# Selective Laser Trabeculoplasty in Steroid Naïve Anti-Vascular Endothelial Growth Factor Associated Open Angle Glaucoma Patients

Anindya Samanta, MD[1]; Chelsey J. Krambeer, MD[1]; Addie Pederson, BA[2]; Matthew S. Porter, MD[1]

1. Department of Ophthalmology and Visual Sciences, Texas Tech University Health Sciences Center (TTUHSC), Lubbock, Texas
2. School of Medicine, TTUHSC, Lubbock, Texas

The authors have no financial relationships to disclose at this time.

# Selective Laser Trabeculoplasty

- Selective Laser Trabeculoplasty (SLT) is utilized in cases of primary and secondary open angle glaucoma (OAG) to increase aqueous humor outflow and therefore decrease intraocular pressure (IOP).
- SLT studies have shown an average IOP reduction of 22% at 6 months[1] and 32% at 5 years.[2]
- The Light Trial demonstrated that SLT is a more effective first line treatment than IOP lowering drops. At 3 years, 74% of patients who received SLT did not require any IOP reduction drops. No patients who received SLT required further surgical intervention, while 11 patients in the control group required surgery.[3]

# SLT & Steroid Induced Increase in IOP

- Previous studies have shown the effectiveness of SLT on steroid induced increases in IOP. Due to its safety profile, SLT is generally accepted as a valid treatment option prior to more invasive treatments. [4-8]
- Two studies have shown that SLT may be effective for prevention of IOP elevation when utilized prior to steroid treatment.[9-10]

# Anti- VEGF Associated OAG

- Some patients that receive anti-VEGF injections have documented long-term increases in IOP. [11]
- Several hypotheses have been proposed to explain the sustained increase in IOP:
  - Cumulative trabecular meshwork damage from the multiple transient increases of IOP with every injection [12]
  - Edema and/or direct inflammation of the trabecular meshwork secondary to components of the injection [13]
  - Physical blockage of the aqueous humor outflow via reduced angiogenesis or physical components of the injection[14]
  - Syringe and other medication materials leak into the injection and cause damage to the eye [15-17]

# Anti- VEGF Associated OAG and SLT

- Currently there is no consensus on the usage of SLT for the treatment of anti-VEGF associated open angle glaucoma patients. Case reports that used SLT in this population only used it after failure with multiple drops. These patients needed surgical intervention.[18-21]
- No studies, either prospective or retrospective, have evaluated the effectiveness of SLT for anti-VEGF associated glaucoma. [18-21]

# Purpose and Methods

- The purpose of this study was to determine if SLT could be effective as a treatment for anti-VEGF associated increases in IOP.
- This was a retrospective chart review. An eye was included in the study if it met all the inclusion criteria and did not meet any of the exclusion criteria.
- Inclusion criteria:
  - diagnosis of OAG or ocular hypertension
  - SLT between January 2019 and January 2022 at TTUHSC
  - at least one anti-VEGF intravitreal injection
- Exclusion criteria:
  - any history of intravitreal steroid injection or implant
  - history of pars plana vitrectomy
  - diagnosis of an iridocorneal endothelial syndrome
  - diagnosis of angle closure, inflammatory, developmental or neovascular glaucoma
- Primary outcome measurements at 3, 6, 9 and 12 months
  - Changes in the intraocular pressure
  - Changes in the number of IOP lowering drops

# Results

| | | |
|---|---|---|
| Age (years) | | 67.2 ± 13.1 |
| Sex | Males | 5 |
| | Females | 10 |
| Race | Black | 1 |
| | Hispanic | 7 |
| | White | 7 |
| Eye | Right | 8 |
| | Left | 3 |
| | Both | 4 |
| Intravitreal Injections | Pre-SLT | 3.78 ± 2.26 |
| | To date | 4.78 ± 2.79 |
| Follow-up (months) | | 7.24 ± 4.16 |

| | | | |
|---|---|---|---|
| POH | AMD | | 5 |
| | BRVO | | 1 |
| | CME 2/2 to latanoprost | | 1 |
| | Degenerative Myopia | | 1 |
| | DR | | 16 |
| Type of disease | OHTN | | 4 |
| | Glaucoma | Mild | 1 |
| | | Moderate | 8 |
| | | Severe | 6 |

Table 1: Demographic data of patients in the study. For age, intravitreal injections and follow-up the average with standard deviation is shown. Intravitreal injections and past ocular history (POH) are shown for the eye that underwent selective laser trabeculoplasty (SLT). AMD: age-related macular degeneration; BRVO: branch retinal vein occlusion; CME: cystoid macular edema; DR: diabetic retinopathy; OHTN: ocular hypertension

# Results

- 19 eyes in the study
  - 1 eye was lost to follow-up after the 2-week follow-up
  - 1 eye required a surgical intervention (cyclophotocoagulation) after 1 month visit and was removed from the study
    - This eye was on 5 IOP lowering drops and underwent SLT to try to prevent surgery
    - Fellow eye remained in the study
  - 15 eyes followed up at the 3- and 6-month follow-up.
    - 9 of these eyes followed up at the 9-month follow-up.
  - 2 eyes have yet to have the 3-month follow-up.

# Results

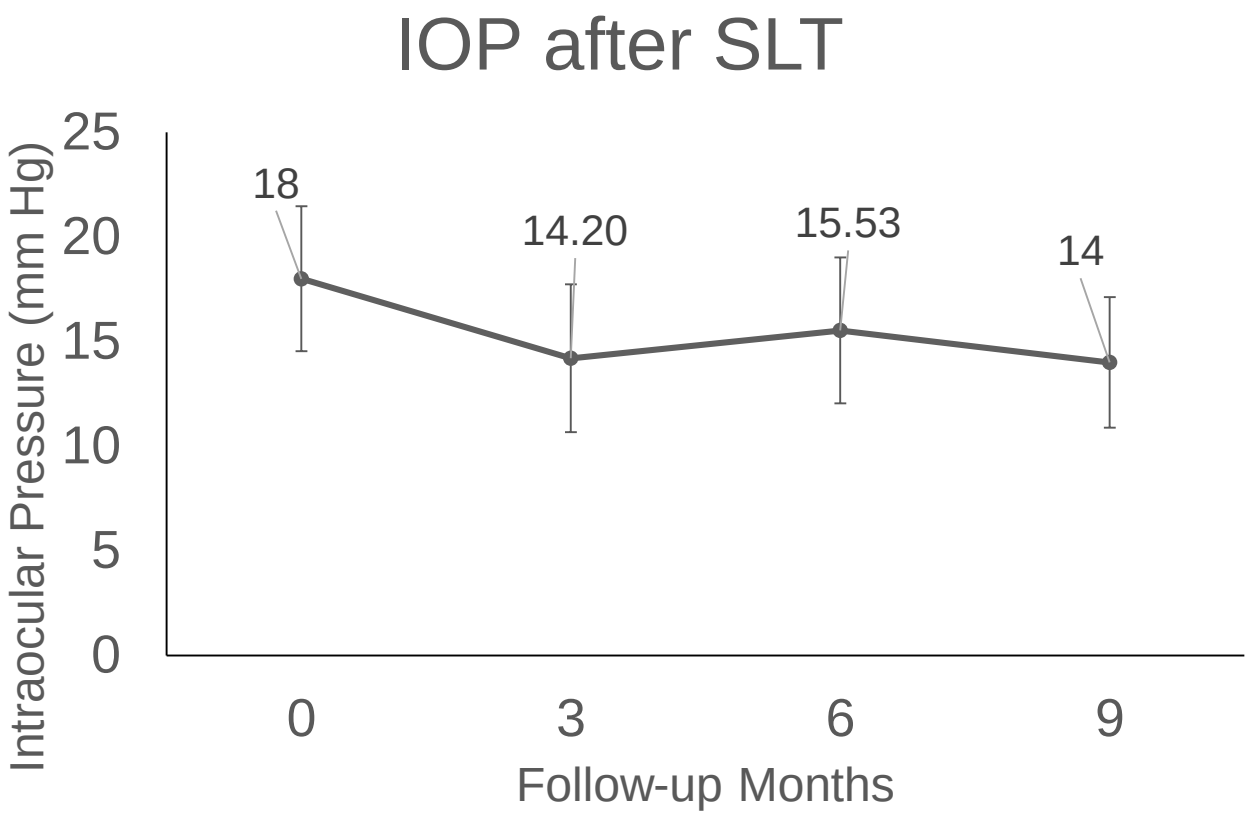


Figure 1: Average intraocular pressure (IOP) with standard deviation was measured in millimeters of mercury (mm Hg) on eyes in the study before Selective Laser Trabeculoplasty (SLT) at 0 month. After SLT was performed, average IOP with standard deviation is shown at the 3-, 6- and 9-month follow-up.

- Average ± standard deviation (mm Hg) of IOP reduction after SLT is shown below. A paired student two-tailed t-test was performed to calculate statistical significance.
  - At 3 month: 3.33 ± 2.32 ($p < 0.01$) in 15 eyes
  - At 6 month: 2.00 ± 3.16 ($p = 0.03$) in 15 eyes
  - At 9 month: 3.56 ± 2.46 ($p < 0.01$) in 9 eyes
- 6/15 (40%) eyes eyes had an IOP reduction of at least 20% or more at the 6-month follow-up after SLT.

# Results

- Average ± standard deviation of IOP lowering drops prescribed is shown below.
  - Before SLT: 2.00 ± 1.60 in 19 eyes
  - At 3 month: 1.91 ± 1.83 in 15 eyes
  - At 6 month: 1.73 ± 1.80 in 15 eyes
  - At 9 month: 2.11 ± 1.62  in 9 eyes
- A paired student two-tailed t-test was performed to calculate statistical significance. There was no statistically significant change in the number of drops prescribed at 3- ($p = 0.33$), 6- ($p = 1$) or 9-month ($p = 0.59$) follow-up.
- Subgroup analysis was done on eyes ($n = 6$) that were not on any drops, prior to the SLT. This SLT as first-line sub-group had an IOP reduction of 3.33 ± 3.14 ($p = 0.05$) mm Hg without any drops at the 3-month follow-up.

# Conclusions

- SLT appears effective in steroid-naive patients with anti-VEGF associated increases of IOP at 9 months. Most of the patients did not need any additional drops or surgical intervention.
- To the best of our knowledge, this is the first study to show the effectiveness of SLT in steroid-naive patients with anti-VEGF anti-VEGF associated open angle glaucoma long-term.

# Works Cited


1. Gracner T. Intraocular pressure response of capsular glaucoma and primary open-angle glaucoma to selective Nd:YAG laser trabeculoplasty: a prospective, comparative clinical trial. Eur J Ophthalmol 2002; 12: 287-92.
2. Lai JS, Chua JK, Tham CC, Lam DS. Five-year follow up of selective laser trabeculoplasty in Chinese eyes. Clin Experiment Ophthalmol 2004; 91:361-5.
3. Gazzard G, Konstantakopoulou E, et al. Selective laser trabeculoplasty versus eye drops for first-line treatment of ocular hypertension and glaucoma (LiGHT): a multicentre randomised controlled trial. The Lancet 2019; 393: 1505-1516.
4. Chen WL, Tsai YY, Chiang CC, Lin JM. Argon laser trabeculoplasty for late glaucoma after intravitreal triamcinolone. Acta Ophthalmol. 2009
5. Giaconi J, Salim S, Aref A, et al. Laser Trabeculoplasty: ALT vs SLT Aref A, ed. eyewiki.aao.org 2021. Available at: https://eyewiki.aao.org/Laser_Trabeculoplasty:_ALT_vs_SLT
6. Rubin B, Taglienti A, Rothman R, Marcus C, Serle J. The Effect of Selective Laser Trabeculoplasty on Intraocular Pressure in Patients With Intravitreal Steroid-induced Elevated Intraocular Pressure.
7. Viola F, Morescalchi F, Staurenghi G. Argon laser trabeculoplasty for intractable glaucoma following intravitreal triamcinolone. Arch Ophthalmol. 2006
8. Tokuda N, Inoue J, Yamazaki I, et al. Effects of selective laser trabeculoplasty treatment in steroid-induced glaucoma. Nippon Ganka Gakkai Zasshi 2012.
9. Bozkurt E, Kara N, Yazici AT, Yuksel K, Demirok A, Yilmaz OF, Demir S. Prophylactic selective laser trabeculoplasty in the prevention of intraocular pressure elevation after intravitreal triamcinolone acetonide injection. Am J Ophthalmol. 2011
10. Bracha P, Moore NA, Ciulla TA, WuDunn D, Cantor LB. The acute and chronic effects of intravitreal anti-vascular endothelial growth factor injections on intraocular pressure: A review. Surv Ophthalmol. 2018;63(3):281-95.
11. Bakri SJ, Moshfeghi DM, Francom S, Rundle AC, Reshef DS, Lee PP, et al. Intraocular pressure in eyes receiving monthly ranibizumab in 2 pivotal age-related macular degeneration clinical trials. Ophthalmology. 2014;121(5):1102-8.
12. Levin AM, Chaya CJ, Kahook MY, Wirostko B. Intraocular Pressure Elevation following Intravitreal Anti-VEGF injections: Short and Long-term Considerations. J Glaucoma 2021.
13. Kahook MY, Ammar DA. In vitro effects of antivascular endothelial growth factors on cultured human trabecular meshwork cells. J Glaucoma. 2010;19(7):437-41.
14. Bracha P, Moore NA, Ciulla TA, WuDunn D, Cantor LB. The acute and chronic effects of intravitreal anti-vascular endothelial growth factor
15. injections on intraocular pressure: A review. Surv Ophthalmol. 2018;63(3):281-95.
16. Bakri SJ, Ekdawi NS. Intravitreal silicone oil droplets after intravitreal drug injections. Retina. 2008;28(7):996-1001.
17. Kahook MY, Liu L, Ruzycki P, Mandava N, Carpenter JF, Petrash JM, et al. High-molecular-weight aggregates in repackaged bevacizumab. Retina. 2010;30(6):887-92.
18. Good TJ, Kimura AE, Mandava N, Kahook MY. Sustained elevation of intraocular pressure after intravitreal injections of anti- VEGF agents. Br J Ophthalmol. 2011;
19. Loukianou E, Brouzas D, Apostolopoulos M. Sustained ocular hypertension following intravitreal injections of 0.5 mg/0.05 ml ranibizumab. Int Ophthalmol. 2011;
20. Skalicky SE, Ho I, Agar A, Bank A. Glaucoma filtration surgery following sustained elevation of intraocular pressure secondary to intravitreal anti-VEGF injections. Ophthalmic Surg Lasers Imaging. 2012
21. Tseng JJ, Vance SK, Della Torre KE, Mendonca LS, Cooney MJ, Klancnik JM, et al. Sustained increased intraocular pressure related to intravitreal antivascular endothelial growth factor therapy for neovascular age-related macular degeneration. J Glaucoma. 2012;