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Highlights



"In our case series of pseudophakic secondary glaucoma, IOP reduction post-SLT was maintained for five years..."

SLT in Pseudophakic Secondary Glaucoma: A Case Series

by Madhu Nagar

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The Importance of Treatment Guidelines

Clinical studies have demonstrated the efficacy of SLT for various patient categories in different clinical situations. Unfortunately, although it is easy to find advice and treatment methods in the literature, these methods are often not fully described and sometimes vary from one paper to another.

To improve the understanding of SLT treatment, Regenerate asked three experienced SLT practitioners to design a set of treatment guidelines for a broad cross-section of glaucoma patients. Developed in collaboration with Madhu Nagar, FRACS Ophth, Ivan Goldberg, MD, and Michael Belkin, Ph.D, the following treatment guidelines will help new SLT users treat their first patients.

This document can be downloaded via slt-ellex.com.



Patient Selection

Almost all patients with abnormally elevated IOP, which may benefit from IOP reduction, are suitable candidates for SLT treatment.

Patients with any type of adult glaucoma, and those who conform to the following criteria, are suitable candidates:

- Require lowering of IOP as either primary or secondary therapy
- Unlikely to comply and/or persist with drug therapy
- Have difficulty administering eye drops

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SLT: A Patient's Perspective

Paul Harding, United Kingdom

During a recent visit to my ophthalmologist I was told that the only treatment available to me was trabeculectomy, which carries a risk of total blindness and requires up to 12 weeks of recovery – if successful. Surely, there had to be another option.

I was diagnosed with glaucoma over 30 years ago at the age of 33. During the early stage of my treatment, Timoptol was the favoured prescription and worked well for me for 25 years, with a later addition of Propine. Four years ago, noticeable eyesight deterioration occurred, and it became increasingly difficult to control my IOP. In early 2006, my consultant, Mr. Ruben of Queen's Hospital, Romford, described my glaucoma as "well advanced." He advised that laser treatment needed to be considered as a treatment option,

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SLT in Pseudophakic Secondary Glaucoma: A Case Series

Ms. Madhu Nagar, FRCS Ophth, MS Ophth, Clayton Eye Center, United Kingdom

While glaucoma following cataract surgery is not uncommon, it is more common when complications occur during cataract surgery. Patients who have posterior capsule rupture during cataract surgery usually have a prolonged intraoperative time and manipulation that leads to inflammation and delayed visual recovery. Secondary glaucoma following complicated cataract surgery is usually treated with topical anti-glaucoma medication or surgery. Recently, selective laser trabeculoplasty (SLT) has emerged as safe and effective treatment modality for primary open angle glaucoma (OAG) and ocular hypertension (OHT).

We present three cases of pseudophakic secondary glaucoma following complicated cataract surgery that were treated successfully with 180-degree SLT.

Introduction

Cataract surgery is the most common operative procedure performed in ophthalmology. One of the complications of cataract surgery is rupture of the posterior capsule with vitreous loss¹, which is associated with increased incidence of corneal oedema, secondary glaucoma, cystoid macular oedema, etc.^{2,3,4} While pseudophakic glaucoma is usually treated with topical anti-glaucoma medication, SLT is a new, non-invasive and effective modality for the treatment of OAG and OHT.⁶ It uses a Q-switched 532 nm Nd:YAG laser to treat the trabecular meshwork (TM).⁵

Case Series

Here, we describe three cases of complicated cataract surgery (intraoperative posterior capsule tear with vitreous loss) with intraocular lens implantation that subsequently developed secondary glaucoma and were effectively treated with 180-degree SLT treatment (Table 1). None of the patients had a previous history of glaucoma in either eye.

Case One: An 81-year-old female patient developed pseudophakic secondary glaucoma in the right eye four weeks after complicated cataract surgery. She was treated with topical anti-glaucoma medications including Timolol 0.5% and Brimonidine 0.2%, and target IOP was achieved. After 14 years, IOP crept up to 24mmHg and the decision to perform SLT was made. She underwent SLT treatment (while still on both of the topical anti-glaucoma medications). IOP following SLT was 17, 16, 16, 16, 17, and 16mmHg at 6, 12, 24, 36, 48, and 60 months, respectively. Brimonidine 0.2% was taken off at 12 months post-SLT treatment. Five years post-SLT, IOP is still controlled at 16mmHg on Timolol 0.5% bd to right eye.

Case Two: An 84-year-old female patient developed pseudophakic secondary glaucoma in the right eye following complicated cataract surgery. IOP was controlled with Timolol 0.5% and Latanoprost 0.05% during follow up. Two years later, despite being on treatment, IOP increased to 28mmHg and SLT was performed. Before SLT treatment, both of the topical anti-glaucoma medications were washed off; as a result, IOP increased to 38mmHg. Post-SLT IOP was 14 and 18mmHg at 6 and 12 months, respectively. But at 15 months post-SLT, IOP increased to 26mmHg. As a result, Latanoprost 0.005% was added to achieve target IOP. IOP was 14, 15, and 14mmHg at 24, 36, and 48 months, respectively.

Case Three: A 77-year-old female patient developed secondary glaucoma in her right eye following complicated cataract surgery. IOP was 30mmHg and was controlled with

Timolol 0.5% and Latanoprost 0.005%. After nine years, IOP again increased to 26mmHg and the patient was treated with SLT. Before SLT treatment, both of the topical anti-glaucoma medications were discontinued; as a result, IOP increased to 40mmHg. Following SLT treatment, IOP was 24, 21, and 21mmHg at 6, 12, and 24 months, respectively. Travoprost 0.004% was added at month nine to achieve target IOP. During two years of post-SLT follow up, the target IOP has been achieved with only one anti-glaucoma medication.

Discussion

SLT is a safe and effective treatment for glaucoma.⁵ It reduces IOP by increasing aqueous outflow.⁷ SLT can be performed easily in cases of glaucoma with open angles. It has been used as primary treatment, adjunctive treatment and replacement therapy in cases of primary open-angle glaucoma⁶ and in one study SLT was found to be as effective as Latanoprost 0.005% in reducing IOP.⁸ It has also been observed that SLT is equally effective in both phakic and pseudophakic eyes.⁹

In our case series of pseudophakic secondary glaucoma, IOP reduction post-SLT was maintained for five years in Case One, four years in Case Two and two years in Case Three (to date). In Case One, topical anti-glaucoma medications were reduced following SLT. In Cases Two and Three, all anti-glaucoma drops were washed off prior to SLT but post-SLT, additional topical anti-glaucoma medication was added to achieve target IOP (Table 1). (None of the patients were on steroids, and angles were widely open in all three cases.)

Table 1:

	Case 1	Case 2	Case 3
Pre-SLT IOP	24mmHg	38mmHg	40mmHg
Post-SLT IOP (at last follow-up)	16mmHg	14mmHg	21mmHg
Duration of follow-up	60 months	48 months	24 months
No. of glaucoma drops pre-SLT	2	0	0
No. of glaucoma drops post-SLT	1	1	1

Clinical Tips

Prashant N. Vasa, MD, Kutch Netramani Clinic & Eye Hospital, Gujarat, India

Prashant N. Vasa, MD, is a consultant ophthalmologist at the Kutch Netramani Clinic & Eye Hospital in Gujarat, India. Dr. Vasa has been in private practice for over 25 years, providing services to more than 300,000 patients. Specialising in glaucoma and cataract management, his practice caters to India's less fortunate through efforts to lessen the economic burden of many of today's advanced procedures. His SLT clinical tips follow:



Prashant N. Vasa

Tips for Use of Selective Laser Trabeculoplasty

- Open-angle glaucoma patients who are on one- or two-drug treatment regimes are ideal candidates for SLT. But even in patients where the angle is narrow, with at least half of the spot size falling in the angle, I have obtained good results. In the case of very narrow angles, laser iridotomy prior to SLT usually gives at least a 180-degree area of treatment.
- If patients must travel from far-flung areas and your clinic is not easily accessible, previous anti-glaucoma medications need to be continued until the entire SLT procedure is completed.
- Approximately 30 minutes prior to treatment, instil 4 percent Pilocarpine to constrict the pupil and to open the angle as much as possible.
- Apply 360-degree SLT treatment split over two 180-degree sessions, scheduled three days apart. Consider applying the treatment in two separate quadrants per 180-degree angle; e.g., 3 o'clock to 6 o'clock and then 9 o'clock to 6 o'clock.
- For patients with highly pigmented angles (as is the case with most of my patients), apply approximately 14 shots per quadrant with an initial energy setting of 0.6 mJ. If small champagne bubbles are visible, titrate energy down to as low as 0.4 mJ or even 0.3 mJ. If no bubbles are visible, titration of energy may go up to 0.8 mJ. The goal should be to achieve champagne bubbles with at least 10 percent of the total shots delivered. Generally, younger eyes require less energy than older ones.
- Prescribing steroids or anti-inflammatory drugs after SLT is not required.
- Often following SLT, patients believe that their glaucoma is cured, and that they don't need to attend follow-up visits. It is necessary to educate each patient that they must attend these follow-up visits as scheduled by their ophthalmologist.

SLT in Pseudophakic Secondary Glaucoma: A Case Series, continued

To our best knowledge, this is the first case series where SLT has been found effective, as a treatment option, in reducing IOP in cases of pseudophakic secondary glaucoma. A larger case study is warranted to establish the long-term effectiveness and safety of SLT in pseudophakic secondary glaucoma.

References:

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- 5 Latina MA, de Leon JM. Selective laser trabeculoplasty. *Ophthalmol Clin North Am* 2005;18:409-19
- 6 McIlraith I, Strasfeld M, Colev G et al. Selective laser trabeculoplasty as initial and adjunctive treatment for open angle glaucoma. *J Glaucoma* 2006;15:124-30
- 7 Kramer TR, Noecker RJ. Comparison of the morphological changes after selective laser trabeculoplasty and argon laser trabeculoplasty in human eye bank eyes. *Ophthalmology* 2001;108:773-79
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Patient Selection continued

- Suffer from drug therapy induced side effects
- Complain of reduced quality of life due to the need to administer eye drops daily
- Failed drug therapy
- Failed ALT treatment, or if ALT ceased to reduce the IOP sufficiently
- Failed SLT treatment, or if SLT ceased to reduce the IOP sufficiently
- Pigmentary or pseudoexfoliation glaucoma (Proceed with caution as there is a risk of post-SLT IOP spike)
- Normal tension glaucoma
- Ocular hypertension

SLT has not been shown to be suitable for the following conditions:

- Pediatric glaucoma
- Juvenile glaucoma
- Primary or secondary narrow-angle glaucoma
- Inflammatory or Uveitic glaucoma
- Any disease process or malformation that blocks the angle
- Unclear view of the trabecular meshwork (TM)

Pre-treatment

Pre-operative medications typically include an alpha agonist, such as brimonidine tartrate, and topical anaesthesia, such as proxymetacaine hydrochloride.

Treatment

The treatment regimen is evolving and protocols vary from treatment of 360°, 180° or 90° of the TM. It has been highlighted that the more aggressive the treatment the higher the risk of inducing temporary pressure spike, which diminishes within 48 hours.

A Latina SLT gonio laser lens, with no magnification to avoid changes to the spot size, is used to perform treatment.

The treatment spot size is fixed at 400µm, which is large enough to irradiate the whole width of the meshwork with some overspill. This provides a comfortable margin for treatment as the overspill is of no clinical significance.

It is important to obtain a clear view of the TM – focus must be on the target tissue and not on the aiming beam spot.

180° treatment involves treatment of a 180° area per treatment period. Treatment is undertaken in single shot mode, placing approximately 50 contiguous but not overlapping energy spots along the meshwork.

Post-treatment

Non steroidal anti-inflammatory drops such as Ketorolac or Acular drops four times daily for three to five days.

Note: An increasing number of physicians are electing not to prescribe post-op medications.

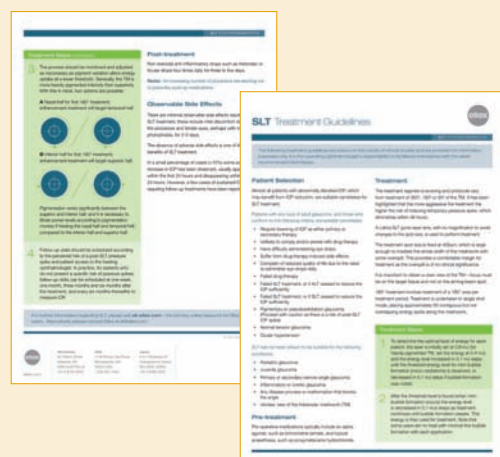
Observable Side Effects

There are minimal observable side effects resulting from SLT treatment; these include mild discomfort during the procedure and tender eyes, perhaps with mild photophobia, for 2-3 days.

The absence of adverse side effects is one of the major benefits of SLT treatment.

In a small percentage of cases (<10%) some post-operative increase in IOP has been observed, usually appearing within the first 24 hours and disappearing within a further 24 hours. However, a few cases of sustained IOP increase requiring follow-up treatments have been reported.

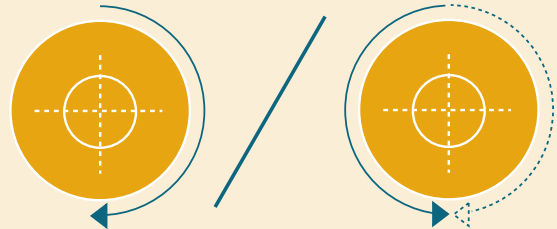
Download the Treatment Guidelines via slt-ellex.com.



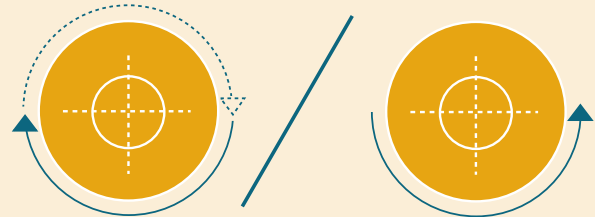
Treatment Steps:

- 1 To determine the optimal level of energy for each patient, the laser is initially set at 0.8 mJ (for heavily pigmented TM, set the energy at 0.4 mJ) and the energy level increased in 0.1 mJ steps until the threshold energy level for mini-bubble formation (micro cavitations) is observed, or decreased in 0.1 mJ steps if bubble formation was noted.
- 2 After the threshold level is found (when mini-bubble formation occurs) the energy level is decreased in 0.1 mJ steps as treatment continues until bubble formation ceases. This energy is then used for treatment. Note that some users aim to treat with minimal fine bubble formation with each application.
- 3 The process should be monitored and adjusted as necessary as pigment variation alters energy uptake at a lower threshold. Generally, the TM is more heavily pigmented inferiorly than superiorly. With this in mind, two options are possible:

A. Nasal half for first 180° treatment; enhancement treatment will target temporal half.



B. Inferior half for first 180° treatment; enhancement treatment will target superior half.



Pigmentation varies significantly between the superior and inferior half, and it is necessary to titrate power levels according to pigmentation more so if treating the nasal half and temporal half, compared to the inferior half and superior half.

- 4 Follow-up visits should be scheduled according to the perceived risk of a post-SLT pressure spike and patient access to the treating ophthalmologist. In practice, for patients who do not present a specific risk of pressure spikes, follow-up visits can be scheduled at one week, one month, three months and six months after the treatment, and every six months thereafter to measure IOP.

Ethnicity-Based Treatment Guidelines

Studies have shown that ethnicity can play an important role in affecting the efficacy of SLT.

Generally in Asia, there is a much higher incidence of angle-closure, open-angle glaucoma in patients with narrow angles, and normal tension glaucoma. Patients from South Asia, for example, typically have dark irises and highly-pigmented angles. For these cases, it is necessary to adapt SLT treatment in order to optimize patient results. Through consultation with SLT users in Asia, Ellex has developed a set of Asian SLT Treatment Guidelines, based on the guidelines highlighted in this article. For a copy of the Asian SLT Treatment Guidelines, please contact slt@ellex.com, or visit slt-ellex.com.

Not All Gonio Lenses are Created Equal

Michael Belkin, MA, MD, Professor of Ophthalmology at Tel Aviv University



SLT effectively reduces IOP by a process that, as yet, is not completely understood. What is known is that this reduction is initiated by the application of laser energy, deflected by the gonio lens onto the trabecular meshwork (TM). There is a direct relationship between the amount of energy imparted to the TM cells and the extent to which IOP is lowered.

With a reduced SLT treatment spot size, the energy applied must be decreased in order to maintain SLT's extremely-low energy fluence of 6 mJ/mm² (compared to ALT's fluence of 40,000 mJ/mm²). For instance, using a non-magnification lens (recommended for SLT treatment) set at 1 mJ energy setting produces SLT's 400 micron spot size with a fluence of 7.96 mJ/mm².

Using a lens with a magnification factor of 1.5 produces a 268 micron laser treatment spot. Consequently, to achieve the same energy fluence as with a non-magnification lens (7.96 mJ/mm²), the energy setting should be set at 0.45 mJ. This precaution is particularly important in heavily pigmented angles and may explain the unusual incidence of pressure spikes that have been noted after treating such angles with SLT.

Furthermore, the smaller treatment spot size induced by a magnifying gonio lens reduces the surface area treated, complicating the aiming and positioning of the laser beam on the TM compared to the 400 micron spot size offered by a non-magnification lens.

What has not been firmly established is the exact dose-response relationship between the amount of energy used per laser application, and the subsequent IOP-lowering effect. The difficulty in computing this is compounded by the fact that gonio lenses differ markedly in the extent to which they magnify the image of the anterior chamber angle. The following table illustrates the differing magnification factor of gonio lenses currently available:

Table 1:

	Latina SLT Gonio (Ocular)	Magna View (Ocular)	Three Mirror Universal (Ocular)	G-1 Trabeculum (Volk)	G-4 Gonio (Volk)	3 Mirror (Volk)	360 Gonio (Volk)	CGAL (Haag-Streit)
Lens Type	single mirror	single mirror	Goldmann	single mirror	four mirror	not avail.	not avail.	single mirror
Material	acrylic	acrylic	acrylic	glass	glass	acrylic	acrylic	glass
Mirror Angle	63°	62°	59°	62°	4 x 64°	60°	n/a°	58
Contact Diameter	14.5 mm	14.5 mm	18 mm	15 mm	8.4 mm	18 mm	14 mm	12 mm
Lens Height	24 mm	23.5 mm	32 mm	not avail.	not avail.	not avail.	not avail.	24 mm
FOV	130°	160°	140°	not avail.	not avail.	not avail.	not avail.	not avail.
Image Mag.	1.0x	1.30x	0.93x	1.5x	1.0x	1.06x	1.5x	1.5x
Laser Spot Mag.	1.0x	0.77x	1.08x	0.67x	1.0x	0.94x	0.67x	0.67x
SLT Spot Size	400	308	432	268	400	376	268	268

Source: Ellex

As seen from the table, magnification of the various lenses varies from 0.93 to 1.5, which means that the size of the laser treatment spot on the TM varies accordingly; thus, the energy imparted per unit area also varies. As such, we can assume that the resultant IOP-lowering effect also varies.

Given that the SLT dose-response function is not yet determined, the effect of these various energy fluences at different levels of magnification on the efficacy of SLT is not completely understood. This problem is mitigated, in part, by the customary titration procedure of irradiating the TM until

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given that three sets of eye drops were no longer controlling my IOP.

Using the Internet, I researched glaucoma laser treatment and discovered both argon laser trabeculoplasty (ALT) and the comparatively new selective laser trabeculoplasty (SLT). On reading all I could find, including information from NHS Direct (health advice and information service provided by the National Health Service, England), I hoped to undergo SLT treatment.

This was not going to be the case, as the preferred treatment in the majority of UK Hospitals is ALT. Mr. Ruben listened to my request and agreed to refer me to Mr. O'Brart at St Thomas' Hospital, one of the few UK hospitals where SLT is available. In August 2006 I saw a Mr. Lim who considered me unsuitable for SLT. Very disappointed with this news, I was pleased to find on a return visit to Mr. Ruben's Clinic in October that my IOP was low enough to remove the urgency for laser treatment.

Sadly, this was short lived. Further treatment became urgent in March 2007. Reluctantly, I received the ALT treatment in May 2007. I was among the small percentage of patients who receive no benefit from ALT; in fact, my pressure increased slightly following the treatment. I felt very pessimistic about the situation and my future treatment options. As I had arranged to take my wife away to celebrate her 60th birthday in late September, I was prescribed Pilocarpine in addition to my other medications to pull the pressure under control, with surgery scheduled for October.

I was still very persistent that I should try SLT. Mr. Ruben kindly arranged a second referral to Mr. Ansari at Maidstone Hospital, Kent.

On August 20, Mr. Ansari undertook a

detailed assessment of my glaucoma, measuring the IOP in both eyes at 19mmHg. To my absolute joy, Mr. Ansari agreed to perform SLT in early September.

My SLT treatment commenced with the addition of drops to minimise any pressure spikes, followed by the SLT treatment laser. Anti-inflammatory drops were not used following treatment. The treatment process was rather an anticlimax, as apart from a flashing light, there was no pain or discomfort whatsoever, unlike the ALT treatment. Had I not had belief in this treatment, I would probably have doubted its effectiveness – "no pain, no gain." However, I confidently stopped the Pilocarpine as instructed by Mr. Ansari and looked forward to less pain in and around the eyes, together with the hope that my vision would return to the level it was before I started using Pilocarpine.

I saw Mr. Ansari one week later; the pressure in both eyes was already falling, even without the Pilocarpine, and the sight test on my sighted eye had improved. Pilocarpine had done its job well, but I was glad to be without it for the holiday with my wife in the Orkneys, Scotland, the following week.

My next visit to Mr. Ansari's clinic on October 22 recorded a further drop in IOP to 12 and 13mmHg, and I was discharged back to Mr. Ruben. This amazing result would not, of course, last forever, so I set out to find an optometrist who would be prepared to give me monthly IOP checks with a Goldman tonometer to complement



Paul enjoying the company of his grandson, Isaac.

"My SLT treatment ... was rather an anticlimax, as apart from a flashing light, there was no pain or discomfort whatsoever..."

my hospital visits. On October 31 my new optometrist, Emma Leahy, recorded 10mmHg in each eye and 9.5mmHg on December 7. Ten days later, I saw Mr. Ruben's Registrar who measured the IOP at 15mmHg in each eye. Although higher than I had hoped, he explained that IOP can fluctuate, but that SLT treatment had successfully reduced the pressures to a safe level.

It has since been five months, during the course of which my optometrist has recorded consistent readings of 9mmHg in both eyes, so the outlook is promising. The best news is that if the pressures start to rise, I will be referred for further SLT treatment whilst it proves effective, thus hopefully avoiding surgery.

We want to hear more about your patients' experiences with SLT. And most importantly, how Ellex can help you better treat your patients with SLT.

Send your feedback to slt@ellex.com, or post your thoughts online at slt-ellex.com.

Events

Symposia

Chinese SLT Symposium

COOC Meeting
Nanjing China, April 5

Croatian SLT Symposium

Dubrovnik, Croatia, May 17

Polish SLT Symposium

Wroclaw, Poland, June 13

WOC SLT Symposium

World Ophthalmology Congress (WOC)
Hong Kong, June 30

ESCRS SLT Symposium

ESCRS Congress
Berlin, Germany, September 15

Register at ellex.com/events

User Group Meeting

Lebanon SLT User Group

Lebanon, June 26

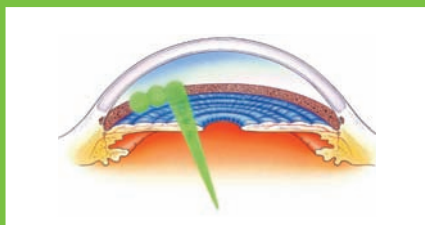
Jordan SLT User Group

Jordan, June 27

WOC SLT User Group

Hong Kong, date TBC

If you are an Ellex SLT user and would like to join a User Group, please contact slt@ellex.com.



Not All Gonio Lenses are Created Equal, *continued*

champagne bubbles are produced, and then reducing the energy setting for the rest of the trabeculoplasty.

Despite this, it is possible that the disparities in SLT results reported by various investigation sites around the world are likely to be a function of the gonio lenses and their differing levels of magnification.

Clinical experience indicates that the optimal gonio lens for SLT has the following characteristics (refer to Table 2):

- No magnification (1.0x).
- A large single mirror, which is better than multi-mirror lenses as it requires less re-positioning during treatment.
- A low mirror angle.
- Made of mineral glass – a superior material due to its advanced optical properties, reduced color distortion and higher resistance to surface scratching.
- Anti-reflective coating.

To summarize, the optimal gonio lens has the following characteristics:

Table 2:

Lens Type	single mirror
Mirror Size	large w/ AR coat
Contact Surface	w/ flange
Material	mineral glass
Mirror Angle	58°
Contact Diameter	14.5 mm
Lens Height	20 mm
FOV	130°
Image Mag.	1.0x
Laser Spot Mag.	1.0x
SLT Spot Size	400 µm

Source: Ellex

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