Gold Micro-Shunt Implants versus Ahmed Glaucoma Valve: Mid-term Outcomes of a Randomized, Interventional, Prospective Clinical Trial

Purpose/Relevance:
To compare mid term outcomes of 24µ Gold Micro-Shunt (GMS), 48µ GMS and Ahmed Glaucoma Valve (AGV) implantation for treatment of refractory glaucoma.

Methods:
Three-armed, randomized, interventional, prospective clinical trial. Within an institutional setting, 29 adults (29 eyes) with open angle refractory glaucoma and prior failed filtration surgery were randomly assigned to 24µ GMS, 48µ GMS or AGV implantation. The three groups were comparatively evaluated, preoperatively and 1, 2, 3 and 5 years postoperatively. The main outcome measure was Kaplan–Meier survival rate. Secondary outcomes were postoperative IOP reduction and number of glaucoma medications.

Results:
Mean follow-up was 49.4 ± 5.2 months for the 24µ GMS group, 40.7 ± 4.4 months for the 48µ GMS group and 36.7 ± 7.5 months for the AGV group. Cumulative probabilities of success at 5 years were 77.8%, 72.7%, and 77.8%, respectively. In all groups the final IOP (in mmHg) was significantly lower than the preoperative IOP (17.8 ± 2.4 vs. 25.7 ± 0.7, P = 0.0001; 19.6 ± 5.2 vs. 35.6 ± 2.2, P = 0.0001; and 17.3 ± 2.6 vs. 33.5 ± 6.7, P = 0.004, in the 24µ GMS, 48µ GMS, and AGV groups, respectively). Differences between initial and final mean numbers of medications were not significant for all three groups (2.9 ± 0.8 v 2.9 ± 0.6, P = 0.24; 2.5 ± 0.8 v 3.2 ± 0.5, P = 0.24 and 2.1 ± 0.8 v 2.5 ± 0.6, P =0.43, in the 24µ GMS, 48µ GMS, and AGV groups, respectively).

Discussion:
The results of this study confirm the efficacy and safety of GMS implantation in the suprachoroidal space in eyes with refractory glaucoma. In addition, because of its prospective, randomized design and mid-term follow up, the study makes it possible to compare, for the first time, the efficacy of AGV and GMS devices in lowering IOP over time. Our results indicate that the AGV and the two GMS devices used were equally effective.

Conclusion:
During mid term follow up, success rates in the two GMS groups and the AGV group were similar. Likewise, IOP reduction and the need for continued glaucoma medical therapy remained high and were similar for all devices.

Reference:
**2 Collagen Crosslinking: A Novel Therapeutic Approach for Leaking Filtering Blebs**

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**Affiliation(s):**
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2. University of Montreal

**Purpose/Relevance:**
To examine the results of collagen crosslinking in treating leaking filtering blebs.

**Methods:**
Clinical and demographic information was collected through a retrospective chart review. Clinical outcomes were measured by intraocular pressure (IOP) and best-corrected visual acuity (BCVA). Anterior segment OCT exams were consulted. Post-crosslinking pachymetry and spectral microscopy were performed to follow for safety. A successful outcome was defined as resolution of aqueous humor leakage and improvement of hypotony and/or BCVA.

**Results:**
6 eyes that underwent crosslinking for leaking filtering blebs were identified. All leakages were late-onset. The average duration from trabeculectomy to leakage was 81.3 ± 44.8 (standard deviation) months. The average pre-leakage IOP decreased from 10 ± 3.5 mmHg to 4.2 ± 2.7 mmHg before crosslinking. The corresponding BCVA also worsened from 0.22 ± 0.16 (logMAR) to 0.45 ± 0.29. A standard crosslinking procedure was done. The average postoperative IOP was 7.0 ± 2.7, 8 ± 6.4 and 11.3 ± 7.4 mmHg and the average BCVA was 0.23 ± 0.16, 0.2 ± 0.17 and 0.39 ± 0.45 at 1-2 months, 3-6 months and >6 months respectively. Only one case had persistent bleb leakage after treatment and was subsequently treated with argon photocoagulation. All the other cases had successful outcomes. No adverse event was reported.

**Discussion:**
Riboflavin, when excited by ultraviolet A, interacts with reactive oxygen species to form covalent bonds between collagen fibers. Traditionally used to treat corneal ectatic disorders, crosslinking has also been used for corneal edema and infectious keratitis with success (1). Bleb leakage is a common complication after trabeculectomy and filtering blebs were found to have increased apoptosis of metabolically active cells and collagen synthesis suppression (2). By stabilizing the weakened collagen fibers and possibly by altering fibroblasts, collagen crosslinking may result in favorable clinical response in a leaking bleb, a finding confirmed by our experience.

**Conclusion:**
Collagen crosslinking is an effective, non-invasive treatment for filtering bleb leakage, and may spare patients invasive surgical bleb revisions.

**References:**
3 The Antifibrosis Effect of an FDA-Approved Histone Deacetylase Inhibitor, Suberoylanilide Hydroxamic Acid (SAHA) in Glaucoma Filtration Surgery

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Purpose/Relevance:
Glaucoma filtration surgery (GFS) is frequently used to treat glaucoma. Postoperative subconjunctival fibrosis is the main cause of failure of GFS. SAHA is a FDA-approved medication. We found SAHA highly potent to inhibit corneal scarring in vivo without toxicity. This study tested the hypothesis that the use of SAHA in GFS is effective and safe to inhibit postoperative fibrosis and increase the bleb survival.

Methods:
Eight New Zealand White rabbits were placed in SAHA group and control group and underwent sclerotomy surgery. Animals received subconjunctival injection of 0.2ml 50uM SAHA or balanced saline solution (BSS) at surgical site 30 minutes before the surgery. Then a sclerotomy was performed. The intraocular pressure (IOP) was measured before the surgery and 3, 7 and 14 days after the surgery. Clinical examination was performed at postoperative day 3, 7 and 14 to evaluate the gross appearance, and the size and vascularity of the bleb were graded. On postoperative day 14, rabbits were sacrificed and the specimens of blebs were collected and snap frozen in optimal cutting temperature (OCT) fluid. The tissues were sectioned and stained with hematoxylin and eosin (H&E) for histology study. The level of fibrosis was assessed by immunostaining with α-smooth muscle actin (SMA), a marker for myofibroblast, and F actin, a marker for activated fibroblasts.

Results:
The clinical exams revealed larger elevated blebs in SAHA group. The vascularity of the blebs was significantly reduced in SAHA group compared to the control one. H&E histology study showed significantly decreased fibrosis at sclerotomy sites of SAHA group. Immunostaining detected significantly decreased SMA+ and F-actin+ cells in SAHA group. There were no apparent clinical signs of toxicity in the eyes of SAHA treated rabbits.

Discussion:
The results suggested SAHA inhibits the activation of myofibroblasts and fibroblasts, significantly decreased the postoperative fibrosis in glaucoma filtration surgery.

Conclusion:
SAHA significantly decreased postoperative fibrosis and improved the outcome of GFS. SAHA may be a potential antifibrotic agent used in glaucoma surgery.

Reference:
Factors Associated with Successful Outcomes in Trabectome-Only Surgery

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2 Scheie Eye Institute
3 University of Pittsburgh School of Medicine

Purpose/Relevance:
Surgical outcomes can be enhanced by identifying the proper patient. Our objective is to investigate which factors and patient characteristics are associated with success in Trabectome only surgical procedures.

Methods:
There were 594 glaucoma patients who underwent Trabectome only with at least 12 months of follow-up that were analyzed. Baseline demographics and medical data were collected. The main outcome measure was failure as defined as IOP>21mmHg, IOP reduced by less than 20% from baseline on any two consecutive visits after 3 months and if secondary glaucoma surgery was performed. Risk factors for failure were determined by using univariate and multivariate Cox regression with time-varying variable.

Results:
Of the Trabectome only study group, majority were Caucasians (61%), female (55%) with a mean age of 67±16 and diagnosed with primary open angle glaucoma (POAG) (75%). At baseline, IOP was 24.3±7.7mmHg and number of medications was 2.7±1.3. At 12 months, IOP was 16.4±3.9 (p<0.01) and number of medications was 2.0±1.3 (p<0.01). The survival rate at 12 months was 77%. Multivariate analysis showed that diagnosis of pseudoexfoliative glaucoma has a 60% lower risk of failure than patients with POAG (95% Confidence Interval (CI): 0.19-0.82). Patients that were on one less glaucoma medication had 30% lower risk of failure than patients with one more medications (95% CI: 0.81-0.63). Diagnosis and number of medications were found to be statistically significant. Race, age, gender and visual field were not statistically significant.

Discussion:
A recently published prospective study by Jordan et al reported supportive findings in a subgroup analysis of 173 eyes with pseudo-exfoliative glaucoma showing better IOP control and reduction of medications than in the POAG group who underwent Trabectome with cataract extraction(1). In our study, Trabectome only populations were selected to identify risk factors since Trabectome with cataract surgery had very low failures to allow identification of risk factors.

Conclusion:
Pseudo-exfoliative glaucoma and low numbers of glaucoma medications are factors associated with successful outcomes in Trabectome only procedures.

Reference:
5 Clinical Safety and Efficacy of 360-Degree Gonioscopy-Assisted Transluminal Trabeculotomy (GATT) for The Treatment of Refractory Glaucomas

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Affiliation(s): 1 Glaucoma Associates of Texas

Purpose/Relevance:
To describe results of the GATT procedure in eyes with previously failed glaucoma surgery. Additionally, to investigate the IOP lowering effect, risk profile, and postoperative complications in this group.

Methods:
This retrospective, IRB-approved chart review at Glaucoma Associates of Texas analyzed data of 23 eyes that underwent a GATT procedure for the treatment of refractory glaucomas, including eyes with prior trabeculectomy (n=11), prior tube (n=8), or both (n=4). Intraocular pressure (IOP), number of IOP lowering medications, visual acuity, complications, and secondary procedures were recorded at baseline, 1 day, 1 week, and 1, 3, 6, 12 months postoperatively.

Results:
The pre-operative mean (SD) IOP was 25.3 (6.9) mmHg on 3.3 (1.1) medications, which decreased to 18.5 (3.3) mmHg [p=0.030] on 1.8 (1.2) medications [p=0.001] at 12 months. Mean follow-up time is 10.9 (range 6-19) months. At postoperative week one, 9 (39%) eyes had a transient layered hyphema (the most common complication). There was no difference between pre- and post-operative visual acuity. Two eyes required further glaucoma surgery, one tube and one trabeculectomy. Cumulative proportions [S.E.] of success (without reop and IOP lowered by >= 20%) were 96% [4%], 96% [4%], 86% [8%], and 50% [13%], at months 3, 6, 9, and 12 respectively.

Discussion:
The GATT procedure, a minimally invasive conjunctival sparing circumferential trabeculotomy, is effective in lowering IOP in primary glaucomas. Options for eyes that fail external filtration surgery include further trabeculectomy or drainage implants, or cyclodestruction. Eyes having the GATT procedure after failing prior glaucoma surgery fared well with good IOP control and low complications, offering a minimally invasive alternative for refractory glaucomas. Longer follow up is required to determine the long-term safety and efficacy of this procedure in these glaucomas.

Conclusion:
The GATT procedure appears to be effective in reducing IOP in patients with refractory glaucomas, with an excellent safety profile.

References:
Safety and Efficacy of Stand-Alone CyPass Micro-Stent Implantation in Patients Refractory to Topical Glaucoma Therapy: One-Year Results

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Affiliation(s): 1 Ophthalmology Associates 2 Universidad Complutense, Madrid, Spain 3 Eye Clinic, Cham Germany 4 University of Pisa, Pisa, Italy 5 Eye Institute of Sofia, Sofia, Bulgaria 6 Transcend Medical

Purpose/Relevance:
Evaluate the safety and outcomes of supraciliary micro-stent implantation as a treatment for primary open-angle glaucoma (POAG).

Methods:
In prospective, multicenter interventional case series (DUETTE), the CyPass Micro-Stent (Transcend Medical, Inc, Menlo Park, CA) was implanted into the supraciliary space through a 1.5 mm incision in subjects with POAG for whom medical therapy was insufficient to control intraocular pressure. Safety data, including adverse events, complications, intraocular pressure, and medications, are reported up to 12 months (12M) postoperative.

Results:
Sixty-five subjects were enrolled in the study, and there were 47 patients evaluable at 12M. At baseline, the majority of subjects (69%) were on 2 or more medications and all had a baseline medicated IOP ≥ 21 mmHg. Mean ± standard deviation (SD) medicated IOP at baseline was 24.5 ± 2.8 mmHg. There were no cases of suprachoroidal hemorrhage, bleb-related complications, retinal complications or hypotony maculopathy. At 12 months after surgery, mean ± SD IOP was 16.7 ± 5.5 mmHg with a 32% reduction in IOP from baseline (p<0.0001). Mean ± SD medication usage (meds) also decreased from 2.2 ± 1.1 meds to 1.5 ± 1.3 meds at 12M (p=0.008).

Discussion:
The results of this study demonstrate the performance of a supraciliary micro-stent as a standalone treatment for patients with POAG, without the potentially confounding effects of phaco-cataract surgery.

Conclusion:
The supraciliary CyPass Micro-Stent provided safe and sustained IOP reduction in patients with POAG refractory to medications.

Reference:
Inter-Eye Differences in Patients with Pseudoexfoliation Syndrome Presenting with Intraocular Lens Dislocation

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Purpose/Relevance:
Pseudoexfoliation (PXF) syndrome is the most common identifiable cause of secondary glaucoma. It is considered a bilateral syndrome with asymmetric manifestations, and is associated with higher rates of complications after cataract surgery, including intraocular pressure rise and intraocular lens (IOL) dislocation. The purpose of this study was to analyze differences in glaucoma severity between fellow eyes of patients with PXF, who present with IOL dislocation.

Methods:
Consecutive patients with histories of PXF and bilateral uneventful cataract surgery with in-the-bag IOLs presenting with IOL dislocation (n=71) were retrospectively reviewed over a 5-year period. Fellow eyes were compared using McNemar’s test to assess the presence of glaucoma, and Wilcoxon signed rank tests to assess: corrected distance visual acuity (CDVA), intraocular pressure (IOP), mean deviation (MD) on visual field, retinal nerve fiber layer (RNFL) thickness, and glaucoma medication requirements. These parameters were also compared pre- and post-IOL exchange or repositioning surgery in the eye experiencing IOL dislocation.

Results:
Seventy-one participants were included, of whom 59% were female. The average age was 80 ± 6 (SD) years. The mean duration between initial cataract surgery and IOL exchange/repositioning was 8 ± 5 years. The affected eye was more likely to have glaucoma, or more severe glaucoma, than the fellow eye (p<0.0005). In addition, the affected eye had worse mean CDVA (1.14 ± 0.79 logMAR vs. 0.35 ± 0.46 logMAR, p<0.0005), higher mean IOP (19 ± 7 vs. 15 ± 4, p<0.0005), greater mean number of glaucoma medication classes (1.4 ± 1.4 vs. 0.5 ± 1.1, p<0.0005), worse MD (-13.83 ± 6.89 vs. -.659 ± 6.63 dB, p<0.0005) and mean RNFL (69.2 ± 26.3 vs. 82.4 ± 13.7, p=0.001). In the affected eye, there were post-operative improvements in mean CDVA, IOP, and glaucoma medication requirements.

Discussion:
When comparing fellow eyes in patients with pseudoexfoliation syndrome, eyes presenting with IOL dislocation were more likely to be associated with the presence of glaucoma, and of greater severity.

Conclusion:
In pseudoexfoliation syndrome with pseudophakia, glaucoma severity may be a predictor of late onset IOL dislocation, presenting years after cataract surgery.

References:
Markers of Vascular Structure and Function Associated with Angle Surgery Outcomes

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Affiliation(s): \( ^1 \) University of Michigan

Purpose/Relevance:
Determine markers of vascular structure and function (ie, hyphema, fluorescein canalograms) associated with surgery outcomes using iTrack™ 250A microcatheter.

Methods:
Review of canaloplasty and trabeculotomy cases enrolled in an IRBMED protocol. The following data were reviewed: demographics, diagnoses, lasers, surgeries, medications, glaucoma severity, intraocular pressure (IOP), complications and interventions. Fluorescein canalograms videos were analyzed by ImageJ software. Vascular structures downstream of Schlemm’s canal were examined in human research eyes by fluorescent microspheres.

Results:
Canaloplasty or trabeculotomy was performed on 32 eyes (60.4±18.9 yrs; range 15–88 yrs) with glaucoma diagnoses of primary open-angle, secondary, uveitic, normal tension or juvenile. These eyes had 60 procedures of laser, glaucoma or cataract surgeries. The IOP outcome was 21±8.6 mmHg pre-operatively and 12±3.3 at the last visit. The medication count outcome was 2.8 pre-operatively and 1.7 at the last visit. Complications included partial trabeculotomy (n=2, who had trabecuoplasty), non-clearing hemorrhage on posterior capsule (n=1, who had combined phaco/IOL and canaloplasty) and transient hematoma with descemet’s detachment (n=1). There was no correlation between IOP outcome and hyphema (1). Preliminary analyses of the fluorescein canalogram videos show variation between cases in retrograde fluorescein diffusion through the trabecular meshwork (TM), anterograde flow through Schlemm’s canal, and anterograde flow through episcleral and intrascleral veins. Preliminary analyses of fluorescent microsphere canalogram from research eyes show more prominent episcleral and intrascleral veins in nasal compared to temporal regions.

Discussion:
This small case series shows: 1) canaloplasty is possible after failed surgeries; 2) hyphema does not correlate with outcome; 3) preliminary canalogram analysis shows variation in fluorescein permeability through the TM and outflow through Schlemm’s canal and the episcleral and intrascleral veins.

Conclusion:
The episcleral and intrascleral veins downstream of Schlemm’s canal may be relevant to assess angle surgery outcomes.

Reference:
9 IOP Elevation After Cataract Surgery: Results for Residents and Senior Staff at Henry Ford Health System (HFHS)

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Purpose/Relevance:
To determine the incidence of IOP elevation on postoperative day 1 (POD#1) following cataract surgery by residents and senior staff for the sake of direct comparison while examining the influence of associated variables. A previous study established a resident POD#1 IOP elevation rate (defined as >23mmHg) of 22% without direct comparison to senior staff and without examining incremental increase over baseline.1

Methods:
Retrospective review of 2472 consecutive 2.2-2.8mm temporal clear corneal cataract extractions by phacoemulsification performed by either residents or senior staff at HFHS. Fellow eyes were excluded resulting in 1847 eyes. IOP measurements of >40mmHg, >30mmHg and >23mmHg were examined along with incremental IOP elevations of ≥ 20mmHg and 10mmHg relative to preoperative/baseline IOP. Associated variables included: Age, Gender, Diabetes, Hypertension, Glaucoma, Glaucoma Suspicion, Uveitis, and Vitreous Loss. Logistic regression analysis of the data was performed using a Wald Chi-Square test.

Results:
>40 mmHg: Overall 1.0%, Residents 3.7%, Staff 0.7%. Significant results: Glaucoma 4.4 (p=0.006), trauma 10.3 (p=0.003), vitreous loss 12.42 (p<0.001), resident 5.76 (p<0.001).

>30 mmHg: Overall 4.7%, Residents 10.1%, Staff 4.0%. Significant results: Glaucoma 3.0 (p<0.001), trauma 5.7 (p<0.001), vitreous loss 7.4 (p<0.001), resident 2.7 (p<0.001).

>23 mmHg: Overall 14.6%, Residents 23.3%, Staff 13.6%. Significant results: Male 1.4 (p=0.006), Glaucoma Suspicion 1.54 (p<0.01), Glaucoma 2.3 (p<0.001), trauma 3.0 (p=0.01), vitreous loss 3.6 (p<0.001), resident 1.9 (p<0.001).

≥ 20 mmHg from baseline: Overall 1.7%, Residents 4.8%, Staff 1.4%. Significant results: Glaucoma 2.8 (p=0.002), trauma 8.8 (p<0.001), vitreous loss 9.1 (p<0.001), resident 3.6 (p=0.002).

≥ 10 mmHg from baseline: Overall 10.9%, Residents 20.6%, Staff 9.8%. Significant results: Male 1.6 (p=0.002) Glaucoma 2.0 (p<0.001), trauma 2.8 (p=0.03), vitreous loss 4.5 (p<0.001), resident 2.4 (p<0.001).

Discussion:
The resident incidence at HFHS (23.3%) was similar to the previously determined incidence. The simultaneous senior staff incidence was 12.3%. Resident odds ratios were significant for all measurements. Other variables: Gender, Trauma, Vitreous Loss, Glaucoma, Glaucoma Suspicion, were statistically significant contributors. Patients with OAG had rates of POD#1 IOP > 23 mmHg of 24.5%, >30 mmHg of 10.3%, >40 mmHg of 2.6% . This compared with rates of 12.2%, 3.7% and 0.6% respectively for those without Glaucoma (odds ratios all being statistically significant).

Conclusion:
Residents have 2-5 times the incidence of POD#1 IOP elevation and other variables such as gender, trauma, vitreous loss, Glaucoma, Glaucoma Suspicion are also significant contributors.

Reference:
Effect of Trabectome in Patients with Prior Failed Tube Shunts Surgery

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Purpose/Relevance:
To evaluate the safety and efficacy of Trabectome after failed Tube Shunt Surgery

Methods:
24 patients with prior failed tube shunt surgery that underwent the Trabectome alone or Trabectome combined with phacoemulsification procedures were included in this study. All patients had at least 3m of follow-up. Outcomes measured included IOP, glaucoma medications and secondary glaucoma surgeries if any. The success for Kaplan Meier survival analysis is defined as IOP < 21 mmHg, IOP reduced by at least 20% from pre-operative IOP, and no secondary glaucoma surgery.

Results:
The mean pre-operative IOP was 23.0 ± 6.5 mmHg and mean number of glaucoma medications was 3.2 ± 1.4. At 12 months, IOP was reduced to 16.1 ± 4.9 mmHg (p=0.02) and number of medications was reduced to 2.4 ± 1.5 (p=0.34). The survival rate at 12 months was 83% and 3 patients required additional glaucoma surgery with 15 patients reaching 12 months follow up. 2 patients were reported with hypotony at day one, but quickly resolved.

Discussion:
Trabecular bypass procedures have traditionally been considered an approach appropriate for early to moderate glaucoma, however, our study indicates benefit in refractory glaucoma as well. Eyes that are prone to conjunctival scarring and hypertrophic wound healing respond such as those who have failed tube shunt surgery, may benefit from procedures that avoid conjunctival incision such as trabectome. This Study indicates potential benefits in this patient population.

Conclusion:
Trabectome may be a viable option for patients with prior failed tube shunt surgery.

References:
Outcomes of Sequential Glaucoma Drainage Implants in Refractory Glaucoma

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Purpose/Relevance:
To describe the demographics, efficacy, and complications of eyes that have undergone a second glaucoma drainage implant procedure.

Methods:
A retrospective review of eyes that underwent a second glaucoma drainage implant (GDI) surgery from 2006 to 2013 was conducted. Eyes with a minimum follow up of at least 3 months were included. Primary outcome measures included intraocular pressure (IOP) reduction and failure rates. Secondary outcome measures included glaucoma medication use and number of reoperations. Success was defined as IOP<22 mmHg and IOP >5 mmHg with at least 25% reduction in IOP at 3 months follow up or more. Failure was defined as the lack of success, the need for another glaucoma surgical procedure or loss of light perception vision.

Results:
Fifty eyes (48 patients) had a mean follow up of 25.1 ± 23.2 months. Sixty-four percent of second GDIs were an Ahmed-FP7 valve implant (New World Medical, Inc., Rancho Cucamonga, CA) and 24% were either a Baerveldt-350 or 250 implant (Abbott Medical Optics, Inc., Santa Ana, CA). Fifty percent of second GDIs were placed in the inferotemporal quadrant and 30% were place in the inferonasal quadrant. The average IOP reduction at one-year follow up was 43% ± 25%. The failure rate at one-year follow up was 42% (95% confidence interval 29-57%) (Figure 1). The number of postoperative glaucoma medications at one-year follow up was reduced from 3.7 ± 1.2 preoperatively to 1.8 ± 1.3 medications postoperatively. Four eyes required reoperation for better IOP control and 6 eyes required reoperation for complications.

Discussion:
This is the largest study to date documenting the postoperative course of sequential GDIs. The postoperative IOP control and reduction in hypotensive agents in this case series is similar to previous studies.1,2

Conclusion:
Most eyes undergoing a second GDI can achieve adequate IOP control with fewer hypotensive agents. Patients should be counseled for the possible need for another glaucoma surgery for IOP control or tube revision.

References:
12 Comparison Between Trabectome Combined with Phacoemulsification Cataract extraction (PCE) and Trabeculectomy Combined with PCE

BRIAN A. FRANCIS

Purpose/Relevance:
To compare the intraocular pressure (IOP)-lowering effect of Trabectome combined with Phacoemulsification cataract extraction (PCE) and trabeculectomy combined with PCE.

Methods:
This is a prospective, non-randomized, comparative trial of 112 patients. There were 89 eyes in the Trabectome+PCE group and 23 eyes in the Trabeculectomy+PCE group with a minimum follow-up of 1 year. The main outcome measures were intraocular pressure (IOP) and complications, and glaucoma medications.

Results:
Trabectome+PCE: The mean IOP was 22.1±5.5 mmHg (n=89) preoperatively and reduced by 27% to 15.4±3.1 mmHg at 1 year (p<0.01). Subsequent secondary glaucoma procedures were performed in 4 (4%) patients by the end of 1 year.
Trabeculectomy+PCE: The mean IOP preoperatively was 23.0±10.7 mmHg (n=23) and reduced by 44% to 11.0±5.7 mmHg at 1 year (p<0.01). Subsequent procedures were performed in 3 (13%) patients.

Discussion:
The reduction in IOP in both the Trabeculectomy+PCE and Trabectome+PCE groups was significant at 1 year. Applying the success criteria of the Tube vs. Trabeculectomy Study, there was no significant difference in success at 1 year between the groups. Although IOP reduction was greater at one (1) year in the Trabeculectomy+PCE group, the incidence of postoperative complications and surgical re-intervention was also higher in this group.

Conclusion:
Trabectome+PCE are a viable alternative to Trabeculectomy+PCE due to its favorable risk profile. Data suggests that patients requiring very low target IOP may still benefit from Trabeculectomy+PCE.

Reference:
Postoperative Outcomes Through 18 Months Following Implantation of Two Trabecular Micro-Bypass Stents, One Suprachoroidal Stent and Travoprost in OAG Not Controlled by Trabeculectomy and Medications

L. JAY KATZ
Affiliation(s): 1 Wills Eye Hospital

Purpose/Relevance:
An advantage of trabecular bypass therapy is restoration of natural physiologic outflow in OAG. Outcomes of multiple trabecular bypass stent surgery have demonstrated use of this technology as titratable therapy to reduce intraocular pressure (IOP) to ≤15 mmHg with sustained efficacy and safety.[1] Combination of trabecular bypass with either a topical glaucoma medication or a suprachoroidal stent may further reduce IOP for treatment of refractory OAG. This study assessed outcomes after surgery with two trabecular bypass stents and one suprachoroidal stent with postoperatively prescribed Travoprost in refractory open angle glaucoma (OAG) subjects previously not controlled following trabeculectomy and medical therapy.

Methods:
A prospective study by the Micro-Invasive Glaucoma Surgery (MIGS) Study Group enrolled phakic or pseudophakic subjects with OAG and IOP ≥18 mmHg and ≤45 mmHg following trabeculectomy and use of 1 to 3 ocular hypotensive medications. Subjects then underwent medication washout prior to surgery and were eligible for surgery if their unmedicated IOP was ≥21 mmHg and ≤45 mmHg. Eighty eligible subjects were implanted with two iStents and one iStent supra (Glaukos) and prescribed travoprost postoperatively. One year efficacy endpoints were IOP reduction ≥20% and IOP ≤ 15 mmHg. Slit-lamp and optic nerve evaluation, BCVA and adverse events will comprise the safety evaluation through five years.

Results:
To date, 80 subjects have been enrolled and 30 subjects have been followed 18 months. Mean preoperative IOP was 22.0 ± 3.1 mmHg on an average of 1.2 ± 0.4 medications and 26.4 ± 2.4 mmHg after medication washout. Mean postoperative IOP was 13.3 ± 1.8 mmHg at 6 months and 13.6 ± 1.5 mmHg at 12 months. In 30 subjects followed through Month 18, mean IOP was 13.2 ± 1.3 mmHg. All subjects were on one postoperative medication. No intraoperative or postoperative ocular adverse events have been reported to date.

Discussion:
Data through 18 months show substantial IOP reduction with reduction in medications and no adverse event reports.

Conclusion:
Eighteen month results in this study of two trabecular bypass stents, one suprachoroidal stent and one postoperative medication in refractory OAG subjects uncontrolled after trabeculectomy showed significant IOP reduction, reduction in drug burden, and an overall favorable safety profile.

Reference:
15  Degree of Angle Opening Is Not Related to Outcome in Phaco-Trabectome or Trabectome Surgery

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3 University of Pittsburgh School of Medicine

Purpose/Relevance:
The purpose of this study was to compare outcomes of phacotrabectome (PT) and trabectome surgery (T) by degree of angle and to determine to what extent angle changes may contribute to IOP lowering in combined procedures. Progressively narrow angles have been shown to be correlated with higher Intraocular Pressure (IOP), presumably by causing higher outflow resistance1, while cataract surgery may deepen the angle and lower IOP2. Narrow angles were considered a relative contraindication to trabectome surgery3 because they could be more prone to synechiae formation, descemetization or fibrosis.

Methods:
This retrospective study enrolled all patients in the Trabectome Study Group database3 with 1 year follow-up. Inclusion criteria were patients with a diagnosis of glaucoma (with or without visually significant cataract). Exclusion criteria were missing preoperative data, including Shaffer angle grading, and less than 1 year of follow-up. A total of 617 patients were included. The indication for T consisted of an IOP above target after maximally tolerated medical or laser therapy. The indication for PT consisted of a visually significant cataract with 20/50 or worse on brightness acuity testing and the need to lower IOP or the number of glaucoma medications. The main outcome measure was the IOP at 12 months.

Results:
In T, for patients with Shaffer grade (SG)<=2, the IOP was reduced from a baseline of 27.3±7.4mmHg to 15.7±3.0 mmHg (42% decrease, p<0.01), on 0.2 less medications (p=1.00) at 12 months. In T patients with SG>=3, the IOP was reduced from 26.1±7.8 mmHg to 16.4±3.9 (37% decrease, p<0.01) on 0.8 less medications (p<0.01). In PT, patients with SG=2 had a decrease in IOP from 20.7±7.0mmHg to 15.7±3.6 (24% decrease, p<0.01), on 0.8 less medications (p<0.01). In PT patients with SG>=3, the IOP was reduced from 22.6±6.4 mmHg to 17.0±3.4 (25% decrease, p<0.01) on 0.7 less medications (p<0.01). There was no statistically significant difference between SGs=2 and SGs=3 in IOP or number of medications in either the T or PT groups after 1 year. There was also no statistically significant difference in the number of complications.

Discussion:
Preoperative angle width is not correlated with IOP 1 year after trabectome surgery. We found no statistically significant difference in IOP 1 year after trabectome surgery when comparing cases of anatomically narrow angles to open angle glaucoma. Trabectome surgery significantly decreases IOP even in the presence of narrow angles.

Conclusion:
Narrow angles, previously relatively contraindicated for trabectome surgery, do not influence outcomes. A deeper angle preoperatively did not correlate with better IOP outcomes.

References:
16 Collagen Matrix (Ologen) as a Patch Graft in Glaucoma Tube Shunt Surgery

JOHN STEPHENS  
Affiliation(s):  Dean McGee Eye Institute

Purpose/Relevance:
To determine the safety and efficacy of collagen matrix (Ologen) as a patch graft in glaucoma drainage surgery. Collagen matrix grafts do not need to be harvested from human donors and have improved cosmesis compared to sclera or pericardium.

Methods:
An institutional, retrospective review of 43 patients with at least 12 months follow up status post glaucoma drainage implant surgery were evaluated for signs of tube erosion after initial placement of collagen matrix patch graft.

Results:
41 of 43 eyes (95.3%) required no intervention for patch graft tube erosion. Average follow up was 32 months (range: 12-45). Tube erosion in two patients occurred at 4 and 26 months post op requiring revision.

Discussion:
Both patients with tube erosion had histories suggestive of poor wound healing and/or ocular inflammation. The first case was in an 86-year-old woman with open angle glaucoma and a history of iritis. Partial exposure occurred at one week and full exposure at 4 months. Revision with conjunctiva was successful for a total follow up of 32 months. The second was a 74-year-old woman with open angle glaucoma and long-standing diabetes mellitus with superior conjunctival scarring. Erosion occurred at 26 months. Revision with donor sclera was successful for a total follow up of 32 months.

Conclusion:
Collagen matrix patch grafts may be used successfully in glaucoma tube shunt surgery. They offer the advantage of not needing to be harvested from a human donor and provide better cosmesis than sclera or pericardium; however, like other grafts, there may be an increased risk of exposure in patients with a history of ocular inflammation or long-standing diabetes mellitus.

References:
17 Short-Term Outcomes with a Porous Plate Valved Glaucoma Implant

AHMAD A. AREF 1, Eun Sara Huh 1, Thasarat S. Vajaranant 1, Jacob T. Wilensky 1
Affiliation(s): 1 Illinois Eye & Ear Infirmary

Purpose/Relevance:
To study the short-term safety and efficacy of porous plate valved glaucoma drainage implant (GDI) surgery in glaucomatous individuals.

Methods:
This study was approved by the University of Illinois at Chicago institutional review board. A retrospective medical record review of all patients undergoing porous plate valved GDI surgery at a single tertiary care eye center was performed. Exclusion criteria included < 30 days of follow-up and GDI surgery combined with keratoprosthesis implantation. The primary outcome was postoperative intraocular pressure (IOP). Secondary outcomes included visual acuity, use of supplemental medical therapy, complications, and incidence of a hypertensive phase. A hypertensive phase was defined as IOP greater than 21 mmHg after initial postoperative reduction to less than 22 mmHg [1].

Results:
Thirty-one eyes underwent porous plate valved GDI surgery. Seven eyes were excluded due to inadequate follow-up (n=5) or combined keratoprosthesis surgery (n=2). Among included participants (n=24), mean follow-up time was 111.5±46.5 days. IOP and medication usage were reduced from 28±10.6 mmHg and 2.9±1.2 medications to 17±3.4 mm Hg (P<.001) and 1.7±1.4 (P<.001) medications by last follow-up, respectively. Four (18%) eyes experienced vision loss > 2 Snellen lines. Nine (37.5%) eyes experienced a hypertensive phase at 71±26 days postoperatively. Complications included postoperative hyphema (n=1) and aqueous misdirection (n=1).

Discussion:
The porous plate valved glaucoma implant is a modification of polypropylene plate valved devices. The valve mechanism is encased within a porous polyethylene shell with the goal of reducing capsular outflow resistance. In contrast to prior reports [2], the present study suggests that a hypertensive phase remains possible with this novel device in the postoperative period.

Conclusion:
The porous plate valved glaucoma implant is effective in the short-term IOP-lowering of glaucomatous patients. However, the potential for a hypertensive phase requires close monitoring for possible re-institution of adjunctive medical therapy. Future study with longer-term follow-up is required to better assess the potential utility of this device in glaucoma surgical management.

References:
Outcomes of Glaucoma Drainage Implant Surgery in Patients with Limbal Stem Cell Transplant

TARA GOLISCH 1, Anup K. Khatana 1, Edward J. Holland 1, Jeff Zink 1
Affiliation(s): 1 Cincinnati Eye Institute

Purpose/Relevance:
Many patients with severe ocular surface disease requiring limbal stem cell transplant also have glaucoma. Medical management of glaucoma in these patients can be difficult. Often, these eyes require surgical intervention to lower intraocular pressure, and glaucoma drainage implant surgery is a viable option. This study aims to examine the outcome of glaucoma drainage implant surgery in patients with limbal stem cell transplant surgery.

Methods:
Retrospective chart review of patients who underwent limbal stem cell transplant surgery as well as glaucoma drainage implant surgery at Cincinnati Eye Institute between January 1, 2000 and October 31, 2013. Limbal stem cell transplant surgery was performed by a single surgeon (EJH). Glaucoma drainage implant surgery was performed either by AKK or by JMZ. All eyes were followed for a minimum of 18 months (mean 45.5 months). Intraocular pressure, number of pressure-lowering medications, complications, and additional surgeries were noted at baseline and through last follow-up.

Results:
16 eyes of 12 patients met the inclusion criteria. Mean age at the time of glaucoma drainage implant surgery was 43.7 years. A Baerveldt 101-350 implant was used in all eyes; 15 with anterior chamber insertion and one with pars plana insertion. Four eyes had MMC exposure at the time of the tube. 10 eyes had GDI surgery before stem cell transplant, 6 had GDI surgery after stem cell transplant.

Prior to surgery, mean IOP was 26.5±10.5 mmHg and mean number of pressure-lowering drops was 2.8±1.6. At 18 months (n=16), mean IOP was 11.8±4.1mmHg and mean number of drops was 1.1±1.3.

No eyes required additional surgery to lower IOP. Two of the eyes required at least one revision for tube erosion; neither had been exposed to MMC. Three eyes required surgery to treat hypotony. One eye, which was not treated with MMC, had failure of the graft.

Discussion:
This study, though consisting of a small cohort, shows that glaucoma drainage implant surgery is an effective surgical option to lower intraocular pressure in patients with stem cell transplantation.

Conclusion:
Additional research with a larger study population is warranted to give further insight into management of glaucoma in limbal stem cell transplant patients.

Reference:
19 Phaco-iStent in Management of Patients with Cataract and Advanced Open Angle Glaucoma

SOURABH ARORA 1, Khaliq Kurji 1, Michael W. Dorey 1, Chris J. Rudnisky 1
Affiliation(s): 1 University of Alberta

Purpose/Relevance:
To investigate the efficacy and safety of Phaco-iStent in patients with cataract and advanced stage open angle glaucoma (OAG).

Methods:
Patients with advanced OAG who underwent combined phacoemulsification and implantation of two iStents (Phaco-iStent) between August 2011 and February 2013 at a University-affiliated hospital were retrospectively reviewed. Cases were identified by reviewing billing codes, and cross-checking with booked surgical lists; eyes with less than 6 months follow-up were excluded. The primary study outcome was IOP reduction and change in number of glaucoma medications at 6 and 12 months follow-up. Success criteria were: no need for additional surgery and IOP maintained ≤ 14 mmHg with or without glaucoma medications, throughout 12 months follow-up.

Results:
Fifty-one eyes of 41 patients were included in the study. Two patients had prior filtering surgery. Pre-operative IOP was 17.9 ± 5.4 (range: 9-32) and pre-operative number of medications was 2.12 ± 1.32 (range: 0-4). At 6 months (n=51), there was a significant reduction in IOP of 4.1 mmHg (13.8 ± 3.40; p<0.001). The number of medications was also significantly reduced to 1.84 ± 1.02 (p<0.01). At 12 months (n=25), there was a significant reduction in IOP of 5.3 mmHg (12.56 ± 3.50; p<0.001) and there was still a significant reduction in the number of medications to 2.00 ± 1.16 (p<0.01). Complications within the first month included one patient with hyphema and one patient with IOP spike greater than 21 mmHg. The success rate was 76.5% (4 patients required additional filtering surgery, 8 patients did not meet IOP requirement).

Discussion:
Previously published studies have evaluated phaco-istent in the setting of early and moderate glaucoma patients. Our study shows that after one year, Phaco-iStent appears efficacious and safe with a low incidence of early IOP spikes in patients requiring cataract surgery with advanced glaucoma.

Conclusion:
This data provides support for a potential off-label indication for Phaco-iStent in select advanced OAG patients. However further prospective comparative studies are needed.

Reference:
20  Outcomes of Complex Cataract Surgery in Glaucoma Patients

NEIL KALBAG 1, Suqin Guo, Amir Cohen 1, Robert D. Fechtner 1, Albert S. Khouri 1

Affiliation(s): 1 Rutgers New Jersey Medical School

Purpose/Relevance:
To determine visual and intraocular pressure outcomes of complex cataract surgery in glaucomatous eyes.

Methods:
Review of records of open angle glaucoma patients that underwent complex cataract surgery at Rutgers University between 1/2008-12/2012. Visual acuity (VA), intraocular pressure (IOP), and number of glaucoma medications were recorded at baseline, and postoperatively at 1 day, 1 week, 1 month, 3 months, 6 months, and 12 months. Inclusions: Complex cataract surgery requiring pupillary/iris manipulation with ancillary techniques including capsular staining or high molecular weight viscoelastic manipulation. Exclusion: Combined cataract and glaucoma procedures (endoscopic cyclophotocoagulation, shunt, filtering surgery). Glaucoma other than OAG. Glaucoma surgery after cataract extraction was considered an endpoint. Means were compared using 2-tailed independent samples t-test and ANOVA.

Results:
Thirty-eight eyes were identified. Mean LogMAR VA, IOP, and number of glaucoma medications are summarized in table. At 12 m, VA significantly improved, while IOP and number of meds were not statistically different from baseline. Pupillary/iris manipulation was required in 33 eyes (86.8%): iris retractors (23 eyes), malyugin ring (3 eyes), and kuglen hooks (9 eyes), while 4 eyes only required viscoelastic manipulation with capsular staining. LogMAR final best corrected visual acuity was 0.467 significantly improved from the baseline (P<0.05). Uncontrolled IOP (>21mmHg 12 eyes, >30mmHg 2 eyes). The majority of uncontrolled IOP (13/15, 86.6%) occurred within 3 months of surgery. Two eyes (16.6%) required glaucoma surgery to control IOP.

Discussion:
Visual acuity improved significantly up to 1 year after complex cataract surgery in glaucoma patients. Unlike with conventional cataract extraction, no significant drop in mean IOP was noted after complex cataract surgery, although medication burden decreased but was not statistically significant. Uncontrolled IOP was common within 3 months, but only a minority required glaucoma surgery.

Conclusion:
Glaucoma patients undergoing complex cataract surgery experience an improvement in visual acuity but may not experience a significant post-surgical drop in IOP.

Reference:

<table>
<thead>
<tr>
<th></th>
<th>Preop</th>
<th>1 day</th>
<th>1 week</th>
<th>1 mo</th>
<th>3 mo</th>
<th>6 mo</th>
<th>12 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>LogMAR VA</td>
<td>0.952</td>
<td>0.916</td>
<td>0.875</td>
<td>0.614*</td>
<td>0.768</td>
<td>0.601*</td>
<td>0.527*</td>
</tr>
<tr>
<td># Medications</td>
<td>1.184</td>
<td>0.00*</td>
<td>0.515*</td>
<td>0.686</td>
<td>0.786</td>
<td>0.880</td>
<td>1.050</td>
</tr>
</tbody>
</table>

* P < 0.05
21 Long-term Outcomes of Baerveldt Glaucoma Implant (BGI) Shunts

MIRELA KRASNIQI 1, Todd E. Woodruff 1, Evan Lagouros 2, Jeffrey Dunmire 1, Deepak P. Edward 1
Affiliation(s): 1 Summa Health System 2 University of Pittsburgh 3 Johns Hopkins University

Purpose/Relevance:
To report on long-term intraocular pressure (IOP) outcomes of the BGI as a primary or secondary procedure in different types of glaucoma.

Methods:
Retrospective, non-comparative case series of BGI (350mm² in 89.2%) by a single surgeon for various types of glaucoma. Success was defined as IOP < 21mmHg with/without medications, lack of visual field progression or need for additional glaucoma surgery. Success rates were calculated for the overall group and those undergoing primary BGI’s.

Results:
In n=203 (n=154 primary; n=49 secondary; follow up range of 2-12 years with mean follow up time of 5.8±2.3 years; POAG most common in 55.7% patients), mean IOP was reduced from 30.6±10.22 mmHg preoperatively to 5, 7, and 9-year mean postoperative values of 13.1±5.00 mmHg (57.0% reduction, P <0.001), 13.5±5.55 mmHg (55.9% reduction, P <0.001), and 12.9±5.0 mmHg (57.8% reduction, P <0.001) respectively. The mean medications were reduced from 3.0±1.06 preoperatively to 1.2±1.11, 1.4±1.10, and 1.7±1.07 at 5, 7, and 9 years respectively. The overall success rates at 5, 7, and 9-year follow up times were 83.5% (91/109), 81.5% (44/54), 66.7% (18/27) respectively. BGI as a primary procedure was performed in n=154 (75.9%) with a follow-up dropout to n=77 at 5 years, n=36 at 7 years, and n=18 at 9 years. The success rates for the primary BGI were 85.7%, 83.3%, and 72.2% respectively at 5, 7, and 9-year follow up. Significant risk factors in the overall group for failure at 9 years included age <56.7 years at surgery (p<0.001), 13.5±5.55 mmHg (55.9% reduction, P <0.001), and 12.9±5.0 mmHg (57.8% reduction, P <0.001) respectively. The larger Molteno3 shunt does not provide a statistically significant reduction in mean intraocular pressure or medication reduction at this follow up interval.

Discussion:
This study demonstrates moderate long term success rates for BGI performed as a primary procedure and as an overall group. There was an overall significant, persistent long term IOP reduction at 5, 7, and 9 years. A decrease in glaucoma medication use was noted long-term in the overall study group.

Conclusion:
This study shows that BGI’s as a primary or secondary procedure are an effective treatment for long-term intraocular pressure control in glaucoma patients.

References:

22 Comparison of Surgical Outcomes of the Molteno3 230mm² and the Molteno3 175mm²: Is there a difference?

ANNA SILVERMAN 1, Shamil S. Patel 1, George R. Reiss 1
Affiliation(s): 1 Reiss Ophthalmology

Purpose/Relevance:
To compare the surgical outcomes of the Molteno3 230mm² to the Molteno3 175mm².

Methods:
Retrospective, single surgeon comparative case series of 66 eyes that underwent glaucoma shunt surgery for uncontrolled glaucoma (all diagnoses included). The first 32 eyes underwent placement of a Molteno3 230mm² shunt and the next 34 eyes underwent placement of a Molteno3 175mm² shunt. The primary outcome measures were intraocular pressure, number of postoperative medications, complication rate, and surgical success. Surgical success is defined as intraocular pressure between 5 and 21mmHg, with or without glaucoma medications, and without additional surgical intervention or loss of light perception vision.

Results:
Average follow-up was 9.8±5.3 months for the 230 group and 6.8±3.4 months for the 175 group. No significant difference was noted in mean intraocular pressure, change from baseline intraocular pressure, adjunctive use of glaucoma medications, complication rates, or surgical success rates at current follow-up duration. Mean IOP reduction was 43.1% for the 230 group and 51.2% for the 175 group. Mean medication reduction was 28.0% for the 230 group and 37.0% for the 175 group. Comparison analysis by Tukey-Kramer and student’s T-test demonstrated that the difference in mean IOP reduction and mean medication reduction was not statistically significant.

Discussion:
Surgical outcomes after insertion of the Molteno3 230mm² and 175mm² shunts are not statistically different in regards to mean intraocular pressure reduction and mean medication reduction at this follow up interval.

Conclusion:
The larger Molteno3 shunt does not provide a statistically significant reduction in mean intraocular pressure or medication reduction in comparison to the smaller Molteno3 shunt. Longer-term follow up and classification based on disease will need to be evaluated to determine if bleb remodeling and initial pathology affect final outcomes. Given the ease of insertion and lack of muscle manipulation, the Molteno3 175mm² may be used without concern of reduced IOP control in the short-term in comparison to the Molteno3 230mm².

Reference:
23 **Intraocular Pressure Elevation Following Implantable Collamer Lens (ICL)**

**SALEM MALIKI †, Deepak P. Edward ‡, Nasser A. Alsaabani †, Abdullah A.A. Abubakar †**

Affiliation(s): † King Khalid Eye Specialist Hospital-Riyadh-KSA

**Purpose/Relevance:** Few case reports describe the risk of IOP elevation following ICL’s. We report on the clinical features and outcomes in patients who developed high IOP following ICL implantation.

**Methods:**
We identified eyes that developed elevated IOP following ICL implantation in 534 eyes. Medical records were reviewed and IOP in the postoperative period at 2-4 hours, 24 hours, 2 weeks, 3 months, 6 months were analyzed. Outcome measures included the course and causes of IOP elevation, BCVA at last visit, number of glaucoma medications, other interventions, the presence or absence of glaucomatous damage and the need for surgical intervention.

**Results:**
A total of 58 eyes that underwent ICL developed high IOP, postoperatively. The risk of developing IOP elevation following ICL in this cohort was 10.8%.

IOP elevation was most commonly seen in 23/58 eyes (39.7%) on the first P.O day and was related to retained viscoelastic; followed by steroid related IOP elevation in 22/58 eyes (37.9%). IOP elevation in 6 eyes (10.3%) was related to high vaulting and pupillary block in 4 eyes (6.9%) due to synechial angle closure and other causes (n=3). BCVA at last postoperative visit was better than 20/40 in 56/58 eyes (96.6%).

5/58 (8.6%) eyes were on glaucoma medications at the last visit due to persistent steroid response (n=2), synechial angle closure (n=1) and other causes (n=2). One eye demonstrated glaucoma damage. Two eyes with high vault and elevated IOP underwent explantation of the ICL.

**Discussion:**
This report highlights the 10.8% risk of IOP elevation following ICL implantation in a large cohort. IOP elevation was most common in the early post-operative period due to viscoelastic or steroid use. Persistent IOP elevation was related to ICL size causing secondary angle closure.

**Conclusion:**
There is a moderate risk of transitory IOP elevation after ICL implantation with good outcomes. Careful attention is ICL selection warranted to prevent high vaulting and synechial angle closure.

**Reference:**
Trabeculectomy with Mitomycin C versus Ahmed Valve Implantation for Uveitic Glaucoma

DANIEL BETTIS 1, Richard G. Morshedih, Jason A. Goldsmith 1, Alan S. Crandall 1, Norm A. Zabriskie 1
Affiliation(s): 1 University of Utah 2 University of Arkansas

Purpose/Relevance:
To compare the results of trabeculectomy with mitomycin C (MMC) and Ahmed valve implantation in patients with uveitic glaucoma.

Methods:
We retrospectively reviewed the records of 41 eyes of 29 patients who underwent trabeculectomy with MMC or Ahmed valve implantation for medically uncontrolled uveitic glaucoma. 17 eyes underwent trabeculectomy, and 24 eyes underwent Ahmed valve implantation. The main outcomes measured were postoperative intraocular pressure (IOP), percent reduction in IOP, postoperative number of medications, time to failure, and complications. Failure was defined as IOP higher than 21 mmHg despite medications, IOP less than 6 mmHg with structural complications of hypotony, reoperation due to inadequately controlled IOP, or loss of light perception.

Results:
Mean IOP was reduced from 29.2 to 18.4 mm Hg in the trabeculectomy group (31.3%), compared to a reduction from 33.4 to 15.5 mm Hg in the valve group (42.7 %) (p=0.53). An average of 1.76 medications were used postoperatively in the trabeculectomy group compared with 1.83 medications in the valve group (p= 0.89). Likelihood of success at 1 year was 66.7% in the trabeculectomy group, compared to 100% in the valve group (p = 0.02). Mean time to failure was 8.36 months in the trabeculectomy group, compared with 21.8 months in the valve group (p = 0.02). Complications in both groups were typically rare and self-limited, with post-operative recurrence of inflammation being the most common: 3 eyes in the trabeculectomy group (17.6%) and 8 eyes in the valve group (33.3%).

Discussion:
Our study showed similar success rates for trabeculectomy with MMC and Ahmed valve implantation over a 3 year period. Ahmed valves did show a significantly increased rate of success during the first year and a non-significant trend toward improved success rate at two and three years following surgery. Ahmed valve implantation was also associated with a longer mean time to failure. No significant difference between the procedures was found for post-operative complications or the need for re-operation.

Conclusion:
Although trabeculectomy with MMC and Ahmed valve implantation are both reasonable surgical options in the management of uncontrolled uveitic glaucoma, Ahmed valve implantation was associated with higher cumulative success rate at one year and a longer mean time to failure.

Reference:
27 Safety and Efficacy Outcomes of the Molteno 3 Glaucoma Drainage Implant

TYLER SORENSEN 1, 2, Steven Sarkisian 1

Affiliation(s): 1 Dean McGee Eye Institute, 2 University of Oklahoma

Purpose/Relevance:
To evaluate the efficacy and safety outcomes of the recently redesigned Molteno 3 glaucoma drainage implant in patients undergoing glaucoma drainage implant surgery.

Methods:
This IRB-approved study represents a retrospective, consecutive case series of patients receiving the Molteno 3 glaucoma drainage implant from October 2011 to June 2012 at the Dean McGee Eye Institute (N= 29 patients, 34 eyes). All surgeries were performed by Steven R. Sarkisian Jr, MD (SRS).

Results:
Data including intraocular pressure (IOP) and number of ocular hypotensive medications used was obtained preoperatively and postoperatively at time points of 3 months, 6 months, and 1 year. The mean (SD) preoperative IOP was 23.8 (8.8) mmHg with a mean of 2.9 ocular hypotensive medications used. The mean (SD) postoperative IOP at 12 months was 14.5 (6.1) mmHg (p=0.0003) with a mean of 1.6 ocular hypotensive medications used (p=0.0005). The most frequent complications encountered were hypotony and bleb leak (hypotony without bleb leak occurring in 3/34 eyes (8.82%) and bleb leak with or without hypotony occurring in 3/34 eyes (8.82%).

Discussion:
Our case series demonstrates that implantation of the recently remodeled Molteno 3 glaucoma drainage implant significantly lowers intraocular pressure and reduces dependency on ocular hypotensive medications. The results are similar to and validate those obtained in a related study. Like other glaucoma filtering surgeries, hypotony and bleb leaks represent the most common postoperative complications.

Conclusion:
The results of this retrospective study show that the recent redesign of the Molteno 3 glaucoma drainage implant remains an effective and safe option for patients requiring implantation of an aqueous shunt device in the management of glaucoma.

Reference:
28 Clinical Experience with Ahmed M4 Tube-Shunt in Various Types of Glaucoma: A Pilot Study

VICTOR CVINTAL 1, Marlene R. Moster 1, Wanda Hu 1, Naryan Sabherwal 1, Feyzahan Ekici 1, Michael Waisbord 1, Michael J. Pro 1

Affiliation(s): 1 Wills Eye Hospital

Purpose/Relevance:
To evaluate the safety and efficacy of the Ahmed Glaucoma Valve model M4 (AGV; New World Medical Inc., Rancho Cucamonga, CA). This device consists of a porous polythethiene shell, which is believed to reduce the fibrotic reaction around the plate.1

Methods:
Patients charts who underwent implantation of the AGV model M4 from December 2012 until August 2013 were reviewed. Primary outcome: intraocular pressure (IOP); Secondary outcome: number of glaucoma medications and number of reoperations. Clinical parameters were collected pre-operatively and on day 1, week 1 and 1, 3 and 6 months.

Results:
Thirty-six eyes of 36 patients were included. Mean follow-up time was 136 ± 62 days. Preoperatively, the subjects had a mean of 0.97 ± 1.0 prior glaucoma surgeries and a mean LogMAR visual acuity of 1.04 ± 0.89. Table 1 shows the mean IOP and number of glaucoma medications on each visit. Thirteen patients (36.11%) had at least 1 complication, hypHEMA (n=4) was the most prevalent early complication. Four eyes needed re-operation for glaucoma after 3 month follow-up. No significant vision-threatening complications were recorded.

Discussion:
The IOP reduction at one month is comparable to the published data.1 Higher IOP values were noted at 3 and 6 months follow-up visits; however, this can be explained by a lower number of hypotensive drops used, compares to the previous report.

Conclusion:
The AGV model M4 effectively reduced IOP in the first post-operative month. There was a trend toward higher IOP values after 3 and 6 months. Further studies are required to evaluate the long term efficacy and safety of this device.

Reference:

Table 1: Mean IOP and number of glaucoma medications on each follow-up visit.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Operative</th>
<th>1 day</th>
<th>7 days</th>
<th>1 month</th>
<th>3 months</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mean IOP± SD (mmHg)</td>
<td>32.2±11.5</td>
<td>8.1±2.7</td>
<td>11.0±4.9</td>
<td>13.8±3.4</td>
<td>21.2±8.1</td>
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<tr>
<td>IOP Range</td>
<td>11.0-68.0</td>
<td>4.0-14.0</td>
<td>5.0-28.0</td>
<td>8.0-22.0</td>
<td>11.0-46.0</td>
<td>12.0-53.0</td>
</tr>
<tr>
<td>Mean Number of</td>
<td>2.92 ± 0.84</td>
<td>0.29 ± 0.79</td>
<td>0.13±0.35</td>
<td>0.13±0.43</td>
<td>0.59±0.96</td>
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</tr>
<tr>
<td>medications ± SD</td>
<td>n (eyes)</td>
<td>36</td>
<td>34</td>
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</tbody>
</table>
First Report of Bleb Revision by Needling with Mitomycin C After Filtering Surgery with Ex-PRESS SHUNT COMPARED to Standard Trabeculectomy

JONATHAN GAMBRELL 1, Melissa O. Ajunwa 1, Caroline L. Denwood 1, Darrell WuDunn 2, Yara P. Catoira-Boyle 2

Affiliation(s): 1 Indiana University Glick Eye Institute

Purpose/Relevance:
Bleb revision by needling with Mitomycin C (MMC) has been reported to re-establish filtration in prior trabeculectomy, but there were no reports of this revision after Ex-Press shunt filtration surgery. Twelve-month outcomes of bleb needling with MMC for Ex-Press shunt filtration and trabeculectomy were determined and compared.

Methods:
A retrospective review of 40 eyes from 38 patients with prior filtration surgery, 15 with trabeculectomy with MMC (T-MMC group) and 25 with Ex-Press shunt with MMC (E-MMC group), undergoing bleb needling with MMC by a single surgeon was performed. Patient demographics, dates of surgery and bleb revision, pre- and post-needling medications, pre- and post-intraocular pressures (IOP) and complications were collected. Mean success survival and survival probability at 6 months and 12 months were calculated (Kaplan-Meier Analysis).

Results:
T-MMC group: mean age was 68.2 years, mean time to needling was 8.79 months, mean pre-operative number of medications was 3.33, mean post-operative number of medications was 0.67, mean pre-operative IOP was 17.23 mmHg, mean survival was 27.4 months, and survival probability was 0.59 at 6 months and 0.59 at 12 months. Complications included bleeding, transient hypotony with choroidal effusions, and hypotony with non-resolving choroidal effusions requiring drainage.

E-MMC group: mean age was 67.44 years, mean time to needling was 12.04 months, mean pre-operative number of medications was 1.56, mean post-operative number of medications was 0.64, mean pre-operative IOP was 16.94 mmHg, mean survival was 25.0 months, and survival probability was 0.71 at 6 months and 0.57 at 12 months. There were no documented complications.

Discussion:
Both groups had similar ages and pre-operative IOPs. The T-MMC group had a longer time from surgery to bleb needling and a higher pre-operative number of medications. There was no statistically significant difference between the two groups in survival (p=0.99, log rank test).

Conclusion:
Bleb needling with MMC was as successful in patients with prior Ex-Press shunt implant as with prior trabeculectomy producing similar mean survival times. The advantage of bleb revision by needling with MMC in patients with Ex-Press shunt was no penetration of the anterior chamber.

References:
Mitomycin C (MMC)-Augmented Transconjunctival Needle Revision (TCNR) Following Failed Trabeculectomy

GINTIEN HUANG †, Joseph Panarelli †, Paul A. Sidoti †

Affiliation(s): † New York Eye and Ear Infirmary

Purpose/Relevance:
To evaluate the safety and efficacy of mitomycin-C (MMC)-augmented transconjunctival needle revision (TCNR) in patients requiring intraocular pressure (IOP) reduction following trabeculectomy.

Methods:
The medical records of 32 patients (32 eyes) with a failed trabeculectomy who subsequently underwent TCNR by a single surgeon between September 2001 and August 2013 were retrospectively reviewed. All study patients followed the same protocol in the operating room. A subconjunctival injection of 16.7mcg/0.1cc MMC was given approximately 8-10mm posterior to the limbus at a site adjacent to the prior trabeculectomy. The scleral flap was visualized with a Hoskins lens (when necessary) and the external revision was performed with a microvitreoretinal (MVR) blade. Main outcome measures were visual acuity, intraocular pressure, and number of required glaucoma medications. Failure was defined as an IOP less than 5 mm Hg, greater than 21 mm Hg, or reduced less than 20% below baseline on two consecutive follow up visits (conducted at least 1 month apart) after 3 months. Patients were also classified as having failed if they lost light perception or required additional glaucoma surgery.

Results:
All patients underwent TCNR an average of 52.6 ± 44.6 months after trabeculectomy. The mean follow-up period after TCNR was 24.9 ± 24.3 months (range 0.25 to 96 months). The mean IOP was reduced from 21.8 ± 6.2 mm Hg to 13.6 ± 7.8 mmHg at the most recent follow-up, which represents a 37.6% reduction in mean IOP. The mean number of glaucoma medications decreased from 3.8 ± 1.4 to 1.2 ± 1.7. Successful post-operative IOP control was achieved in 18 (56.2%) of 32 patients. Kaplan Meier survival analysis showed a probability of continued success of 60% at 12 and 24 months and 48% at 36 months. Additional procedures included 5-fluorouracil (5-FU) injections in 17 patients and subconjunctival bevacizumab injections in 6 patients. Postoperative complications included choroidal effusions in 7 patients (all of which resolved with medical management), a wound dehiscence that required revision in the operating room in 1 patient, and a hyphema that resolved without intervention in 1 patient.

Discussion:
Transconjunctival needle revision with MMC can successfully restore function to a failed trabeculectomy. As a minimally invasive procedure, it can decrease the risk of serious complications and avoid or delay further surgery.

Conclusion:
TCNR with MMC is a safe and effective treatment option for patients requiring IOP reduction after failed trabeculectomy surgery.

Reference:
Comparison of Needle Revision Outcomes Following Conventional Trabeculectomy Versus Ex-PRESS

ADAM C. BREUNIG 1, Steven VL. Brown 1, Michael Beaucaire 1
Affiliation(s): 1 Chicago Glaucoma Consultants

Purpose/Relevance:
To compare the outcomes of the Ex-PRESS mini glaucoma shunt (Alcon, Fort Worth, TX) and conventional trabeculectomy, including analysis of needle revisions in patients with uncontrolled IOP following surgery.

Methods:
The records of 22 patients/eyes with Ex-PRESS implants and 21 patients/eyes with trabeculectomy were reviewed. The mean ages were 69 (± 15.0) years in the Ex-PRESS cohort and 67 (± 13) years in the trabeculectomy cohort. All primary cases between October 2010 and July 2011 were performed by SVLB. Complete success was defined as a 30% reduction in intraocular pressure without reoperation or medications. Qualified success was defined as complete success with the addition of IOP-lowering medication. The same criteria were used for revision success.

Results:
The complete success rates were 9/22 (41%) and 6/21 (29%) in the Ex-PRESS and trabeculectomy cohorts, respectively (P=0.53). The qualified success rates of the Ex-PRESS and trabeculectomy cohorts were 15/22 (68%) and 14/21 (67%), respectively (P=1.00). Analysis of outcomes with at least a 20% reduction of IOP with or without medications revealed 19/22 (86%) in the ExPRESS group and 17/21 (81%) in the trabeculectomy group (P=0.7). The pre-op and post-op visual acuities were statistically unchanged. The intraocular pressure at last follow-up was significantly reduced from baseline, with 12.3 mmHg in the Ex-PRESS cohort (p=0.000001) and 12.4 mmHg in the trabeculectomy group (p=0.0009). The number of postoperative IOP-lowering medications for the Ex-PRESS and trabeculectomy groups was not statistically different (p=0.73). In patients who had uncontrolled IOP after surgery, the average time to failure was 15 months in the Ex-PRESS cohort, and 25 months in the trabeculectomy cohort. Three out of the four trabeculectomy needle revisions were successful, with an average of two revisions needed per patient. Two of the three Ex-PRESS revisions were successful, with an average of two revisions per patient.

Discussion:
In this retrospective case-consecutive series comparing the Ex-PRESS mini-shunt with conventional trabeculectomy, both procedures significantly lowered the intraocular pressure. Although overall success rates were similar, including following slit-lamp needle revision, surgical failure tended to occur earlier in Ex-PRESS patients.

Conclusion:
In the event of trabeculectomy or Ex-PRESS failure, slit lamp needle revision is a viable option to achieve target IOP control, salvage the original operation, and avoid returning to the operating room. Multiple needle revisions may need to be performed in order to achieve success. A larger patient population and longer follow-up are needed to corroborate these results.

References:
35 Trabectome Outcome by Single Surgeon

MICHAEL STILES
Affiliation(s): Stiles Eyecare Excellence & Glaucoma Institute PA

Purpose/Relevance:
To evaluate the efficacy and safety of Trabectome procedure by single surgeon.

Methods:
A total of 270 cases were included in the study. Patients without pre-operative IOP were excluded. All surgeries were performed by a single surgeon (MCS). Outcome measures include IOP, number of medications and secondary glaucoma surgery, if any. Success was defined as IOP ≤ 21 mmHg, IOP reduced by 20% or more from baseline on any two consecutive visits after 3 months. Kaplan-Meier was used for survival analysis.

Results:
The mean age of the study group was 71 years old. Majority were Caucasians (82%) diagnosed with primary open angle glaucoma (68%). Average baseline IOP was 23.2±7.1 mmHg with 2.4±1.2 glaucoma medications. At 6 months, the IOP was reduced to 16.9±4.0 mmHg (p<0.01) and number of medications was 1.8±1.2 (p<0.01). At 12 months, the average IOP was 15.3±3.5 mmHg (p<0.01) and average number of medications was 1.5±1.2 (p<0.01). Survival at 12 months was 87%. Nine cases (3%) required additional glaucoma surgery. One case of hypotony was noted on day one, but it was quickly resolved.

Discussion:
Trabectome seems to be effective in reducing IOP and number of medications after one year. The low risk profile also makes Trabectome a viable alternative to traditional glaucoma surgery.

Conclusion:
Trabectome appears to be safe and effective for glaucoma patients.

Reference:

36 One-Year Results of Combined Phacoemulsification and Endoscopic Cyclophotocoagulation at a Tertiary Care Center

JEFFREY SOOHOO, Mina B. Pantcheva, Malik Y. Kahook, Leonard K. Seibold
Affiliation(s): University of Colorado

Purpose/Relevance:
To evaluate the efficacy of combined phacoemulsification cataract extraction (phaco) and endoscopic cyclophotocoagulation (ECP) at one-year postoperatively.

Methods:
This was a retrospective review of patients who underwent combined phaco/ECP at our institution from January 1, 2007 to September 30, 2012. The medical record of each patient was reviewed to evaluate the outcomes at one-year postoperatively, including visual acuity, intraocular pressure (IOP), and use of IOP-lowering medications. Failure was defined as IOP ≥ 21 mmHg or ≤ 5 mmHg or not decreased at least 20% from baseline on two consecutive visits, loss of light perception vision, or re-operation for glaucoma within one year.

Results:
Seventy-four patients met inclusion criteria. Average preoperative visual acuity was 0.52 ± 0.66 logMAR. Entering IOP averaged 17.2 ± 6.3 mm Hg on a mean of 1.7 ± 1.2 IOP-lowering medications (range 0-4). Thirty-eight patients (51%) were classified as failures: 28 due to IOP not decreased 20% from baseline, 5 due to IOP ≥ 21 mmHg, 4 due to additional IOP-lowering surgery within one year, and 1 due to loss of light perception vision. The mean visual acuity at one year improved to 0.28 ± 0.42 logMAR (p < 0.001). Mean postoperative IOP was significantly reduced to 13.7 ± 3.7 mmHg (p < 0.001) with a mean use of 1.3 ± 1.3 IOP-lowering medications (p = 0.003, range 0-4).

Discussion:
In our study, a significant reduction in IOP was sustained at one-year of follow-up and the use of IOP-lowering medications decreased significantly as well. Limitations of this study include its retrospective nature and the lack of standardized treatment protocols and data collection.

Conclusion:
The results of our study show that combined phaco/ECP improves visual acuity, lowers intraocular pressure, and/or decreases the use of IOP-lowering medications at one-year postoperatively in many patients. Additional studies are needed to determine if these benefits are sustained for a longer period of time after surgery and to further elucidate a role for phaco/ECP in the management of glaucoma.

References:
40 Surgical Outcomes Following the Use of a Biodegradable Subconjunctival Collagen-Glycosaminoglycan Matrix in Revisions of Late-Onset Glaucoma Filtering Bleb Leaks

OLVEWATOSIN U. SMITH 1, David G. Godfrey 1, Davinder S. Grover 1, Michelle R. Butler 1, Ronald Fellman 1

Affiliation(s): 1 Glaucoma Associates of Texas

Purpose/Relevance:
The use of Ologen®, an implantable biodegradable collagen-glycosaminoglycan matrix to modulate tissue repair processes and improve morphology of the filtering bleb in primary trabeculectomy is currently a known practice in glaucoma surgery. Our purpose was to describe the use and assess the surgical outcomes and wound healing reactions after the use of Ologen® for bleb revisions in patients with avascular cystic blebs with associated bleb leaks following trabeculectomy with mitomycin C in a retrospective case series.

Methods:
Four eyes of four patients that underwent bleb revisions for bleb leaks with cystic avascular bleb configurations was included in a retrospective review of cases. One patient had a prior conjunctival graft for bleb leak 4 years prior to revision. All patients had an excision of the avascular conjunctival tissue and then advancement of the conjunctiva after placing Ologen® over the scleral flap with no adjunctive use of an antimetabolite. None of the patients had additional sutures placed in the scleral flap. Data collected included pre and post operative intraocular pressure and external photos of post operative bleb morphology for review.

Results:
Patients had a mean preoperative IOP of 4.5mmHg (Range 0-14mmHg) and mean post operative IOP of 10.5mmHg at last followup. Average follow up postoperatively was for nine months with 2 patients being followed for up to one year. All patients were off medication at their last follow up visit with diffuse posterior mildly vascular blebs. There were no early or recurrent bleb leaks in the follow time frame. Mean age of patients was 71.5 years.

Discussion:
The use of conjunctival advancement in patients with late bleb leaks has been found to have more successful outcomes with fewer intraocular infections than those managed more conservatively. However, patients who undergo surgical revision occasionally redevelop over time a cystic configuration to their bleb likely due to exposure to antimetabolite in the past. The use of Ologen® was seen to produce a more visually appealing bleb with higher pressure in hypotonous eyes. There were no significant complications from this technique and vision was maintained or improved in all patients.

Conclusion:
The use of Ologen® proposes an additional surgical tool in the treatment of cystic avascular blebs with associated leaks resulting in improvement in the bleb morphology and appearance following surgical bleb revision. There was improvement in intraocular pressure in patients with hypotony and maintenance of bleb function following surgery in all patients. The longterm survival of bleb function using this technique is yet to be determined and continued follow up is required.

References:
Two Year Follow-up of a Minimally Invasive Ab Interno Transscleral Implant in Refractory, Open-Angle Glaucoma Patients

ROBERT J. NOECKER

Purpose/Relevance:
To establish the safety and efficacy of a minimally-invasive ab-interno gelatin stent to reduce IOP and glaucoma medications in patients presenting with refractory glaucoma (POAG). Mean IOP, IOP change, reduction in medications, and safety were recorded in 47 subjects through 24 months.

Methods:
The surgical approach with this device provided IOP lowering comparable to that seen with other transscleral surgeries.

Results:
No major adverse events were reported, and five patients were converted to another surgical glaucoma procedure through 24 months. The mean preoperative (best medicated) IOP was 22.0 mmHg. The mean postoperative IOPs were: 13.5 at 12 months, 12.2 at 18 months, and 14.7 at 24 months. The mean decrease in IOP was -8.5 (-38% reduction) at 12 months, -9.8 (-44% reduction) at 18 months, and -7.3 (-36% reduction) at 24 months. At 12 months anti-glaucomatous medications were reduced by 61% from the preoperative mean of 3.1 (patients not washed out pre-surgery), and by ~71% at 18 and 24 months.

Discussion:
The surgical approach with this device provided IOP lowering comparable to that seen with other transscleral surgeries.

Conclusion:
The clinically proven ab-interno subconjunctival pathway (i.e. trabeculectomy and tube surgeries) combined with the minimally invasive conjunctiva sparing approach of this broadly adoptable implant procedure may provide a safe and effective approach to controlling IOP and reducing medications in patients with glaucoma.

Reference:
43 Single-Center Retrospective Chart Review
Comparing Efficacy and Safety of the EX-PRESS Glaucoma Filtration Device to Trabeculectomy in Patients with Glaucoma

STEVEN SARKISIAN 1, Doug HUBATSCHE 2
Affiliation(s): 1 Dean A. McGee Eye Institute
2 Alcon

Purpose/Relevance:
To compare the efficacy and safety of the EX-PRESS glaucoma P50 filtration device to trabeculectomy in patients with open angle glaucoma.

Methods:
We will present a review of a single site, single surgeon (SRS), retrospective chart analysis. Patients included those with primary open angle glaucoma (baseline IOP > 18 mmHg) that were indicated for filtration surgery and either had a trabeculectomy or an EX-PRESS device implanted after 2005 to manage their IOP. The primary surgeon has published EX-PRESS data in the past; however, all of the patients in this study with EX-PRESS device implantation had to have failed previous medical and conventional surgical interventions. Patient data was collected up to approximately 7 years after the surgical procedure.

Results:
A total of 98 patient charts were included in the analysis (52 EX-PRESS, 46 trabeculectomy). There were more females in the trabeculectomy group (58.7%) than in the EX-PRESS device group (42.3%). The mean age in the two groups was similar: 68.2 vs. 67.2 yrs of age, respectively for the trabeculectomy and EX-PRESS device groups. Baseline IOPs were 29.3±9.5 and 25.1±7.0 mmHg for trabeculectomy and the EX-PRESS device. At 3 months post-procedure, mean IOP in the trabeculectomy group was 13.0 ± 6.39 mmHg and 12.9 ± 6.11 mmHg in the EX-PRESS device group. IOP reductions remained up to 42 months post-procedure (10.7 and 11.9 mmHg, respectively), after which low patient numbers increased IOP variability. There was a trend towards requiring less IOP medication (3.8 vs. 3.1) and fewer post-operative clinic visits with the EX-PRESS device. Adverse events in both groups were low but hypotony was observed in 4 EX-PRESS device cases and in 7 trabeculectomy cases. Choroidal effusions were also rare with 2 cases in the trabeculectomy group and 1 in the EX-PRESS device group.

Discussion:
In this single surgeon, single site, retrospective chart review of 98 patients, the EX-PRESS device and trabeculectomy lowered IOP from baseline up to 42 months post-procedure. EX-PRESS patients trended toward requiring less IOP lowering medications and fewer clinic visits post-operatively. No new post-operative complications were found in this analysis.

Conclusion:
The EX-PRESS device is an alternative to trabeculectomy that may provide similar IOP lowering results and a comparable safety profile.

Reference:
Bleb Revision for Bleb Leakage After Trabeculectomy

CHANPING LIANG 1, 2, Mohamed Soliman 1, Shaohui Liu 1, Lisa Sun 1

Affiliation(s): 1 LSU Health – Shreveport
2 University Health

Purpose/Relevance:
To determine the effectiveness of bleb revision for bleb leakage after trabeculectomy.

Methods:
Chart review was performed on 58 eyes that underwent bleb revision between 2005 and 2011. Data collected included types of conjunctiva incision fornix based versus limbal based, time from the initial surgery to bleb leakage, techniques of bleb revision which included conjunctival graft, conjunctival advancement or sclera patch enhancement, intraocular pressure before, one month and 3 months after revision, the number of glaucoma medications, and significant complications.

Results:
Of all the eyes that had bleb leakage, fornix based conjunctival incision was performed on 30 eyes, and limbal based conjunctival incision was done on 28 eyes. Average time from trabeculectomy to bleb leakage was 30 months in eyes with fornix based conjunctival incision and 41 months in eyes with limbal based conjunctival incision. For the 23 eyes that underwent conjunctival graft, average IOP before, one month and 3 months after revision were 8.0, 14.5 and 11.2mmHg, respectively. For the 35 eyes that had conjunctival advancement, average IOP before, one month and 3 months after revision were 9.7, 18.4 and 16.7mmHg, respectively. For the 5 eyes that had sclera patch enhancement, average IOP before, one month and 3 months after revision were 6.5, 12.5 and 11.5mmHg, respectively. The average numbers of glaucoma medications before and after revision were no difference. Ptosis developed in 6 eyes with conjunctival advancement and 2 eyes with conjunctival graft. Diplopia occurred in 2 patients with conjunctival advancement.

Discussion:
Bleb leakage occurred in both fornix- and limbal-based blebs. Post-revision IOP was better controlled in the eyes that underwent conjunctival graft and scleral patch graft than in those had conjunctival advancement. Complications such as ptosis and diplopia occurred more frequently in the conjunctival advancement group.

Conclusion:
Conjunctival graft and advancement are useful tools to repair bleb leakage with high successful rate. Conjunctival graft resulted in better IOP control and less complications such as ptosis and diplopia. Scleral patch enhancement is reserved for cases with hypotony and thin sclera.

Reference:
**45 Preliminary Results of Tube-Shunt Coverage with Gamma-irradiated Cornea Allograft (VisionGraft)**

**FEYZAHAN EKICI 1, Marlene R. Moster 1, Victor Cvintal 1, Wanda Hu 1, Michael Waisbourd 1**

**Affiliation(s):**
1 Wills Eye Hospital

**Purpose/Relevance:**
To report the surgical outcomes of tube-shunt coverage using sterile, gamma-irradiated cornea allograft (VisionGraft, Tissue Bank International Inc., Baltimore, MD).

**Methods:**
In this retrospective study, medical records of patients who underwent glaucoma tube-shunt surgeries using VisionGraft at the Wills Eye Hospital between December 2012 and August 2013 were reviewed. Demographic characteristics, tube-shunt type and location were recorded. Evidence of graft thinning or tube erosion were specifically reviewed and recorded at 1 day, 1 week, and then 1, 3, 6 and 12 months postoperatively.

**Results:**
Thirty-six eyes of 34 patients were enrolled in the study. Mean ±SD age was 69±13 years. The mean ±SD follow-up time was 4.7±2.0 months. The type of tube-shunts were Ahmed M4 (77.7%), Baerveldt 350 (8.4%), Baerveldt 250 (8.4%) and Ahmed FP7 (5.5%). Tube-shunts were placed superotemporally (52.8%), inferotemporally (25%), superonasally (13.9%) and inferonasally (8.3%). The allografts were stable during the follow-up period with no evidence of immunological reaction, infection or exposure.

**Discussion:**
We found VisionGraft safe and effective in patients who underwent tube-shunt surgery. Pilot studies showed promising results using this patch-graft1,2; however to the best of our knowledge this is the largest case series published to date. There are cosmetic advantages for VisionGraft, especially for inferior tubes and functional advantages including ease of suture lysis for Baerveldt tube-shunts.

**Table 1: Baseline Characteristics of Study Patients**

<table>
<thead>
<tr>
<th>Study Group (n=34)</th>
<th>Age (years), mean±SD</th>
<th>Gender, n (%)</th>
<th>Diabetic Mellitus, n (%)</th>
<th>Hypertension, n (%)</th>
<th>IOP (mmHg), mean±SD</th>
<th>Glaucoma medications, mean±SD</th>
<th>Diagnosis, n (%)</th>
<th>Previous Glaucoma Surgery, mean±SD</th>
<th>Follow-up time (months), mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>69±13</td>
<td>1 Male</td>
<td>9 (26.5%)</td>
<td>24 (70.5%)</td>
<td>27.5±9.3</td>
<td>2.72±0.95</td>
<td>22 (61.1%)</td>
<td>1.02±1.08</td>
<td>4.7±2.0</td>
</tr>
</tbody>
</table>

**Conclusion:**
VisionGraft appears to be safe and effective tube-shunt coverage material. Further study is warranted in order to evaluate long-term outcomes of this gamma-irradiated corneal allograft.

**References:**
Goniotomy for Treatment of Steroid-Induced Glaucoma: Clinical and Tonographic Evidence to Support Therapeutic Goniosurgery

EUN YOUNG CHOI 1, David S. Walton 2

Affiliation(s): 1 Massachusetts Institute of Technology
2 Massachusetts Eye and Ear Infirmary

Purpose/Relevance:
Irreversible steroid-induced glaucoma is most commonly treated with surgery by trabeculectomy with mitomycin C. However, this procedure carries significant risk of complications such as late-onset bleb-related endophthalmitis. A less invasive yet potentially more effective procedure is goniotomy, which appears to lower the intraocular pressure (IOP) by directly restoring the function of the outflow pathway. The purpose of this work is to report the surgical results and support the use of goniotomy for corticosteroid-induced glaucoma.

Methods:
The medical records of two patients with history of goniosurgery for steroid-induced glaucoma were reviewed. Preoperative and postoperative clinical findings were studied, including their topical use of offending steroids, tonometric and gonioscopic findings, goniosurgery, and postoperative results. In addition, tonography was performed on one patient to document the facility of outflow following successful goniosurgery.

Results:
Surgical success was achieved in both patients, with IOP < 18 mm Hg without use of medications for post surgery follow-up intervals of 2 and 5 years, respectively. A normal postoperative facility of outflow (C = 0.30 mm²/min/mm Hg) was found in one patient. No complications of surgery were experienced.

Discussion:
IOP elevation in steroid-induced glaucoma is thought to result from an increased resistance to aqueous outflow caused by pathology in the juxtacanalicular tissue. Goniotomy precisely targets the site of blockage by creating an incision in the trabecular meshwork. The relief of resistance provided by the opening restores the mechanical function of the filtration system and may explain the effectiveness of the procedure. The immediate lowering of IOP following surgery, along with documented restoration of the outflow facility in one patient, provides evidence for the restorative effect of goniosurgery for steroid glaucoma.

Conclusion:
Goniotomy is a potentially effective procedure for persistent uncontrolled intraocular pressure in steroid-induced glaucoma, and should be considered for initial surgical treatment.

References:
**48 Endophthalmitis Associated with Glaucoma Drainage Implants**

**MICHELLE R. BUTLER 1, Harry W. Flynn 1, Michael Banitt 1, Steven J. Gedde 1, Avnish Deobhakta 1**

Affiliation(s): 1 Bascom Palmer Eye Institute

**Purpose/Relevance:** To identify the risk factors, causative organisms, and treatment outcomes of patients with endophthalmitis associated with glaucoma drainage implants (GDIs).

**Methods:**
This is a retrospective non-comparative, consecutive observational case series at a single University referral center. A chart review was performed of patients diagnosed with culture-positive endophthalmitis associated with a GDI. Clinical and microbiological data on patients meeting study criteria were collected between 1999 and 2012. The main outcome measure was BCVA at last follow up. Other data gathered included symptoms and signs at the time of diagnosis of endophthalmitis, BCVA and IOP. Diagnostic paracentesis of the vitreous was performed in all eyes and culture results were noted. All eyes received intravitreal antibiotics and topical and/or intravitreal steroids. The treatment and follow-up schedule were determined by the individual physician.

**Results:**
Eleven patients were identified with GDI-associated endophthalmitis. The average age was 65 years (range 3-87 years) and 45% had type 2 diabetes mellitus. The glaucoma surgery preceding infection included tube shunt placement (9 cases), tube revision (1), and tube exchange (1). Five cases were combined surgery with either pars plana vitrectomy or penetrating keratoplasty. The average time from glaucoma surgery to endophthalmitis was 20.1 months. Culture results were Staphylococcus species (4), Streptococcus species (2), P. acnes (1), Serratia (2), and mixed (2). When tube exposure was present (7 cases), the tube shunt was revised or removed. The mean follow up after endophthalmitis treatment was 33 months (1 week- 108 months). Median visual acuity pre-infection was 20/100 (20/50 to LP) and post-infection was HM (20/60 to NLP). Visual acuity of equal or better than 20/400 was maintained in 5/11 patients. The mean pre-infection IOP was 19 mmHg (6-34 mmHg) and the mean post-infection IOP was 14 mmHg (6-26 mmHg). Evisceration was performed in 2 cases.

**Discussion:**
Exposed hardware has been identified as the greatest risk factor for developing GDI-associated endophthalmitis. In the current study, the tube was exposed in 64% of the cases. Staphylococcus species were the most commonly isolated species which may help explain poor visual outcomes. This study also found a high incidence of additional intraocular surgical procedures done in conjunction with the antecedent glaucoma procedure. The complexities involved in such eyes may represent sources for seeding of infection. Tube removal was performed in 7 of 11 patients. Two patients with tube exposure retained their implants, undergoing surgical revision without removal. Recommendations as revision of the tube shunt with a patch graft or explantation are controversial. Some sources have suggested that tube removal is beneficial in resolving the active infection or preventing recurrence; however other sources have indicated that it is not necessary to remove the implant if proper antibiotic treatment is initiated. In the current study, there was no definite trend between explantation and visual acuity or recurrence of endophthalmitis; however sample size in the current study is too small to make any definitive conclusions.

**Conclusion:**
Endophthalmitis associated with GDI is most often caused by gram positive organisms. Tube exposure is frequently an inciting event and tube revision with or without explantation is generally required. Visual outcomes are usually poor.

**References:**
Epidemiology and Clinical Studies

49  Glaucoma Awareness in Relatives of Patients with Glaucoma

OMOLOLA IDOWU 1, Aaron Smith 1
Affiliation(s): 1 University of Mississippi Medical Center

Purpose/Relevance:
First-degree relatives of glaucoma patients have a higher risk of developing glaucoma.1 We evaluated the knowledge of the glaucoma, risk factors, and interest in screening in persons accompanying glaucoma patients seen at The University of Mississippi Medical Center glaucoma clinic.

Methods:
A voluntary survey was offered to 113 persons accompanying clinic patients with a known diagnosis of glaucoma. Questions assessed their basic knowledge of the disease, risk factors, and if they had a diagnosis of glaucoma or had ever been screened. All volunteers were then provided with information regarding glaucoma and offered free screening.

Results:
Among 113 persons surveyed (58 first-degree relatives), there was a strong understanding that glaucoma led to blindness (86% relatives) and that if diagnosed early and treated, blindness could be prevented (85% relatives). 72% of first-degree relatives knew that lowering intraocular pressure treated glaucoma. Only 51% of first-degree relatives understood the family link of glaucoma and less than half (42%) knew they were at risk for glaucoma. Only 29% of first-degree relatives had been told they should be screened for glaucoma with only 33% having a history of being screened. None had been told by their relative to get screened. Only 62% of first-degree relatives knew that loss was permanent and 40% of relatives didn’t know glaucoma couldn’t be treated with glasses.

Discussion:
There was a fairly basic knowledge of glaucoma but a lack of understanding of glaucoma risk and inadequately screening. Only 42% of siblings knew family history increased the risk of glaucoma and just 62% knew that loss was permanent.

Conclusion:
Glaucoma patients are not adequately notifying their family of their risk and are not telling them to get screened. Further education of glaucoma patients is needed with special attention on risk factors and the importance of notifying their family of their risk. The responsibility partly lies in the hands of the eye doctor we cannot reach every one at risk. Public health initiatives similar to those for hypertension, dyslipidemia and diabetes are needed.

Reference:
50 Does a Positive Family History of Glaucoma Foretell Severity?

KHIEM T. VU 1, Nathan L. Markel 1, Kisan Parikh 1, Karanjit S. Kooner 1, Beverley Adams-Huet 1, Xilong Li 1

Affiliation(s): 1 University of Texas Southwestern Medical Center

Purpose/Relevance:
There is a threefold increase in the risk of primary open-angle glaucoma (POAG) in individuals with positive family history. We wished to see if the family history also led to a more severe form of the disease.

Methods:
In an IRB-approved retrospective chart study at a university-affiliated medical center, data was collected from 224 patients diagnosed with glaucoma. Positive family history was defined by first, second, or third degree relatives affected (FHx-pos). Patients with negative family history were referred to as controls. Patients with unknown family history were excluded. Age, gender, race, BMI, cup/disk ratio (C/D), visual field defects, intraocular pressure (IOP), central corneal thickness (CCT), and current glaucoma medications were recorded. FHx-pos and control groups were compared using Fisher’s Exact and Wilcoxon Rank sum tests for categorical and continuous variables, respectively.

Results:
Among patients with glaucoma, there were 82, 120, and 22 patients with positive, negative, and unknown family history, respectively. The FHx-pos group was 47.6% white, 39% black, and 13.4% Hispanic, while the control group was 40.8% white, 40.8% black, and 18.4% Hispanic; no clinically significant differences were noted. Both groups were similar in age (63.3±14.8 vs. 64.9±11.8 years, p=0.5) and CCT (539 vs. 540 µm, p=0.8). The FHx-pos group was predominantly female (70.7% vs. 45%, p<0.001), had elevated IOPs (16.9±4.0 vs. 15.7±4.2 mm Hg, p=0.040), and were prescribed more glaucoma medications (98.9 vs. 92.5%, p=0.05). The mean C/D for both groups was approximately 0.73 (p=0.86) with the FHx-pos group having slightly more optic nerve cupping, all of which indicate a more severe form of the disease.

Discussion:
The results suggest that glaucoma patients with affected relatives tend to be female. Sex-specific genetic factors or expression may contribute to disease progression, but a full mechanism has yet to be completely delineated. The FHx-pos group also had higher IOP, required more medications, and experienced slightly more optic nerve cupping, all of which indicate a more severe form of the disease.

Conclusion:
The results of this study corroborate the importance of taking a family history of glaucoma. This is especially important for females, for whom aggressive treatment may be necessary. The gender finding merits further study into the possible heritability of predisposing factors in the pathogenesis of POAG in female populations.

Reference:
51 Geographic Variation in Diagnostic Testing in Patients with Newly Diagnosed Open-Angle Glaucoma

ANGELA ELAM 1, Taylor S. Blachley 1, Joshua D. Stein 1
Affiliation(s): 1 University of Michigan

Purpose/Relevance:
To determine the extent of geographic variability in the rate of visual field testing, fundus photography or other ocular imaging (e.g. optical coherence tomography) for patients with incident open-angle glaucoma (OAG) in different communities throughout the United States (U.S.).

Methods:
We identified enrollees with newly-diagnosed OAG age ≥40 years old during 2001-2011 residing in 119 U.S. communities using a large managed care network database. All communities contributed ≥ 30 enrollees with incident OAG. The proportion of enrollees undergoing visual fields, fundus photography (FP) and other ocular imaging (OOI) within 2 years of first OAG diagnosis was determined for each community and comparisons were made of the variability in testing among the communities.

Results:
Of the 16,311 enrollees with newly-diagnosed OAG, the proportion of patients undergoing VF testing within two years after initial diagnosis ranged from as low as 44% in Lafayette, LA to as high as 94% in Takoma Park, MD. The proportion receiving FP within two years after initial diagnosis ranged from as low as 9% in Shreveport, LA to as high as 35% in Ocala, FL. The proportion undergoing OOI within two years after initial OAG diagnosis varied from as low as 9% in Birmingham, AL to as high as 2% in Clearwater, FL. The proportion of incident OAG patients undergoing VF testing but no OOI within two years ranged from as low as 2% in Lafayette, LA to as high as 51% in Birmingham, AL. In contrast, the proportion undergoing OOI but no VF testing within two years ranged from as low as 0% in Des Moines, IA, Takoma Park, MD, Ann Arbor, MI, and Covington, KY to as high as 42% in Lafayette, LA.

Discussion:
There is considerable geographic variability in the proportion of patients with incident OAG undergoing diagnostic testing throughout the US. In some communities, fewer than 50% of patients with newly diagnosed OAG are undergoing perimetric testing. Likewise, in some communities a greater proportion of patients with newly diagnosed OAG are undergoing OOI than VF testing.

Conclusion:
This study highlights the considerable geographic variability in utilization of diagnostic tests for patients with newly-diagnosed OAG.

Reference:
52 Importance of Various Barriers to Glaucoma Medication Adherence

PAULA ANNE NEWMAN-CASEY 1, Taylor S. Blachley 1, Karen B. Farris 1, Alan L. Robin 2, Paul Lee 1
Affiliation(s): 1 University of Michigan Kellogg Eye Center 2 Johns Hopkins University

Purpose/Relevance:
We identified 11 barriers to adherence that have been repeatedly cited in the literature. We hypothesized that each glaucoma patient would have a unique set of barriers to overcome to achieve optimal adherence. We administered a questionnaire to determine which barriers were most common.

Methods:
We surveyed a convenience sample of 190 glaucoma patients (mean years with glaucoma 11.5±10.8). Subjects rated 11 barriers’ importance on a 20-point response scale anchored with “very important” to “not important.” We measured patient reported adherence using a validated instrument, the Morisky Adherence Scale. We assessed socio-demographic characteristics and use of technology. We conducted descriptive analyses and logistic regression to predict the association of each barrier with medication adherence.

Results:
Subjects rated the following as important barriers to optimal adherence: 52% cited skepticism that glaucoma will cause vision loss, 51% cited skepticism that glaucoma medications are effective, 43% cited a lack of knowledge, 34% cited a lack of self-efficacy, 34% cited forgetfulness, 31% cited their doctor-patient relationship, 31% cited cost, 31% cited difficulties with their medication schedule, 30% cited side effects, 30% cited difficulty instilling eye drops, and 30% cited stress. 26.5% of subjects were non-adherent. Univariate logistic regression analysis revealed that those who cited the following 6 barriers had reduced odds of being adherent: decreased self-efficacy, OR = 0.21 [95% CI 0.10-0.43]; difficulty instilling drops, OR = 0.48 [95% CI 0.23-0.98]; forgetfulness, OR = 0.18 [95% CI 0.09-0.38]; side effects, OR = 0.48 [95% CI 0.23-0.97]; stress OR = 0.46 [95% CI 0.23-0.93]; difficulties with medication schedule, OR = 0.36 [0.18-0.74]. For each additional barrier a subject cited as important, there was an 11% increased odds of being non-adherent, OR = 0.89 [95% CI 0.82-0.97].

Discussion:
No single barrier to adherence emerged as most important to glaucoma patients as each of the eleven barriers was cited as significant by 30%-52% of subjects.

Conclusion:
Since poor adherence is associated with disease progression, it is imperative to develop individualized interventions to help glaucoma patients improve their self-management.

Reference:
53 Effect of Obesity on Postural Intraocular Pressure Changes

YVONNE M. BUYS 1, Cindy Lam 2, Laura Beltran-Agullo 2, Jason Cheng 1, Graham Trope 1

Affiliation(s): 1 University of Toronto 2 Institut Català de la Retina, Barcelona 3 Khoo Teck Puat Hospital, Singapore

Purpose/Relevance:
The etiology of IOP increase in dependent body positions may be a shift in body fluid under gravity, causing increased episcleral venous pressure and choroidal vascular congestion. We hypothesized that this response is exaggerated in obesity.

Methods:
This was a prospective, case control study enrolling 25 morbidly obese patients and 25 healthy, age- and gender-matched controls. Subjects had tonometry performed in 2 sets of positions, sitting and supine, with the order randomized. In the sitting position, IOP was measured with the neck in neutral position, flexion at 30°, and extension at 30°. In the supine position, IOP was measured in supine, right and left lateral decubitus, and with the head and upper body elevated at 30°. The order of measurements within each set was also randomized.

Results:
Mean IOP in the obese group was significantly higher than the control group across all positions (P<0.02). There was no difference in the magnitude of postural IOP change compared to controls. There was no difference in mean IOP between sitting with head straight, neck flexed, or neck extended in either group. In both groups, there was a significant increase in IOP in supine, right and left lateral decubitus compared to sitting with head straight (P<0.05). In supine with 30° head elevation, there was a significant increase in mean IOP immediately compared to sitting with head straight in both groups, but the difference was mitigated at 5 minutes in the right eye of the obese group and left eye of the control group. In the obese group, the dependent eye in right lateral decubitus had higher IOP at 0 minutes (P=0.02), but not at 5 minutes (P=0.14). This difference was not found in left lateral decubitus, or in either eye of the control group.

Discussion:
Postural IOP change was a significant phenomenon in both our obese and normal weight subjects, however weight does not appear to play a significant role in the magnitude of postural IOP change.

Conclusion:
The results support epidemiological data showing an association between obesity and ocular hypertension. Future steps include measuring postural IOP in the same group following bariatric surgery.

Reference:
54 Burden of Glaucoma: Adjunct Eye Diseases

KISAN PARIKH \(^1\), Khiem T. Yu \(^1\), Nathan L. Markel \(^1\), Karanjit S. Kooner \(^1\), Beverley Adams-Huet \(^1\), Xilong Li \(^1\)

Affiliation(s): \(^1\) UT Southwestern

Purpose/Relevance:
The purpose of this study was to better understand the broad impact of primary open-angle glaucoma (POAG) on patients by identifying adjunct eye conditions commonly associated with this multifactorial disease.

Methods:
An IRB-approved retrospective chart study was conducted at a major academic institution. A total of 713 ethnically diverse, age-matched patients met the inclusion criteria: 411 were diagnosed with POAG and 302 were controls with no glaucoma diagnosis. Information was collected on: demographics, refractive errors, and concurrent ocular ailments. Cochran-Mantel-Haenszel tests were used to compare eye disease prevalence between the two groups.

Results:
The POAG group (mean age: 64.3, SD=13.3) was 44% female and the control group (mean age: 64.8, SD=12.3) was 47% female. The POAG group showed a higher prevalence of astigmatism (80% vs 60%, p<0.0001), myopia (66% vs 54%, p=0.0004), legal blindness (4.6% vs 1%, p= 0.004), pseudophakia (43% vs 35%, p=0.01), blepharitis (18% vs 12%, p=0.006), retinal detachment (4.1% vs 1.3%, p=0.03), central retinal vein occlusion (CRVO) (3.4% vs 0%, p=0.001), ptosis (12% v 4%, p=0.0001), and uveitis (2.4% vs 0.3%, p=0.02).

Discussion:
The POAG group had an increased prevalence of astigmatism, myopia, legal blindness, pseudophakia, blepharitis, retinal detachment, CRVO, ptosis, and uveitis. Some of these results are explainable and expected. Glaucoma is the second leading cause of legal blindness in the United States. In addition, myopes have an increased risk of POAG and retinal detachment. The high prevalence of blepharitis and cataracts (pseudophakia) may be partly related to the side-effects of glaucoma medications. Lastly, glaucoma is a known risk factor for CRVO. The results involving uveitis and ptosis are more difficult to explain but may still be drug-related.

Conclusion:
This study has shown that patients with POAG have a host of other ocular diseases that may affect their quality of life. Awareness of these associations and their causes would be invaluable to clinicians as they screen for and treat ocular diseases. Future work to replicate the findings of this study and the elucidation of potential mechanisms underlying these associations are indicated.

Reference:
Intraocular Pressure Rises in Subjects With and Without Glaucoma during Four Common Yoga Positions

JESSICA JASIEN 1, Gustavo De Moraes 2, Robert Ritch 3
Affiliation(s): 1 Einhorn Clinical Research Center
2 New York University School of Medicine

Purpose/Relevance:
Elevated intraocular pressure (IOP) is the most common known risk factor for glaucomatous damage. IOP increases on assuming a body position other than the upright one. An increase in IOP is directly related to the inclination of the body toward the complete inverted position. Studies have described an elevated IOP following a headstand posture, particularly in glaucoma patients. The purpose of this study is to investigate IOP changes during four common yoga positions (asanas) in glaucoma and healthy participants. As inverted positions are known to increase IOP significantly, specifically the headstand (Sirsasana), common yoga positions have been incompletely investigated.

Methods:
Ten glaucoma subjects (9 female and 1 male; mean age 62.3±15.59) and ten healthy control subjects (8 female and 2 male; mean age 36.3±12.82) were included. Adho Mukha Svanasana, Uttanasana, Halasana and Viparita Karani were the four positions tested; in this respective order. IOP was measured prior, immediately at start of the position, 2 minutes into the position, and immediately after assuming a sitting position. Subjects waited 10 minutes and a final IOP was taken, all using a calibrated Reichert Pneumatonometer.

Results:
Repeated-measures ANOVA revealed a significant IOP increase at each time point for all 4 positions both in glaucomatous and healthy eyes (all P<0.01). Aside from the Halasana position, which reached borderline significance (P=0.08), there was no significant difference between glaucomatous and healthy eyes regarding the IOP response to position changes. However, glaucoma severity – based on the visual field mean deviation was associated with increased IOP response in all groups (all P<0.05). (Table 1). The Adho Mukha Svanasana position was associated with the highest IOP increase (P<0.01).

Discussion:
Previous studies have only tested the headstand position, as shown; common practiced yoga positions also increase IOP. All four positions show a significant increase in IOP in all subjects. In glaucoma patients, the severity of their disease was in association with their increase in IOP during all four positions.

Conclusion:
Yoga practitioners should be aware of the significant increase in IOP during these common positions, specifically glaucoma patients with severe disease.

References:

Table 1. Mean IOP (mmHg) during each position.

<table>
<thead>
<tr>
<th></th>
<th>Adho Mukha Svanasana</th>
<th>Uttanasana</th>
<th>Halasana</th>
<th>Viparita Karani</th>
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<tbody>
<tr>
<td></td>
<td>Glaucoma</td>
<td>Control</td>
<td>Glaucoma</td>
<td>Control</td>
</tr>
<tr>
<td>Baseline</td>
<td>16.89±3.2</td>
<td>16.6±2.8</td>
<td>17.09±3.9</td>
<td>17.98±2.5</td>
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<tr>
<td>Immediate</td>
<td>27.25±4.3</td>
<td>28.1±4.2</td>
<td>26.75±3.4</td>
<td>25.28±3.8</td>
</tr>
<tr>
<td>2 min.</td>
<td>28.08±3.8</td>
<td>28.83±3.9</td>
<td>26.44±3.1</td>
<td>26.05±3.6</td>
</tr>
<tr>
<td>Seated</td>
<td>17.64±3.7</td>
<td>17.87±2.6</td>
<td>17.91±4.6</td>
<td>18.07±3.1</td>
</tr>
<tr>
<td>10 min.</td>
<td>17.33±3.8</td>
<td>17.98±2.5</td>
<td>17.31±3.5</td>
<td>18.3±3</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td>18±3.7</td>
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<td>16.5±2</td>
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<td>17.11±3.4</td>
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<td>16.6±2.2</td>
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Patient Reported Problems with and Question-Asking About Glaucoma Medications: A Video-Taped Study

ROBYN SAYNER 1, Susan J. Blalock 1, Delesha Carpenter 1, Kelly W. Muir 2, M Elizabeth Hartnett 3, Scott D. Lawrence 2, Alan L. Robin 5, Betsy L. Sleath 4, Annette L. Giangiacomo 6

Affiliation(s): 1 UNC Eshelman School of Pharmacy
2 Duke University
3 University of Utah
4 University of North Carolina
5 Johns Hopkins University
6 Emory University

Purpose/Relevance:
Little is known about whether patients who experience glaucoma medication problems share this with their providers. We examined (a) the extent to which patients who reported glaucoma medication problems asked one or more questions about them during their visits, (b) the association between patient characteristics and whether patients asked at least one glaucoma medication question related to their problems, and (c) the extent to which patients reported the same medication problem one month following the medical visit.

Methods:
We recruited English-speaking adults with glaucoma at six geographically diverse ophthalmology practices, both private and university based. All visits were videotaped. We interviewed patients following their visits, asking specific questions about medication-associated problems. Patients returned one month later for a second interview. We used bivariate analyses to analyze the data.

Results:
We included 142 patients who disclosed at least one glaucoma medication problem during the initial interview. Fifty-four percent of these patients asked one or more questions about these problems to their physicians. African Americans were significantly less likely to ask at least one glaucoma medication question about their reported problems (p=0.040) than non-African Americans. One hundred (70%) patients reported the same glaucoma medication-related problems one month later.

Discussion:
African Americans are more likely to go blind from glaucoma. In our study, African Americans were less likely to ask a glaucoma medication question to their physician about a problem they reported after the exam. Ophthalmologists should specifically ask about medication-related problems.

Many patients reported the same glaucoma medication problems one month after their initial visit. Ophthalmologists should prompt patients to talk about any issues that they may have with using their glaucoma medications.

Conclusion:
This study highlights that patients may not reveal medication-associated issues. Problems may not be resolved unless the physician is aware of them and can then possibly alter therapy. Doctor-patient communication, especially regarding adverse events, is important. Increased questioning about adverse events should be emphasized during training to change practice.

References:
Provider Education about Glaucoma and Glaucoma Medications During Video-Taped Medical Visits

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Affiliation(s): 1 UNC Eshelman School of Pharmacy
2 Duke University
3 University of North Carolina
4 Emory University School of Medicine
5 University of Utah
6 Husson University
7 Johns Hopkins University

Purpose/Relevance:
Little is known about ophthalmologist-patient communication during glaucoma visits. Prior studies have associated inconsistent glaucoma follow-up to both unfamiliarity with the duration of glaucoma treatment and a lack of knowledge of the permanency of glaucoma-induced vision loss. We examined what patient and provider characteristics are associated with whether providers educate patients about glaucoma and IOP-lowering medications.

Methods:
We conducted a cross-sectional study at six geographically distinct centers, recruiting English-speaking adult glaucoma patients. We videotaped and three coders analyzed patients’ medical visits assessing communication variables. The main outcome measures were whether the provider educated patients about glaucoma and glaucoma medications. We used general estimating equations to analyze data.

Results:
We enrolled 279 subjects. Providers were significantly more likely to educate patients about glaucoma and glaucoma medications if they were newly prescribed (p < 0.001). Providers were significantly less likely to educate African American patients (p < 0.01) and patients of lower health literacy about glaucoma medications (p < 0.01). Patient age and gender were not associated with any difference in providers educating patients.

Discussion:
Providers were significantly less likely to educate those who might most need additional education. Glaucoma is the leading cause of blindness in African Americans yet they received less education. Also, those with low health literacy (< 8th grade) may require supplemental verbal education as they may not fully comprehend written instructions and brochures.

Even when providers knew their exams were being recorded, most did not offer any information regarding medications, such as the purpose of medications, the need for continued use, and the potential for adverse events.

Disparities are increasingly important. Providers may be unaware of these disparities and may require education to minimize them.

Conclusion:
This study presents new information on potential problems with doctor patient education that could have a significant effect on adherence and the prevention of needless visual disability. Also, the study highlights several areas where education can be improved.

References:
Correlation of Serum Electrolyte Levels and
Primary Open-Angle Glaucoma

DOUGLAS DWORAK 1, Krishna Patel 1, Shuchi B. Patel 2, Thomas D. Patrianakos 1

Affiliation(s): 1 Cook County Health and Hospitals System
2 University of Missouri Kansas City
3 Loyola University Medical Center

Purpose/Relevance:
To analyze serum electrolyte levels of sodium, potassium, chloride and bicarbonate (Na+, K+, Cl-, HCO3-) in patients with primary open angle glaucoma (POAG) versus those without.

Methods:
A retrospective chart review was done in order to determine the correlation between serum electrolyte levels and primary open angle glaucoma in patients seen at John H. Stroger Jr. Hospital of Cook County in Chicago, IL. Consecutive patient charts were reviewed retrospectively until around 200 patients in each group were identified. Exclusion criteria were ages younger than 50, no electrolyte levels within the last two years, or any other type of glaucoma or ocular hypertension. Patients that met these criteria were categorized as either control or POAG. The mean ages and serum electrolytes levels were determined for each group.

Results:
The mean age of the control group (n=203) was 61.9. The mean serum Na+, K+, Cl-, and HCO3- levels were 138.2, 4.4, 102.4, and 26.8 respectively. The mean age in the POAG group (n=189) was 66.8 with the mean serum Na+, K+, Cl-, and HCO3- levels of 138.9, 4.2, 104.0, and 26.2 respectively. Therefore the differences were a mean Na+ level of 0.7 higher in the POAG group, mean K+ level of 0.2 higher in the control group, mean Cl- level of 1.6 higher in the POAG group, and mean HCO3- level of 0.6 higher in the control group. An unpaired two-tailed T test was used to calculate the p-value, which was statistically significant for Na+, K+, and Cl- with p-values of 0.0141, 0.0017, 0.0011 respectively. The difference between HCO3- was not statistically significant with a p-value of 0.3519.

Discussion:
A correlation between serum electrolytes and POAG did exist. The POAG group had higher Na+ and Cl- and lower K+ serum levels than the control.

Conclusion:
Active secretion of aqueous humor via the Na+/K+ and HCO3-/Cl- ion pumps is a major driving force in primary open angle glaucoma. This study found a correlation between serum electrolytes and POAG. This difference in electrolytes could help correlate a possible increase in active secretion to POAG patients. With this information, it may be important someday to monitor chemistry panels in patients with POAG or those at risk.

References:
Is Breast Cancer a Risk Factor for Glaucoma?

NATHAN L. MARKEL 1, Kisan Parikh 1, Khiem T. Vu 1, Nathan L. Markel 1, Beverley Adams-Huet 1, Xilong Li 1

Affiliation(s): 1 University of Texas Southwestern Medical Center

Purpose/Relevance:
In 2012, we reported that women with primary open angle glaucoma (POAG) had a twofold increase in the prevalence of breast cancer (BC). To determine which factors may predispose women with BC to POAG, we analyzed the UT Southwestern Cancer Data Warehouse (CDW).

Methods:
An IRB approved retrospective chart study was performed utilizing the CDW. To ensure accurate POAG diagnosis, only patients with BC who visited university eye clinics were included. Males were excluded. Patients were categorized as having POAG (Group A) or having no POAG (Group B), and were also age matched. Data was collected on the following POAG factors: family history, cup/disc ratio, intraocular pressure, visual field defects, and medications. Data was also collected on the following BC factors: family history, risk factors, stage, grade, markers, surgery, radiation therapy, hormonal therapy, chemotherapy, and corticosteroid use. Groups were compared using Fisher’s Exact and Wilcoxon Rank sum tests for categorical and continuous variables, respectively.

Results:
There were 20 patients in Group A and 95 patients in Group B. Both groups had a similar age at BC diagnosis (yrs.; 67.0±12.5 vs 66.8±9.7) and duration of follow up (median 2.7 vs 2.2 yrs., p=0.9). Both groups received radiation therapy at similar rates (65.0% vs 58.4%, p=0.6), but Group A patients received less chemotherapy (25.0% vs 43.4%, p=0.05). All other variables yielded no significant findings.

Discussion:
BC treatment is usually based on markers and severity, but we found no differences in the stage, grade, or markers of either group. A lower rate of chemotherapy in Group A may suggest that POAG patients suffered from less aggressive BC overall. Another explanation is that Group A patients experienced less responsive BC, wherein chemotherapy would have provided no therapeutic or palliative benefit. Limitations of our analysis were a small number of women with POAG and a need for a longer duration of follow-up. We cannot rule out medical surveillance bias.

Conclusion:
No variables adequately explained why women with BC may have higher prevalence of POAG. Confirmation that POAG is connected with BC could have important clinical implications for history taking and screening in both POAG and BC. A prospective study with longer follow-up could more accurately examine the connection between these diseases.

Reference:
60 Isolated Bilateral Congenital Microspherophakia and Pupillary Block Glaucoma

JUSTIN NEEDHAM 1, Travis C. Frazier 2, William R. Raymond 2, Steven M. Brady 3

Affiliation(s): 1 US Army - Winn Army Community Hospital
2 US Army - Madigan Army Medical Center
3 University of Washington

Purpose/Relevance:
This case report discusses our management of congenital bilateral microspherophakia with pupillary block glaucoma presenting within the first month of life. To our knowledge this is the earliest reported case of microspherophakia and pupillary block glaucoma.

Methods:
This case report details our approach to dealing with this unique problem in a neonate.

Results:
Gonioscopy was performed which demonstrated the spherical lens protruding through the iris plane causing pupillary block glaucoma. A pars plana lensectomy was then performed in each eye. This approach relieved the episodes of angle closure and high intraocular pressures. In addition removal of the small spherical lens reduced the severe myopia and allowed for easier aphakic correction and prevention of amblyopia. Postoperatively, control of IOP was achieved with single agent therapy and the child demonstrated excellent visual potential. (Photo and video of findings are available).

Discussion:
Prior reports of microspherophakia have been presented, however these patients are typically older and have associated genetic anomalies such as Weill-Marchesani. To our knowledge this is the first report of microspherophakia with associated pupillary block glaucoma in a patient presenting in the first month of life and with no history of systemic disease or familial consanguinity. We decided to perform pars plana lensectomy because the patient demonstrated repeated episodes of intermittent pupillary block associated with lens phacodonesis. This was felt to be the safest choice because it both removed the source of the pupillary block, but also eliminated the high myopia and alleviated the potential danger of lens dislocation. We chose the pars plana approach due to the significant zonular instability.

Conclusion:
Pars plana lensectomy is an effective option in treating very young patients with microspherophakia who have significant lens instability and pupillary block glaucoma.

References:
Patient-Appropriate Health Literacy Educational Materials in Ophthalmology

CINDY M. HUTNIK 1, David Mikhail 2, Kari L. Visscher 2, Yufeng N. Chen 2
Affiliation(s): 1 Ivey Eye Institute 2 University of Western Ontario

Purpose/Relevance:
To evaluate the literacy level of glaucoma patients in an urban teaching and suburban community center, and to assess comprehension of education material written at different reading levels.

Methods:
A prospective, randomized, double blinded study was performed. Eligible and consenting subjects underwent a validated literacy study and were classified as adequate, barely adequate, marginal, or inadequate. They were then randomized to receive educational pamphlets written at either a grade 5 or grade 10 reading level. Comprehension and preference of the material were determined by analysis of Cloze testing and a feedback questionnaire.

Results:
199 participants were included. The literacy testing revealed that 35% of patients in the suburban community and 30% in tertiary care center had “marginal” or “inadequate” literacy skills with no significant difference between sites (p= 0.77). Comprehension of the education material was higher in the intervention group versus the control group (p=0.0057), with a mean Cloze score of 57.9% in the intervention and 48.3% in the control group. The intervention group spent significantly less time reading the pamphlets (p=2x10^-6), with an average of 2.52 minutes compared to 4.51 minutes.

Discussion:
In both urban and suburban settings, about 30% of glaucoma patients have marginal or inadequate literacy skills. However despite literacy level, all patients better comprehend, and were more receptive, to educational material written at grade 5 reading level regardless of initial literacy level.

Conclusion:
Effective communication is essential in chronic disease management. A grade 5 level of literacy in written educational material may provide an optimal degree of communication.

References:
62 Establishing a Regional Glaucoma Physician Collaborative to Improve Quality of Care

**JENNIFER WEIZER**, Nauman Imami, Joshua D. Stein, Paul P. Lee, Jeffrey Wentzloff

**Affiliation(s):** 1 University of Michigan 2 Henry Ford Health System 3 Grand Traverse Ophthalmology

**Purpose/Relevance:** To establish a regional glaucoma physician collaborative to report physician adherence rates to new glaucoma patient visit guidelines according to the American Academy of Ophthalmology’s Primary Open-angle Glaucoma (POAG) Preferred Practice Pattern (PPP).

**Methods:**
We enrolled three glaucoma group practices in Michigan into the physician collaborative. A data manager from each group practice reviewed all consecutive initial visits for each POAG patient from July 2012-June 2013 to assess whether the visit included the recommended 13 major examination elements recommended by the POAG PPP (i.e. evaluation of visual function, ophthalmic history, visual acuity measurement, pupil exam, anterior segment exam, intraocular pressure (IOP) measurement, gonioscopy, optic nerve head (ONH) and/or retinal nerve fiber layer (RNFL) exam/analysis with documentation, fundus exam, central corneal thickness (CCT) measurement, visual field evaluation, target pressure determination, and treatment plan determination [observation, medical, laser, or surgical treatment]), and electronically submitted these data to a centralized database. The physician adherence rates for each of the 13 recommended examination elements for all groups were combined and averaged, and the overall averages for the collaborative were reported to each group. The results were discussed in a group conference call to strategize how adherence rates could be improved.

**Results:**
Data from 274 new patient visits were submitted to the centralized database by the three group practices. Mean combined adherence rates were: visual function 91.2%, ocular history 99.6%, visual acuity 100%, pupil exam 99.6%, anterior segment exam 100%, IOP measurement 100%, gonioscopy 96.3%, ONH/RNFL exam 100%, fundus exam 100%, CCT measurement 93.4%, visual field evaluation 98.9%, target pressure determination 73.4%, and treatment plan 100%.

**Discussion:**
Adherence rates to POAG PPP guidelines were comparable to or higher than rates previously described.1,2 Future directions include reassessing adherence rates after result feedback to see if adherence improves further.

**Conclusion:**
It is possible to establish a glaucoma physician collaborative to assess and improve quality of care.

**References:**
Phase-OCT (PhS-OCT): Technology to Measure Functional Rather than Structural Properties of Tissues Involved in the Glaucoma Process

MURRAY A. JOHNSTONE 1, Ruikang Wang 1
Affiliation(s): 1 University of Washington

Purpose/Relevance:
To describe a new technology that measures in vivo tissue motion, permitting analysis of functional properties of the tissues involved in the glaucoma process. Ocular tissues are subjected to continuous oscillatory cardiac-dependent pulse waves. We hypothesized pulse waves induce motion in trabecular meshwork (TM) and optic nerve (ONH) tissues that are capable of in vivo measurement by PhS-OCT.

Methods:
Laboratory-designed PhS-OCT system capable of nanometer level sensitivity to motion. Powerlab pressure recording system, digital pulsimeter, human eyes for anterior segment measurements (n = 20), for ONH (n=5). OCT measurements of TM and ONH motion were correlated with digital pulse (TM) or of the central retinal artery pulse (ONH). Triggers synchronized TM and digital pulse as well as ONG and CRA pulse measurements.

Results:
Anterior segment human studies demonstrated pulse-dependent TM motion that was highly correlated with the ocular pulse (R²=0.996, P<0.0001). TM motion strength, harmonics, velocity and phase lag were characterized. Phase lag was correlated with heart rate but not age. PhS-OCT also measured pulse-induced axial motion of the ONH with a mean amplitude of 3.5±0.8µm and a fundamental frequency of 1.2±0.02Hz. ONH motion was negatively correlated with the central retinal artery pulse (100%).

Discussion:
Aqueous flows from Schlemm’s canal (SC) to the aqueous veins by pulsatile mechanisms that slow and finally stop as glaucoma progresses. Pulsatile aqueous discharge from SC requires (TM) movement that is in turn dependent on tissue biomechanical properties that become abnormal in glaucoma. The optic nerve head (ONH) becomes abnormal in glaucoma but to explain progressive optic nerve head damage, especially in the presence of normal IOP, some parameter in addition to pressure, such as abnormal ONH tissue biomechanical properties must be involved.

Conclusion:
PhS-OCT measurement of pulse-induced motion is feasible and reflects functional properties of the tissues that maintain IOP homeostasis and prevent excavation of the optic nerve. Such properties may provide valuable predictive information useful in the management of glaucoma.

References:
Marijuana Use in Glaucoma: A Survey of Perceptions Among Glaucoma Patients in an Urban Glaucoma Clinic in Washington, DC

NISHA CHADHA 1, Rashed Alhabshan 1, Ana Maria del Río Gonzalez 1, Jacob A. Dan 1, David Belyea 1

Affiliation(s): 1 The George Washington University

Purpose/Relevance:
To identify factors that could lead to intentions to use marijuana (MJ) among glaucoma patients given the legal status of medical MJ in DC since 2010.

Methods:
204 glaucoma patients completed a survey that included items related to demographics, perceived severity of glaucoma, past MJ use, perceptions toward MJ (legality, side effects, safety/effectiveness, false beliefs), perceptions toward current glaucoma management (satisfaction, ability to pay for treatment) and intentions to use MJ for glaucoma. Medical records were reviewed for disease severity.

Results:
Intentions to use MJ in this sample were generally low (Mean = 2.36 on a 1 to 5 scale). Previous recreational use of MJ was reported by 50% of the sample, 4.5% reported previous use for glaucoma and 3% had used MJ for other medical conditions. Younger age, prior knowledge of MJ use in glaucoma, recommendation to use MJ from family member or a friend, prior use of MJ for glaucoma or for recreational purposes and perceptions toward MJ and current glaucoma management were significantly correlated with intentions, while disease severity was not.

A two-step linear regression analysis indicated that both prior use of MJ for recreational purposes and for glaucoma were significant predictors of intentions to use MJ, but were no longer significant when perceptions were added in the model. Perceptions of legality, false beliefs regarding MJ, satisfaction with treatment, and trouble paying for treatment were significant predictors in the second step. Perceptions that MJ should be legal were found to mediate the effects of past use and other perceptions.

Discussion:
Our results show that prior use of MJ, false beliefs about MJ, perceptions MJ should be legal, less satisfaction with glaucoma management and trouble paying for treatment are significant predictors of intention to use MJ. Surprisingly, neither the level of education nor the severity of glaucoma were found to be correlated with intentions to use MJ.

Conclusion:
It is important to understand the factors associated with patients’ intentions to use MJ as a treatment for glaucoma. Such understanding will allow us to help our patients make informed and better decisions regarding their treatment. More studies in this area are needed.

Reference:
Effect of Repeated Intravitreal Injections of Anti-vascular Endothelial Growth Factor (VEGF) Agents on Intraocular Pressure (IOP)

CHARLES TRESSLER 1, Marla Sultan 1, Kui Huang 1, Duo Zhou 1, Jingping Mo 1

Affiliation(s): 1 Pfizer Inc

Purpose/Relevance:
Evaluate the present literature regarding repeated anti-VEGF intravitreal injections on IOP and describe an exploratory analysis for demonstrating a rise in IOP with repeated intravitreal injections in patients with choroidal neovascularization (CNV) in age-related macular degeneration (AMD).

Methods:
A review of the medical literature was performed to evaluate the evidence for increasing IOP after repeated IVT injections of anti-VEGF therapies including pegaptanib, ranibizumab, bevacizumab, and aflibercept. An assessment of these data will be presented. Application of an exploratory analysis for this event of increased IOP was applied to clinical data from a prospective pegaptanib clinical study to include a generalized estimation equation (GEE) analysis on the incidence of increased IOP per patient.

Results:
Clinical literature from case reports and retrospective studies demonstrates that a slow rise in IOP occurs with repeated IVT injections of anti-VEGF medications over time. In the prospective study, patient demographics (age, ethnicity and smoking history) were similar to other patient populations with AMD. During the study period, 3,754 IVT injections were administered for AMD treatment. The mean number of pegaptanib treatment was 6.9 ± 4.2 IVT injections. The model applied data collected from 501 patients from 69 sites in 13 countries. The GEE analysis demonstrated a risk of slow rise in IOP which increased 2-fold after 5 injections (roughly 5-6 months of treatment). There was a positive association between the incidence of increased IOP and the number of injections received.

Discussion:
Repeated intravitreal injections can lead to a slow, sustained rise in IOP. Some patients may require medical or surgical intervention for control of IOP.

Conclusion:
With continued use of IVT injections, IOP should be monitored closely. A comparison of baseline IOP with IOP measurements over the course of repeated treatments should be reviewed since a slow IOP rise over time may be difficult to discern by a review of a single IOP alone.

Reference:
**69 Improving Access to Eye Care Among High-Risk Persons for Glaucoma in Philadelphia**

*LISA HARK 1, L. Jay Katz 1, George L. Spaeth 1, Michael Waisbourd 1, Jeffrey D. Henderer 2, Harjeet K. Sembhi 2, Jonathan S. Myers 1*

**Affiliation(s):**
1 Wills Eye Hospital
2 Temple University

**Purpose/Relevance:**
The Wills Eye Hospital Glaucoma Research Center, in cooperation with the Centers for Disease Control and Prevention, is conducting a 2-year demonstration project to implement a community-based intervention to improve detection and follow-up eye care of individuals at high-risk for glaucoma. The project aims to 1) identify and engage adults in underserved communities in Philadelphia who are most vulnerable to glaucoma (African Americans >age 50 and adults >age 60), 2) provide on-site educational workshops about glaucoma, 3) perform 2,000 ocular examinations to detect glaucoma, and 4) provide on-site management, treatment, follow-up, and referrals in individuals diagnosed with glaucoma, glaucoma suspect or anatomically narrow angle.

**Methods:**
A team of ocular technicians, community health educators, and glaucoma specialists conduct examinations which include 1) ocular, medical and family history of glaucoma 2) visual acuity 3) pupil examination 4) biomicroscopy of the anterior segment, 5) intraocular pressure 6) gonioscopy 7) undilated optic nerve evaluation by indirect biomicroscopy and 8) visual field testing. A total of 40 community sites, such as senior centers, community centers, housing buildings, and faith-based organizations are partnering with Wills Eye to recruit patients and conduct these examinations.

**Results:**
From January 1, 2013 to October 1, 2013, 985 patients have been examined. Race/ethnicity data: 64% African American, 15% White, 15% Asian, and 6% Hispanic/Latino. Forty-six patients (4.6%) have been diagnosed with glaucoma, 221 (22.4%) with glaucoma suspect, 106 (10.8%) with anatomical narrow angle, 68 (7%) with existing glaucoma, and 24 (2.4%) with other eye conditions. Individuals diagnosed with glaucoma who require treatment are recommended for selective laser trabeculoplasty (SLT), laser peripheral iridotomy (LPI), or medication. Seven individuals have completed SLT treatment and 48 individuals have completed LPI treatment at the community-based site. Eighty percent of patients have scheduled follow-up appointments in the community setting and 75% of those have attended these follow-up appointments.

**Discussion:**
This project clearly demonstrates how a community-based intervention can improve access, detection, management, treatment, and follow-up eye care of individuals at high-risk for glaucoma.

**Conclusion:**
The long-term impact of this CDC-funded project aims to reduce disability, ocular health disparities, and the economic burden from vision loss due to glaucoma.

**References:**
Spaeth-Richman Contrast Sensitivity Test in Cataract Patients

JESSE RICHMAN 1, Victor Cvintal 1, Camila Zangalli 1, Yi Sun 1, George L. Spaeth 1

Affiliation(s): 1 Wills Eye Hospital

Purpose/Relevance:
Contrast sensitivity (CS) plays an evolving role in the aid for Glaucoma diagnosis and progression. Cataracts may decrease contrast sensitivity and decrease visual acuity, masking the results. The Pelli-Robson (PR) test is based on central visual acuity. The Spaeth-Richman Contrast Sensitivity (SPARCS) test is an innovative computerized contrast sensitivity test that is independent of visual acuity and tests CS in central as well as four peripheral quadrants. The purpose of the study is to evaluate the CS in cataract patients using the SPARCS.

Methods:
Patients with cataracts and control subjects were prospectively evaluated using PR and SPARCS tests. Testing was performed in each eye separately in a randomized and standardized testing environment. SPARCS contrast scores were determined for central, right upper quadrant (RUQ), right lower quadrant (RLQ), left upper quadrant (LUQ) and left lower quadrants (LLQ). PR and SPARCS scores for each area of vision in cataract patients were compared with controls.

Results:
Forty-three eyes from 23 patients and 119 eyes from 61 control subjects were analyzed. The PR score had the highest agreement among the 7 tests (ICC=0.728 for all eyes, 0.745 for cataract eyes) while the RUQ test had the lowest (ICC=0.428 for all eyes, 0.273 for cataract eyes). Among the 5 SPARCS regions scores, the Center was highest. The estimated mean score by SPARCS position and group adjusted for age, race, and visual acuity show significant differences between groups only for LLQ and LUQ.

Discussion:
The ability of the eye to distinguish contrast varies depending on various factors, including the presence of specific abnormalities such as glaucoma and cataract. PR had the highest agreement amongst the tests performed, however it only analyses the center of the visual field. The results illustrates the significant influence of different nuclear opacities on contrast sensitivity and emphasize the importance of the periphery testing by the SPARCS.

Conclusion:
SPARCS is a user-friendly, highly specific and highly sensitive method of determining contrast sensitivity, without influence of the effects of acuity and literacy.

Reference:
Assessing the Effect of a Glaucoma Surgical Curriculum in Resident Physicians

LUCY Q. SHEN ¹, Louis R. Pasquale ¹, Angela V. Turalba ³
Affiliation(s): ¹ Massachusetts Eye and Ear Infirmary

Purpose/Relevance:
A literature search revealed no prospective study on the effect of formal surgical teaching in glaucoma. In this study, we replaced the apprentice style training with a structured curriculum to teach glaucoma surgery to senior residents (PGY4) and prospectively evaluated the effect on their performance in glaucoma surgery and other intraocular surgeries.

Methods:
A structured teaching curriculum composed of wet lab practice, teaching in the operating room with fellowship-trained surgeons, feedback and repetition was implemented for senior residents who graduated in 2013. The number of glaucoma cases performed by a resident was compared between the 2013 (structured curriculum approach) and 2012 classes (conventional apprenticeship approach). A validated survey to assess surgical competency was completed by chief residents (PGY5) regarding each resident’s performance in intraocular surgeries. A similar survey was used for self-assessment by the graduating residents on surgical skills and knowledge in glaucoma at the time of graduation. Paired t-test was applied to compare the survey responses between the classes before and after the curriculum implementation.

Results:
In a class of 8 resident physicians per year, the mean glaucoma surgical volume increased from 8.9 ± 0.8 trabeculectomy and tube cases to 13.6 ± 2.5 after the introduction of the structured curriculum (p=0.001). The surveys from chief residents showed an overall improvement, particularly in handling adverse events (p<0.001), knowledge of procedure (p=0.010), use of non-dominant hand (p=0.010) and pre-operative planning (p=0.043). The self-assessment by graduating residents was better in instrumental handling (p=0.024), knowledge of tube procedure (p=0.039) and suturing (p=0.042).

Discussion:
The number of glaucoma procedures performed by resident physicians significantly increased after the introduction of a structured surgical curriculum. Although bias may be present in surveys, our data suggest that such a curriculum can improve the resident’s overall surgical education.

Conclusion:
Glaucoma surgical training is an important part of resident education. A formal teaching curriculum showed advantages over apprentice style and can be considered by other residencies.

References:
Glaucoma Knowledge and Referral Practices Among Family Physicians Compared to Ophthalmologists’ Expectations

ALFRED BASILIOUS 1, Yvonne M. Buys 1, Jason Cheng 1
Affiliation(s): 1 University of Toronto

Purpose/Relevance:
To determine family physicians’ glaucoma knowledge and ophthalmic clinical skills compared to ophthalmologists’ expectations.

Methods:
A cross-sectional survey of family physicians and ophthalmologists was undertaken to evaluate glaucoma knowledge, referral practices, and clinical exam skills among family physicians compared to a complementary survey of ophthalmologists to identify the expected level of family physician clinical knowledge. Chi-square tests were used to identify differences between family physician and ophthalmologist responses. Differences in family physician knowledge based on practice location, frequency of patient visits with a history of glaucoma and year of graduation was also evaluated.

Results:
110 family physicians and 142 ophthalmologists completed the survey. 82% of family physicians reported seeing patients with a diagnosis of glaucoma weekly, monthly, or semi-annually. Although family physicians identified some glaucoma risk factors, a considerable percentage were unaware that African descent (46%), corticosteroid use (84%) and last eye examination greater than 5 years ago (49%) are risk factors. Family physicians were significantly less likely to refer based on risk factors (72%) than expected by ophthalmologists (91%, p<0.001). Only 28% were comfortable performing direct ophthalmoscopy and 37% were comfortable checking for a RAPD which was significantly below the expectations of ophthalmologists (48% and 70% respectively, p<0.001 for both). A significant percentage lacked knowledge of glaucoma medications (30%) and side effects (57%). Rural family physicians were more comfortable performing tonometry than urban physicians (p = 0.003).

Discussion:
Since vision loss from glaucoma is irreversible, early diagnosis and treatment is important. Early diagnosis however is complicated by the lack of symptoms until advanced disease. In a study of newly diagnosed patients with glaucoma, 50% had moderate/advanced disease at time of diagnosis.1 In this same cohort after optometrists, family physicians were the next most common referral source.2 Since only 27-64% of Canadians attend regular optometric exams,3 family physicians could play an important role in identifying those at risk for glaucoma and initiating a referral.

Conclusion:
This study revealed significant disparities in family physician glaucoma knowledge, clinical examination skills, and referral practices. Educational materials should be aimed at increasing family physician glaucoma awareness.

References:
Proportion of Undetected Narrow Angles or Angle Closure in Cataract Surgery Referrals

DEVESH K. VARMA 1, Stephanie N. Kletke 2, Amandeep S. Rai 1, Iqbal Ike K. Ahmed 1

Affiliation(s): 1 University of Toronto 2 McMaster University

Purpose/Relevance:
To identify the proportion of patients referred for cataract surgery consultation that had undetected narrow angles (primary angle closure suspect (PACS)), primary angle closure (PAC), or primary angle closure glaucoma (PACG).

Methods:
Phakic patients with no known history of glaucoma or of any glaucoma related procedures, referred by eye care providers (optometrists and ophthalmologists) for assessment and management of cataracts only between July 1, 2010 and June 30, 2012 were identified and reviewed. Demographic, referral, and specialist assessment information, as well as biometric data, including anterior segment OCT, were collected. Patients with undetected narrow angles were identified. Univariate and multivariate analyses were performed to determine risk factors for undetected narrow angles or angle closure.

Results:
976 patients were included. The mean patient age was 67.0 +/- 13.2 years 52.6% of patients were female, and 46% were Asian or South Asian. Of the sample population, the proportion of underlying PACS was 9.4%, PAC was 0.5%, and PACG was 0.2%. Overall, 10.1% of patients had missed narrow angles or angle closure. Multivariate logistic regression (table 1) confirmed three independent predictors of PACS/angle closure: Asian race (odds ratio 3.1, P<0.001), shorter axial length (AL) (odds ratio 1.3, P=0.018), and smaller anterior chamber depth (odds ratio 30.3, P<0.001). Optimal cut off values for predicting angle closure were <2.9mm for anterior chamber depth and <23.5mm for axial length.

Discussion:
Missed angle closure has significant implications because subsequent glaucoma progression is permanent and often preventable with laser peripheral iridotomy (LPI). Left untreated, ACG causes blindness in at least one eye of up to 75% of affected individuals. The predominant ethnicities in this population were Indian, Asian and Caucasian. Although PACS/angle closure occurred in several ethnic groups, a higher proportion of Indian and Asian people had PACS/angle closure as compared with Caucasians. Asian race was found, on multivariate analysis, to be an independent predictor of narrow or closed angles. Patients with angle closure tended to have smaller eyes, characterized by significantly shorter axial lengths, shallower anterior chamber depths and a significantly more hyperopic refractive status. On multivariate analysis, refraction was not found to be a significant predictor of narrow or closed angles, but shallow anterior chamber depth and shorter axial length were both strong predictors. Of those with undetected PACS/angle closure, the majority had PACS (9.4%). A small proportion of those with narrow angles had PAC (0.5%) and PACG (0.2%). It is therefore not surprising that IOP was similar between the PACS/angle closure population and those with open angles in this study.

Conclusion:
A significant number of patients referred for cataract surgery were found to have undetected narrow angles or angle closure. These results imply that gonioscopy may not be adequately performed in this patient population, and possibly in general.

References:

Table 1. Multivariate Predictors of PACS/Angle Closure based on Logistic Regression Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>LRT</th>
<th>P value</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>0.37</td>
<td>0.542</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>1.71</td>
<td>0.191</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Asian race</td>
<td>14.28</td>
<td>&lt;0.001*</td>
<td>3.1</td>
<td>1.7 – 5.7</td>
</tr>
<tr>
<td>IOP, mmHg</td>
<td>1.72</td>
<td>0.190</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>SER</td>
<td>0.14</td>
<td>0.713</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Shorter AL, mm</td>
<td>5.56</td>
<td>0.018*</td>
<td>1.3</td>
<td>1.1 – 1.6</td>
</tr>
<tr>
<td>Smaller AC depth, mm</td>
<td>67.18</td>
<td>&lt;0.001*</td>
<td>30.3</td>
<td>11.9 – 76.9</td>
</tr>
<tr>
<td>Referring Professional</td>
<td>0.75</td>
<td>0.385</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

IOP, intraocular pressure; SER, spherical equivalent refraction; AL, axial length; AC, anterior chamber; LRT, likelihood ratio test; CI, confidence interval.

* Statistically significant independent predictor.
Bilateral Same-Day Laser Peripheral Iridotomy in a Community-Based Glaucoma-Screening Project in Philadelphia

MICHAEL WAISBOURD 1, Radha Delvadia 1, Lisa Hark, L. Jay Katz 1
Affiliation(s): 1 Wills Eye Hospital

Purpose/Relevance:
The project Improving Access to Eye Care Among High-Risk Persons for Glaucoma in Philadelphia is a community-based project that aims to improve detection, management, treatment, and follow-up care of individuals at high risk for glaucoma in senior centers and community centers in Philadelphia. This novel project utilized a strategy of performing laser peripheral iridotomy (LPI) for high-risk persons with anatomically narrow angle (ANA), where 2 eyes received laser therapy on the same day. The objective of this study is to report the safety and efficacy of bilateral, same-day LPI in patients with ANA.

Methods:
The Wills Eye Glaucoma Research Center retrospectively reviewed the records of patients who were examined in a community-based, glaucoma-screening project between January 1, 2013 and July 31, 2013. Patients who underwent bilateral same-day LPI in community settings were included. Visual acuity, intraocular pressure (IOP), angle grading, post-operative complication and recommendation for post-operative IOP lowering medications were recorded before and after each treatment.

Results:
Among the 723 patients examined, 34 patients (4.7%) underwent bilateral same-day LPI due to ANA. Seven patients (21%) had IOP spikes >5mmHg following treatment and were given IOP lowering medications for a period of 2 to 3 weeks. IOP spikes of >10mmHg occurred in 4 patients (12%). IOP returned to normal in all but one patient who was diagnosed with chronic angle-closure glaucoma and continued the use of ophthalmic medications. Seven patients (21%) had repeat LPI treatment. All patients successfully tolerated LPI treatment without serious complications.

Discussion:
Bilateral LPI was well tolerated by patients enrolled in a community-based glaucoma-screening project in Philadelphia. Similar to same-day bilateral cataract surgery1 or intravitreal injections,2 this approach allows fewer office-visits and may be more convenient to some patients. Further cost-effective analysis should be performed to evaluate the financial aspects of this treatment paradigm.

Conclusion:
Performing bilateral LPI on the same day to treat ANA was found to be a safe procedure in a large community-based, glaucoma-screening project. Applying this treatment strategy may be considered in similar settings, where patients’ access to eye-care is limited.

References:
1. Arshinoff SA. Same-day cataract surgery should be the standard of care for patients with bilateral visually significant cataract. Surv Ophthalmol. 2012 Nov;57(6):574-9
Corneal Haze as a Potential Prognostic Factor in Primary Childhood Glaucoma

CATHERINE ORIGLIERI 1, Lekha Ravindraraj 1, Robert D. Fechtner 2, Albert S. Khouri 1

Affiliation(s): 1 Children’s National Medical Center
2 New Jersey Medical School

Purpose/Relevance:
Corneal haze is frequently seen in primary childhood glaucoma (PCG) with high intraocular pressure (IOP) and/or Haab striae. The aim of our study is to investigate the frequency of corneal haze and its relationship to disease severity.

Methods:
Patient records from 2002-2012 using the diagnosis code for childhood glaucoma (365.14) were identified. PCG was defined as newborn or birth-onset congenital glaucoma (age <1 month), infantile-onset primary congenital glaucoma (age 1-24 months), and late-onset or late-recognized primary infantile glaucoma (age >24 months). Patient age at diagnosis and the presence of corneal haze were recorded. IOP was collected at the time of diagnosis and at all subsequent visits for the following three years. All IOP-lowering medications and surgical interventions were also recorded. Exclusion criteria included secondary childhood glaucomas and lack of data at the time of presentation/diagnosis.

Results:
16 patients (29 eyes) with PCG were identified. Subset diagnoses and age at presentation included newborn-onset congenital glaucoma (2 eyes; mean age 3 days), infantile-onset congenital glaucoma (18 eyes; mean age 0.37 years), and late-recognized congenital glaucoma (9 eyes; mean age 10 years). Of these 29 eyes, 15 had corneal haze at the time of presentation (mean age 0.54 vs. 6.33 years, p=0.009). Mean IOP for eyes with versus without corneal haze was as follows: baseline (30.1 vs. 25.4, p=0.218), year one (21.4 vs. 18.3, p=0.309), year two (20.0 vs. 16.9, p=0.498), and year three (18.1 vs. 16.0, p=0.431). Mean number of IOP-lowering medications for eyes with versus without corneal haze was as follows: year one (1.1 vs. 0.5, p=0.331), year two (1.2 vs. 1.3, p=0.882), and year three (1.9 vs. 1.4, p=0.644). Cumulative number of IOP-lowering procedures performed over three years following presentation was 1.7 for eyes with corneal haze versus 0.9 for eyes without haze (p=0.13).

Discussion:
Corneal haze was present at diagnosis in approximately half of eyes with PCG in our cohort. This important sign was associated with higher IOP at baseline and throughout the following three years, however this did not reach statistical significance. The presenting age of PCG patients with corneal haze was significantly younger than those without haze. Eyes with corneal haze also required more IOP-lowering surgeries over the three years following diagnosis.

Conclusion:
Half of PCG patients did not present with corneal haze. The presence of corneal haze in PCG may be reflective of disease severity and prognosis.

Reference:
Central Corneal Thickness and Treatment with Recombinant Human Growth Hormone During Childhood

RONY RACHMIEL 1, Marianna Rachmiel 2, Amir Rosenblatt 2
Affiliation(s): 1 Tel Aviv Medical Center
2 Tel Aviv University

Purpose/Relevance:
An association between endogenous growth hormone levels, recombinant human growth hormone (rhGH) and increased intraocular pressure (IOP) has previously been reported. Association between growth hormone deficiency (GHD) and central corneal thickness (CCT) was suggested. The purpose of this study was to evaluate the association between rhGH treatment and CCT in children.

Methods:
This is a cross-sectional case control study including comparison between children treated with rhGH for at least 12 months (treatment group), and matched children prior to treatment (control group). All children underwent an ocular slit lamp assessment, CCT measurements and Goldmann applanation tonometry. Charts were reviewed for cause of therapy, treatment duration, IGF-1 level, and rhGH dosage.

Results:
The treatment group included 43 children and the control group included 33 children. Mean age at examination was comparable at 11.4±2.9 years and 11.8±3 years respectively (p=0.34). Male ratio was comparable at 23 (54.8%) and 23 (69.7%), respectively (p=0.06). Treatment duration was 29.5 ±21.2 months. Mean IOP was significantly increased in the treatment group compared to the control group (16.09±2.2 mmHg, 14.1±1.97 mmHg, respectively, p<0.001). Mean CCT was similar in both groups 552.6± 35.1µm and 556± 37.1µm, respectively (p = 0.56), and comparable to reported mean CCT in healthy children. Mean CCT in males was significantly higher than in females in the treatment group, 560.7±34.9µ and 542.9 ±33.1µm (p=0.05), not in the control group. No correlation was demonstrated between CCT, cause for treatment, length of treatment, and IOP.

Discussion:
It has been suggested that patients with GH deficiency have greater CCT that can represent a sign of a delayed growth of the eye. In our study, CCT in similar groups of children, treated with rhGH and untreated is similar, although there is a significantly higher IOP in the treated children.

Conclusion:
CCT in both our groups is similar to reported healthy pediatric population.

Reference:


**78 Triggerfish Recordings Pre and Post Outflow Modifying Treatments**

**CATHERINE M. BIRT 1, Cody X. Li 2, Devesh K. Varma 1, Javiera M. Compan 1, Delan Jinapriya 2**

**Affiliation(s):** 1 University of Toronto 2 Queen’s University at Kingston

**Purpose/Relevance:**
The Triggerfish device monitors corneal strain as a surrogate for IOP over 24 hours of continuous monitoring. The study was intended to evaluate recording output after clinical modification of outflow from a variety of treatments, to assess utility of the device in a clinical setting.

**Methods:**
The was a prospective cohort study evaluating Triggerfish recordings pre and post outflow modifying treatments. 24 total patients were recruited by 3 Canadian Triggerfish Investigation Sites. 24hr Triggerfish recordings were performed pre and 1 month post an outflow improving modality (SLT, med, peripheral iridotomy, argon iridoplasty, iStent). Goldmann applanation tonometry was performed prior to and following removal of the Triggerfish device. A detailed log of activities was kept by the participants. Data was evaluated for the period from 2200-0800.

**Results:**
24 patients were recruited (15 SLT, 3 med, 3 iridoplasty, 2 PI, 1 iStent). 23 patients completed both Triggerfish recordings. Of these, 5 data sets had to be excluded because of recording errors. The average IOP reduction post treatment in the cohort was 11%. 12 of the 18 graphs demonstrated an increase in the post treatment curve relative to the pre-treatment curve, while 6 of 18 had a decrease in the post treatment curve.

**Discussion:**
The Triggerfish recordings did not appear to have a direct correlation with IOP. Given that the majority of the curves increased while IOP decreased indicates that in vivo the recordings may be reflective of other IOP related parameters in addition to IOP.

**Conclusion:**
The fact that the majority of the curves increased while IOP decreased indicates that in vivo the recordings may be reflective of other related parameters in addition to IOP.

**Reference:**
79 Automated Detection and Quantification of Circadian Eye Blinks Using a Contact Lens Sensor

KAWEH MANSOURI 1, Robert N. Weinreb 2
Affiliation(s): 1 Department of Ophthalmology, Geneva University Hospital
2 Hamilton Glaucoma Center

Purpose/Relevance:
To evaluate detection and quantification of eye blinks and identification of wake and sleep periods during 24-h intraocular pressure (IOP) monitoring with a contact lens sensor (CLS).

Methods:
Data pooled from 18 clinical studies across 17 centers. A total of 249 recordings of 24-h IOP patterns from 202 participants using a CLS (Triggerfish, Sensimed AG, Switzerland)1,2 were included. Software was developed to automatically detect eye blinks, wake and sleep periods. In a pilot, comparison to video recordings of eye blinks was conducted. The blink detection method was based on detection of CLS signal peaks greater than a threshold proportional to the signal amplitude. Three methods for automated detection of the sleep and wake periods were evaluated. These relied on blink detection and subsequent comparison of the local signal amplitude with a threshold proportional to the mean signal amplitude. These methods were compared with manual sleep/wake verification.

Results:
Mean (SD) age of participants was 57.4±16.5 years (males, 49.5%). The CLS measured a mean blink frequency of 29.8±1.9 blinks/minute, a blink duration of 0.26±0.03 seconds and an inter-blink interval of 1.91±0.25 seconds. The best method for identifying sleep periods had an accuracy of 95.2±0.5%.

Discussion:
Transient IOP elevations during blinking have been hypothesized to play an important role in the pulsatile flow of aqueous into aqueous and episcleral veins.3 Therefore, the ability to measure blink parameters may be of value in investigating mechanisms of glaucoma damage.

Conclusion:
Automated analysis of 24-h IOP recordings with a CLS can accurately quantify eye blinks and identify sleep and wake periods. These data may contribute to improved understanding of circadian IOP characteristics.

References:
Intraocular Pressure Assessment in Keratoprosthesis Eyes: Comparison of Tono-Pen XL and Schiotz Tonometer

IGOR ESTROVICH 1, Steven L. Mansberger 1, Yvonne I. Chu 2

Affiliation(s): 1 Devers Eye Institute
2 Baylor College of Medicine

Purpose/Relevance:
To determine if current tonometry devices can obtain accurate, reliable and reproducible IOP measurements in eyes with Keratoprosthesis.

Methods:
We connected a digital manometer (XP2I Digital Test Gauge, Crystal Engineering, San Luis Obispo, CA) to a 27-gauge cannula and placed the cannula in the anterior chamber of human cadaver eye. A single surgeon sutured the Boston Keratoprosthesis into the central cornea in the usual fashion. We used a Schiotz Tonometer (Sklar, New York, NY) with a 7.5 gram plunger load and a Tono-pen XL tonometer (Medtronic, Jacksonville, FL) to determine IOP at the temporal corneoscleral limbus and temporal sclera (3mm posterior to the limbus) with the manometer set at 10, 20, 30 and 40 mmHg. We determined precision and accuracy of each device at each specified anatomic site. We used Generalized Estimation Equation models to determine an average absolute difference between the tonometers compared to the manometric IOP.

Results:
We obtained 76 measurements per eye for a total of 380 measurements for our study. For all manometric pressures, the average absolute difference at the temporal sclera with the Schiotz tonometer was 5.4 mm Hg (SD +/- 4.3) and with the Tono-pen tonometer was 35.4 mm Hg (SD +/- 19.0), (p-value <0.001). For all manometric pressures, the average absolute difference at the corneoscleral limbus with the Schiotz tonometer was 5.6 mm Hg (SD +/- 4.7) and with the Tono-pen tonometer was 20.9 mm Hg (SD +/- 17.1), (p-value <0.001).

Discussion:
Glaucoma is common in eyes undergoing KPro implants because of the extent of anterior segment disease present and the prevalence is even higher after implantation. The current standard of care to ascertain IOP in these eyes is palpation, which has been shown to be inaccurate. The data from this experiment demonstrates that Schiotz tonometry measured at the temporal sclera is the best method of measuring IOP in this clinical setting.

Conclusion:
This experiment demonstrates that the Schiotz tonometer is more accurate than the Tonopen, with an absolute difference of 5.5mm Hg across the clinical spectrum. The measurements were more accurate at the temporal sclera than at the limbus, however this was not statistically significant. While this level of uncertainty is not ideal, it can still provide clinically useful information to improve patient care.

Reference:
81 Comparison of Ambulatory Blood Pressure and Intraocular Pressure in Non-glaucomatous Patients

O’RESE J. KNIGHT 1, Scott D. Lawrence 1, Anthony J. Viera 1, Jean-Claude Mwanza 1, Donald Budenz 1

Affiliation(s): 1 University of North Carolina

Purpose/Relevance:
The relationship between ocular perfusion pressure (OPP) and the development of glaucoma may lead to improved understanding of the underlying mechanisms. However, to date, our ability to examine this relationship has been limited by needing to wake sleeping patients to obtain systemic blood pressure (BP) and intraocular pressure (IOP) measurements. The Triggerfish lens is a novel device containing a strain gauge that measures stretch at the corneoscleral junction in response to IOP changes over a 24 hour period. This pilot study compares diurnal trends of systemic BP and IOP in patients without glaucoma when measured with automated devices over 24 hours.

Methods:
We recruited ten participants with no history of hypertension or ocular disease. Participants underwent Snellen visual acuity assessment, gonioscopy, Goldmann applanation tonometry, and funduscopy in both eyes. We fit each participant with an Oscar 2 ambulatory BP monitor (SunTech, Morrisville, NC) on their non-dominant arm. Keratometric measurements with the IOL Master 500 (Carl Zeiss Meditech, Dublin, CA) were performed, and the appropriate Triggerfish lens (Sensimed AG, Lausanne, Switzerland) was placed in the ipsilateral eye. The participants wore the BP cuff and Triggerfish lens with their respective monitors for 24 hours. We calculated mean systemic BP during wake and sleep cycles and percentage decrease during sleep (“dip”) as well as mean sleep and awake IOPs. Overall means of BP and IOP were graphed to allow examination of diurnal patterns.

Results:
The mean age of the participants was 50.9 ± 10.9 years, and 6 of the 10 participants were women. The mean, awake, and sleep systolic BPs were 138.5 ± 12.0 mmHg, 146.2 ± 10.6 mmHg, and 126.5 ± 14.5 mmHg, respectively. The mean, awake, and sleep diastolic pressures were 82.1 ± 9.6 mmHg, 85.7 ± 10.6, and 72.1 ± 9.4 mmHg, respectively. The % dips between awake and sleep was 11.4% for systolic and 15.3% for diastolic pressure. The mean awake IOP equivalent was -45.7 ± 140.6 mV Eq and the mean sleep IOP equivalent was 39.9 ± 183.9 mV Eq. Figure 1 shows the 24-hr averages of BP and IOP across the 10 participants.

Discussion:
Null

Conclusion:
Among patients without glaucoma, during recumbent sleep the mean systolic BP dips and the IOP rises, leading to a decreased nocturnal OPP. These relationships should be assessed in glaucoma patients as well.

Reference:
**Comparative Retinal Oxygen Saturation in Eyes with and Without Primary Open Angle Glaucoma**

**SCOTT D. LAWRENCE †, O’Reese J. Knight †, Jean-Claude Mwanza †, Mao Yang †, Pooja D. Jani †, Donald Budenz †**

**Affiliation(s):** † University of North Carolina

**Purpose/Relevance:**
A disturbance in blood flow to the retina and optic nerve has been implicated in the pathophysiology underlying glaucomatous optic neuropathy. This study sought to determine whether there is a difference in retinal oxygen saturation in eyes with primary open angle glaucoma (POAG) versus controls.

**Methods:**
Thirty-eight eyes (30 patients) with POAG (20 Mild, MD = -2.82 ± 1.20 dB; 12 Moderate, -9.16 ± 2.03 dB; and 6 Severe, -14.46 ± 2.40 dB) and 20 normal eyes (13 patients) completed retinal oximetry imaging (Oxymap T1 retinal oximeter, Reykjavik, Iceland). Mean retinal arterial and venous oxygen saturation was calculated for each eye globally and by quadrant (inferonasal, IN; superonasal, SN; inferotemporal, IT; and  superotemporal, ST). Additionally, glaucoma patients completed Sita-Standard 24-2 Humphrey Visual Fields (HVF) and peripapillary retinal nerve fiber layer (RNFL) measurements using spectral domain ocular coherence tomography (SD-OCT).

**Results:**
Venous oxygen saturation (SvO₂) was higher in glaucomatous eyes (61.23 ± 1.34%) compared to control eyes (51.39 ± 1.91%, p = 0.002). SvO₂ was also significantly elevated in each quadrant in glaucomatous eyes versus control eyes (IN, p < 0.001; SN, p = 0.029; IT, p = 0.004; ST, p = 0.026). The mean global arteriovenous (A-V) difference was lower in glaucomatous eyes compared with control eyes (30.21% vs. 37.84%). The A-V difference was also decreased in three sectors in eyes with POAG relative to controls (IN, 32.34% vs. 46.06%; IT, 35.28% vs. 44.83%; ST, 26.43% vs. 36.01%). There was no difference in mean arterial oxygen saturation between groups (p = 0.40). No significant correlation existed between mean retinal venous oxygen saturation and mean RNFL thickness (p = 0.730) or HVF mean deviation (p = 0.139) in glaucomatous eyes.

**Discussion:**
Patients with POAG exhibit significantly elevated SvO₂ and decreased arteriovenous difference in retinal oxygen saturation compared with normal eyes and suggests potential for retinal oximetry to discriminate glaucomatous from non-glaucomatous eyes.

**Conclusion:**
These findings suggest decreased oxygen utilization and metabolism in glaucomatous eyes. More work is required to assess correlation between retinal oxygen saturation and other measures of structure and function in eyes with glaucoma.

**Reference:**
Application of Anterior Segment Optical Coherence Tomography in Micro-invasive Glaucoma Surgery

**Purpose/Relevance:**
To evaluate the application of Anterior Segment Optical Coherence Tomography (AS-OCT) in locating the trabecular micro-bypass (iStent) and to evaluate the relationship between the position of this device and its hypotensive efficacy.

**Methods:**
Prospective, non-comparative, uncontrolled, interventional case series study. We enrolled subjects who had postoperative visit from May 2013 to August 2013 at Duke eye center had combined iStent Trabecular Micro-bypass Stent implantation and phacoemulsification from September 2012 to June 2013. All subjects provided written informed consent. We performed Heidelberg Spectralis AS-OCT using a specially designed anterior segment lens. Detailed views of Schlemm’s canal at the region of the iStent placement were obtained. The pre and postoperative intraocular pressure (IOP) and antiglaucoma medications were reviewed.

**Results:**
A total of 12 eyes of 11 patients were enrolled in the study. In all eyes we could locate iStent in the Schlemm’s canal, including one eye which was identified as a shallow implantation by gonioscopy. The preoperative mean baseline IOP was 17.9±2.7mmHg and the mean IOP at 3 months postoperative follow up was 14.6±4.6mmHg. The mean number of hypotensive medications at baseline was 2.2±1.1 (range 0-4) and at 3 months postoperative appointment was 1.2±1.1(range 0-3). The reduction was both statistically significant (p<0.05). One subject had iris iStent snorkel blockage which was resolved with YAG laser.

**Discussion:**
AS spectral domain OCT is able to identify the location of iStent implant. The lumen size of Schlemm’s canal around iStent can be measured.

**Conclusion:**
AS spectral domain OCT is an efficient method to determine the position of the iStent in Schlemm’s canal. The iStent is a safe and effective treatment option in patients with open-angle glaucoma, and reduces the topical treatment burden.

**Reference:**
Non-pupillary Block Secondary Angle Closure After Implantable Collamer Lens: A Cadaver Eye Study

RICHARD G. MORSHEDI 1, Adam Gess 2, Jason A. Goldsmith 3

Affiliation(s): 1 University of Arkansas for Medical Sciences
2 Eye Doctors of Washington
3 University of Utah

Purpose/Relevance:
To show changes in anterior chamber anatomy following implantation of an intentionally oversized implantable collamer lens (ICL).

Methods:
Two phakic cadaver globes from one donor were used. Pre-implantation measurements included axial length (calipers), white-to-white measurement (IOLMaster and calipers), sulcus-to-sulcus distance with ultrasound biomicroscopy (UBM), and anterior segment optical coherence tomography (AS-OCT).
In one eye, the proper sized ICL was implanted, using the manufacturer’s algorithm. In the other eye, the next size larger ICL was implanted. Post-implantation measurements (AS-OCT and UBM) were performed and compared qualitatively and quantitatively with pre-implantation measurements.

Results:
Axial length of each eye was 24.0mm. White-to-white for the two eyes was 11.9mm and 11.8mm with the IOLMaster, and 11.5mm and 11.3mm with calipers. Sulcus-to-sulcus distance with UBM was 9.52mm and 9.48mm. The algorithm called for a 12.6mm diameter ICL, which was implanted in eye #1. The next size larger (13.2mm) ICL was implanted in eye #2. See Table 1 for results. Eye #1 showed a small decrease in AC depth, no change in iris configuration, and minimal ICL vault (0.12mm). Eye #2 showed a large decrease in anterior chamber depth, marked mechanical shallowing of the peripheral anterior chamber in the horizontal meridian where the ICL haptics were placed, and marked ICL vault (1.12mm).

Discussion:
Although ICL implantation is a safe and effective refractive procedure, pupillary block is known to be an uncommon complication. Therefore, preoperative peripheral iridotomy is generally recommended. However, there have been rare reports of non-pupillary block angle closure following ICL implantation, resolving only with explantation of the ICL. This cadaver study shows that oversizing the ICL can cause drastic changes in the anterior chamber anatomy and lead to mechanical angle closure from the ICL haptics pushing the peripheral iris anteriorly.

Conclusion:
ICL implantation can be associated with non-pupillary block angle closure that would not be expected to resolve with peripheral iridotomy. Glaucoma surgeons should be aware of this potential complication. Refractive surgeons should avoid oversizing the ICL to avoid this rare but serious complication.

Reference:

Table 1. Anterior chamber depth measurements by ultrasound biomicroscopy (UBM) and anterior segment OCT (AS-OCT) pre- and post-implantation of implantable collamer lenses in cadaver eyes.

<table>
<thead>
<tr>
<th></th>
<th>Eye #1 (correct sized ICL)</th>
<th>Eye #2 (oversized ICL)</th>
</tr>
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<tbody>
<tr>
<td>Pre-implantation</td>
<td>2.46 mm</td>
<td>2.51 mm</td>
</tr>
<tr>
<td>UBM</td>
<td></td>
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<tr>
<td>Post-implantation</td>
<td>2.17 mm</td>
<td>1.51 mm</td>
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<tr>
<td>0.12 mm vault</td>
<td></td>
<td>1.12 mm vault</td>
</tr>
<tr>
<td>Pre-implantation</td>
<td>2.10 mm</td>
<td>2.28 mm</td>
</tr>
<tr>
<td>AS-OCT</td>
<td></td>
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<tr>
<td>Post-implantation</td>
<td>2.46 mm</td>
<td>1.98 mm</td>
</tr>
<tr>
<td>0.17 mm vault</td>
<td></td>
<td>1.03 mm vault</td>
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</table>
Comparison of Anterior Segment Optical Coherence Tomography Bleb Grading, Moorfields Bleb Grading System and Intraocular Pressure

JOANNE WEN 1, Sanjay G. Asrani 1
Affiliation(s): 1 Duke Eye Center

Purpose/Relevance:
Though many classification systems and imaging methods have been developed to characterize a post-trabeculectomy bleb,1,2 few studies have examined the relationship among the clinical and cross-sectional appearance of the bleb and the intraocular pressure (IOP) of the eye. The purpose of this study was to compare an anterior segment optical coherence tomography (AS-OCT) grading system with a clinical bleb grading system and to correlate both systems with IOP following trabeculectomy surgery.

Methods:
This was an imaging center study examining the blebs of 124 eyes at post-operative months 4, 6 and 12 following trabeculectomy surgery. At each visit, AS-OCT images and clinical photos were acquired. Images were graded by masked reviewers using a novel grading system based on the degree of bleb wall thickening and reflectivity within the bleb. Photos were graded by masked reviewers using the Moorfields Bleb Grading System (MBGS). The 2 grading systems were compared and correlated with the IOP.

Results:
The AS-OCT bleb grading was significantly correlated with the following MBGS parameters: bleb height at post-operative months 4, 6 and 12 (p<0.0001, p=0.0014 and p<0.0001, respectively), central bleb vascularity at months 4 and 12 (p=0.0008 and p=0.0044) and maximal bleb area at months 6 and 12 (p=0.0026 and p=0.0356). Though a greater AS-OCT bleb grade was significantly correlated with higher IOP at months 4 and 6 (p=0.0042 and p=0.0202), this correlation was no longer significant at month 12 (p=0.0985). None of the MBGS parameters correlated significantly with IOP at any of the post-operative months.

Discussion:
The AS-OCT grading system may be limited because the cross-sectional image of a bleb is unable to capture the full extent of the functioning bleb area. The system is also unable to assess the amount of fluid percolating through the bleb microcysts, which may be a better indicator of bleb function. That none of the MBGS parameters correlated with IOP further suggests that there are aspects of bleb function unaccounted for by assessing the external bleb appearance alone.

Conclusion:
Further clinical and AS-OCT imaging characteristics need to be identified to better predict bleb function as represented by IOP.

References:
Increased Prevalence of Peripapillary Schisis in Glaucoma and Glaucoma Suspects Compared to a Control Population.

DILRAJ GREWAL 1, Daniel J. Merlau2, Marion R. Munk 1, Amani Fawzi 1, Lee M. Jampol 1, Angelo P. Tanna 1

Affiliation(s): 1 Northwestern University 2 Columbia University

Purpose/Relevance:
To identify the prevalence of peripapillary schisis in patients with glaucoma or glaucoma suspects compared to a control population of normal subjects.

Methods:
Medical records for 800 consecutive patients examined in the glaucoma clinic over a six-month period were reviewed. A total of 495 patients (990 eyes) who had undergone optic nerve head raster OCT and did not have optic nerve pits, pseudopits or coloboma were included in the study. Optic nerve head scans, using spectral domain OCT (Spectralis HRA-OCT, version 4; Heidelberg Engineering, Heidelberg, Germany) were reviewed (Raster lines protocol: 4 mm by 4 mm area centered on the optic disc). 278 eyes, from 144 participants (81 females, 63 males) with a mean age of 37.6 years (range 18 to 74; SD = 15.5) were used as controls and were scanned using the raster 3D-OCT scan protocol (512 × 128 scans centering at the optic nerve head). Scans with poor quality were excluded. OCT scans of both groups were reviewed by a single observer. Cases with uncertain findings on the initial evaluation were adjudicated by a team of a two retina specialists and one glaucoma specialist.

Results:
None of the 278 eyes of control subjects had peripapillary schisis. A total of 11 eyes of 7 patients (2 females, 5 males, mean age 64.5 ± 9.2 years) had peripapillary schisis, 2/11 eyes also had extension of the schisis cavity into the macula. Of these 7 patients, 2 (28.6%) had primary open angle glaucoma, 3 (42.9%) were glaucoma suspects, 1 (14.3%) had chronic narrow angle glaucoma and 1 (14.3%) had pigmentary glaucoma. The mean visual field mean deviation was -3.48 and PSD was 3.45. 7/11 (63.6%) eyes had vitreous traction and 6/11 eyes (54.5%) had beta-zone peripapillary atrophy.

Discussion:
Cases of macular and peripapillary schisis in patients with cupping and glaucoma have been recently reported and various hypotheses for their etiology have been proposed including fluctuations in IOP, holes in the lamina cribrosa and vitreous traction.[1-3] We report an increased prevalence of peripapillary schisis among glaucoma and glaucoma suspect patients compared to controls.

Conclusion:
11/990 eyes (1.1%) with glaucoma or suspected to have glaucoma had evidence of peripapillary schisis on OCT compared to 0/278 controls. A majority of the 11 eyes had evidence of adherent vitreous with traction and had peripapillary atrophy.

References:
91 CORDA (Color Reflectivity Discretization Analysis) in the Detection of Glaucomatous Nerve Fiber Layer Defects

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Purpose/Relevance:
To compare the ability of Cirrus RNFL thickness and the CORDA (Color Reflectivity Discretization Analysis, a novel OCT analysis method) HR1 parameter to differentiate between normal subjects, glaucoma suspects and glaucoma patients.

Methods:
A total of 291 eyes of 148 subjects (94 healthy eyes, 100 glaucoma suspect eyes and 97 glaucomatous eyes) underwent peripapillary RNFL imaging using Cirrus HD-OCT (optic nerve head cube 200 x 200 protocol) with post-acquisition CORDA analysis of peripapillary RNFL B-scan images. The area under the receiver operating characteristic curve (AUC) was calculated for each region and method (Cirrus vs. CORDA) for differentiating eyes with glaucoma, and those that are glaucoma suspect, from normal control eyes.

Results:
The CORDA HR1 parameter discriminated glaucoma patients from normal subjects more accurately than Cirrus RNFL thickness in the nasal (P = 0.003) and temporal (P = 0.001) regions. Both algorithms had similar accuracy for the mean and the inferior and superior regions. CORDA HR1 parameter showed greater AUC than Cirrus RNFL thickness measurement when discriminating glaucoma suspects from normal subjects in the superior (P = 0.02), nasal (P = 0.003) and temporal (P = 0.001) regions. Both algorithms had similar AUC for the mean and the inferior regions (Figure 1).

Discussion:
The novel CORDA algorithm showed greater diagnostic accuracy when differentiating between normal subjects and glaucoma suspects. In some sectors, CORDA also more accurately discriminated between normal subjects and those with glaucoma than Cirrus RNFL measurements.

Conclusion:
The CORDA algorithm shows similar performance to RNFL thickness analysis of Cirrus SD-OCT images in differentiating glaucoma from normal, and may be superior in differentiating glaucoma suspect nerves from normal.

References:

Figure 1: The AUC graph for the mean RNFL thickness and mean HR1 values (normal subjects vs. glaucoma suspects).
92 Detecting Glaucomatous Visual Field Progression with Macular Spectral Domain Optical Coherence Tomography

TOBIAS ELZE 1, Louis R. Pasquale 1, Peter Bex 1, Lucy Q. Shen 2
Affiliation(s): 1 Harvard Medical School
2 Massachusetts Eye and Ear Infirmary

Purpose/Relevance:
To identify parameters from macular spectral domain optical coherence tomography (SD-OCT) which can distinguish stable from progressing glaucomatous visual fields (VF).

Methods:
From glaucoma patients and suspects recruited for a prospective study, Humphrey visual field tests (HVF) and macular SD-OCT thickness and volume parameters (RTVue, EMM5 and GCC protocols) were obtained regularly over a 3-year period. Presence of HVF glaucomatous progression was determined by two glaucoma specialists using event and trend analyses after stratification of the pattern deviation plot. For each of the 41 indices extracted from SD-OCT, linear regression slope, intercept, and their interaction were calculated, for which logistic regression (regressor: VF progression) was performed. The variable was chosen as a predictor if a model selection criterion (BIC; Schwarz, 1978) preferred it over a null model. The full model of all predictors was compared to the best simple model selected by BIC from all models with any combination of the predictors.

Results:
Of 122 eyes from 61 enrolled patients (63.9% male, mean age 60.8±12.6 years and mean IOP 14.6±4.0 mmHg at baseline), 91 eyes had at least 3 (mean 4.5±1.2) reliable OCT measurements over a follow-up period of 2.15±0.52 years. 25.3% of these eyes progressed based on VF analysis. 16 SD-OCT parameters, including global full and inner retinal thickness, inferior inner retinal thickness, and full thickness and volume of the perifoveal region, constitute the full model (Figure, solid line) with an area under the ROC curve (AUC) of 0.88. The best simplified model (Figure, dashed line) consists of slope and intercept of GCC inner retinal thickness parameters also showed reasonable performance in identifying VF progression.

Discussion:
Based on our statistical analysis, a model combining parameters from EMM5 and GCC protocols distinguishes well between stable and progressing VFs. For some of the parameters, such as perifoveal measurements, their modeled initial value (intercept) rather than their development over time (slope) was incorporated into the model. A simplified model consisting of GCC inner retinal thickness parameters also showed reasonable performance in identifying VF progression.

Conclusion:
Parameters obtained from serial macular SD-OCT measurements can be incorporated in a statistical model to discriminate stable from progressing VFs and may have clinical utility to confirm functional worsening from glaucoma.

Reference:
93 3D and 2D Digital Images Versus 3D Slide Film for the Evaluation of Glaucomatous Optic Disc Features

FAAZIL KASSAM 1, Sourabh Arora 2, Chris Rudnisky 3, Gordon R. Douglas 1, Marianne C. Edwards 1, Karin L. Verstraten 1, Beatrice K. Wong 3, Karim F. Damji 2

Affiliation(s): 1 University of Calgary 2 University of Alberta 3 Loma Linda University

Purpose/Relevance:
To compare the sensitivity, specificity, and reproducibility of 3-dimensional (3D) versus 2-dimensional (2D) digital photography in detecting glaucomatous optic nerve head features.

Methods:
Eyes with glaucomatous, suspicious, or normal optic nerves were imaged with 3D digital, 2D digital (1024 X 1280 pixels) and stereo slide film. The primary disc features of interest were vertical cup-to-disc ratio (VCDR), disc hemorrhage and notching. Each format was graded by 4 glaucoma specialists starting with digital 2D then 3D, and finally stereo slide film. Other disc features were also considered. The mean from all 4 specialists was used to combine VCDR evaluations into a single grade; where the standard deviation was > 0.2, VCDR was re-reviewed and a final determination recorded. For disc hemorrhage and notching, the majority opinion was utilized for the final grade; for ties, images were re-reviewed with all 4 graders present to achieve consensus. Weighted kappa was calculated to identify the agreement of 3D and 2D using slide film as the gold standard. Sensitivity, specificity, and area under ROC curve (AUC) were calculated for categorical nerve features as detected by each of 3D and 2D digital.

Results:
There were 192 eyes imaged using 3 image formats to yield 576 images. The overall mean VCDR for slide, 3D, 2D was 0.59±0.20, 0.60±0.18, 0.62±0.17, respectively. The agreement of VCDR between film and 3D was excellent (κ= 0.781; 95% CI: 0.740 - 0.823) whereas there was good agreement for 2D (κ=0.69; 95% CI: 0.632 - 0.748) compared to film. Sensitivity, specificity and AUC of 3D digital imaging to detect notching (95.2%, 95.2%, AUC=0.953) was better than for 2D (90.5%, 88.6%, AUC=0.895; p=0.03). Similarly, sensitivity, specificity and AUC of 3D digital imaging to detect disc hemorrhage (77.8%, 98.9%, AUC=0.883) was better than for 2D (44.4%, 99.5% AUC=0.72; p=0.049). With other disc features, there was no difference between 3D and 2D digital imaging for detecting disc tilt (p=0.7), peripapillary atrophy (p=0.16), grey crescent (p=0.1), or pallor (p=0.43), although 3D better detected sloping (p=0.013).

Discussion:
The role of 2D and 3D digital images in virtual assessment of the optic nerve remains to be established. Previous studies have shown highly sensitive and specific evaluation of optic disc features using 3D digital photography.

Conclusion:
Digital imaging demonstrates excellent reproducibility in comparison to gold standard stereo slide film when evaluating important features of glaucomatous disc damage: VCDR, notching and disc hemorrhage. 3D is slightly more accurate than 2D for evaluating disc hemorrhage, notching and sloping.

Reference:
The Effects of Intravitreal Injection of Anti-VEGF Therapies on Intraocular Pressure

FRED CHU \(^1\), Anjali S. Hawkins \(^1\), Claire L. Kiernan \(^1\), Norbert M. Becker \(^2\)

Affiliation(s): \(^1\) Rush University Medical Center
\(^2\) Stroger Hospital of Cook County

Purpose/Relevance:
To determine if there is an association between intravitreal injections of Anti-VEGF therapies and elevated intraocular pressure. To determine which preoperative factors are associated with ocular hypertension in eyes receiving intravitreal injections of Anti-VEGF therapies.

Methods:
Retrospective chart review of 173 patients (220 eyes) who underwent initial intravitreal injection of Anti-VEGF therapy between January 2006 and December 2011. Data was analyzed at months 0, 1, and 3 and then in 3-month increments through December 2011. Injections were performed by the same surgeon. Charts were reviewed for demographic information including age at first injection, diagnosis (e.g. age-related macular degeneration versus diabetic macular edema), pre-treatment IOP, glaucoma status, and lens status. Post-treatment IOP, glaucoma medications and interventions were recorded. Anti-VEGF therapies included bevacizumab, ranibizumab, and pegaptanib. The primary outcome was initiation or escalation of glaucoma therapy (medications, laser trabeculoplasty or incisional surgeries). We defined a significant elevation in IOP as a rise of 20% or greater from baseline to a number greater than 21 mmHg.

Results:
14.1% of eyes developed a significant IOP increase by our definition. 7.7% of eyes received treatment for elevated IOP. Eyes treated for elevated IOP began treatment an average of 18 months (range 1-42 months) after initial injection and underwent an average of 6 injections (range 1-22 injections) prior to anti-hypertensive treatment. 1 of 17 eyes underwent SLT. 0 of 17 underwent incisional surgery. Eyes requiring additional antihypertensive treatment started with a higher baseline IOP (18.3 mmHg, SD ± 4.9 vs. 14.9mmHg, SD ± 3.3; p = 0.001) and received more injections (13.2, SD ± 9.2 vs. 8.1, SD ± 7.2; p = 0.039).

Discussion:
Our definition of ocular hypertension was less restricting which may account for our higher levels of ocular hypertension compared with previous studies. The baseline diagnosis requiring Anti-VEGF therapy or type of injection did not affect rates of ocular hypertension or need for treatment.

Conclusion:
There likely is an association between intravitreal injections of Anti-VEGF therapies and ocular hypertension. It is important to closely monitor IOP in these patients, especially if beginning with a relatively high IOP at baseline.

Reference:
Toxicity of Mitomycin C in the Suprachoroidal Space

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Affiliation(s): 1 Illinois Glaucoma Center, LTD
2 Institut du Glaucome de Montreal
3 Purdue University
4 University of Alabama @ Birmingham
5 Instituto de Ofalmología Gabriel Simón

Purpose/Relevance:
To evaluate for evidence of inflammatory changes and toxicity in the suprachoroidal space (SCS) after direct application of mitomycin-C (MMC) in rabbits.

Methods:
After surgical exposure to the SCS, twenty New Zealand White male rabbits were injected with 0.10 cc of Balanced Salt Solution (BSS) or MMC. Four groups were assigned: Group 1 (5 rabbits, Control, BSS), Group 2 (5 rabbits, MMC at 0.25 mg/ml), Group 3 (5 rabbits, MMC at 0.40 mg/ml), Group 4 (5 rabbits, MMC at 1.0 mg/ml). The MMC exposure time in the SCS was 1 minute for Groups 2-4, followed by irrigation with BSS. Post-op examinations by a masked examiner, including measurement of intraocular pressure (IOP) using a Tonometer, were performed for 4 weeks. The eyes were then enucleated, fixed, processed and sectioned for a blinded histologic evaluation.

Results:
In 6/20 rabbits no significant findings were noted. In the remaining 14/20 rabbits, the only lesions identified were in the area of the injections, but were considered of minimal severity consisting of a small collection of mononuclear inflammatory cells occasionally associated with minimal fibrosis. The lesions appeared to be consistent with injection site reactions and were static in nature. There was no observed difference between the control group and the treatment groups, nor was there an associated dose-response relationship in the three treatment groups. There was also no significant difference in IOP between the 4 groups: Group 1 (BL: 16.2 ± 1.6mm Hg; 4 weeks 13.6 ± 1.3); Group 2 (BL: 14.2 ± 2.5; 4 weeks 13.8 ± 2.2); Group 3 (BL: 15.6 ± 2.2; 4 weeks 12.8 ± 2.0); Group 4 (BL: 14.8 ± 3.7; 4 weeks 14.0 ± 2.6).

Discussion:
Anti-metabolites such as MMC are commonly used in clinical practice to help reduce post-operative scarring in glaucoma filtration surgery. However, there is little scientific evidence and literature related to wound healing and the use of anti-metabolites directly in the SCS. In this rabbit study, apart from mild injection site reactions, the treatment with MMC at 3 different concentrations had minimal influence in the SCS or surrounding tissues, including the ciliary body and retina. IOP also remained largely unchanged across the 4 groups during the study.

Conclusion:
The direct application of mitomycin-C in the suprachoroidal space in a rabbit model was well tolerated and did not result in any significant toxicity. Additional investigation in human subjects in conjunction with novel glaucoma drainage devices is warranted.

Reference:
97 Drug-Induced Bilateral Secondary Angle-Closure Glaucoma: A Literature Synthesis

Belay Bakir 1, Rory R.M. Murphy 2, Janey Wiggs 1, Louis R. Pasquale 1
Affiliation(s): 1 Massachusetts Eye and Ear 2 University College Dublin

Purpose/Relevance:
To review and evaluate the scientific literature for the probability of drug-induced bilateral secondary angle closure glaucoma (bSACG).

Methods:
We performed an extensive review of the literature using Pubmed to identify bSACG case reports. Subsequently, we evaluated these reports using the Naranjo adverse drug reaction probability scale to assess the probability and causality of adverse drug reactions and a secondary angle closure glaucoma (SACG) scoring system to determine the likelihood that the adverse drug reaction caused bSACG. Two independent graders performed this analysis and their scoring was averaged for interpretation. The Naranjo scale ranges from -4 to +13 and the drug reaction is considered definite if the score was ≥ 9, probable if 5 - 8, possible if 1 – 4, and doubtful if ≤ 0. The SACG score ranges from (0 – 7). We considered a SACG score of ≥ 4 as evidence of significant likelihood that the drug reaction caused bSACG.

Results:
30 total drugs or drug groups were evaluated in this review. None were found to have definite Naranjo scores but 16 were found to have probable Naranjo scores and SACG scores ≥ 4 (acetazolamide, “anorexiant mix”, bupropion, cabergoline, “ecstasy”, escitalopram, flavoxate, fluocoxacin, hydrochlorothiazide, hydrochlorothiazide/triamterene, mefanamic acid, methazolamide, oseltamivir, topiramate, topiramate/bactrim and venlafaxine). Of these, the two drugs with the highest number of case reports were topiramate and acetazolamide. Root chemical analysis failed to find a recurring structure that contributed to bSACG. Sulfur containing and non-sulfur containing compounds alike contributed to bSACG.

Discussion:
Drug-induced bSACG is an ophthalmic emergency that threatens vision, typically occurring in patients who are young adults. The entity can disarm the treating physician who is not aware of the entire list of drugs that are associated with it. The treating physician should also be aware that some forms of illicit drug use, which the patient may not admit to, could contribute to drug-induced bSACG.

Conclusion:
A surprising large spectrum of compound preparations are implicated in the development of drug-induced bSACG, suggesting this entity is more common than suspected.

Reference:
99 Double-Masked, Randomized, Dose-Response Study of AR-13324 Ophthalmic Solution Compared to Latanoprost in Patients with Elevated Intraocular Pressure

JASON BACHARACH 1, Brian Levy 2, Casey Kopczynski 2, Gary D. Novack 2
Affiliation(s): 1 North Bay Eye Associates 2 Aerie Pharmaceuticals, Inc

Purpose/Relevance:
AR-13324 represents a new class of ocular hypotensive compounds that inhibit both Rho kinase and norepinephrine transporter to increase trabecular outflow and decrease aqueous production. Study objectives were to evaluate the ocular hypotensive efficacy and ocular and systemic safety of two concentrations of AR-13324 compared to latanoprost.

Methods:
Adult patients with open-angle glaucoma or ocular hypertension (baseline IOP’s 22-36 mm Hg) were randomized to receive either AR-13324 0.01% or 0.02% q.d. (PM) or latanoprost q.d. (PM) for 28 days.

Results:
A total of 224 patients were randomized. Mean unmedicated diurnal IOP was 25 to 26 mm Hg across groups. On Day 28, in the mITT population of 221, mean diurnal IOP was 20.1, 20.0 and 18.7 mm Hg for the AR-13324 0.01%, 0.02% and latanoprost groups, respectively, representing a decrease from unmedicated baseline of 5.5, 5.7 and 6.8 mm Hg (p < 0.0001). In a planned subgroup analysis of patients with baseline IOP’s <=26 mmHg (N=106), the decrease from baseline in each group on Day 28 was 5.4, 5.8 and 6.0 mm Hg, respectively (p < 0.0001). The difference in the change from baseline between AR-13324 0.02% and latanoprost was 1.2 mm Hg (p=0.009) in the mITT population compared to 0.2 mm Hg in the subgroup with baseline IOPs <= 26 mmHg (p=0.754). These results show that AR-13324 0.2% maintained similar efficacy regardless of baseline IOP, whereas latanoprost was less effective at baseline IOPs <= 26 mmHg. The only drug-related safety finding of note for AR-13324 was conjunctival hyperemia, which for the majority of patients was mild to moderate and transient.

Discussion:
AR-13324 0.01% and 0.02% produced clinically and statistically significant reductions in IOP. AR-13324 0.02% was less effective than latanoprost by approximately 1 mm Hg in patients with unmedicated IOPs in the range of 22 – 36 mm Hg. AR13324 0.02% had equivalent efficacy to latanoprost (within 0.2 mm Hg) in patients with baseline IOPs of 22 – 26 mm Hg. The only adverse event drug-related finding of note was conjunctival hyperemia which for the majority of patients was mild to moderate and transient.

Conclusion:
In this 28-day study, AR-13324 was effective and well tolerated in patients with glaucoma and ocular hypertension.

Reference:
Changes in Aqueous Humor Dynamics During Puberty Affect Efficacy of Intraocular Pressure-lowering Drugs

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Purpose/Relevance:
To identify changes in aqueous humor dynamics in the rabbit eye during puberty that may explain age-dependent changes in intraocular pressure (IOP) efficacy of latanoprost and timolol.

Methods:
In a longitudinal study, 15 male Dutch belted rabbits were studied between the ages of 9 weeks (prepuberty) and 42 weeks (adult). Between 10 PM and 5 AM, measurements were made of central cornea thickness and anterior chamber depth by pachymetry, IOP by pneumatonometry, aqueous flow by fluorophotometry, and outflow facility (C) by tonography and fluorophotometric method. Puberty was monitored monthly by measuring body weight, blood testosterone levels and testicle volume. These measurements were repeated in a randomized crossover manner after topical treatment with latanoprost (25 µl of 0.006% once daily for two days), timolol (25 µl, 0.5%, twice daily for two days) and placebo (saline, 25 µl twice daily for two days). Statistical tests included repeated measures analysis of variance, paired t-tests and Spearman’s correlations.

Results:
Puberty was determined to be between ages 9 and 30 weeks. IOP increased from 23.3±0.4 mmHg (puberty) to 28.7±0.4 mmHg (adult, P < 0.0001). Aqueous flow decreased from 2.8±0.2 µl/min (puberty) to 2.2±0.1 µl/min (adult, P = 0.003). Although outflow facility decreased from 0.31±0.08 to 0.25±0.09 µl/min/mmHg during puberty this change was not statistically significant. Timolol reduced IOP and aqueous flow during and post puberty whereas latanoprost only lowered IOP post puberty.

Discussion:
Latanoprost did not reduce IOP in young animals but did effectively reduce IOP when the animals reached adulthood possibly because of maturation of tissues in the uveoscleral outflow pathway. Direct assessment of uveoscleral outflow could not be done in this longitudinal study. These results suggest that changes in the uveoscleral outflow pathway may occur in children to explain why latanoprost is more effective in adult humans than prepubertal children.

Conclusion:
Timolol reduced IOP in rabbits when young and after maturity by reducing aqueous flow. Latanoprost did not reduce IOP when the rabbits were young but did reduce IOP in when the rabbits matured probably because of increases in uveoscleral outflow.

Reference:
Comparison of U.S. and Canadian Glaucoma Medication Prices and Price Change from 2006 to 2013

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Purpose/Relevance:
The cost of glaucoma topical medications represents a significant burden to patients and health care systems, and affects compliance. This study compares U.S. and Canadian glaucoma medication prices and their price change from 2006 to 2013.

Methods:
We obtained the retail non-insurance price of various brand name and generic medications from Costco locations in the U.S. (Massachusetts) and Canada (Ontario) in October, 2013. We calculated the price per mL for each medication by country, and then compared the prices by expressing the Canadian prices as a percentage of the U.S. prices. For price change over time, we obtained the Average Wholesale Price for medications in the U.S. and the Ontario Drug Benefit Price in Canada for 2006 and 2013. We calculated the percentage increase or decrease relative to 2006 prices.

Results:
Figure 1 lists the Canadian glaucoma medication prices as a percentage of U.S. prices. For brand name medications, the Canadian prices were on average one quarter of the U.S. prices (mean: 28%; range: 15% to 54%). For generic medications, the Canadian prices were on average the same as U.S. prices, though variation exists (mean=102%; range: 13% to 276%). For price change from 2006 to 2013, all brand name medications increased in price and most generic medications decreased in price. The U.S. brand name medications increased in price more than the Canadian brand name medications (U.S. price increase range: 49% to 141%; Canadian price increase range: 3% to 32%).

Discussion:
U.S. brand name glaucoma medications are significantly more expensive than Canadian brand name medications. Generic medication prices are similar in both countries, with some drug specific variation. The prices of brand name medications increased in both Canada and the U.S. from 2006 to 2013, though more so in the U.S. Most generic prices decreased from 2006 to 2013.

Conclusion:
The cost of branded topical medications is higher and increasing faster in the U.S. than in Canada, while the cost of generic medications is more similar in the two countries.

References:
Similar Outcome After Trabeculectomy Treated Post-operatively with Difluprednate or Prednisolone Acetate

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Purpose/Relevance:
Difluprednate has higher glucocorticoid potency, higher glucocorticoid receptor affinity, and better corneal penetration than prednisolone acetate (PA). Hence, the aim of this study was to evaluate if post-operative treatment with difluprednate after trabeculectomy with intra-operative mitomycin C (trab plus MMC) results in higher success rates.

Methods:
This is a retrospective, non-randomized, interventional, comparative case-series of patients who underwent trab plus MMC between 3/2003 and 6/2012 were evaluated. From the period between 3/2003 and 5/2010, all eyes received postoperative PA while all eyes from 6/2010 to 6/2012 were treated with difluprednate. Inclusion criteria were age ≥ 18 years (y) with no upper limit and a diagnosis of open angle glaucoma. Exclusion criterions were follow-up <3 month and history of a concurrent surgery that lowers IOP other than laser trabeculoplasty, cataract surgery, or trabecular meshwork bypass procedures. The main definition for success was intraocular pressure (IOP) ≤ 21mmHg and ≥ 20% reduction below baseline after 1 month, no hypotony (IOP >5mmHg), and no additional glaucoma surgery, nor loss of light perception vision. Primary (IOP, anti-glaucoma medication (AGM), time to failure, and Kaplan-Meier survival) and other secondary outcome measures (post-operative interventions and complications) were evaluated.

Results:
75 eyes were treated with PA and 40 with difluprednate. Follow-up was 41.6±23.1 months in the PA group and 21.5±9.0 months in the difluprednate group. Mean defect was higher in the PA group (-16.1 ± 9.5 vs. -11.5 ± 9.4; P=0.023). Otherwise, there were no differences in baseline characteristics. IOP and AGM could be significantly lowered in the PF group for up to 6y (from 22.8±8.7mmHg at baseline to 13.5 ± 4.2mmHg, P=0.018; and from 3.3 ± 1.1 to 0.7 ± 1.0, P=0.034) and in the difluprednate group (from 21.4 ± 7.3mmHg to 10.4 ± 4.0, P<0.001; and from 3.3 ± 1.1 to 1.0 ± 1.3, P=0.012) for up to 2.5y. However, there was no statistical significant difference (P>0.05) between the two groups in regard to IOP, AGM, Kaplan-Meier survival (PA group: 80.7% at 1y, 75.9% at 2y, 65.8% at 2.5y, and 37.2% at 6.5y; difluprednate group: 76.9% at 1y, 62.8% at 2y, and 62.8% at 2.5y) for up to 2.5y, as well as regarding complications and post-operative interventions.

Discussion:
When used to prevent scarring after trab, there was no difference in the amount both drugs lowered IOP and reduced AGM. Furthermore, success rates, complications, and post-operative interventions were comparable for the whole follow-up time of the difluprednate group for both drugs.

Conclusion:
No advantage of difluprednate over prednisolone acetate could be found for post-operative treatment after trab plus MMC.

References:
2. Korenfeld MS, Silverstein SM, Cooke DL, Vogel R, Crockett RS; Difluprednate Ophthalmic Emulsion 0.05% (Durezol) Study Group. Difluprednate ophthalmic emulsion 0.05% for postoperative inflammation and pain. J Cataract Refract Surg. 2009 Jan;35(1):26-34.
AM Versus PM IOP Lowering and Tolerability with the Novel FP/EP3 Dual Receptor Agonist ONO-9054 in Patients with Ocular Hypertension or Early Open-Angle Glaucoma

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Purpose/Relevance:
Comparison of ocular hypotensive effect and tolerability with AM vs. PM dosing of the investigational dual agonist ONO-9054 in patients with OHT or mild OAG.

Methods:
Twelve patients were evaluated in a randomized, double-masked, 2-sequence crossover study. ONO-9054 was dosed at 30µg/ml (0.003%) QD (AM or PM) for 14 days with active and 12 hours later with vehicle solution. After a 14 day washout, patients were switched to the opposite active dose regimen for another 14 days, until Day 42. Tolerability (irritability, itching and dryness) and efficacy (IOP lowering) were assessed. IOP was measured at 8 and 10AM, 12, 4, 8 and 10 PM on Day 14 and 42.

Results:
T tolerability did not differ with AM or PM dosing. Maximum IOP reduction at 8AM on Day 2 was -7.42 mmHg (-30.74% from baseline) for AM dosing (1hr post dose[MSB1]) and -9.08 mmHg (-37.53%) for PM dosing (13hrs post dose). IOP observed values after the last dosing in the AM group were 13.96-17.00 mmHg and in the PM group 14.63-16.38 mmHg. After the last dosing, the percentage of subjects who achieved IOP ≤16 mmHg in the AM group were 25.0% at 8 AM and 75.0% at 8P Mand in the PM group were 58.3% at 8 AM and 66.7% at 8PM.

Discussion:
Preclinical studies suggest ONO-9054 acts by increasing both trabecular and uveoscleral outflow.1 EP agonists have been suggested to produce beneficial therapeutic effects in combination with FP agonist drugs,2 and FP mediated release of endogenous prostaglandins acting through the EP3 receptor contribute to IOP lowering.2,3 ONO-9054 produced substantial IOP lowering as early as Day 2 that was sustained for at least 24hrs after the last dose on Day 14.

Conclusion:
These data suggest that both AM or PM dosing of the novel FP/EP3 agonist ONO-9054 yield effective lowering of IOP. A higher proportion of subjects experienced IOPs of ≤16 mmHg with PM dosing of the drug. Further study of IOP lowering in Phase 2 clinical trials is warranted for ONO-9054.

References:
106 Association Between Glaucoma, Glaucoma Therapies, and Erectile Dysfunction

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Affiliation(s): University of British Columbia

Purpose/Relevance:
To examine the association between 1) glaucoma and erectile dysfunction (ED), and 2) topical beta-blocker (BB) use and ED.

Methods:
A comprehensive, province-wide database of physician visits and diagnoses, and prescription drug dispensing was used to identify cases of ED (1380) and find corresponding controls (13,800). A conditional logistic regression model was used to estimate rate ratios for two main exposures: 1) diagnosis of glaucoma and 2) use of a prescription of a topical BB prior to the index date. A variety of risk factors were adjusted for.

Results:
Cases were more likely to have coronary artery disease, chronic obstructive pulmonary disease, and diabetes. The crude rate ratio of a current diagnosis of ED in a population with at least 2 separate diagnoses of glaucoma was 1.34, and adjusted for a number of variables (including oral BB use), this ratio was 1.37 (95% CI 1.06-1.76). Use of topical BB in the 30 days prior to the diagnosis of ED did not have a significant association with a diagnosis of ED, with crude and adjusted rate ratios of 1.05 and 1.10 (95% CI 0.61-1.99). Topical ocular prostaglandin use was also not associated with ED with crude and adjusted rate ratios of 0.96 and 0.93 (95% CI 0.57-1.53).

Discussion:
Our results confirm an association between ED and glaucoma that cannot be attributed to topical BB use. Given that most cardiovascular and metabolic risk factors were adjusted for, further research in this area will be necessary to elucidate the nature of this association and potential causation.

Conclusion:
There is an association between glaucoma and ED that is not attributable to the use of topical beta-blockers; the nature of this association is yet to be elucidated, but ED does not appear to be a result of topical beta-blocker use.

References:
Effectiveness of Xalatan Versus Generic Latanoprost in IOP Control in a Community Setting

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Purpose/Relevance:
In 2011 Xalatan became available in a generic formulation, Latanoprost. Providers often use these products interchangeably, but there are anecdotal accounts of poor responses and adverse effects following the transition from Xalatan to generic Latanoprost. A 2007 pilot study in India suggested the clinical superiority of Xalatan.1 The purpose of this investigation is to compare the effectiveness of Xalatan with generic Latanoprost IOP control in a community setting.

Methods:
A retrospective chart review was performed, and patients who had been on Xalatan and were transitioned to Latanoprost were identified from one private practice office. The IOP at 2 visits prior to the change in therapy was compared with the IOP at 2 visits following the change. Subgroup analyses were performed evaluating patients on prostaglandin monotherapy, different manufacturers’ generic versions of Latanoprost, and different numbers of IOP lowering agents.

Results:
153 charts were reviewed, and 69 patients were included. The patients’ mean age was 73 years, and they were on a mean of 1.4 IOP lowering drops. Patients’ mean IOP was 15.09 mmHg while on Xalatan, compared with 15.26 mmHg while on Latanoprost (p=0.52). The change in IOP ranged from -5.5 to +7.5 mmHg. There was no significant difference among patients on prostaglandin monotherapy (p=0.53), on generic Latanoprost from 4 different manufacturers (p=0.459) or using 1, 2, or 3 IOP lowering agents (p=0.372).

Discussion:
For this study population, there was no difference in the effectiveness of Xalatan compared with generic Latanoprost, even among the various sub-groups analyzed. There were, however, several patients who experienced an increase or decrease of >5 mmHg when transitioned to Latanoprost.

Conclusion:
There is no significant difference in IOP-lowering effect between Xalatan and Latanoprost on a population level. But, individual patients may have an enhanced or diminished effect on Latanoprost, and the transition from Xalatan to Latanoprost warrants clinical monitoring as with other changes in therapy.

References:
Effects of Primary Selective Laser Trabeculoplasty on Aqueous Humor Dynamics

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Purpose/Relevance:
To study the effects of selective laser trabeculoplasty (SLT) on aqueous humor dynamics (AHD) in patients with ocular hypertension and primary open angle glaucoma (POAG).

Methods:
Twenty nine consecutive subjects with a diagnosis of ocular hypertension or POAG scheduled to undergo SLT as their primary intraocular pressure (IOP) lowering therapy were enrolled in this prospective observational study. All subjects underwent a baseline assessment of AHD in both eyes (if the contralateral eye met eligibility criteria). The primary outcomes of interest were IOPs at 9 am and 12 noon (pneumatonometry), daytime (9 am to noon) aqueous flow measurement (fluorophotometry), episcleral venous pressure (venomanometry), outflow facility (pneumatonography and fluorophotometry after oral acetazolamide administration) and uveoscleral outflow (calculated using modified Goldmann equation). All subjects underwent 360 degrees SLT (80 spots) within a week after baseline measurements. Subjects underwent a repeat assessment of AHD in both eyes at 3 months following SLT. Subjects were not on any additional IOP lowering medications at the time of either assessment.

Results:
In the 27 subjects that completed all study measurements the IOPs at 3 months after SLT were significantly lower at 9 am (19.21±2.96 mmHg vs. 23.0±5.15 mmHg at baseline; p<0.001) and 12 noon (19.69±3.40 mmHg vs. 23.68±4.55 mmHg at baseline; p<0.001). Outflow facility by fluorophotometry was significantly increased from 0.18±0.11 µl/min/mmHg at baseline to 0.25±0.14 µl/min/mmHg at 3 months (p=0.015). The changes in outflow facility by tonography (baseline: 0.17±0.07 µl/min/mmHg vs. 3-months: 0.20±0.12 µl/min/mmHg; p=0.16) did not reach statistical significance. There was no change in aqueous flow, episcleral venous pressure or uveoscleral outflow observed at 3 months after SLT. There were no changes in IOP or AHD in the contralateral untreated eye. In a sub-analysis of 20 subjects with a 10% or greater IOP reduction at either of the 2 measurement time points, the only significant change was an increase in fluorophotometric outflow facility from 0.17±0.11 µl/min/mmHg at baseline to 0.29±0.18 µl/min/mmHg at 3 months after SLT (p=0.008).

Discussion:
The IOP lowering effect of SLT appears to be mediated through an increase in trabecular outflow facility. There is no change in IOP or AHD at 3 months after SLT in the contralateral eye.

Conclusion:
SLT addresses a mechanism of IOP-lowering that is not addressed by the known mechanism of action of the most widely used IOP lowering medications such as prostaglandin analogs or aqueous suppressants.

References:
The Effects of Cataract Extraction on the Fast and Slow Components of Visual Field Decay Rates

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Purpose/Relevance:
To investigate the effects of cataract extraction on the fast and slow component of visual field decay as determined with a pointwise exponential regression model.

Methods:
This is a retrospective noncomparative interventional study. Eighty-five eyes of 68 patients with open-angle glaucoma who had cataract extraction were included. All patients had five or more reliable SITA standard 24-2 visual fields both before and after surgery. Pointwise exponential regression was used to perform trend analysis on thresholds at visual field locations before and after cataract surgery. Visual field progression rates were partitioned into slow and fast components. A univariate linear regression of mean deviation (MD) was performed. Changes in intraocular pressure, number of anti-glaucoma medications, and best corrected visual acuity were also studied.

Results:
The average slow component rate of decay before surgery was 0.48±0.73 %/year and this slowed significantly to 0.26±0.42 %/year after surgery (P=0.037). The average fast component rate of decay showed no change, and was 3.37±4.05 %/year before surgery and 3.46±3.56 %/year after surgery (P=0.290). The MD regression slope was -0.290±0.718 dB/year before surgery and -0.294±0.517 dB/year after surgery (P=0.476). There were no significant changes in the fast component of decay or MD rates after surgery. Visual field sensitivities showed an improvement immediately after surgery in the mean threshold of 0.51±2.13 dB for the slow component cluster of test locations and 2.82±2.13 dB for the fast component cluster of test locations (P=0.019, P<0.001, respectively).

Discussion:
Although the mean threshold improved in both the slow and fast clusters, the decay rate of the slow component alone was significantly slowed. These results suggest that cataract formation may be the main contributing factor for deterioration of the slow component rate of decay and affects little the fast component rate of decay.

Conclusion:
We conclude that the fast component of visual field decay may be used to monitor glaucomatous visual field progression in patients with coexisting glaucoma and cataract.

References: