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Ahmed glaucoma valve tube repositioning in eyes at risk of corneal endothelial decompensation: a prospective, nonrandomized, comparative cohort study

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Abstract

Background/Objectives:

To evaluate the feasibility, safety, and longitudinal corneal outcomes associated with posterior repositioning of a functioning Ahmed glaucoma valve (AGV) tube in eyes with progressive endothelial decompensation.

Subjects/Methods:

In this prospective, single-centre, non-randomised comparative cohort, 44 eyes underwent ciliary sulcus/posterior chamber repositioning (n = 13), anterior vitreous cavity repositioning (n = 14), or conservative observation (n = 17). The primary outcome was annual central endothelial cell density (ECD) change, estimated using a mixed-effects model with participant-specific random intercepts and time slopes. Secondary outcomes included coefficient of variation (CV), central corneal thickness (CCT), best-corrected visual acuity (BCVA), intraocular pressure (IOP) and complications.

Results

All 27 repositioning procedures retained the original AGV plate. Across 319 central ECD observations, central ECD declined by − 107.41 cells/mm²/year in Control and − 40.22 cells/mm²/year after any repositioning, a difference of + 67.19 cells/mm²/year ($P < 0.001$). Compared with Control, both repositioning groups showed slower increases in tube-adjacent and tube-opposite CV (all $P \leq 0.021$), less CCT thickening and less BCVA deterioration (both $P < 0.001$). Haze progression was lower after repositioning ($P = 0.008$), while IOP trajectories remained similar among groups. Six control eyes developed corneal oedema or endothelial decompensation, and two underwent keratoplasty during follow-up.

Conclusions

Posterior repositioning of a functioning anterior chamber AGV tube in eyes with progressive ECD decline was technically feasible, maintained IOP control, and was accompanied by slower endothelial loss, less corneal thickening and haze progression, and better visual trajectories than conservative observation.

Introduction

Glaucoma drainage device (GDD) surgery is an established treatment for refractory glaucoma. Since Molteno introduced drainage implants in 1969, their use has expanded steadily as surgical indications have broadened.[1–3] Canadian data showed that GDD procedures increased from 0.9% to 33% of

glaucoma filtration surgeries between 1992 and 2012,[4] and major Chinese eye centers reported a doubling of GDD implantation from 2016 to 2019.[5] Similar trends have been described in Japan, Portugal, Germany, and Nigeria.[6–9] Alongside this wider use, long-term corneal endothelial injury has become one of the most important complications of GDD surgery.[10, 11]

Ahmed glaucoma valve (AGV) tubes are conventionally placed in the anterior chamber. Endothelial cell loss during the first 2 years after anterior chamber tube implantation has been reported at 11.5%–18.6%, well above normal age-related decline.[10, 12, 13] The mechanism is probably multifactorial. The tube changes the normal distribution of aqueous flow and concentrates outflow toward a single orifice, creating localized turbulence and shear stress; intermittent tube-cornea proximity or direct contact adds a mechanical component.[12, 14–17] Many eyes requiring an AGV already have reduced endothelial reserve because of advanced glaucoma, previous surgery, or chronic inflammation, and are therefore less able to tolerate further injury.[18–20]

Progressive loss of endothelial cells eventually leads to persistent corneal edema, reduced vision, and corneal transplantation. This is a difficult endpoint in an eye with a functioning anterior chamber tube. The donor endothelium remains exposed to the same tube position and abnormal aqueous flow that contributed to the original damage, while previous surgery, inflammation, and neovascularization increase the risk of graft rejection and failure.[21, 22] In fact, mean survival of DMEK posterior lammellar corneal transplants in eyes with GDD is around 2 years, much shorter than in normal eyes.[22] Donor scarcity and uncertain graft survival make transplantation an unsatisfactory solution when the source of endothelial injury remains in place.

Moving the tube away from the cornea offers a more direct approach. Primary placement in the ciliary sulcus or through the pars plana has been associated with less endothelial loss than anterior chamber placement while providing comparable IOP control.[23–29] These studies, however, have mainly examined tube position at the time of initial implantation. Adjustment of a malpositioned AGV tube has been described in individual cases, including scleral fixation of the tube tip,[30] but there is little prospective comparative evidence on redirecting a previously implanted, functioning tube after progressive endothelial damage has already been documented.

We used a standardized repositioning technique that preserves the existing AGV plate and filtration bleb and changes only the intraocular course of the tube. The study evaluated the feasibility and safety of redirecting the tube to the ciliary sulcus/posterior chamber or, after pars plana vitrectomy, to the anterior vitreous cavity. Longitudinal central and regional ECD, CV, CCT, corneal haze, BCVA, and IOP were compared with conservative observation. The primary comparison combined both repositioning routes versus observation; the direct comparison between the two surgical routes was exploratory (Supplementary Fig. S1).

Subjects and methods

Study Design

This single-center, prospective, nonrandomized comparative cohort study was conducted at the Department of Ophthalmology, Tongji Hospital, Tongji University. The study was approved by the institutional review board (No. 2021 – 113), adhered to the Declaration of Helsinki, and obtained written informed consent from all participants.

Participants

Eligible participants had a previously implanted AGV with the tube in the anterior chamber, central ECD decline greater than 200 cells/mm² within 1 year, tube-adjacent ECD below 800 cells/mm², and controlled IOP of 6–21 mmHg with or without topical medication at cohort entry. These ECD criteria were protocol-defined empirical clinical thresholds used to identify eyes considered at imminent risk.

Exclusion criteria were inability to complete the required examinations; corneal disease or previous refractive surgery likely to affect endothelial measurements; previous corneal transplantation; or uncontrolled systemic disease that materially increased examination or surgical risk.

Only one eye was included per participant. The analysis population therefore comprised 44 participants and 44 study eyes.

Treatment Selection

Management was not randomized. Treatment reflected patient preference, clinical suitability for reoperation, ocular anatomy, and the procedure ultimately completed. Participants who declined or were not suitable for immediate reoperation underwent conservative observation. Among eyes undergoing repositioning, PC was preferred when ciliary sulcus placement was anatomically feasible and the tube tip could be visualized reliably. AVC was used when PC placement was unsuitable because of insufficient tube length, lens or IOL constraints, extensive iris abnormality or posterior synechiae, absence of a usable posterior chamber space, or posterior-segment disease requiring vitrectomy. Intraoperative conversion from planned PC to AVC was permitted. Analyses used the final tube position achieved.

Outcome Definitions

The primary outcome was the rate of change in central ECD (cells/mm²/year) over continuous follow-up time. The prespecified primary contrast compared any repositioning (PC and AVC pooled) with Control. Group-specific PC, AVC, and Control slopes and regional ECD trajectories were secondary estimates; the PC-versus-AVC comparison was exploratory.

Secondary continuous outcomes were ECD at tube-adjacent and tube-opposite regions, regional CV, CCT (μm), BCVA (logMAR), and IOP (mmHg). Corneal haze was treated as an ordinal outcome. Change from

baseline to the last available assessment was summarized as median (interquartile range), and worsening was defined as an increase of at least 1 grade. Surgical feasibility required withdrawal and posterior redirection of the tube while retaining the existing AGV plate and filtration pathway, watertight closure of the original entry site, confirmation of the final tube position, and no need for AGV explantation or replacement.

Examinations

Baseline variables included age, sex, study-eye laterality, glaucoma diagnosis, previous ocular surgery, topical glaucoma medication count, lens status (phakic, pseudophakic, or aphakic), IOL type and location, iris adhesion, interval from original AGV implantation to cohort baseline, ECD, CV, CCT, anterior chamber depth, BCVA, IOP, and regional haze grade.

ECD and CV were measured at the central, tube-adjacent, and tube-opposite cornea using confocal microscopy (Confoscan 3.0; NIDEK, Gamagori, Japan) at every assessment. CCT and anterior chamber depth were assessed with Scheimpflug imaging (Pentacam; Oculus Optikgeräte, Wetzlar, Germany). BCVA was converted to logMAR. Regional haze was graded with slit-lamp biomicroscopy using the scale adapted from Fantes et al. and shown in Supplementary Table S1.[31]

Feasibility and Safety

Adverse events were sought intraoperatively and throughout follow-up. Recorded events included hyphema, wound leakage, hypotony, vitreous prolapse, conjunctival hyperemia, anterior chamber exudation, IOP elevation, tube displacement or exposure, recurrent tube-cornea contact, encapsulated bleb, persistent corneal edema or endothelial decompensation, and keratoplasty. Events were categorized as intraoperative, early complications (within 90 days), or late complications (more than 90 days) from the surgical or cohort-baseline date. Event date, treatment, resolution date, and recovery status were recorded.

Surgical Procedures

All repositioning procedures were performed by the same experienced ophthalmic surgeon under retrobulbar anesthesia (2–3 mL of a 1:1 mixture of 2% lidocaine and 0.75% bupivacaine), supplemented by local subconjunctival lidocaine infiltration around the previous tube entry site, usually in the superotemporal quadrant.

PC repositioning

Expose the existing tube through conjunctival and Tenon's dissection, free the tube from surrounding tissue, withdraw it from the anterior chamber, and close the original scleral fistula watertight.

Inject viscoelastic into the anterior chamber and intended posterior chamber trajectory to maintain space and reduce false passage or iris-root injury.

Create a new scleral tunnel with a 22-gauge needle and advance the tube through the ciliary sulcus between the posterior iris and the anterior surface of the IOL.

Adjust the tube tip into the pupillary zone and confirm its position by direct intraoperative visualization.

When cataract surgery was indicated, perform phacoemulsification with posterior chamber IOL implantation before sulcus tube insertion. Clear-lens eyes in which sulcus placement risked lens injury, and eyes with inadequate tube length or IOL-iris adhesion, were managed with AVC repositioning.

AVC repositioning

Expose and free the existing tube, withdraw it from the anterior chamber, and close the original scleral fistula watertight.

Perform standard three-port pars plana vitrectomy. In neovascular glaucoma, clear vitreous hemorrhage, remove epiretinal membrane when present, and add retinal photocoagulation as clinically indicated.

Introduce the tube through a pars plana sclerotomy and advance it into the anterior vitreous cavity under direct visualization.

Confirm the intraocular tube position first by microscopic inspection with localized external scleral indentation and then with an indirect inverting lens and indentation.

Close the sclerotomies and conjunctiva. Postoperative topical corticosteroid and antibiotic therapy was continued for 8 weeks and adjusted clinically.

Statistical Analysis

Analyses used R version 4.6.1. Continuous variables were summarized as mean (SD) or median (interquartile range), and categorical variables as counts (%). Baseline comparisons used ANOVA, Kruskal-Wallis, or Fisher exact tests, including the Fisher-Freeman-Halton extension. The primary mixed-effects model included group, continuous time (days/365.25), and their interaction as fixed effects, with participant-specific random intercepts and slopes. It used baseline and all available follow-up measurements and was estimated by restricted maximum likelihood. PC and AVC were pooled versus Control; three-group ECD models allowed group-specific random-slope variances. Adjusted postbaseline models included baseline central ECD, age, and neovascular or uveitic glaucoma; additional anatomical covariates were omitted to limit overfitting. Sensitivity analyses varied random-effects structures, compared participant-specific ordinary least-squares slopes using Welch *t* tests, and excluded the aphakic eye. Other continuous outcomes used analogous three-group mixed models. Haze changes were compared using Kruskal-Wallis and Holm-adjusted pairwise Wilcoxon tests; worsening proportions used Fisher exact tests. Complication rates were compared using Fisher exact tests, between PC and

AVC for perioperative events and across all groups for late and overall events. Wald 95% CIs and two-sided *P* values were reported, with $P < 0.05$ considered significant. Route-specific and secondary comparisons were exploratory; continuous secondary outcomes were not adjusted for multiplicity.

Results

Participant Flow and Baseline Characteristics

The final cohort included 44 participants and 44 study eyes, with one eye per participant: PC, 13; AVC, 14; and Control, 17.

Mean age was 62.46 ± 9.85 years in PC, 59.64 ± 11.30 years in AVC, and 61.41 ± 9.10 years in Control ($P = 0.762$). Male counts were 6/13, 8/14, and 9/17, respectively ($P = 0.929$). Lens status, IOL type, iris adhesion, and the interval from original AGV implantation to cohort baseline were similar across groups (all $P >= 0.219$). Median follow-up was 19.3, 25.7, and 21.8 months, respectively ($P = 0.084$). Postbaseline visit counts differed among groups (median, 7.0, 6.5, and 5.0; $P = 0.001$), supporting an all-visit longitudinal model (Table 1).

Procedures and Feasibility

Sixteen eyes were initially planned for PC repositioning. Three were converted intraoperatively to AVC: two because the existing tube was too short for reliable pupillary-zone visualization and one because IOL-iris adhesion obliterated the usable posterior chamber space. Final groups were therefore PC 13 and AVC 14. All 27 repositioning procedures achieved technical success, retained the original AGV plate, and required neither device explantation nor replacement (Fig. 1).

Primary Central ECD Trajectory

The primary pooled model included 44 participants and 319 central ECD observations. The random-intercept and random-slope model converged. Estimated central ECD slopes were − 107.41 cells/mm²/year (95% CI, − 137.80 to − 77.02) in Control and − 40.22 cells/mm²/year (95% CI, − 64.23 to − 16.21) after any repositioning. The repositioning-versus-Control slope difference was + 67.19 cells/mm²/year (95% CI, 28.46 to 105.92; $P < 0.001$), and the pooled group-by-time interaction was significant ($F = 11.56$; $P < 0.001$).

In the three-group model allowing group-specific random-slope variances, annual slopes were − 36.84 cells/mm²/year for PC, − 43.14 cells/mm²/year for AVC, and − 108.28 cells/mm²/year for Control. Compared with Control, slope differences were + 71.44 cells/mm²/year for PC (95% CI, 21.22 to 121.67; $P = 0.005$) and + 65.14 cells/mm²/year for AVC (95% CI, 15.35 to 114.93; $P = 0.010$). The exploratory PC-versus-AVC difference was + 6.30 cells/mm²/year (95% CI, − 11.52 to 24.13; $P = 0.488$). The three-group omnibus interaction was significant ($P = 0.021$) (Table 2; Fig. 2).

Regional ECD and Secondary Outcomes

The tube-adjacent cornea had the lowest baseline ECD in all groups. Annual tube-adjacent slopes were −41.19 cells/mm²/year in PC, − 45.43 in AVC, and − 103.17 in Control; PC-versus-Control and AVC-versus-Control differences were + 61.98 ($P < 0.001$) and + 57.74 cells/mm²/year ($P < 0.001$), respectively. Tube-opposite slopes were − 32.96, − 40.16, and − 85.96 cells/mm²/year, with corresponding differences of + 53.00 ($P = 0.003$) and + 45.80 cells/mm²/year ($P = 0.009$). PC and AVC did not differ at either region ($P = 0.659$ and $P = 0.363$).

CV increased over time in every group. Compared with Control, the central CV slope was lower in AVC (difference, − 1.55/year; $P < 0.001$) but not in PC ($P = 0.174$). Tube-adjacent and tube-opposite CV slopes were lower in both PC and AVC than in Control (PC, $P = 0.021$ and $P = 0.013$; AVC, $P < 0.001$ and $P = 0.004$, respectively). CCT increased by 21.25 µm/year in Control, compared with 3.42 µm/year in PC and 3.58 µm/year in AVC; both repositioning-versus-Control differences were approximately − 17.7 µm/year (both $P < 0.001$). BCVA worsened by 0.39 logMAR/year in Control, whereas slopes were − 0.03 in PC and − 0.02 in AVC; both differences versus Control were approximately − 0.4 logMAR/year (both $P < 0.001$). IOP slopes did not differ among groups (all contrast $P >= 0.516$).

Median central haze change was 0.5 [0, 1] grades in PC, 0 [− 1, 1] in AVC, and 1.5 [1, 2] in Control (Kruskal-Wallis $P = 0.008$). Central haze worsened by at least 1 grade in 5/13 PC eyes, 6/14 AVC eyes, and 14/17 Control eyes (Fisher $P = 0.023$). Tube-adjacent and tube-opposite haze changes also differed globally ($P = 0.003$ and $P = 0.002$), with lower changes after repositioning. PC and AVC did not differ in Holm-adjusted pairwise comparisons at any region (Table 3).

Adjusted and Sensitivity Analyses

In the adjusted postbaseline model (44 participants, 275 observations), the pooled repositioning-versus-Control slope difference was + 67.90 cells/mm²/year (95% CI, 27.55 to 108.24; $P < 0.001$). Allowing separate random-slope variances for repositioning and Control produced + 68.09 cells/mm²/year (95% CI, 18.91 to 117.27; $P = 0.007$); the similarly adjusted heterogeneous-variance model yielded + 67.52 cells/mm²/year (95% CI, 19.48 to 115.55; $P = 0.006$). A random-intercept-only model gave a smaller estimate (+ 38.91 cells/mm²/year; 95% CI, 29.00 to 48.81; $P < 0.001$), whereas participant-specific slopes compared by Welch t test yielded + 68.79 cells/mm²/year (95% CI, 14.86 to 122.72; $P = 0.015$). After excluding the single aphakic eye, the primary result remained robust (43 eyes, 311 observations; slope difference, + 71.55 cells/mm²/year; 95% CI, 32.24 to 110.86; $P < 0.001$). All analyses supported slower central ECD decline after repositioning, although the estimated magnitude varied with the assumptions about between-eye slope heterogeneity (Supplementary Table S2).

Safety and Complications

Four intraoperative complications occurred, 2 in PC and 2 in AVC ($P = 1.000$). Early postoperative complications occurred in 3/13 PC eyes and 7/14 AVC eyes ($P = 0.236$), comprising conjunctival

hyperemia in 5 eyes, fibrinous anterior chamber exudation in 4, and transient IOP elevation in 1 AVC eye. All were managed without AGV removal.

Late complications were recorded in 2/13 PC eyes, 2/14 AVC eyes, and 8/17 Control eyes ($P = 0.078$). The surgical events were recurrent tube-cornea contact, tube exposure, tube displacement with partial IOL dislocation after forceful eye rubbing, and an encapsulated Tenon bleb. In Control, 6 eyes developed corneal edema or endothelial decompensation, in which 1 subsequently underwent penetrating keratoplasty and 1 underwent DSAEK. Overall, at least 1 recorded complication occurred in 7/13 PC eyes, 10/14 AVC eyes, and 8/17 Control eyes ($P = 0.440$) (Supplementary Table S3).

Discussion

In this prospective cohort, posterior repositioning of a functioning anterior chamber AGV tube was associated with slower endothelial cell loss than observation in eyes with central ECD near 1000 cells/mm². Regional endothelial, corneal, and visual outcomes showed a similar pattern, while IOP control was maintained. All 27 tubes were repositioned without replacing the existing plate.

Most studies of ciliary sulcus and pars plana tube placement concern primary AGV implantation.[24–29] Later adjustment of a malpositioned tube has also been reported.[30] Here, endothelial decline occurred despite a functioning plate and filtration bleb. Repositioning the intraocular tube segment preserved the established outflow pathway and avoided a new drainage implant, an approach relevant when pressure control is satisfactory but the cornea continues to deteriorate.

The primary mixed-effects model estimated a 67.19 cells/mm²/year difference in central ECD slope between repositioning and Control; the adjusted estimate was similar (+ 67.90 cells/mm²/year). PC and AVC both showed slower decline than Control at the central, tube-adjacent, and tube-opposite cornea. The regional findings suggest that the difference was not confined to the immediate tube-adjacent area. The direct PC–AVC comparison was not significant.

Six of 17 Control eyes developed corneal edema or endothelial decompensation, and 2 underwent keratoplasty; neither event occurred after repositioning during follow-up. Corneal edema and graft surgery are recognized late complications of glaucoma drainage devices.[2, 32–35] An anterior chamber tube may continue to expose donor endothelium to abnormal aqueous flow and mechanical proximity, while previous surgery, inflammation, loss of anterior chamber immune privilege, and neovascularization add to graft failure risk.(21, 22, 36, 37)

At baseline, ECD was lowest beside the tube in all groups (660–677 cells/mm²). Localized turbulence, concentrated outflow, and intermittent tube-cornea proximity may damage adjacent endothelium.(12, 14–17) Cell enlargement and migration may extend the effects of local injury to other regions. Endothelial loss continued after repositioning, consistent with injury accumulated before surgery and the reduced endothelial reserve typical of advanced glaucoma eyes.

CCT, haze, and BCVA followed the same pattern as ECD: corneal thickening, haze progression, and visual deterioration were greater in Control. CV increased in all groups, but generally less rapidly after repositioning. Central CV differed from Control in AVC but not PC, whereas both repositioning groups had smaller CV increases at tube-adjacent and tube-opposite sites. IOP trajectories remained similar across groups.

Posterior repositioning changes the distance between the tube tip and cornea and alters aqueous flow. Computational models suggest increased local shear stress near anterior chamber tubes.[14] A sulcus tube receives aqueous behind the iris, whereas pars plana placement moves the opening into the anterior vitreous cavity. Both avoid a tube tip near the corneal endothelium. Endothelial loss may still progress because glaucoma, previous operations, and chronic inflammation remain relevant.(12, 38–41) The aim is to slow decline sufficiently to preserve corneal clarity and vision.

Preserving the AGV plate avoided dissection around a mature filtration bleb. The new scleral entry must be watertight to limit leakage and hypotony.[42] In PC cases, viscoelastic protected the iris and lens or IOL during tube passage; in AVC cases, vitrectomy helped prevent vitreous obstruction and traction.[43, 44] Three of 16 planned PC procedures were converted to AVC because of insufficient tube length or IOL-iris adhesion. The final route therefore remains an intraoperative anatomical decision.

Two intraoperative complications occurred in each surgical group, and early postoperative events affected 3 PC and 7 AVC eyes. Most were transient, chiefly conjunctival hyperemia and fibrinous anterior chamber exudation. Late complications included recurrent tube-cornea contact and tube exposure in PC, and an encapsulated Tenon bleb and tube displacement with partial IOL dislocation in AVC. The latter occurred after forceful eye rubbing, underscoring the importance of postoperative advice. None required removal of the AGV plate.

PC placement avoids vitrectomy and is suitable when there is adequate tube length, a stable lens or IOL, and a usable ciliary sulcus. AVC is preferable when iris abnormalities, synechiae, IOL position, or posterior segment disease preclude the PC route. The ECD entry thresholds identified eyes with active decline and limited reserve but were not established intervention cutoffs. The decision should combine serial ECD, corneal clarity, tube position, IOP stability, visual potential, and surgical anatomy.

The analysis used all available visits rather than baseline and a single final examination, as visit intervals and individual ECD slopes varied. Models allowing group-specific slope variances and analyses of participant-specific slopes yielded wider confidence intervals but retained the direction of the main association. Excluding the single aphakic eye also did not materially change the finding. The cohort was small, nonrandomized, and from one center. Treatment selection reflected patient preference and surgical suitability, follow-up intensity differed among groups, haze was assessed only at baseline and the last visit, and the observation period did not establish long-term tube stability or graft-free survival.

Conclusions

Posterior repositioning of a functioning anterior chamber AGV tube was technically feasible and maintained IOP control. Compared with conservative observation, it was accompanied by slower central and regional ECD loss, less corneal thickening and haze progression, and more stable vision. PC and AVC should be selected according to lens status, iris and IOL anatomy, tube length, and the need for vitrectomy.

Declarations

Author contributions

Qing Jiang: Writing - review and editing, Writing - original draft, Visualization, Validation, Methodology, Formal analysis, Conceptualization. Yuting Shao: Writing - review and editing, Writing - original draft, Visualization, Validation, Methodology. Juan Zhang: Writing - original draft, Data curation. Yunli Niu: Writing - review and editing, Data curation. Zhen Wang: Writing - review and editing, Data curation. Data curation. Ao Rong: Writing - review and editing, Data curation. Guotong Xu: Writing - review and editing, Data curation. Bing Li: Writing - review and editing, Data curation. Lixia Lv: Writing - review and editing. Haibin Tian: Writing - review and editing. Claus Cursiefen: Writing - review and editing, Supervision. Wenqing Shi: Writing - review and editing, Data curation. Yanlong Bi: Writing - review and editing, Supervision, Investigation, Funding acquisition, Data curation.

Competing interests

The authors declare no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Deidentified participant-level data can be shared by the corresponding author after evaluation of a reasonable request.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to improve language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Tables

Tables 1 to 3 are available in the Supplementary Files section.

Figures

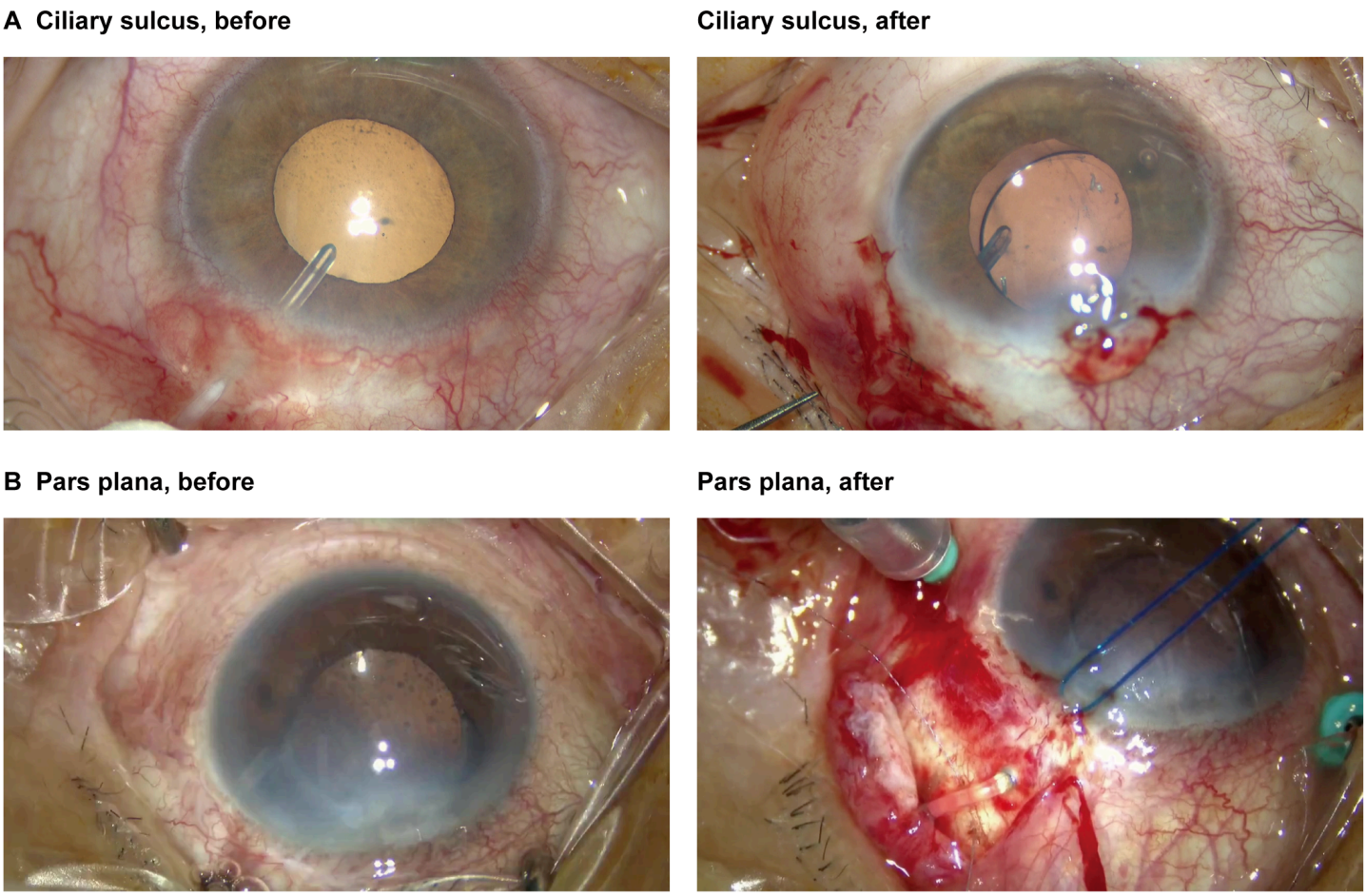


Figure 1

AGV tube repositioning through the ciliary sulcus into the posterior chamber or through the pars plana into the anterior vitreous cavity. (A) Ciliary sulcus/posterior chamber repositioning: preoperative anterior chamber tube (left) and post-repositioning tube visible in the pupillary zone (right). (B) Pars plana/anterior vitreous cavity repositioning: preoperative anterior chamber tube with localized corneal edema (left) and post-repositioning pars plana entry (right).

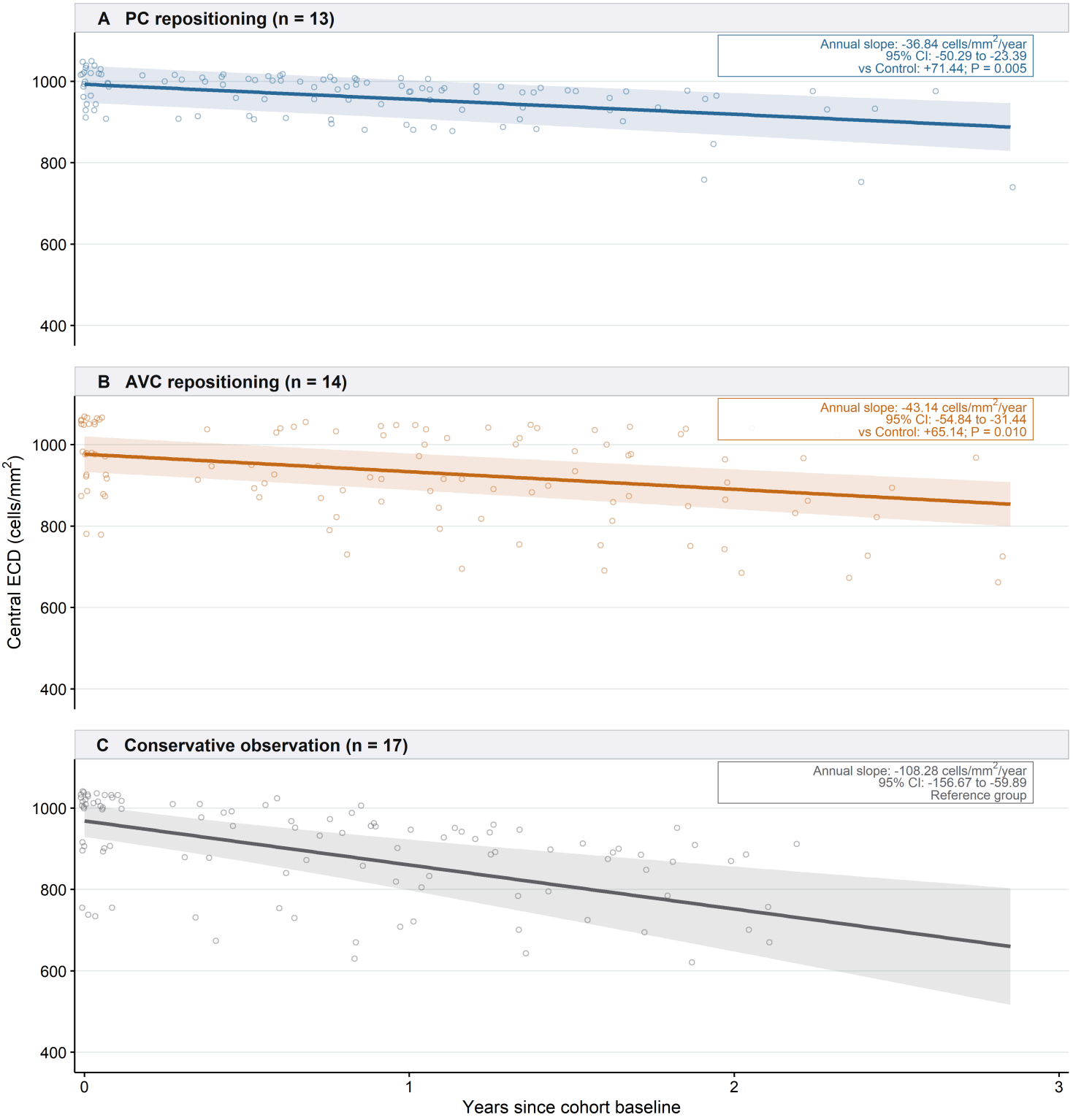


Figure 2

Group-specific observed central ECD values and mixed-effects model trajectories. (A) PC repositioning; (B) AVC repositioning; (C) conservative observation with anterior chamber tube. Hollow circles show all available participant visits; solid lines are fixed-effect predictions from the three-group model allowing group-specific random-slope variances; shaded bands are 95% confidence intervals. In-panel slopes and confidence intervals are in cells/mm²/year. PC and AVC panels also report their slope differences versus

Control. The exploratory PC-versus-AVC difference was +6.30 cells/mm²/year (95% CI, −11.52 to 24.13; *P* = 0.488).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table3.xlsx
- Table1.xlsx
- SupplementaryInformation.docx
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