation in 87 (8%), during viscoelastic removal in 44 (4%), during hydrodissection in 40 (3.8%) and during wound hydration in 2 (0.2%); a sulcus lens was placed in 624 eyes (60%), an in-the-bag lens in 117 (11%), sulcus optic capture in 190 (18.2%) and an anterior chamber lens in 24 (2%), while 87 eyes (8%) were left aphakic.[2] That final 8% is the population to which the present case belongs, and it is a population defined not by disease but by the point at which a surgical plan was abandoned.

An eye left aphakic without capsular support cannot simply be given a lens. Four routes exist, and each trades a different structure for optical rehabilitation. An angle-supported anterior chamber lens is quick and forgiving of iris and scleral anatomy, and it works: in 193 eyes receiving an open-loop four-point-fixated lens, corrected distance acuity improved from 1.73 ± 0.11 to 0.42 ± 0.05 logMAR in the 104 eyes without pre-existing risk factors and from 1.53 ± 0.14 to 0.49 ± 0.10 logMAR in the 49 with them (both $P < 0.001$), with a mean spherical equivalent at last refraction of -0.37 ± 0.18 D in the 153 eyes implanted primarily.[3] The cost falls on the cornea. In a cohort of 65 eyes that lost capsular and sulcus support during routine cataract surgery, pseudophakic bullous keratopathy developed in 10 of 33 eyes (30.3%) given an anterior chamber lens against 1 of 32 eyes (3.1%) given four-flanged scleral fixation ($P = 0.04$), and a glaucoma filtering procedure was required in 4 of 33 anterior chamber eyes (12.1%) against none in the flange group ($P = 0.042$).[4] A retropupillary iris-claw lens avoids the angle but requires healthy iris tissue and a wide incision; a sutured scleral-fixated lens avoids both the angle and the iris but introduces a suture whose knots erode, whose strands break and whose passage lengthens the operation. Sutureless intrascleral fixation avoids all three, and it is for that reason that the flanged double-needle technique has, in the words of one multicentre group, "rapidly expanded worldwide because the technique is more convenient than conventional suture IOL transscleral fixation".[5] The displacement is documented rather than asserted: among 3,597 patients in a nationwide database, anterior chamber lens use fell from 93% to 36% of secondary lens cases between 2015

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

and 2021 while scleral-fixated use rose from 3% to 34% and scleral-sutured use from 4% to 30% (all P < 0.0001), with acuity gains larger for the two scleral techniques (48.7 to 57.6 and 51.5 to 61.2 Early Treatment Diabetic Retinopathy Study letters) than for the anterior chamber lens (44.1 to 49.2 letters).[6]

The flanged double-needle technique described by Yamane and colleagues externalises each haptic of a three-piece lens through a thin-walled needle passed obliquely into the sclera and melts the haptic tip into a bulb that anchors within the scleral tunnel. Its measured advantages are now substantial. A systematic review and meta-analysis of 51 studies of sutureless intrascleral fixation found the flanged approach had a median operative time of 17.1 minutes against 42.7 minutes for the scleral tunnel technique and 56.5 minutes for the glued technique, and a significantly better post-operative best-corrected acuity than either (P = 0.017).[7] In a retrospective comparison of 31 eyes with double-flanged fixation against 34 eyes with conventional sutured fixation, the flange group achieved better uncorrected acuity at six months (0.251 ± 0.328 against 0.418 ± 0.339 logMAR, P = 0.041), a smaller myopic shift (-0.74 ± 0.93 against -1.33 ± 1.15 D, P = 0.007), no iris capture against 10 of 34 eyes (29.4%, P < 0.001) and no decentration against 8 of 34 eyes (23.5%, P = 0.005).[8] In a prospective multicentre study of 234 eyes receiving a single-piece lens designed for sutureless intrascleral fixation, best-corrected acuity improved from 0.74 ± 0.30 to 0.26 ± 0.24 logMAR at 24 months, a prediction error within ±1.00 D was achieved in 77% of eyes, endothelial cell density was preserved (P = 0.895) and no lens dislocation or endophthalmitis occurred.[9]

Those figures are not the whole account. The same meta-analysis attributed to the flanged technique the highest rates of temporarily elevated intraocular pressure (9.9%), iris capture (5.4%), haptic exposure (6.5%) and lens decentration (7.3%) among the three sutureless approaches compared.[7] A multicentre cohort study of 207 eyes followed for more than twelve weeks reported cystoid macular oedema at three months in 13.0% of eyes fixated by the flanged technique against 1.9% of eyes fixated by conventional transscleral suture, in 21 of 155 eyes against 1 of 52, an odds ratio of 7.99 (95% CI 1.05-60.97, P = 0.045) that rises to 10.79 (95% CI 1.34-86.95, P = 0.026) on adjustment; best-corrected acuity was also consistently worse in the flanged group, at a median 0.046 against 0.0 logMAR at three months.[5] Among 182 consecutive eyes undergoing flanged intrascleral fixation at one referral centre, 21 (11.5%) developed post-operative lens tilt, spontaneously in 20 of the 21, at a median of 10 days but with a range extending to 1,086 days, and half of the affected eyes required lens exchange.[10] Over a median follow-up of 3.3 years in 75 eyes, flange exposure beneath the conjunctiva occurred in 21 of 150 flanges (14.0%), with flange diameter identified as a risk factor (odds ratio 1.012, P = 0.023) and a larger white-to-white distance as protective (odds ratio 0.082, P = 0.017).[11] Reports of device malfunction have accumulated in parallel: a regulatory database search returned 178 confirmed malfunction reports for one widely used lens between 2013 and 2024, of which 94 concerned tilt and 53 concerned breakage, the latter comprising 31 haptic-optic disinsertions and 22 haptic breakages, and a single-surgeon series reported five structural failures at the optic-haptic junction.[12,13]

The refractive behaviour of the technique is equally unsettled, and in a direction that matters for any single case. In 116 eyes divided evenly between flanged intrascleral and retropupillary iris-claw fixation, the refractive prediction error was 0.69 ± 0.94 D for the flanged group against 0.21 ± 0.75 D for the iris-claw group (P = 0.03), both residually hyperopic, and only 18 of 58 flanged eyes (31%) fell within ±0.50 D against 30 of 58 iris-claw eyes (52%), a proportion for which the source reports no P value.[14] A prospective series of 28 eyes fixated by a four-flanged technique found a hyperopic prediction error with every formula tested, between 0.35 ± 0.86 D and 0.37 ± 0.73 D, with absolute error within 0.50 D in 54% to 61% of eyes.[15] Yet a retrospective cohort of 50 eyes fixated by the Yamane technique found the opposite, a myopic mean error of -0.43 to -0.31 D across seven formulas using published lens constants, abolished by reducing the optimised constant by a fixed 0.5.[16] Seventy-six eyes fixated with a polyvinylidene-fluoride-haptic lens and the SRK/T formula produced a mean prediction error of -0.20 ± 0.52 D.[17] The direction of the systematic error therefore depends on the lens, the constant and the surgeon rather than on the technique in the abstract, which means that individual cases carry information only when the biometric inputs behind them are recorded.

The flange itself, the one element that defines the technique, is the least standardised part of it. Laboratory work in cadaveric sclera has established that the force required to dislocate a flanged haptic correlates almost perfectly with the ratio of flange diameter to needle diameter (r = 0.975), that 1.0 mm may be the optimal melt length, and that for one polyvinylidene-fluoride-haptic three-piece lens, widening the tunnel from 30-gauge to 27-gauge reduced the dislocation force from 2.04 ± 0.24 N to 0.56 ± 0.36 N (P < 0.001).[18] Comparative tensiometry across four fixation strategies confirmed the flanged haptic as the strongest, exceeding glued, transscleral-tunnel and bent-haptic fixation by about 1.0 N in each case.[19] Flange geometry depends on the haptic material and the heated length rather than on cautery tip temperature: high-temperature (1205 °C) and low-temperature (593 °C) cautery produced flanges of indistinguishable size and shape on both polymethylmethacrylate and polyvinylidene fluoride haptics (P > 0.05), differing only in formation time (1.7 ± 0.6 s against 3.7 ± 0.6 s), and the polyvinylidene-fluoride-haptic lens model used in the present case formed a mushroom-shaped flange of 363 ± 14 µm on the bench from a haptic 126 ± 3 µm across.[20] A systematic study of seven 5-0 and 6-0 suture materials melted with a 392 °C cautery tip found that heating approximately 1 mm from the distal end gives the most controlled geometry, that five of the seven formed flanges reproducibly, and that polypropylene and polyvinylidene fluoride were the two with the most consistent thermoplastic behaviour and the shortest heating times.[21] Against that background, replacing cautery with a laser source is a substantive proposal rather than a cosmetic one: a 532 nm green laser has been used to create the flanges in a series of 33 patients undergoing four-flange scleral fixation of an intraocular lens, where mean best-corrected acuity improved from 0.7 to 0.21 logMAR with early complications in 15 of the 33 (45%),[22] and an 810 nm endoscopic diode laser has been used to remelt and reorient an optic-haptic junction to correct post-operative tilt without lens exchange.[23]

The novelty of the present report is threefold. First, it documents laser-formed flanges in a two-point double-needle intrascleral fixation performed for aphakia rather than in a four-flange suture-based construct, and it does so in an eye whose endothelial reserve was approximately half the mean density measured before routine cataract surgery in an unselected population and below the threshold at which a population study calls a cornea abnormal, which is precisely the circumstance in

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

which the choice between fixation strategies is not academic. Second, it quantifies the result in units that can be compared with the published series rather than described in adjectives, including a full logarithmic unit of best-corrected acuity recovered by one month and a +1.00 dioptre hyperopic prediction error that the record itself characterised as slight. Third, and in our view most usefully, it turns the analytical instrument on the record rather than on the disease: the operation was chosen to protect an endothelium that was never measured again, and the refractive miss cannot be attributed because the biometric inputs were never written down. The aim of this report is therefore to present the clinical course and technical detail of green-laser-flanged intrascleral fixation in an aphakic eye with reduced endothelial reserve, to interpret every recorded value against the recent primary literature, and to close with a numbered minimum data set specifying what must be measured, when, and for what reason, if reports of this modification are to become comparable with one another.

2. Methods

2.1. Case design and reporting framework

This retrospective single-case report describes the clinical presentation, surgical management, and three-month outcome of an adult with aphakia after posterior capsule rupture. The case was selected because green-laser flange formation and reduced endothelial reserve raised specific questions about reproducibility, corneal safety, refractive accuracy, and completeness of outcome reporting.

2.2. Case selection and patient information

The report concerns a de-identified 60-year-old man referred twelve months after complicated left-eye phacoemulsification in which no intraocular lens had been implanted. Relevant medical and ophthalmic history, baseline visual function, anterior- and posterior-segment findings, and available biometry were extracted from the clinical record.

2.3. Clinical assessment, diagnostic reasoning, and intervention

Clinical assessment included Snellen and logMAR visual acuity, refraction, intraocular pressure, slit-lamp examination, specular microscopy, retinal examination, macular optical coherence tomography, and available anterior-segment imaging. The therapeutic alternatives and rationale were evaluated against the patient's capsular support and endothelial reserve. The intervention comprised pars plana vitrectomy and double-needle intrascleral fixation of a three-piece polyvinylidene-fluoride-haptic lens with 532 nm green-laser flange formation.

2.4. Timeline, follow-up, and outcome assessment

Recorded outcomes were assessed at postoperative day 1, week 1, month 1, and month 3. The analysis included uncorrected and best-corrected visual acuity, refraction and refractive prediction error, intraocular pressure where available, anterior-chamber activity, lens position and tilt, corneal status, macular status, adverse events, and the patient-reported functional result. Missing measurements were retained as not recorded and were not imputed.

2.5. Ethics and consent

Clinical care followed the principles of the Declaration of Helsinki. Institutional review board approval was not required for retrospective reporting of a single de-identified case at the authors' institution. Written informed consent was obtained for the procedure, including off-label intrascleral fixation, and separately for publication of the case report and accompanying clinical photographs.

3. Results

3.1. Patient information and history

A 60-year-old man was referred to our clinic for management of aphakia of the left eye. Twelve months earlier he had undergone phacoemulsification in that eye, during which the posterior capsule ruptured; no intraocular lens could be safely implanted at that operation and the eye was left aphakic. He had been corrected since with a +10.00 dioptre aphakic spectacle lens. Despite this he complained of poor depth perception, image distortion and difficulty with everyday tasks, which he attributed to the disparity between the two eyes. The right eye had undergone uncomplicated cataract surgery with an in-the-bag lens and saw 20/20. There was no history of ocular trauma and no other ocular surgery in the left eye, and his general medical history was unremarkable. The demographic, refractive and ophthalmic findings at referral are detailed in Table 1, which also records, for each parameter, whether a value was documented at all.

Two features of that history deserve emphasis before the examination findings are described. The first is the interval. Twelve months of spectacle-corrected aphakia is not a neutral waiting period. A high-plus spectacle worn at a vertex distance magnifies the retinal image of that eye relative to the fellow pseudophakic eye, and the disparity is large enough that binocular single vision is not achievable, so the patient functions monocularly whichever eye he uses. The symptoms he reported - poor depth perception and image distortion - are the expected consequence of that optical mismatch rather than of any retinal pathology. Surgical correction is the standard response, and a 357-eye comparison of three techniques found anterior chamber, intrascleral haptic-fixated and suture-fixated lenses to deliver statistically indistinguishable spherical equivalent (P = 0.87), refractive cylinder (P = 0.91) and corrected distance acuity in eyes without significant comorbidity (P = 0.23).[24] The second is that the index event places him in a well-defined minority. Of 1,042 cataract operations complicated by posterior capsule rupture in one large series, 87 (8%) ended with the eye aphakic; the remaining 92% received a lens at the same sitting, most often in the sulcus.[2]

3.2. Examination at referral

Best-corrected visual acuity in the aphakic left eye was 20/200 with the aphakic spectacle correction, equivalent to 1.00 logMAR. Without correction the patient could count fingers at one metre only. That endpoint resists conversion: the published calibration against the Berkeley Rudimentary Vision Test gives a median of 2.00 logMAR for counting fingers, but for fingers presented at 30 cm, in the 16 patients of the general-pathology subgroup of a 38-patient low-vision study, and the same study reports a median of 2.10 logMAR in its central-field-defect subgroup with considerable overlap against hand-movement acuity.[25] Counting fingers at one metre is a better endpoint than counting fingers at 30 cm, so 2.00 logMAR is a conservative upper bound on this eye's pre-operative uncorrected acuity rather than an estimate of it, and we do not compute an uncorrected gain from it. Intraocular pressure was 15 mmHg. The pupil dilated well and the pupillary reflex was preserved. The cornea was clear on slit-lamp examination, and specular microscopy recorded an endothelial cell density of approximately 1200 cells/mm^2, which the referral record

attributed to the previous surgery. Slit-lamp examination confirmed the absence of a crystalline lens and a deep anterior chamber; the external appearance of the eye at that examination is illustrated in Figure 1, in which the widely dilated pupil is uninterrupted by any lens edge or capsular remnant across its full diameter.

Table 1. Demographic, refractive and ophthalmic findings at referral, twelve months after the complicated phacoemulsification. Values in bold red are outside the expected range; entries in grey italic were never documented and are shown so that the completeness of the record can be judged alongside its content. SD-OCT, spectral-domain optical coherence tomography; logMAR, logarithm of the minimum angle of resolution.

Parameter	Left eye (study eye)	Right eye	Reference or comment
Demographic and history			
Age, sex	60 years, male	-	-
Index event	Phacoemulsification complicated by posterior capsule rupture; no lens implanted	Uncomplicated phacoemulsification, in-the-bag lens	87 of 1,042 ruptures (8%) end aphakic[2]
Interval since index event	12 months	*Not recorded*	-
Optical correction in use	**+10.00 D aphakic spectacle**	*Not recorded*	Three surgical techniques gave indistinguishable spherical equivalent, cylinder and corrected acuity in eyes without significant comorbidity[24]
Systemic history	Unremarkable	-	-
Visual function			
Best-corrected visual acuity	**20/200 (1.00 logMAR)**	20/20 (0.00 logMAR)	-
Uncorrected visual acuity	**Counting fingers at 1 m (approx. 2.0 logMAR)**	*Not recorded*	Counting fingers calibrates to a median 2.00 logMAR[25]
Manifest refraction	**Aphakic**	*Not recorded*	-
Anterior segment			
Intraocular pressure	15 mmHg	*Not recorded*	Expected 10-21 mmHg
Cornea	Clear	Clear	-
Endothelial cell density	**approx. 1200 cells/mm²**	*Not recorded*	Mean 2530 ± 285 cells/mm² before routine phacoemulsification (223 eyes)[26]; below 2000 counted abnormal in 5,713 adults[27]
Endothelial morphology and pachymetry	*Not recorded*	*Not recorded*	Average cell size rose 24.3% at 2 years after scleral fixation in children with congenital ectopia lentis, against 2.7% in controls[28]
Anterior chamber	**Deep; vitreous present**	*Not recorded*	Indicates incomplete anterior vitrectomy at the index operation
Pupil	Dilates well; reflex preserved	*Not recorded*	-
Iris	**Peripheral iridectomy mentioned once; status not further recorded**	*Not recorded*	Intraoperative iridectomy abolished reverse pupillary block (0 of 54 vs 10 of 40)[29]
Lens and capsule	**Aphakic; fibrotic anterior capsular rim only**	In-the-bag intraocular lens	-
Capsular support	**Absent**	Present	-
Posterior segment			
Optic disc and macula	Healthy	*Not recorded*	-
Retina	No tear or detachment	*Not recorded*	-
Macular SD-OCT	Normal foveal contour; no oedema	*Not recorded*	-
Biometry			
Axial length	*Not recorded*	*Not recorded*	Prediction error correlates with axial length at -0.25 to -0.39 D/mm after four-flanged fixation[15]
Keratometry	*Not recorded*	*Not recorded*	Required to compute surgically induced astigmatism
Anterior chamber depth	*Not recorded*	*Not recorded*	Required by every modern formula; the post-operative depth is the strongest correlate of refractive error[30]
White-to-white distance	*Not recorded*	*Not recorded*	Protective against flange exposure[11]

The capsular bag was almost entirely absent apart from a fibrotic anterior capsular rim, so that no part of the periphery could be trusted to hold a sulcus lens. Vitreous was present in the anterior chamber, indicating that the anterior vitrectomy performed at the index operation had been incomplete. Fundoscopy of the left eye showed a healthy optic disc and

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

macula with no retinal tear or detachment, and pre-operative spectral-domain optical coherence tomography of the left macula showed a normal foveal contour without oedema or other pathology. As Table 1 shows, the parameters that were documented were almost all within the range expected for an eye of this history; the exception, and the finding on which the surgical decision turned, is the endothelial cell density, which the record described as within the normal range while simultaneously noting it as slightly reduced. Those two descriptions are not compatible with one another, and the interpretation of that value is taken up in the Discussion.

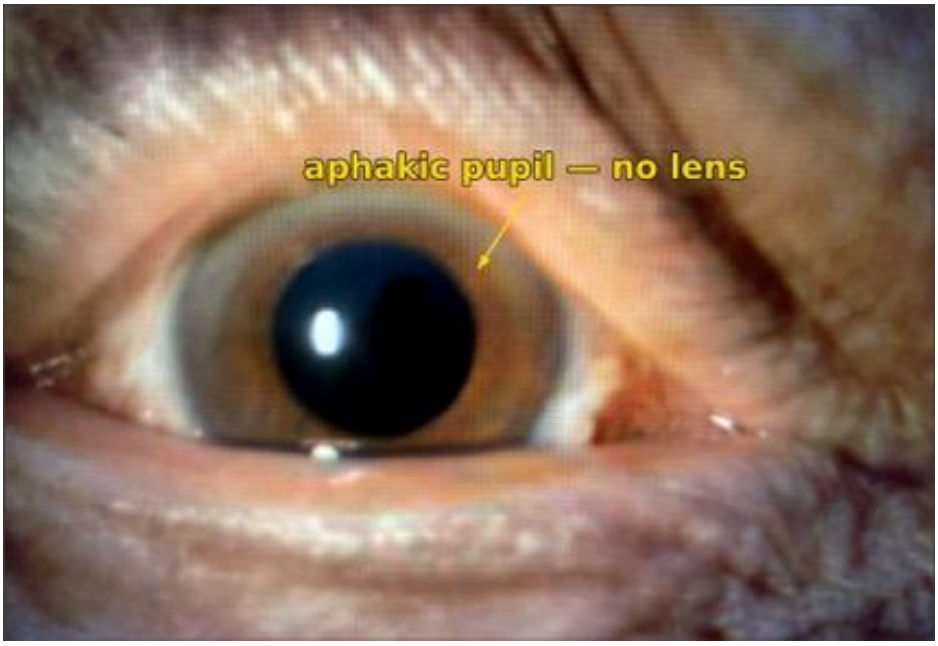

Figure 1. External photograph of the aphakic left eye at referral, twelve months after the complicated phacoemulsification. The pupil is widely dilated and the pupillary space is uninterrupted by any lens edge, capsular remnant or intraocular lens across its full diameter; the arrow marks the aphakic pupil. The caruncle at the viewer's left identifies the medial canthus and so confirms a left eye. The image is a frame captured from the examination video system, and the residual fine texture is the display raster of that system rather than a corneal or iris finding.

Table 1 also makes visible what was not measured. Axial length, keratometry, anterior chamber depth and white-to-white distance are absent from the referral record even though all four are standard components of biometry and all four are used by every modern lens power formula. Endothelial morphology beyond raw cell density - the coefficient of variation of cell size, the percentage of hexagonal cells and central corneal thickness - is likewise absent, and it is those parameters rather than density alone that indicate whether an endothelium is stressed. The consequences of these omissions are pursued systematically in Section 3.9.

3.3. Diagnostic reasoning and surgical decision

The lens-free pupillary space shown in Figure 1 left no doubt that no capsular or sulcus support remained, so a posterior chamber lens could only be placed by fixing it to a structure other than the capsule. An anterior chamber lens was considered and rejected on the grounds of the patient's expected remaining lifespan and the state of his endothelium. An iris-fixated lens was considered next; the wide corneal incision it requires and the presence of a peripheral iridectomy noted at examination made it less attractive. A sutureless scleral-fixated lens implanted by the double-needle flanged technique was therefore recommended on the grounds of anticipated centration, lower induced corneal astigmatism and freedom from suture-related late complications, and the patient consented to it. Consent was obtained separately for the procedure, including the off-label intrascleral fixation of a posterior chamber lens, and for publication of the case with assurances of anonymity.

3.4. Therapeutic intervention and operative technique

Surgery was performed under peribulbar block with sedation. Pars plana vitrectomy was performed first, clearing the vitreous that had prolapsed into the anterior chamber and creating an unobstructed path for the lens; an infusion cannula maintained pressure and chamber depth throughout. Two sclerotomy sites for haptic externalisation were marked 2.0 mm posterior to the limbus at the 3 and 9 o'clock meridians, exactly 180° apart. A three-piece foldable acrylic lens with polyvinylidene fluoride haptics was selected. Lens power was calculated with the Barrett Universal II formula, targeting mild myopia of about -0.50 dioptres to allow for any hyperopic shift arising from the intrascleral effective lens position. A 2.8 mm clear corneal incision was made superiorly at the 12 o'clock position for lens insertion. Every recorded operative parameter, including those that determine flange anchorage, is set out in Table 2.

Table 2. Operative record of the green-laser-flanged double-needle intrascleral fixation, with each recorded parameter placed beside the published evidence that gives it meaning. Entries in bold red mark parameters that materially affect anchorage or refractive outcome; entries in grey italic were not documented. N, newtons.

Domain	Parameter	Value as recorded	Comment
Anaesthesia and access	Anaesthesia	Peribulbar block with sedation	-
	Vitrectomy	Three-port pars plana vitrectomy	Three trocar cannulas visible in Figure 2; the narrative summary calls it a limited anterior vitrectomy (Section 3.10)
	Corneal incision	2.8 mm, superior (12 o'clock)	Narrative summary states 3 mm (Section 3.10)
Scleral tunnels	Meridians	3 and 9 o'clock, exactly 180° apart	Asymmetric fixation points cause decentration and tilt[31]
	Distance behind limbus	2.0 mm on both sides	-
	Needle gauge	**27-gauge thin-walled**	For one PVDF-haptic lens on the bench, dislocation force fell from 2.04 ± 0.24 N (30-gauge) to 0.56 ± 0.36 N (27-gauge)[18]
	Tunnel angle	approx. 10° tangential to the limbus	Nasal-temporal angle asymmetry predicts pupillary optic capture[32]
	Tunnel length	*Not recorded*	A 1.0 mm tunnel gives a longer effective lens position than a 2.0 mm tunnel[31]
Intraocular lens	Type	Three-piece foldable acrylic optic	-
	Haptic material	Polyvinylidene fluoride	One of the two suture materials with the most consistent thermoplastic behaviour on the bench[21]
	Power formula	Barrett Universal II	Mean surprise -0.20 D with this formula in 18 of 24 flanged eyes[33]
	Refractive target	-0.50 D spherical equivalent	Set to allow for a hyperopic shift
	Implanted power and A-constant	*Not recorded*	Lens constants must be refined for scleral fixation; without these fields this eye cannot contribute[16]
Flange formation	Energy source	**532 nm green laser**	Narrative summary states a diode laser (Section 3.10)
	Laser power	*Not recorded*	-
	Exposure duration	*Not recorded*	Formation time differed 1.7 ± 0.6 s vs 3.7 ± 0.6 s between cautery temperatures[20]
	Spot size	*Not recorded*	-
	Melt length	*Not recorded*	A melt length of about 1.0 mm is optimal[18,21]
	Flange diameter	**0.3 to 0.5 mm (intraoperative estimate)**	Bench value 363 ± 14 µm for this haptic material[20]
	Flange burial	Pushed into the scleral tunnel; not externally visible	A scleral pocket gives a significantly deeper flange to 12 months[34]
Closure and duration	Corneal wound	Hydrated; no suture	-
	Sclerotomy wounds	8-0 polyglycolic acid suture	-
	Peripheral iridectomy	*Not recorded whether performed*	Reverse pupillary block 0 of 54 with iridectomy vs 10 of 40 without[29]
	Total operative time	30 minutes	Yamane 25.1 ± 9.9 min in a randomised trial[35]; pooled flanged median 17.1 min[7]
	Post-operative topical regimen	Levofloxacin 5 mg/mL and prednisolone acetate 1% four times daily	*Taper and duration not recorded*
	Intraoperative complications	None	-

Two thin-walled 27-gauge needles were then passed transconjunctivally into the eye, one at each marked site, angled approximately 10° tangential to the limbus, with the tips entering the vitreous cavity about 2 mm behind the limbus on each side. The lens was injected slowly through the corneal incision into the anterior chamber. The leading haptic was grasped with micro-forceps and threaded into the lumen of the first, temporal needle, which was then withdrawn to externalise it through the sclera; the trailing haptic was guided into the second, nasal needle and externalised in the same way. This docking step is shown in Figure 2A, in which the needle tip and the haptic held in its lumen are both visible against the pars plana; externalisation is the step that follows, and panel B presupposes it.

Each externalised haptic tip was then cauterised with a 532 nm green laser to form a bulbous flange of approximately 0.3 to 0.5 mm in diameter, with care taken to keep the flanges small and smooth. The laser application is illustrated in Figure 2B, where the green spot is seen at the haptic tip at the sclerotomy site. The flanged haptic ends were then pushed gently back into the scleral tunnels created by the needles so that each flange lodged just inside the sclera and secured the lens; Figure 2C shows the resulting position, with the optic centred in the posterior chamber behind the iris. The corneal wound was hydrated and each sclerotomy was closed with an 8-0 polyglycolic acid suture. Total operative time was 30 minutes. There was no intraoperative bleeding, hypotony or lens damage.

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

Figure 2. Intraoperative sequence of the green-laser-flanged double-needle intrascleral fixation. (A) The leading haptic is docked into the lumen of a thin-walled 27-gauge needle passed 2.0 mm behind the limbus and angled approximately 10° tangentially; the needle shaft and the intraocular haptic are arrowed. (B) The externalised haptic tip is melted with the 532 nm green laser to form the flange; the arrow marks the laser spot at the sclerotomy. (C) The completed fixation, with the optic centred in the posterior chamber behind the iris. The trocar cannulas of the three-port pars plana vitrectomy are visible in all three panels, and it is on that basis that the vitrectomy is described in Table 2 as three-port rather than limited and anterior.

Table 2 records both of the parameters that the biomechanical literature identifies as the determinants of anchoring force, namely the calibre of the tunnel and the diameter of the flange, and it records the wavelength of the laser used to form the flange. It also records, as blank fields, the laser power, exposure duration, spot size and melt length, none of which was documented. Those blanks are not incidental: they are the parameters that would allow another surgeon to reproduce the modification, and their significance is developed in Section 3.5 and audited in Section 3.9.

3.5. Clinical course, follow-up, and outcomes

Immediately after surgery the lens was well centred in the posterior chamber. On the first post-operative day uncorrected acuity in the left eye was 20/60, that is 0.48 logMAR, improved from a pre-operative counting-fingers level of approximately 2.0 logMAR; the cornea was clear apart from mild stromal oedema adjacent to the wound and intraocular pressure was 18 mmHg. Topical levofloxacin 5 mg/mL and prednisolone acetate 1% were begun four times daily. The full sequence of measurements from referral to the final visit is detailed in Table 3, which gives every acuity in both Snellen and logMAR notation so that the trajectory can be read on a linear scale.

Table 3. Serial measurements from referral to the final recorded visit. Every acuity is given in both Snellen and logMAR notation so that the trajectory can be read on a linear scale. Values in bold red are outside the expected range or represent the derived prediction error; entries in grey italic were not documented at that visit. AC, anterior chamber; AS-OCT, anterior segment optical coherence tomography; BCVA, best-corrected visual acuity; SE, spherical equivalent; UCVA, uncorrected visual acuity.

Visit	UCVA (logMAR)‡	BCVA (logMAR)†	Manifest refraction	IOP (mmHg)	AC cells	Lens position and other findings
Referral	**CF 1 m (approx. 2.0)***	**20/200 (1.00)**	**Aphakic, +10.00 D spectacle**	15	-	Deep chamber, vitreous present, no capsular support, macula normal on SD-OCT
Day 1	20/60 (0.48)	*Not recorded*	*Not recorded*	18	*Not recorded*	Optic well centred; mild stromal oedema adjacent to the wound
Week 1	20/40 (0.30)	*Not recorded*	*Not recorded*	*Not recorded*	1+	Flanges buried and not externally visible; no conjunctival erosion; keratometric astigmatism 0.75 D
Month 1	20/30 (0.18)	20/20 (0.00)	**+0.75 -0.50 (SE +0.50)§**	*Not recorded*	Nil	Optic centred, tilt approx. 2° on AS-OCT, haptics buried; macular OCT free of oedema
Month 3	*Not recorded*	20/20 (0.00)	*Not recorded*	*Not recorded*	*Not recorded*	Lens securely in place; no late complication recorded; observation ended

** Counting fingers at one metre is shown unconverted. The published Berkeley Rudimentary Vision Test calibration gives a median of 2.00 logMAR for counting fingers presented at 30 cm in the general-pathology subgroup (16 patients) of a 38-patient study; counting fingers at one metre is a better endpoint, so 2.00 logMAR is an upper bound rather than an estimate.[25]*

† Best-corrected acuity gain from referral to month 1 = 1.00 logMAR, approximately 50 Early Treatment Diabetic Retinopathy Study letters.

‡ Uncorrected acuity on day 1 (0.48 logMAR) exceeded the pre-operative best-corrected acuity (1.00 logMAR) by 0.52 logMAR. Of the further 0.30 logMAR gained between day 1 and month 1, 0.18 (60%) was gained in the first week. No uncorrected gain is computed from the counting-fingers endpoint.

§ Refractive prediction error = achieved spherical equivalent (+0.50 D) minus target (-0.50 D) = +1.00 D in the hyperopic direction.

By one week uncorrected acuity had improved to 20/40 (0.30 logMAR) and the patient reported markedly better functional vision, performing daily activities without the aphakic spectacle. Slit-lamp examination at that visit showed the lens still centrally positioned behind the iris, the flanges buried and not visible externally, and no conjunctival erosion or inflammation at the haptic exit sites. The corneal incision was well apposed and keratometry showed 0.75 D of corneal astigmatism, recorded as similar to the pre-operative value. There were 1+ cells in the anterior chamber, indicating mild residual inflammation, which settled on continued topical steroid. The fundus examination was unchanged.

At one month uncorrected acuity was 20/30 (0.18 logMAR) and, with a manifest refraction of +0.75 sphere and -0.50 cylinder, best-corrected acuity was 20/20 (0.00 logMAR). Anterior segment optical coherence tomography confirmed that the optic was centred with a tilt of approximately 2° and that each haptic was buried within the scleral wall. Macular optical coherence tomography at that visit showed no cystoid macular oedema. The lens appeared well centred on slit-lamp and iris transillumination testing with no clinically obvious tilt, and the

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

patient reported no glare or haloes. The external appearance of the eye at follow-up is illustrated in Figure 3: the cornea is clear, the pupil round and central, the iris architecture intact, and the conjunctiva over both horizontal meridians is unbroken.

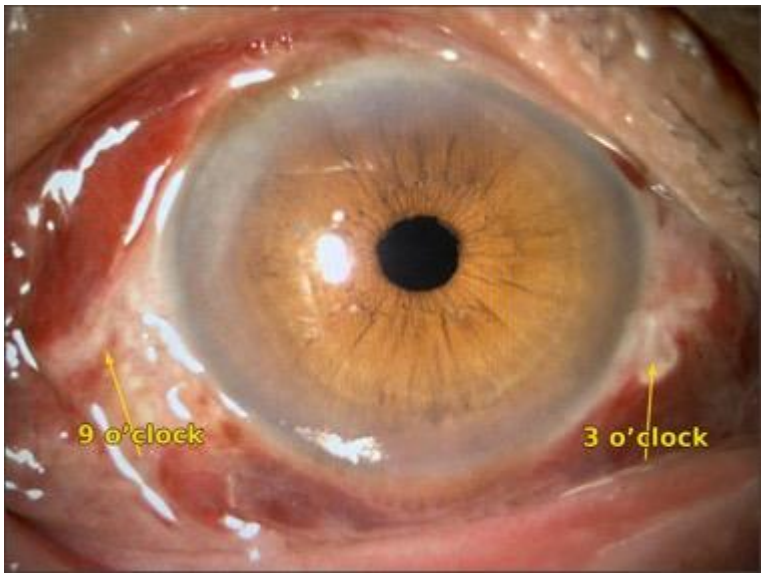

Figure 3. Slit-lamp photograph of the left eye at follow-up. The cornea is clear, the pupil round and central and the iris architecture intact. The arrows mark the 3 and 9 o'clock meridians at which the haptics were externalised 2.0 mm behind the limbus; the conjunctiva over both is unbroken and the buried flanges are not externally visible. Laterality in this panel is taken from the operative record, because the field is cropped within the palpebral aperture and no canthal landmark is available to confirm it independently.

By three months the situation was unchanged: best-corrected acuity remained 20/20, the lens was securely in place, and no late complication had appeared. The patient was satisfied with the result, reporting that the quality of vision in the left eye was close to that of the right and that he had resumed driving and work within days of surgery. The complete fifteen-month course, from the complicated phacoemulsification through to the final recorded visit, is illustrated in Figure 4 as a vertical timeline in which each event is annotated with the measurement that defines it.

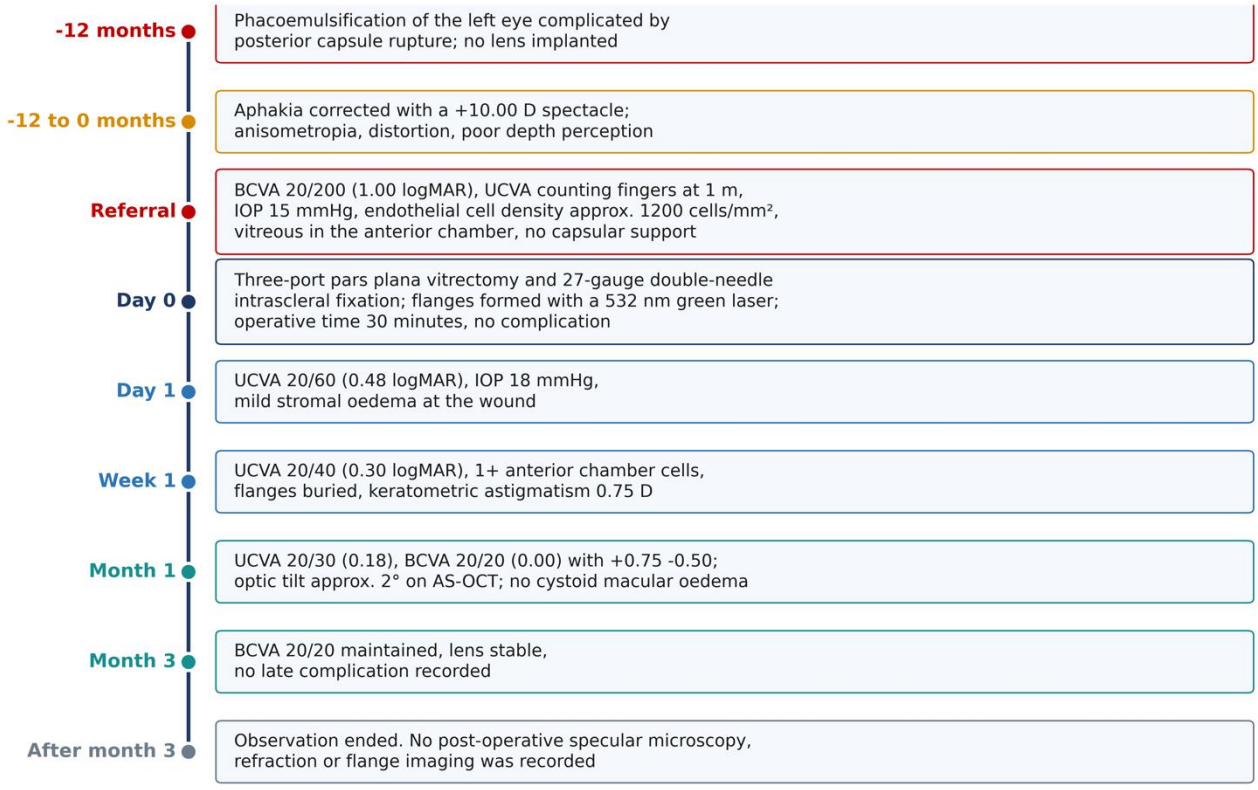

Figure 4. Vertical timeline of the fifteen-month episode, from the phacoemulsification complicated by posterior capsule rupture to the final recorded visit, with each event annotated by the measurement that defines it. Twelve of the fifteen months were spent aphakic and spectacle-corrected at 20/200; the entire functional gain occurred within four weeks of surgery; and observation ended three months after it. AS-OCT, anterior segment optical coherence tomography; BCVA, best-corrected visual acuity; IOP, intraocular pressure; UCVA, uncorrected visual acuity.

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

Figure 4 makes the shape of the episode explicit. Twelve of the fifteen months were spent aphakic and spectacle-corrected at 20/200; the entire functional gain occurred within the four weeks after surgery; and only two further months of observation followed it, the final visit falling three months after surgery, which is short by comparison with the intervals at which the characteristic late complications of this technique appear. Figure 5 presents the same course quantitatively. Panel A plots uncorrected and best-corrected acuity in logMAR against time, with the equivalent Snellen fractions on the right-hand axis, and marks the three visits at which one of the two acuities was not recorded. Panel B places the single recorded endothelial cell density against published reference values and against the magnitude of endothelial loss reported after comparable procedures, and leaves the post-operative bar undrawn because that measurement was never made.

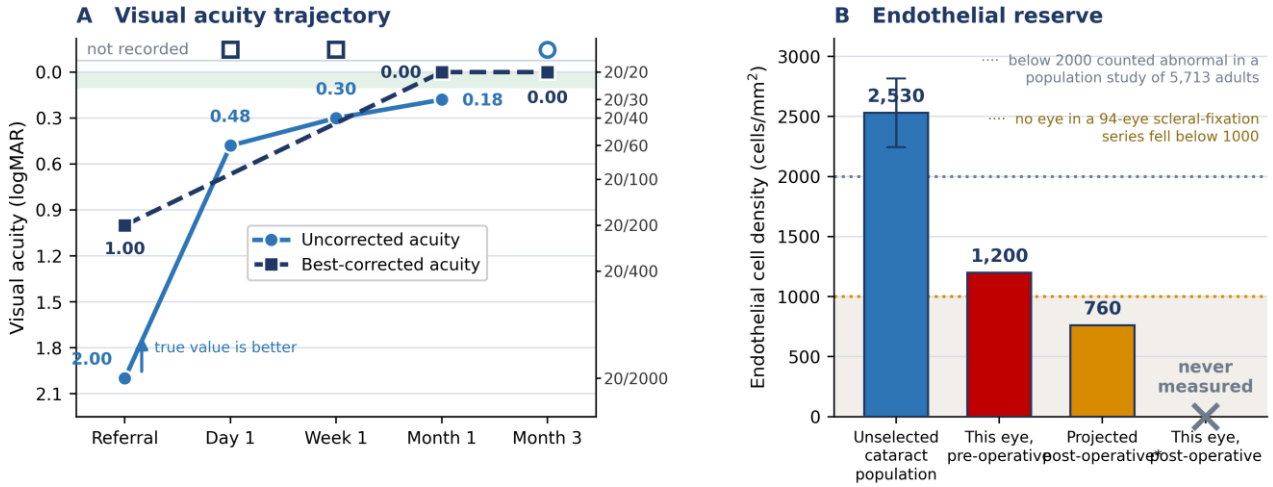

Figure 5. Quantitative summary of the course. (A) Uncorrected and best-corrected visual acuity in logMAR against time, with Snellen equivalents on the right-hand axis. Open symbols in the lane above the data range mark the three visits at which one of the two acuities was not recorded, and the shaded strip marks 0.00 to 0.10 logMAR. Counting fingers at one metre is plotted at 2.00 logMAR, which is the published calibration for counting fingers presented at 30 cm rather than at one metre. The upward arrow marks the direction of better acuity on this inverted axis: the true value for this eye lies above the plotted point, so 2.00 logMAR is an upper bound on the pre-operative logMAR value and the plotted position overstates rather than understates the deficit. No uncorrected gain is computed from it. (B) The single recorded endothelial cell density in this eye set against the mean recorded before routine phacoemulsification in 223 eyes (bar with standard deviation), the two published reference lines, and an illustrative projection (*) obtained by subtracting from this eye's baseline the mean absolute endothelial loss of 439.5 cells/mm² reported after trocar-assisted sutureless scleral fixation in twelve patients. No bar is drawn for the post-operative value because no post-operative specular microscopy was performed. The comparison bar is the pre-operative mean of an unselected cataract population and not an age-stratified normal; the projection illustrates a magnitude and is not a prediction for this eye.

Read together, Figure 5A and Table 3 establish the quantitative claim of this report, and they do so without relying on any conversion of the counting-fingers endpoint. Best-corrected acuity moved from 1.00 to 0.00 logMAR, a gain of one full logarithmic unit or approximately 50 Early Treatment Diabetic Retinopathy Study letters. On the first post-operative day the eye's uncorrected acuity of 0.48 logMAR already exceeded its pre-operative best-corrected acuity of 1.00 logMAR by 0.52 logarithmic units. Of the further 0.30 logMAR of uncorrected improvement recorded between day 1 and month 1, 0.18 - that is 60% - occurred within the first week. Figure 5B shows the counterpart of that success: the pre-operative endothelial cell density sits below the 2000 cells/mm² threshold used to define an abnormal value in population studies and only 200 cells/mm² above the level below which no eye in a 94-eye scleral-fixation series fell, and no bar is drawn for the post-operative value because no post-operative specular microscopy was performed.

4. Discussion

4.1. The result, expressed in comparable units

The claim this case makes is a claim about speed, and speed can only be assessed against series that reported the same quantity. Best-corrected acuity moved from 1.00 to 0.00 logMAR within one month and held at three months, and uncorrected acuity reached 0.48 logMAR on the first post-operative day, 0.30 by one week and 0.18 by one month, as detailed in Table 3 and plotted in Figure 5A. Set beside published cohorts, the endpoint is at the favourable extreme. In 234 eyes followed prospectively for two years after sutureless intrascleral fixation, mean best-corrected acuity was 0.26 ± 0.24 logMAR at 24 months, having started at 0.74 ± 0.30 logMAR.[9] In 250 eyes of 246 patients in a retrospective series of sutureless glueless intrascleral fixation of a three-piece lens, mean best-corrected acuity improved from 0.74 ± 0.6 to 0.48 ± 0.36 logMAR.[36] In 45 aphakic patients in eastern India, mean best-corrected acuity improved from 1.73 ± 0.24 to 0.87 ± 0.27 logMAR at six months, with 41 of 45 (91.1%) improving.[37] In 16 eyes fixated transconjunctivally by the double-needle technique, mean best-corrected acuity improved from 0.70 to 0.40 logMAR and uncorrected acuity from 1.50 to 0.60 logMAR.[38] Against those means, an eye reaching 0.00 logMAR is an outlier in the favourable direction. Only a much younger cohort approaches it: 40 eyes of 33 patients with Marfan syndrome and ectopia lentis, the patients' mean age 30.79 years, improved from 0.80 ± 0.32 to 0.18 ± 0.10 logMAR over a mean 23.9 months, although 12.5% of those eyes went on to lens decentration and 5% to retinal detachment.[39] In a consecutive single-surgeon series of 87 eyes of 85 patients followed for a median of 26.5 months after Yamane fixation, median best-corrected acuity improved from 0.2 ± 0.2 to 0.9 ±

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

0.2 in decimal notation (P < 0.001), and the independent predictors of a lower final acuity were older age (B = -0.005, P = 0.027), macular oedema (B = -0.242, P = 0.035) and prior silicone oil removal (B = -0.237, P = 0.046) rather than the surgical indication.[40] The reason this eye did as well is not obscure: unlike most eyes in those series, this one had a healthy macula, a healthy optic nerve, a clear cornea and no comorbidity, so the ceiling on its recovery was set by optics alone.

The tempo is more informative than the endpoint, and it is also the quantity the published series least often report. Of the cohorts cited here only two sampled acuity before the first month at all. A three-way comparison of 58 eyes measured acuity at day 1, week 1 and months 1, 3 and 6 but plots the time course rather than publishing the early means.[41] A 207-patient series does publish them: at day 1 the best-corrected acuity was 0.77 ± 0.909 logMAR in the 27 eyes given an anterior chamber lens, 1.05 ± 0.976 in the 62 given a retropupillary iris-claw lens and 1.12 ± 0.75 in the 34 given transscleral suture fixation.[42] The present eye's *uncorrected* acuity on the first post-operative day, 0.48 logMAR, was better than all three of those best-corrected means, and it already exceeded its own pre-operative best-corrected acuity. Table 3 makes the mechanism visible, and also its limits. Intraocular pressure was 15 mmHg before surgery and 18 mmHg on the first post-operative day and was not recorded at any later visit, so it can be said to have been normal when measured but not that it never rose; the cornea showed only mild stromal oedema adjacent to a 2.8 mm wound; anterior chamber inflammation never exceeded 1+ at the two visits at which it was graded; and the optic was centred from the first examination. There was, in other words, no obstacle to clear the earlier gain.

4.2. Why recovery was quick: incision, operative time and immediate stability

Three properties of the operation plausibly account for the tempo, and each can be checked against the record. The first is the size of the wound. A 2.8 mm clear corneal incision, sufficient to inject a foldable lens, is about half the 5.5 mm corneal incision used for a retropupillary iris-claw lens in the largest comparative series cited here, and is unlikely to distort the corneal surface materially. In 271 eyes divided between sutureless scleral-fixated and iris-claw fixation, the surgically induced astigmatism at six months was 0.3 (1.8) dioptres for the scleral group against 0.8 (2.1) dioptres for the iris-claw group (P = 0.01), with a mean refractive error of 0.1 (1.2) against 0.5 (1.6) dioptres (P < 0.001).[43] The present record reports 0.75 dioptres of keratometric astigmatism at one week and describes it as similar to the pre-operative value; that is a statement about total corneal astigmatism, not about vector-computed surgically induced astigmatism, and the two are not interchangeable, a point returned to in Section 3.9.

The second is operative time. Total surgical time was 30 minutes, including the vitrectomy. In a meta-analysis of 51 studies the flanged technique had a median operative time of 17.1 minutes against 42.7 minutes for the scleral tunnel technique and 56.5 minutes for the glued technique.[7] In a randomised comparison of 25 eyes fixated by the Yamane technique against 25 by four-point scleral fixation, operative times were 25.1 ± 9.9 and 24.1 ± 8.9 minutes respectively (P > 0.05).[35] A comparison of three fixation techniques in 77 consecutive eyes found the trocar-cannula-based sutureless group to have the shortest operative time and the ab externo sutured group the longest (P < 0.001).[44] Thirty minutes therefore sits within one standard deviation of the randomised Yamane figure and above the pooled flanged median, which is what would be expected when a full pars plana vitrectomy is performed in the same sitting. It is a competitive, not an exceptional, time, and describing it as such is more useful to a reader than describing it as short.

The third, and the one this case documents unusually well, is immediate positional stability. Anterior segment optical coherence tomography at one month recorded an optic tilt of approximately 2°. That figure is at the low end of everything reported for this technique. Twelve eyes fixated by a modified Yamane technique showed a mean tilt of 2.31 ± 0.93° and mean decentration of 0.20 ± 0.13 mm.[45] Twenty eyes fixated with extraocular docking of the trailing haptic showed a mean tilt of 5.57 ± 3.35° and decentration of 0.50 ± 0.26 mm.[46] Forty-four eyes fixated without trimmed haptics by two surgeons showed tilts of 6.33 ± 3.8 and 5.51 ± 3.17°.[47] Twenty-four eyes fixated by the Yamane technique in a randomised comparison showed a tilt of 7.67 ± 3.70° and decentration of 0.57 ± 0.37 mm, against 6.45 ± 2.03° and 0.38 ± 0.21 mm for the Carlevale technique.[48] Thirty-five eyes fixated by a modified suture technique showed a mean tilt of 2.91 ± 2.21°.[49] A tilt of 2° therefore compares with the best of these, and it is consistent with the operative record, which documents both sclerotomies 2.0 mm behind the limbus, exactly 180° apart, at the horizontal meridians. A model-eye study showed precisely why that matters: unequal scleral tunnel lengths displace the optic away from the side of the shorter tunnel and tilt it perpendicular to the fixation axis (P < 0.001 and P < 0.05), and fixation points that are not exactly 180° apart produce both decentration and tilt (P < 0.01 and P < 0.05).[31] Symmetry, in this operation, is the whole of stability.

4.3. The endothelium: the indication that was never measured again

The reason a scleral-fixated lens was chosen over an anterior chamber or iris-fixated lens was the state of the corneal endothelium. It is therefore worth establishing what that state actually was. The record gives a single figure, approximately 1200 cells/mm², and describes it in the same sentence as being within the normal range and as slightly reduced. Only one of those can be true. In 223 eyes undergoing routine phacoemulsification the mean pre-operative central endothelial cell density was 2530.03 ± 285.42 cells/mm², falling to 2364.22 ± 386.98 at twelve months (186 eyes), 2292.32 ± 319.72 at twenty-four months (139 eyes) and 2242.85 ± 363.65 at thirty-six months (107 eyes), with age, pre-operative density and ultrasound time the independent predictors of the loss at twelve months.[26] In 75 phakic subjects with normal corneas stratified prospectively into three 20-year age bands of 25 each, central endothelial cell density fell by 83 cells/mm² per decade of age (P = 0.008).[50] In a population-based cross-sectional study of 5,713 Japanese adults, an endothelial cell density below 2000 cells/mm² was used as the threshold defining an abnormal value.[27] A continuous association points the same way without proposing a cut-off: among 410 Japanese cataract patients graded by specular microscopy, corneal guttae were present in 23.2%, and each additional 100 cells/mm² of endothelial cell density lowered the odds of guttae by about a sixth (odds ratio 0.84, 95% CI 0.74-0.94, P = 0.003), with the coefficient of variation of cell size and the percentage of hexagonal cells both tracking guttae severity (all P < 0.001). That study validates no threshold; it shows that density, variation and hexagonality move together, which is why all three belong in a record.[51] Measured against any of these, 1200 cells/mm² is not within the

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

normal range. It is approximately half the mean pre-operative density of an unselected cataract population and well below the threshold at which a population study calls a cornea abnormal. Figure 5B places the measured value against these reference figures so that the gap can be seen rather than argued about.

The cornea itself looked well throughout: Figure 1 records a clear cornea at referral and Figure 3 records one at follow-up, which is exactly why a cell count matters, since a cornea with 1200 cells/mm² looks no different from one with 2500 until it decompensates. The endothelial figures for all four fixation options are set out in Table 4. Correcting the descriptor is not pedantry, because the number determines how much reserve the operation was allowed to consume. The published losses after the relevant procedures are of the same order as the margin available here. In 94 eyes undergoing scleral fixation by a single surgeon, endothelial cell loss was 1.5% where the existing lens was re-fixated or a new lens placed in an aphakic eye (34 eyes), against 14.3% where the existing lens was removed and replaced (39 eyes, P < 0.001) and 15.4% where phacoemulsification was performed simultaneously (21 eyes, P = 0.005); no eye in that series fell below 1000 cells/mm².[52] That first subgroup is the one the present case belongs to, and 1.5% of 1200 cells/mm² is 18 cells/mm² - a trivial cost. But a smaller comparative series points the other way: among 27 patients, trocar-assisted sutureless scleral fixation in 12 produced an endothelial cell loss of 439.5 ± 89 cells/mm² against 164.4 ± 53 cells/mm² after iris-claw implantation in the other 15 (P = 0.013), although no patient in either group developed bullous keratopathy.[53] A loss of that magnitude from a baseline of 1200 would leave approximately 760 cells/mm². The prospective two-year multicentre series found endothelial cell density preserved after sutureless intrascleral fixation (P = 0.895),[9] while a two-year paediatric series found a 17.8% decline (95% CI -21.8 to -13.9) after scleral-fixated lens surgery against 3.1% in controls (P < 0.001), with axial length of 24 mm or more and a white-to-white distance below 12.2 mm associated with greater loss.[28] A third series adds a middle value: across 35 eyes repositioned by sutured or sutureless intrascleral fixation and followed at least twelve months, the mean change in endothelial cell density was -4.5%, with no significant difference between techniques.[54] A fourth measured all three options side by side in the same unit: at six months the endothelial cell density was 2,073 ± 691 cells/mm² after conventional scleral fixation, 2,014 ± 692 after retropupillary iris-claw implantation and 1,712 ± 891 after intrascleral fixation in 23, 23 and 12 eyes respectively, every group lower than before surgery.[41] Those three figures are not commensurable - the 1.5% is a 34-eye subgroup in which no lens was removed and no phacoemulsification performed, the 439.5 cells/mm² is a 12-patient scleral arm whose 164.4 cells/mm² comparator is the iris-claw arm rather than a scleral result, and the 17.8% is a paediatric congenital-ectopia-lentis cohort. The honest summary is therefore that the endothelial cost of this operation is not settled, that it ranges across the published series from negligible to substantial, and that the only way to know which applies to a given eye is to measure it.

No post-operative specular microscopy was performed. The operation was selected to protect the endothelium, and the endothelium is the one structure whose fate the record does not report. This is not a peculiarity of a single case. A retrospective cohort of 89 eyes followed for a mean of 34.49 ± 10.19 months after flanged scleral fixation reported loss of intraocular pressure control in 12 patients (13.5%) and pseudophakic bullous keratopathy requiring posterior lamellar keratoplasty in 3 (3.4%), and its authors stated explicitly that their findings should be interpreted cautiously given the absence of endothelial cell data.[55] A literature in which the largest long-term series and an individual case report share the same omission is a literature that cannot answer the question its own indication depends on. Figure 5B is drawn to make that omission conspicuous: no bar is drawn at the post-operative position, because the measurement does not exist.

Three further endothelial parameters are missing from Table 1 and are worth naming separately, because density alone is a poor guide to reserve. The coefficient of variation of cell size and the percentage of hexagonal cells describe whether the remaining cells are enlarging and losing their regular mosaic, which is what a stressed endothelium does before it fails; a two-year study of children after scleral-fixated lens surgery tracked average cell size alongside density and found it rose by 24.3% (17.1 to 31.6) in operated eyes against 2.7% (1.0 to 4.5) in controls (P < 0.001).[28] Central corneal thickness is the third. An eye with 1200 cells/mm², a normal coefficient of variation and a normal pachymetry is in a different position from an eye with 1200 cells/mm², marked polymegethism and a thickened stroma, and nothing in this record distinguishes the two.

4.4. A +1.00 dioptre prediction error, and where it did not come from

Lens power was calculated with the Barrett Universal II formula and the target was mild myopia of approximately -0.50 dioptres, chosen, as the operative record states, to allow for a hyperopic shift from the intrascleral effective lens position. The manifest refraction at one month was +0.75 sphere with -0.50 cylinder, a spherical equivalent of +0.50 dioptres. The prediction error, the achieved spherical equivalent minus the intended one, is therefore +1.00 dioptre in the hyperopic direction, as set out in Table 3. The record describes this as a slight hyperopic shift. It is not slight, and calling it slight removes the case from the evidence base rather than adding to it.

One dioptre is the accepted boundary of acceptable refractive accuracy, and the published series place it precisely. Among 234 eyes in a two-year prospective multicentre study of sutureless intrascleral fixation, a prediction error within ±1.00 dioptre was achieved in 77% of eyes.[9] Among 58 eyes fixated by the flanged technique, the refractive prediction error was 0.69 ± 0.94 dioptres and only 18 (31%) fell within ±0.50 dioptres, against 30 of 58 (52%) iris-claw eyes (P = 0.03).[14] Among 28 eyes fixated by a four-flanged technique, the prediction error was hyperopic with all three formulas tested (0.35 ± 0.86, 0.36 ± 0.78 and 0.37 ± 0.73 dioptres), with absolute error within 1.00 dioptre in 79% of eyes.[15] Among 53 eyes randomised between Yamane and Carlevale fixation, the absolute error fell within 0.50 dioptres in 45% to 71% and within 1.00 dioptre in 72% to 92% of eyes depending on formula and technique.[48] A prediction error of exactly +1.00 dioptre therefore sits at the outer edge of the band that roughly three-quarters to nine-tenths of eyes fall inside, and outside the band that only about half achieve.

The direction is as informative as the magnitude, because the literature does not agree on it. A retrospective cohort of 50 eyes fixated by the Yamane technique found a myopic mean error with all seven formulas tested when published lens constants were used, from -0.43 to -0.31 dioptres, eliminated only by reducing the optimised constant by a fixed 0.5.[16] Seventy-six eyes fixated with a polyvinylidene-fluoride-haptic lens using the SRK/T formula and the manufacturer's recommended A-constant of 119.0 gave a mean prediction error of -0.20 ± 0.52

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

dioptres and a mean absolute error of 0.44 ± 0.33 dioptres.[17] A three-way comparison in one unit split the difference by technique: the prediction error was -0.15 ± 0.77 dioptres after conventional scleral fixation but +0.56 ± 0.62 after retropupillary iris-claw implantation and +0.44 ± 1.00 after intrascleral fixation, the latter two hyperopic, with no difference between the three in absolute prediction error.[41] Twenty-four eyes of 23 patients fixated by the double-needle flanged technique gave a mean actual refraction 0.06 dioptres more myopic than predicted, with the Barrett Universal II formula specifically producing a mild myopic surprise of -0.20 dioptres in the 18 of those eyes for which that formula was computed.[33] That figure is directly comparable with the present case, because it is the same formula: where 18 eyes averaged -0.20 dioptres, this eye returned +1.00 dioptre. Whatever produced the discrepancy, it was not the formula behaving as it does on average.

Nor was it tilt. Tilt does shift refraction, but the relationship is steeply non-linear. In 72 eyes assessed with second-generation anterior segment optical coherence tomography, the degree of intraocular lens tilt correlated with refractive error (Spearman coefficient -0.32, P = 0.006), and only tilt above 10° was found to affect refraction materially, whereas post-operative anterior chamber depth correlated more powerfully than any other measured variable (coefficient 0.50, P < 0.001) and decentration, axial length and keratometry did not correlate significantly (coefficients -0.17, -0.08 and -0.06; P = 0.15, 0.49 and 0.64).[30] That study reported no coefficient for tilt restricted to angles below 10°, so the inference that 2° cannot carry a dioptre is an extrapolation from its threshold finding rather than a measured comparison. Note also that the same study found no significant association between axial length and refractive error, whereas a four-flanged series found prediction error correlated with axial length at -0.25 to -0.39 D/mm; the two are not in conflict, because one measures the residual error after fixation and the other the slope of the formula's error against eye length.[15] By elimination the error belongs to the effective lens position, which is exactly what the model-eye work predicts: a 1.0 mm scleral tunnel produced a significantly longer effective lens position than a 2.0 mm tunnel or suture fixation (P < 0.05 and P < 0.01 respectively).[31] Post-operative anterior chamber depth was not measured in this case, so the inference cannot be closed, and that is precisely the point: the one measurement that would have converted a refractive miss into a usable observation was not taken. In a series of 20 eyes of 12 children with a mean age of 8.8 years, the early hyperopic prediction error of +0.90 ± 1.31 dioptres at four weeks was followed by a mean myopic shift of -0.54 dioptres by six months, with the proportion within ±1.0 dioptre rising from 45% to 60%.[56] That drift is confounded in children by axial growth and cannot be transferred to a 60-year-old eye, but it raises the possibility that the present error would have moved; no refraction was recorded after the first month, so that too is unknowable.

The practical consequence is a lost opportunity rather than a harmed patient. The patient reached 20/20 with a low-power spectacle and was satisfied without it. But an individual case contributes to constant optimisation only if the axial length, keratometry, anterior chamber depth, white-to-white distance, implanted power, formula and A-constant are all recorded, and none of them is. Constant optimisation is not an abstraction: the study that found a uniform myopic bias across seven formulas was able to remove it by a single fixed adjustment precisely because it had those inputs for 50 eyes.[16] Without them this case can report that the miss occurred but cannot say why, and cannot be pooled with others.

4.5. What "laser-flanged" has to mean before it can be evaluated

Replacing cautery with a laser as the heat source for flange formation is the novel element of this operation, and it is a proposal that deserves to be tested rather than asserted. The published experience is small. A series of 33 patients undergoing four-flange scleral-fixated lens implantation with a 532 nm green laser used for flange formation reported mean best-corrected acuity improving from 0.7 to 0.21 logMAR, mean intraocular pressure falling from 19.48 to 17.12 mmHg and mean spherical equivalent from 8.98 to 0.63 dioptres, with early complications within one month in 15 patients (45%), comprising corneal oedema in 6 (18.18%), cystoid macular oedema in 3 (9.09%), lens tilt in 2 (6.06%), flange exposure in 2 (6.06%) and one case each (3.03%) of vitreous haemorrhage and glaucoma.[22] Separately, an 810 nm endoscopic diode laser has been used to melt and reshape the optic-haptic junction of a tilted lens in the operating room, correcting the tilt without lens exchange.[23] Those two reports establish that laser energy can shape a haptic; they do not establish that it does so better than cautery, and the present case cannot settle it either.

What the case can do is specify the question. The relevant laboratory work shows that the variable governing flange geometry is not peak temperature but the controllability of the melt. Flanges formed on polymethylmethacrylate and polyvinylidene fluoride haptics with high-temperature cautery at 1205 °C and low-temperature cautery at 593 °C were indistinguishable in size and shape (P > 0.05); they differed only in formation time, 1.7 ± 0.6 seconds against 3.7 ± 0.6 seconds, and the authors concluded that the slower low-temperature process may allow greater control during flange creation.[20] A study of seven suture materials heated with a cautery tip at 392 °C found that a heating length of approximately 1 mm gives the most controlled geometry and that polypropylene and polyvinylidene fluoride are the materials whose thermoplastic response is reproducible enough for clinical use, both forming mushroom or rhomboid flanges whose length grows faster than their width as heating is prolonged.[21] If control is the operative variable, then a laser is interesting precisely because power, pulse duration and spot size are digitally set and can be repeated exactly, which cautery cannot be. That is a testable claim. Testing it requires the numbers.

The laser application itself is shown in Figure 2B, and the flange it produced was never re-imaged afterwards. The present record documents the wavelength, 532 nm, and the resulting flange diameter, 0.3 to 0.5 mm. It does not document the laser power, the exposure duration, the spot size or the length of haptic melted, as Table 2 shows by leaving those fields explicitly blank. Without them no other surgeon can reproduce the step, and a modification that cannot be reproduced cannot accumulate evidence. This is the single most consequential gap in the record, because it concerns the one element that makes the case novel, and it is the first entry in the minimum data set proposed in Table 5.

4.6. A 363 micrometre flange in a 27-gauge tunnel

The record does document the two parameters that the biomechanical literature identifies as the determinants of anchorage, and that is unusual enough to be worth exploiting. Cadaveric work measuring the force required to pull a flanged haptic out of human sclera found that dislocation force

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

correlated with the ratio of flange diameter to needle diameter with a coefficient of 0.975, that 1.0 mm was the optimal melt length, and that for one three-piece lens the dislocation force fell from 2.04 ± 0.24 N with 30-gauge needles to 0.56 ± 0.36 N with 27-gauge needles ($P < 0.001$); the same study measured 0.93 ± 0.41 N, 0.70 ± 0.34 N and 0.27 ± 0.19 N for three other lens models with 30-gauge needles.[18] A separate tensiometric comparison of four fixation strategies in human corneoscleral tissue confirmed the flanged haptic as the strongest, exceeding glued, transscleral-tunnel and bent-haptic fixation by approximately 1.0 N in each pairing.[19] A more recent ex vivo comparison in twenty human corneoscleral tissues found a least required dislocation force of 1.09 ± 0.48 N for the flanged haptic technique with a three-piece polyvinylidene-fluoride-haptic lens, 0.73 ± 0.54 N for a double-flange polypropylene construct ($P = 0.221$ against the flanged haptic technique) and 3.95 ± 0.55 N for expanded polytetrafluoroethylene suture fixation ($P = 0.042$ and $P < 0.001$ respectively).[57]

Placed alongside those figures, the present construct can be described quantitatively rather than qualitatively. The lens used carries polyvinylidene fluoride haptics, and bench measurement of that same haptic material in a three-piece Kowa lens gives a mushroom-shaped flange of 363 ± 14 µm formed from a haptic 126 ± 3 µm in diameter.[20] That measured value falls inside the 0.3 to 0.5 mm range recorded intraoperatively here, which is a useful external check on the operative note. The tunnels, however, were made with 27-gauge rather than 30-gauge needles, and the same biomechanical study measured the external diameters of the needles it used as 0.424 ± 0.003 mm for 27-gauge and 0.321 ± 0.001 mm for 30-gauge.[18] A flange of 0.363 mm would therefore exceed the outer diameter of a 30-gauge tunnel but not that of a 27-gauge one, which is the geometric expression of the reduction in dislocation force measured directly when tunnel calibre was widened. That conditional matters, because the flange in this eye was recorded only as an intraoperative estimate of 0.3 to 0.5 mm, a range that straddles both figures: at 0.30 mm it would not exceed even a 30-gauge outer diameter, and at 0.50 mm it would exceed a 27-gauge one. The ratio in this eye is therefore indeterminate from the record. We do not claim that this eye was at risk; the lens was stable at three months and the flanges were buried and invisible at every examination. We claim only that the two numbers which decide the question were recorded here, that neither was recorded precisely enough to settle it, and that most operative records do not contain either.

The trade-off runs in both directions, which is why the ratio must be reported rather than optimised blindly. In 75 eyes followed for a median of 3.3 years after modified Yamane fixation, flange exposure beneath the conjunctiva occurred at 21 of 150 flanges (14.0%), and multivariate analysis identified flange diameter as a risk factor (odds ratio 1.012, $P = 0.023$) and a larger white-to-white distance as protective (odds ratio 0.082, $P = 0.017$); scleral thickness increased at the flanged end and mid-tunnel positions but no progressive thinning was seen in eyes followed five years or more, and no lens dislocated.[11] A larger flange therefore holds better and erodes more often. Depth of burial is the third variable, and it is modifiable: a randomised comparison of 18 eyes with a modified scleral pocket against 18 without found a significantly deeper flange position on anterior segment tomography at one, three, six and twelve months ($P < 0.05$) with no difference in corrected acuity or spherical equivalent at twelve months.[34] None of flange depth, white-to-white distance or post-operative flange imaging was recorded here.

4.7. What three months of follow-up cannot exclude

The final recorded visit was at three months, as the last annotated event in Figure 4 shows. Every characteristic complication of this technique has a described time course, and for most of them three months is inside rather than beyond the window of risk. Lens tilt is the clearest case. Among 182 consecutive eyes undergoing flanged intrascleral fixation, 21 (11.5%) developed post-operative tilt, spontaneously in 20 of the 21, at a median of 10 days but with a range extending to 1,086 days and an interquartile range of 1 to 74 days; lens exchange was performed in 10 of the 21 (48%), repositioning in 7 (33%), observation in 3 (14%) and lens removal in 1 (5%), and mean best-corrected acuity improved from 1.10 to 0.55 logMAR after intervention ($P = 0.03$).[10] A multicentre report identified 18 further cases of severe spontaneous rotational tilt, including 5 among 46 consecutive cases at one centre over 24 weeks against none among 33 cases in the equivalent period the previous year, with haptic rotation or dehiscence at the optic-haptic junction documented in at least 8.[58] A device database search identified 178 confirmed malfunction reports for a single scleral-fixation lens between 2013 and 2024, of which 94 concerned tilt and 53 concerned breakage, comprising 31 haptic-optic disinsertions and 22 haptic breakages, with 118 (66.3%) occurring intraoperatively and 60 (33.7%) postoperatively.[12] A single-surgeon case series described five structural failures at the optic-haptic junction, two frank optic breakages and three microfractures, all at the leading haptic junction.[13] Lens model may matter as well as technique: among 49 patients grouped by lens model within the modified Yamane technique, a haptic tip fracture and an optic-haptic separation occurred perioperatively and a further optic-haptic separation on the first post-operative day, all three in the same 22-patient model group, although that study found the difference in haptic problems between the two models statistically insignificant.[59] An optic tilt of 2° at one month is reassuring about the first ten days; it says nothing about the next three years.

Cystoid macular oedema is the second. The multicentre cohort comparing techniques found oedema at three months in 13.0% of eyes fixated by the flanged technique against 1.9% fixated by conventional suture, an odds ratio of 7.99 ($P = 0.045$), among 207 eyes observed for more than twelve weeks.[5] A longitudinal single-surgeon study of 43 patients followed for a mean of 27.5 months and a median of 14.67 months recorded cystoid macular oedema in 8, and although all other complications appeared within 1.25 years, two cases of oedema were identified as late as three years.[60] The meta-analysis of 51 studies attributed to the flanged technique the highest rates of temporarily elevated intraocular pressure (9.9%), iris capture (5.4%), haptic exposure (6.5%) and lens decentration (7.3%) among sutureless approaches.[7] Macular tomography in the present case was normal at one month; the risk window extends well beyond the period observed. It is also worth noting that the largest determinant of pseudophakic oedema risk in routine surgery is a prior episode in the fellow eye, which raised the risk from 0.9% to 10.7% among 54,209 patients, with epiretinal membrane (relative risk 4.1), a history of retinal vein occlusion (relative risk 2.94) and diabetes without macular oedema (relative risk 2.08) the next strongest factors, in a cohort from which prior macular oedema and perioperative topical anti-inflammatory use had been excluded;[61] none of these applied here, which is a reason for optimism but not for discharge.

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

Reverse pupillary block is the third, and it is the complication most directly connected to an unexplained line in this record. A comparative series of 94 eyes found that intraoperative peripheral iridectomy abolished it: block developed in 10 of 40 eyes (25.0%) without iridectomy and in none of 54 eyes with it (P < 0.001), with pupillary capture in a further 4 (10%) of the non-iridectomy group; post-operative anterior chamber depth was 3.79 ± 0.67 mm with iridectomy against 4.11 ± 0.75 mm without (P = 0.03) and intraocular pressure 15.51 ± 2.48 against 18.20 ± 4.51 mmHg (P < 0.001).[29] A separate series found the configuration in 11 of 41 eyes after sutureless scleral-fixated implantation and recommended intraoperative iridectomy or laser iridotomy in eyes with a flaccid iris.[62] A case report describes it appearing five years after Yamane fixation, having progressed through cystoid macular oedema to a full-thickness macular hole with 360-degree iris capture of the optic and repeated subluxation.[63] The present record mentions a peripheral iridectomy once, as a reason for preferring scleral to iris fixation, and never again; it does not state whether the iridectomy was pre-existing or created during this operation, and no iridectomy is identifiable in Figure 1 or Figure 3. Given the magnitude of the effect reported, that single ambiguous line is a material gap.

Haptic and flange erosion is the fourth. A multicentre series of 19 eyes with conjunctival haptic erosion after sutureless intrascleral fixation reported a mean interval from surgery to erosion of 278 ± 437 days, a mean age at fixation of 64 ± 12 years, erosion superiorly in 8 of 19 (42%), inferiorly in 9 (47%) and temporally in 2 (11%), with 18 of 19 (95%) lenses stable after repair and no endophthalmitis; notably, 18 of 19 (95%) sets of haptics in that series had been flanged with low-temperature cautery.[64] The conjunctiva over both haptic exit sites was intact at every examination, as Figure 3 shows. Pupillary optic capture is the fifth: among 126 eyes, it occurred in 20 (15.9%), and multivariate analysis linked it to larger differences between the nasal and temporal scleral tunnel angles and to greater horizontal tilt (P < 0.05), which is the same geometric argument made in Section 3.2 from the opposite direction.[32] Haptic failure is the sixth: among eight complicated cases collected from 24 reviewed across three referral centres during the learning curve, six had haptic breakage, slippage or disinsertion, one of them also suffering a retinal detachment, and the remaining two had uveitis-glaucoma-hyphaema syndrome and lens tilt respectively.[65] The symmetry documented in Table 2 is therefore protective against precisely this complication, and the three-month interval is again too short to demonstrate any of it. A series of 30 eyes of 30 patients followed for a mean of 46.07 ± 7.96 months puts the cumulative burden in perspective: retinal detachment occurred in 2 (6.7%), epiretinal membrane in 2 (6.7%) and cystoid macular oedema in 1 (3.3%), and more than a third of the series required at least one additional surgical procedure at the time of fixation.[66]

4.8. Choosing among four options in an eye with halved endothelial reserve

The decision recorded in Section 2.3 was reached on clinical grounds and reached correctly, but the reasoning as written is thinner than the evidence allows. Table 4 sets out the four options against the outcomes that matter in an eye whose endothelial reserve is approximately half the expected value, with the supporting figures and their denominators. Three conclusions follow from it. The first is that an angle-supported anterior chamber lens is the option this eye could least afford: pseudophakic bullous keratopathy developed in 10 of 33 such eyes (30.3%) against 1 of 32 flange-fixated eyes (3.1%, P = 0.04) in a directly comparable population, and 4 of the 33 (12.1%) required a glaucoma filtering procedure against none in the flange group (P = 0.042).[4] That said, an anterior chamber lens is not without a constituency: in 193 eyes receiving an open-loop four-point-fixated lens, corrected distance acuity improved from 1.73 ± 0.11 to 0.42 ± 0.05 logMAR in 104 eyes without pre-existing risk factors and from 1.53 ± 0.14 to 0.49 ± 0.10 logMAR in 49 eyes with them (both P < 0.001), the mean spherical equivalent at last refraction was -0.37 ± 0.18 D in the 153 primary-implantation eyes and -0.15 ± 0.51 D in the 40 secondary ones, and 40 of the 76 eyes in which a 2.5 D addition was used fell within ±0.50 D of target (52.6%).[3] A 357-eye comparison of anterior chamber, intrascleral haptic-fixated and suture-fixated lenses found them statistically indistinguishable on spherical equivalent (P = 0.87), refractive cylinder (P = 0.91) and corrected distance acuity in eyes without significant comorbidity (P = 0.23), with return to theatre differing not between techniques (P = 0.08) but between two lens models inside the intrascleral group (P = 0.03).[24] A more recent vitreoretinal cohort of 138 eyes divided among four secondary lens types found anterior chamber lenses associated with worse acuity at three months and a higher rate of post-operative cystoid macular oedema (P = 0.002), with post-operative retinal detachment in 3 of 138 eyes (2.2%) overall.[67] A prospective study of 83 eyes with late spontaneous dislocation of the lens-capsular bag complex is blunter still: iris fixation gave a better median corrected acuity than exchange for an anterior chamber lens (0.1 against 0.3 logMAR, P = 0.001), a significantly smaller fall in endothelial cell density (P < 0.001), stable rather than increased corneal astigmatism (P < 0.001), and cystoid macular oedema in 4.4% against 39% (P = 0.01).[68] In an eye with 1200 cells/mm² and two decades of expected use ahead, those advantages do not outweigh a 30% keratopathy rate.

The second conclusion is that the comparison between scleral and iris fixation is genuinely close, and that the record's premise, that scleral fixation is the endothelium-sparing choice, is not securely established. In 116 eyes divided evenly, both techniques improved corrected acuity with no significant difference between them and no significant difference in complication rates, while refractive predictability favoured the iris-claw lens.[14] In 271 eyes, best-corrected acuity at six months was 0.39 (0.55) logMAR after iris-claw implantation against 0.47 (0.58) after sutureless scleral fixation (P = 0.12), and the iris-claw operation was the shorter of the two at 41.9 ± 24.4 against 59.8 ± 21.1 minutes (P < 0.001).[43] In 60 sutureless scleral-fixated eyes and 57 iris-claw eyes compared by Scheimpflug imaging at one year, uncorrected and corrected acuity did not differ (P = 0.236 and P = 0.293) and anterior chamber depth, angle and volume did not differ (P = 0.770, 0.401 and 0.812 respectively), although anterior corneal astigmatism did (P < 0.001).[69] And on the specific question at issue, the small comparative series that measured it found more endothelial loss after trocar-assisted sutureless scleral fixation than after iris-claw implantation (439.5 ± 89 against 164.4 ± 53, P = 0.013).[53] The decision taken here was defensible - the wide incision an iris-claw lens requires is itself a burden on a compromised cornea, and the record notes the iris was not ideal - but it was defensible on incision size and iris anatomy rather than on any demonstrated endothelial advantage, and the record should say so.

The third conclusion, and the one the endothelial row of Table 4 records most plainly, is that sutured scleral fixation retains one specific advantage that is relevant here. In the series that

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

stratified endothelial loss by what was done to the lens, the subgroup that lost almost nothing, 1.5%, was the subgroup in which no lens was removed and no phacoemulsification was performed - which is this patient's situation.[52] Sutured fixation also produced a lower rate of cystoid macular oedema than the flanged technique in the multicentre comparison,[5] and in a comparison of 15 Yamane eyes against 52 Gore-Tex-sutured eyes the sutured groups showed statistically significant acuity improvement while the Yamane group did not, with a greater incidence of cystoid macular oedema in the Yamane cohort ($P < 0.05$), although all suture-material complications and both cases of decentration occurred in the sutured group.[70] Against that, in 140 patients compared directly - 63 given a flanged construct and 77 a Hoffman scleral pocket - the flanged technique produced a less myopic spherical equivalent (-0.63 ± 2 against -2.3 ± 1.3 dioptres, $P = 0.003$) but more elevated pressure (11 of 63, 17.5%, against 4 of 77, 5.2%; $P = 0.02$), more corneal oedema (7 of 63, 11.1%, against 1 of 77, 1.3%; $P = 0.02$) and more cystoid macular oedema (10 of 63, 15.9%, against 2 of 77, 2.6%; $P = 0.005$), the authors attributing part of that excess to a higher rate of combined vitrectomy in the flange group; operative time did not differ (70 against 77 minutes, $P = 0.29$), so the common assertion that sutured fixation is slower is not supported by that comparison.[71] There is no dominant option. There is only a choice that should be documented with the reasons and the measurements that support it.

Table 4. The four routes to correcting aphakia without capsular support, compared on the outcomes that matter in an eye whose endothelial cell density is approximately half the mean value measured before routine cataract surgery in an unselected population. Denominators are given wherever a proportion is quoted. Values in bold red identify the outcome that excluded an option in this eye. BCVA, best-corrected visual acuity; CME, cystoid macular oedema; ECD, endothelial cell density; IOP, intraocular pressure; OR, odds ratio; RPE, refractive prediction error; SE, spherical equivalent; SIA, surgically induced astigmatism; UCVA, uncorrected visual acuity.

Outcome domain	Anterior chamber lens	Retropupillary iris-claw lens	Sutured scleral fixation	Flanged intrascleral fixation (chosen here)
Representative recent evidence	193 eyes[3]; 33 vs 32 eyes[4]; 83 eyes[68]	58 eyes[14]; 175 eyes[43]; 23 eyes[41]; 15 patients[53]	34 eyes[8]; 29 + 23 sutured cases[70]; 77 patients[71]	234 eyes[9]; 250 eyes[36]; 87 eyes[40]; 51 studies[7]
Visual outcome	logMAR 1.73 ± 0.11 to 0.42 ± 0.05 in 104 low-risk eyes[3]	BCVA 0.39 (0.55) logMAR at 6 months[43]	UCVA 0.418 ± 0.339 logMAR at 6 months[8]	UCVA 0.251 ± 0.328 logMAR at 6 months[8]; BCVA 0.26 ± 0.24 at 24 months[9]
Refractive predictability	Mean spherical equivalent -0.37 ± 0.18 D in 153 primary eyes; 40 of 76 (52.6%) within ±0.50 D[3]	RPE 0.21 ± 0.75 D; 30 of 58 (52%) within ±0.50 D[14]; +0.56 ± 0.62 D hyperopic[41]	Myopic shift -1.33 ± 1.15 D[8]; SE -2.3 ± 1.3 D[71]	RPE 0.69 ± 0.94 D; 18 of 58 (31%) within ±0.50 D[14]; +0.44 ± 1.00 D hyperopic[41]; 77% of 234 eyes within ±1.00 D[9]
Endothelial impact	**Bullous keratopathy in 10 of 33 (30.3%) vs 1 of 32 (3.1%), P = 0.04**[4]	ECD loss 164.4 ± 53 cells/mm² (15 patients)[53]; 2,014 ± 692 cells/mm² at 6 months (23 eyes)[41]	ECD loss 1.5% where no lens was removed and no phacoemulsification performed (34 eyes)[52]	ECD loss 439.5 ± 89 cells/mm² with trocar-assisted fixation (12 patients)[53]; ECD preserved at 24 months, P = 0.895[9]
Operative time	No operative time reported in the cited series[3]	41.9 ± 24.4 minutes[43]	Not reported in the comparators cited; did not differ from the flanged technique in one comparison (77 against 70 minutes, P = 0.29)[71]	17.1 minutes pooled median[7]; 25.1 ± 9.9 minutes randomised[35]; 30 minutes in this case
Principal risks	Glaucoma filtration in 4 of 33 (12.1%)[4]; CME 39% vs 4.4% after iris fixation, P = 0.01[68]; anti-glaucoma medication in 15 of 49 higher-risk eyes (30.6%)[3]	Requires an intact iris diaphragm and a 5.5 mm corneal incision or sclero-corneal tunnel; SIA 0.8 (2.1) D[43]	Iris capture 10 of 34 (29.4%) and decentration 8 of 34 (23.5%) in the sutured arm[8]; suture exposure 7 of 34 (20.6%) against flange exposure 4 of 31 (12.9%), P = 0.409	CME 21 of 155 (13.0%) vs 1 of 52 (1.9%), OR 7.99 (95% CI 1.05-60.97)[5]; tilt 21 of 182 (11.5%)[10]; flange exposure 21 of 150 flanges (14.0%)[11]; IOP rise 9.9%, iris capture 5.4%, haptic exposure 6.5%, decentration 7.3%, all pooled across 51 studies[7]
Suitability at an ECD of approximately 1200 cells/mm²	**Least suitable of the four**	Acceptable; the lowest measured endothelial loss in the one series that compared them directly	Acceptable; the lowest loss where no lens is removed and no phacoemulsification is performed	Chosen here; the endothelial cost is unresolved in the literature and was not measured in this eye

Table 4 also records what each column cannot answer. No study in it followed an eye starting at 1200 cells/mm² specifically, and its endothelial column therefore describes average behaviour in populations whose mean baseline was far higher; in a further series not tabulated here, the mean pre-operative density in 20 eyes was 2,282 cells/mm², falling to 2,091 at the last visit.46 Extrapolating a mean percentage loss or a mean absolute loss to an eye at half that baseline is an approximation, and it is presented in Figure 5B, and stated once in Section 3.3, as an illustrative projection rather than as a prediction. The correct response to that uncertainty is not a better extrapolation but a measurement.

4.9. A care-gap audit of this record, and a minimum data set

The preceding sections have repeatedly reached the same wall: a result that can be described but not explained, because a measurement was not made. Rather than list those omissions as regrets, we have audited the record against the determinants of outcome that the recent primary literature actually quantifies, and Table 5 sets out the result item by item, naming for each the measurement, the moment at which it should be taken, and the reason it changes what can be concluded. The audit identified eight gaps. Figure 4 marks where the record stops, Table 2 records the laser wavelength and nothing else about the laser, and the comparison in Table 4 shows how little of what distinguishes the four options was measured in this eye. It is worth stating plainly that this is an audit of an ordinary, competently kept record producing an excellent clinical outcome. That is what makes it worth publishing: if a record this good cannot support the inferences its own case invites, the problem is not the individual surgeon's diligence but the absence of an agreed reporting standard for this operation.

Table 5. Care-gap audit of this record against the determinants of outcome that the recent primary literature quantifies, and the resulting eight-item minimum data set for reports of laser-flanged intrascleral intraocular lens fixation. The final column, in bold red, states what the present record actually contains. AS-OCT, anterior segment optical coherence tomography; OR, odds ratio; SIA, surgically induced astigmatism.

#	Measurement	When	Why it changes what can be concluded	Status here
1	Laser power, exposure duration, spot size and melt length	Intraoperatively, at flange formation	Flange geometry is governed by the controllability of the melt rather than by peak temperature; without these the novel step cannot be reproduced or compared with cautery protocols whose geometry has been measured directly[20,21]	**Absent**
2	Specular microscopy: cell density, coefficient of variation, hexagonality, central corneal thickness	Before surgery and at 3 and 12 months	This is the indication for choosing scleral over angle- or iris-supported fixation; published loss after related procedures runs from 1.5% in a 34-eye subgroup in which no lens was removed, through 439.5 cells/mm^2 after trocar-assisted fixation in 12 patients, to 17.8% at two years in a paediatric cohort[28,52,53]	**Pre-operative density only**
3	Full biometry with implanted power, formula and A-constant	Before surgery	The only route to attributing a refractive prediction error and the only way an individual eye can contribute to lens-constant optimisation; prediction error correlates with axial length at -0.25 to -0.39 D/mm[15,16]	**Absent**
4	Post-operative anterior chamber depth	At 3 and 12 months	The strongest measured correlate of refractive error after intrascleral fixation (coefficient 0.50, P < 0.001), ahead of tilt (coefficient -0.32, P = 0.006)[30]	**Absent**
5	Manifest refraction at every visit at which acuity is recorded	Day 1, week 1, months 1, 3 and 12	Early hyperopic error drifts: in 20 eyes of 12 children a prediction error of +0.90 ± 1.31 D at four weeks moved by -0.54 D by six months, raising the proportion within ±1.0 D from 45% to 60%[56]	**Month 1 only**
6	Keratometry before and after surgery for vector-computed SIA	Before surgery and at 3 and 12 months	Total corneal astigmatism is not surgically induced astigmatism; SIA after related sutureless procedures is 0.86 ± 0.44 D at 12 months in an imaging subgroup and 0.80 ± 0.55 D at 12 weeks after Carlevale fixation[9,72]	**Post-operative value only**
7	Flange depth and lens position: tilt in degrees and decentration in millimetres by AS-OCT	At 3 and 12 months	Flange diameter predicts exposure (OR 1.012, P = 0.023) and burial depth is modifiable by a scleral pocket (P < 0.05 to 12 months)[11,34]	**Tilt at month 1 only**
8	Follow-up of at least 12 months, with macular tomography at 3 months	Through 12 months	Tilt has been detected as late as 1,086 days, flange exposure in 14.0% of flanges in a cohort followed for a median of 3.3 years, cystoid macular oedema as late as 3 years and reverse pupillary block at 5 years[10,11,60,63]	**3 months**

Four of the eight entries in Table 5 - the second, fifth, sixth and seventh - concern measurements that were made once and should have been made twice. Endothelial cell density was recorded pre-operatively and never afterwards, which removes the only outcome by which the choice of operation can be judged; the reported losses after related procedures run from 1.5% in a subgroup with no lens removal through 439.5 cells/mm^2 after trocar-assisted fixation to 17.8% in a paediatric cohort, so the outcome in this eye could plausibly have been anywhere between negligible and a substantial fraction of its remaining reserve.[28,52,53] Keratometry was recorded at one week and described as similar to a pre-operative value that does not appear in the record, so surgically induced astigmatism cannot be computed even though its published magnitude after related sutureless procedures - 0.86 ± 0.44 dioptres at twelve months and 0.90 ± 0.62 at twenty-four in the anterior segment tomography subgroup of one prospective series,[9] and a fall from 1.78 ± 0.96 dioptres at one week to 0.80 ± 0.55 at twelve weeks after Carlevale fixation[72] - is of the same order as the total astigmatism reported here. Manifest refraction was recorded at one month but not afterwards, so any drift of the early hyperopic error cannot be checked in this eye.[56] Flange depth and lens position were captured once, as a tilt angle at one month, with no decentration in millimetres and no repeat.[34] Macular tomography, which belongs to the eighth entry, was recorded pre-operatively and at one month but not at the three-month visit at which the largest comparative study measured its primary endpoint.[5]

The same pattern extends beyond the eight numbered items: intraocular pressure was recorded at two of five visits and anterior chamber cells at two of five, so neither can be described as a trajectory. Three entries concern measurements that were never made at all. Biometry - axial length, keratometry, anterior chamber depth and white-to-white distance - is absent, and with it any possibility of attributing the +1.00 dioptre prediction error or of contributing the eye to constant optimisation.[15,16] Post-operative anterior chamber depth is absent, which is the single variable that correlated most strongly with refractive error in the study that measured all the candidates.[30] Laser parameters other than wavelength are absent, which prevents reproduction of the modification that makes the case novel and prevents any comparison with the cautery protocols whose flange geometry has been measured directly.[20,21] The eighth entry concerns duration rather than content: three months of follow-up cannot address tilt detected as late as 1,086 days, flange exposure found in 14.0% of flanges in a cohort followed for a median of 3.3 years, cystoid macular oedema identified as late as three years, or reverse pupillary block reported at five.[10,11,60,63]

From that audit we propose the following minimum data set for reports of laser-flanged intrascleral fixation, stated as eight numbered items in Table 5 and summarised here as a sequence a surgeon can follow. Before surgery, record specular microscopy with cell density, coefficient of variation, hexagonality and central corneal thickness, and record full biometry including axial length, keratometry in both meridians, anterior chamber depth and white-to-white distance, together with the implanted power, the formula and the A-constant used. During surgery, record the needle gauge, the distance of each sclerotomy from the limbus, the angle of each tunnel, the meridians used, the laser wavelength, power, exposure duration and spot size, the length of haptic melted and the resulting flange diameter. After surgery, repeat specular microscopy and keratometry at three and twelve months, record manifest refraction at every visit at which acuity is recorded, image the flange and measure lens tilt, decentration and anterior chamber depth by anterior segment tomography at three and twelve months, and record macular central subfield thickness at three months. Follow the eye for at least twelve months. None of these is exotic; all of them were available in the unit that performed this operation; and together they would have converted a good outcome into an interpretable one.

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

4.10. Inconsistencies in the source record, declared

In preparing this report we identified eight internal inconsistencies or ambiguities in the source documentation, and we declare them rather than silently resolving them. First, the endothelial cell density is described in a single sentence as being within the normal range and as slightly reduced; we have adopted the numerical value of approximately 1200 cells/mm² and rejected the descriptor, for the reasons given in Section 3.3. Second, the vitrectomy is described in one place as a limited anterior vitrectomy performed by a pars plana approach and in another as a posterior pars plana vitrectomy; the intraoperative photographs in Figure 2 show three trocar cannulas in the standard configuration, so we have adopted the latter description. Third, the corneal incision is given as 2.8 mm in the operative note and as 3 mm in the narrative summary; we have used 2.8 mm throughout and note that the difference does not affect any inference drawn here.

Fourth, the flange is described in the operative note as having been formed with a 532 nm green laser and in the narrative summary as having been formed with a diode laser. Those are not the same device: 532 nm is the frequency-doubled green wavelength, whereas the diode laser used in the published account of haptic re-curing operates at 810 nm.[23] We have adopted the operative note's 532 nm, which is also the wavelength used in the only published series of laser-formed flanges.[22] Fifth, a 60-year-old man is characterised in the source narrative as relatively young; we have not reproduced that characterisation, since the relevant comparison is with the published cohorts, whose mean ages were 77.83 ± 9.33 years in one long-term series[55] and 65.3 ± 13.5 years in another,[46] and against which 60 is unremarkable rather than young.

Sixth, a peripheral iridectomy is mentioned once, as a factor weighing against an iris-claw lens, and never described again; whether it was pre-existing or created at this operation is not recorded, and its presence or absence bears directly on the risk of reverse pupillary block.[29,62] Seventh, the refractive target of -0.50 dioptres is justified in the record as an allowance for an anticipated hyperopic shift, yet the achieved refraction was hyperopic by a further 1.00 dioptre relative to that already-adjusted target, so the allowance was made and was still insufficient; we have reported the arithmetic rather than the intention. Eighth, the fellow right eye is recorded as seeing 20/20 with an in-the-bag lens, but no refraction, intraocular pressure or endothelial cell density is given for it, which removes the internal control that a fellow eye would otherwise provide for both the refractive and the endothelial analysis. Table 1 marks each of these absences explicitly rather than leaving the cell blank.

4.11. Limitations

This is a single case, observed for three months, reported retrospectively, and it can support no inference about the comparative efficacy or safety of laser-formed against cautery-formed flanges. The comparisons drawn throughout are between one eye and the means of published cohorts, which is a descriptive exercise and not a statistical one; where a published figure is a mean, we have said so, and where a denominator is a subgroup rather than a whole cohort we have given the subgroup. The counting-fingers starting acuity is not converted anywhere in this report, and no uncorrected gain is computed from it: the published calibration is for fingers presented at 30 cm, in 16 patients of one subgroup of a 38-patient study that reported considerable variation and substantial overlap with hand-movement acuity. Plotting the referral point at 2.00 logMAR in Figure 5A is therefore an upper bound on the pre-operative logMAR value, and because a better true value would make the deficit smaller, that placement overstates rather than understates the starting impairment.[25] Every quantitative claim in this report rests instead on the recorded Snellen measurements. The flange diameter of 363 ± 14 µm attributed to the implanted haptic material is a bench measurement of the same lens model rather than a measurement of this patient's flanges, which were recorded only as 0.3 to 0.5 mm by intraoperative estimation.[20] The needle outer diameters cited in Section 3.6 are nominal gauge dimensions, and thin-walled needles of a given gauge have a larger lumen but the same outer diameter, so the ratio argument concerns the tunnel the needle cuts rather than the lumen the haptic passes through. The intervals labelled in Figure 4 are relative to the operation because no absolute dates were recorded, so the fifteen-month span is an interval arithmetic rather than a calendar. Finally, the laterality of the panels in Figure 1 and Figure 3 is asserted from the operative record; in Figure 1 it is independently supported by the caruncle visible at the viewer's left, which identifies the medial canthus of a left eye, but in Figure 3 the field is cropped within the palpebral aperture and no anatomical landmark confirms it.

5. Conclusion

An aphakic eye that had been without a lens for twelve months, corrected to 20/200 by a +10.00 D spectacle and carrying an endothelial cell density approximately half the mean measured before routine cataract surgery, recovered a full logarithmic unit of best-corrected acuity to 20/20 within one month of double-needle intrascleral fixation of a three-piece polyvinylidene-fluoride-haptic lens whose flanges were formed with a 532 nm green laser rather than with cautery. Uncorrected acuity on the first post-operative day already exceeded the pre-operative best-corrected acuity by 0.52 logarithmic units, the optic sat at approximately 2° of tilt at one month, which is at the favourable end of everything reported for this technique, and the result was unchanged at three months with no intraoperative or post-operative complication. On the evidence of this eye, laser flange formation is compatible with the rapid rehabilitation and immediate stability that make sutureless intrascleral fixation attractive in a cornea that cannot afford an angle-supported lens.

The report's more transferable finding concerns the record rather than the eye. The operation was chosen to protect an endothelium that was never measured again; the refractive target was missed by +1.00 dioptre, a figure the record called slight and which lies at the outer edge of the band that three-quarters of published eyes fall inside, and the miss cannot be attributed because no biometric input and no post-operative anterior chamber depth was recorded; and the laser step that makes the case novel cannot be reproduced because power, exposure duration, spot size and melt length were not written down. A structured audit against the determinants of outcome that the recent primary literature quantifies identified eight such gaps in an otherwise competently kept record, and from them we propose the eight-item minimum data set tabulated in Table 5 covering pre-operative specular microscopy and biometry, intraoperative tunnel and laser parameters, and post-operative endothelial, refractive, positional and macular measurements at three and twelve months. Adopting it would cost nothing that was not already available in the unit that performed this operation, and it would allow the next fifty cases of laser-flanged

e-ISSN 2747-2051
DOI: 10.37275/amcr.v7i4.929

intrascleral fixation to answer the question that this one can only pose.

6. Declarations

Statement on the Use of Artificial Intelligence

No use of generative artificial intelligence was declared by the authors.

Author Contribution Statement

AJN and Y: Conceptualization, Clinical Care/Investigation, Data Curation, Interpretation, Writing - Original Draft, Writing - Review & Editing, and Validation. Both authors approved the final version of the manuscript and agree to be accountable for the work.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest / Competing Interests

The authors declare that they have no competing interests. No manufacturer of any device, lens, or laser named in this report had any role in its preparation.

Data Availability Statement

All data supporting the findings of this report are contained within the article and its tables and figures. Further de-identified detail is available from the corresponding author on reasonable request, subject to the protection of patient confidentiality.

Ethical approval and consent to participate

The patient's clinical care was delivered according to the principles of the Declaration of Helsinki. Institutional review board approval is not required for the retrospective reporting of a single de-identified case at the authors' institution.

Consent for publication

Written informed consent was obtained from the patient for the surgical procedure, including the off-label intrascleral fixation of a posterior chamber intraocular lens, and separately for publication of this case report and the accompanying clinical photographs. No image contains a recognisable facial feature or identifying mark.

Acknowledgements

None declared.

Author Approval

All authors have reviewed and approved the final version of the manuscript and agree to be accountable for the work.

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