PSS NEWS

An On-Line Publication for COPE Continuing Education in Optometry

Glaucoma: What To Do After the First Drop - A Guide to SLT

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Learning Objectives:

1. **To review the basics of SLT in glaucoma**
2. **To discuss the indications and procedures for SLT in glaucoma**
3. **To discuss post operative care of the patient undergoing SLT treatment**

Background

Selective laser trabeculoplasty (SLT), introduced by Latina and Park in the mid-1990's and FDA approved in 2001, has been a mainstay of glaucoma therapy for nearly two decades. SLT uses a 532 nm Q-switched, frequency-doubled Nd:YAG laser with a short pulse duration of 3 ns. The quick pulse duration allows SLT to achieve selective photothermolysis, which is the process by which energy can be selectively absorbed by a pigmented cell population within a tissue to cause only localized damage and permit target selectivity, thereby reducing collateral damage.[1] Selective photothermolysis is achieved due to the fact that the 3 ns pulse duration of SLT is quicker than the thermal relaxation time of melanin which is approximately one microsecond. Therefore, SLT laser energy, which is selectively absorbed by melanin within the trabecular meshwork (TM), is not spread collaterally as a photocoagulation or thermal burn within the TM. The effect is "biologic" or "inflammatory" in effect, or better described as selective photothermolysis.

The mechanism by which SLT lowers intraocular pressure (IOP) is not completely understood and is likely multifactorial.[2] Numerous studies have shown that SLT increases aqueous outflow through the TM.[3] Since limited structural damage occurs to the TM, the mechanical and structural theories which have been suggested to explain the mechanism of action of Argon laser trabeculoplasty (ALT), do not fully apply to SLT. Moreover, SLT has been demonstrated to induce biological changes that modulate increased aqueous outflow through the TM, including changes in gene expression, cytokine secretion, matrix metalloproteinase induction, and TM remodeling.[1,4]

Recent studies described light microscopy, scanning electron microscopy (SEM), and transmission electron microscopy findings from cadaver eye sections that were treated with either ALT or SLT using power ranging from 0.4 to 2.0 mJ. Eyes treated with ALT demonstrated significant disruption of TM architecture. Eyes treated with SLT showed normal TM architecture on light microscopy,

but transmission electron microscopy did show some disruption of TM cells with cracked extracellular pigment granules even at low power settings. On SEM, TM treated with high power (2.0 mJ) showed more obvious tissue destruction. This suggests that treatment with SLT does have the potential to cause structural damage to the TM and that dose titration remains important. [2,5]

Indications

Key Indications (in order):

- Primary Open Angle Glaucoma (POAG)
- Ocular Hypertension (OHT)
- Normal-Tension Glaucoma (NTG)
- Pigment Dispersion Syndrome (PDS) or Pigmentary Glaucoma
- Pseudoexfoliation Syndrome (PXE) or Pseudoexfoliative Glaucoma
- Primary Angle Closure (PAC) or Primary Angle Closure Glaucoma (PACG) after successful angle closure treatment

When considering a laser procedure into the anterior chamber angle, it is critical to ensure that the patient has an open angle. POAG and ocular hypertension are the two strongest indications to consider SLT due to the fact that studies show positive predictors for success include:

- Pre-laser IOP with higher IOP's being more predictive of greater IOP lowering.[6,7]
- Fewer number of medications the patient is on at the time of the SLT. As with eye drops, typically SLT earlier in the course of therapy leads to more robust lowering of IOP.
    - Some research indicates that lack of prostaglandin analogue drop use at the time of SLT may increase chances of robust IOP lowering.[8]

Despite higher pre-laser IOP's being likely the most predictive factor of SLT success, there still is an indication for normal-tension glaucoma. The IOP lowering effect is more modest in NTG compared to POAG, with studies showing a 12-15% IOP reduction with 27-41% fewer medications 1-2 years postoperatively.[9,10] Additionally, SLT also has a positive effect on diurnal IOP fluctuations which may be an additional benefit in NTG patients.[11,12]

Pigmentation in the trabecular meshwork has been shown in some studies to be another predictive factor for SLT success with heavier pigmentation being more predictive of greater IOP lowering.[7] Patients with pigmentary glaucoma have similar success rates with SLT as patients with other types of open-angle glaucoma.[2,13,14] However, caution must be taken when considering SLT in pigmentary glaucoma, as the high levels of pigmentation can cause an overproduction of the biologic or inflammatory SLT effect. Studies have suggested there may be an increased complication rate, including eye pain, inflammation, IOP spikes, and a greater need for surgical intervention, after SLT in patients with highly pigmented TM.[2,14] In a case series of 4 patients with post-SLT IOP spikes lasting 4 days to 3 months, 3 had pigmentary glaucoma and the other had a heavily pigmented angle. Three of these patients eventually required trabeculectomy. Lowering power settings and treating 180 degrees or less may be necessary in patients with heavily pigmented angles.[2,15]

Patients with pseudoexfoliative glaucoma seem to have similar IOP lowering efficacy, failure rate, and adverse event rate compared with patients with other open angle glaucomas. The presence of pseudoexfoliation does not seem to be a risk factor for IOP spikes or complications after SLT.[2,16]

Many patients with PAC or PACG will require additional therapy beyond the angle closure treatment to maintain IOP control.[2,17]

One study examined subjects with at least 180 degrees of open angle after peripheral iridotomy and found a 17% IOP reduction with SLT.[18] Consequently, even though it is counterintuitive, SLT may be an additional IOP lowering option in patients with PAC or PACG whose anterior chamber angles have been opened with angle closure therapy and the TM remains healthy without synechiae.[2,18]

Contraindications

Key Contraindications:

- Narrow angles or angle closure where adequate TM is not visible
- Inflammatory Glaucoma
- Neovascular Glaucoma
- Angle Recession Glaucoma
- Juvenile Glaucoma
- Prior SLT that failed
- Significant corneal endothelial disease

The presence of less than 90-180 degrees of visible posterior pigmented TM on gonioscopy likely is a contraindication for performing SLT. Numerous secondary glaucomas, including inflammatory, neovascular, angle recession, and juvenile, are either absolutely or relatively contraindicated due to the potential for worsening the condition (inflammatory glaucoma), needing other therapy (neovascular glaucoma), or likely non-effectiveness of treatment (angle recession and juvenile glaucoma).

The effect of SLT on the corneal endothelium may be transient, and long-term effects are probably negligible in normal corneas. However, in compromised corneas and corneas with pigment deposits on the endothelium, there may be a risk of corneal endothelial compromise, especially after repeated SLT.[19] Therefore, it may be wise to limit the number of shots and energy when considering SLT in a patient with a compromised corneal endothelium.

Pre-operative Care

Key Pre-operative Considerations:

- Gonioscopy assessing for openness of the angle, amount of pigment in the TM, indications and contraindications
- Pre-operative drops: alpha-agonist, proparacaine, and pilocarpine (rare)

If not already performed, angles should be viewed via gonioscopy to assess visible structures, amount of pigmentation in the TM and any pathology such as peripheral anterior synechiae.
The amount of pigmentation in the TM will affect starting energy level with lighter pigmented meshworks requiring higher energy levels, and heavier pigmented meshworks requiring lower energy levels.

Approximately 15-30 minutes prior to the procedure, one or two drops of an alpha-agonist such as brimonidine (0.1% to 0.2%) or apraclonidine 1% should be instilled into the selected eye to blunt any potential IOP spike. Pilocarpine 1% may also be used to help move the iris out of the angle and visualize more of the TM and angle structures. Immediately before the procedure, proparacaine should be instilled into both eyes; instillation in the fellow eye will help control blinking during the procedure.

Settings and Procedure

Key SLT Settings:

- Energy
  - 0.8-1.0 mJ (standard grade 1-2 meshwork pigmentation)
  - 1.1-1.4 mJ (light meshwork pigmentation)
  - 0.4-0.7 mJ (heavy meshwork pigmentation)
- Spot Size
  - 400 microns (fixed/not adjustable)
- Pulse duration
  - 3 ns (fixed/not adjustable)

SLT settings

Due to the laser spot size and pulse duration being internally fixed and not adjustable for the doctor, there are less laser settings to dial in for an SLT compared to other laser procedures. Typical starting energy setting is between 0.8 and 1.0 mJ and is adjusted based on TM pigmentation. Angles with heavy pigmentation (grade 3 or 4) may require titrating the energy down to 0.4 – 0.7 mJ depending on the patient and tissue reaction during the procedure. Angles with light pigmentation (trace pigmentation or less) may require titrating the energy up to 1.1 – 1.4 mJ or more.

As with every laser procedure, the laser shot counter should be reset or "zeroed" before starting, with the last thing done before beginning the procedure is turning the laser on.

The procedure

Key Procedural Points:

- Magnification – 12.5-20x (medium mag)
- Illumination tower variable to wherever produces the best view
- Laser lens mirror placement:
    - Latina lens 1-mirror placed at 9:00 (for clockwise rotation) or 3:00 (for counter-clockwise rotation) if desiring to treat the inferior 180º first which is typical
    - Rapid SLT lens 4 mirrors placed at 12:00, 3:00, 6:00 and 9:00
- Approximately 100 non-overlapping laser pulses for 360º treatment, 50 laser pulses for 180º treatment
- Desired tissue reaction = lowest laser energy which produces champagne bubbles approximately 50-75% of the time
- 360º treatment for POAG, ocular hypertension, NTG
- 180º treatment for pigmentary or pseudoexfoliative glaucoma

Many of the same skills and slit lamp settings necessary for gonioscopy are utilized in SLT. Magnification is usually high enough to visualize angle structures such as the TM, but not too high as to cause the treating clinician to lose orientation. The illumination tower should be positioned in a manner that gives the best view possible with minimal glare and reflections. Clinically speaking, it has been the author's experience that the illumination tower on the opposite side of the mirror (for example, working in the right mirror with the illumination tower slightly to the left) generally gives the brightest, clearest view while minimizing reflections and glare.

Laser lens placement on the eye depends on which laser lens is being used. Traditionally the inferior 180º is the first half of the eye treated as it is the most open half of the angle and usually contains the most pigment in the TM. With the 1-mirror Latina lens (figures 1 & 2), the mirror should initially be placed at 9:00 (if moving clockwise) or 3:00 (if moving counter-clockwise). The single aiming beam should be placed to cover the entire width of the TM, and 8-12 non-overlapping laser pulses are usually placed in the mirror followed by rotating the mirror to the next location. The Latina lens typically requires 8-12 mirror rotations during a 360º treatment session. With the 4-mirror Rapid SLT lens (figures 3 & 4), the mirrors should be placed at 12:00, 3:00, 6:00, and 9:00. It is recommended to start in the 12:00 mirror since it provides a direct view of the inferior TM, and continue to the 3:00 mirror, 6:00 mirror, and then 9:00 mirror. The aiming beam should again be placed to cover the entire width of the TM (figure 5), and 10-

15 non-overlapping laser pulses should be placed in each mirror, giving approximately 50 shots after completing the 4 mirrors. If treating 360 degrees, the Rapid SLT lens should then be rotated 45º one time to place the 4 mirrors in the oblique locations, and treatment continues with the 10:30, 1:30, 4:30, and finally 7:30 mirror locations. Approximately 90-110 laser pulses are typically placed for a 360º SLT treatment session, with 45-60 laser pulses for a 180º SLT treatment session.

With the mechanism of action of SLT being photothermolysis/biologic/inflammatory, minimal tissue reaction will be seen while performing an SLT. The desired tissue reaction is the appearance of small cavitation or champagne bubbles after the majority of laser pulses (Figure 6). If champagne bubbles are present for the first 4-5 laser pulses, the energy should then be titrated down 0.1 mJ to determine if champagne bubbles are present at the lower energy level. If no champagne bubbles are seen with the first 4-5 laser pulses, the energy should be titrated up until champagne bubble formation is seen. The lowest energy setting that produces champagne bubbles approximately 50-75% of the time is currently considered the most appropriate laser energy setting for SLT.[22-26]

How many degrees of the angle to treat depends on clinician preference and the type of glaucoma being treated. The early days of SLT generally recommended 180º of treatment consistent with prior ALT treatment protocols. Due to the mechanism of action, minimal structural damage in the angle, lower side effect profile, and repeatability, it has become generally accepted to perform 360º of SLT treatment for POAG, ocular hypertension, and NTG.[2,23,25,27-30] Conversely, some studies indicate that fewer degrees of treatment may be as effective as a full 360º treatment while reducing the incidence and magnitude of postoperative IOP elevation.[2,22,23,25,31,32] Heavier amounts of pigment in the angle can potentially cause an overproduction of inflammation leading to higher rates of potential adverse events. Therefore, the general consensus is to perform 180º or less in patients with heavy pigmentation in the TM, pigmentary glaucoma, or pseudoexfoliative glaucoma.[2,24]

Post-operative Care/Co-Management (follow-up schedule)

Key Post-operative Considerations:

- Post-operative drops: alpha-agonist in-office and anti-inflammatory prescribed
- IOP check 30-60 minutes post-procedure
- IOP check and anterior chamber assessment 1-week post-procedure
- Final IOP check to assess full effectiveness of the procedure 6-8 weeks post-procedure

Immediately after completing the procedure and removing the SLT laser lens, another 1-2 drops of brimonidine or apraclonidine should be instilled into the post-operative eye. After 30-60 minutes, IOP should be assessed and treated if a significant rise in IOP is noted.

The number of shots, energy per shot, and total amount of energy used should be recorded in the chart. A notation similar to "The patient tolerated the procedure well and left in no apparent distress" should be added to the chart.

Traditionally, a topical NSAID as needed or no anti-inflammatory eye drops have been used post-op as to not overly suppress the inflammation needed to necessitate SLT effectiveness. Numerous studies have concluded anti-inflammatory drops after SLT do not cause a significant reduction in inflammation or altered IOP-lowering efficacy.[1,33,34] More recently studies have shown that a topical steroid or topical NSAID for 3-5 days post-SLT may lead to a better 12-week SLT IOP reduction than no drops used

post-procedure.[35] Prednisolone acetate four times a day, Durezol® (difluprednate) twice a day, a topical NSAID as directed, or no anti-inflammatory drops post-operatively are all acceptable options for the post-operative eye for 3-5 days. A follow-up visit for one week is scheduled with instructions to the patient to return if any increased redness, increased pain, or decreased vision is noted. Specific patient education is given regarding ocular soreness for the 2-3 days following the SLT due to the nature of the procedure.

At the one-week follow-up, the doctor should inspect the anterior chamber for degree of inflammation, and IOP should be measured. Patient education should discuss the importance of continuing any current glaucoma drop therapy until the 6-8-week follow-up visit when the full effect of the SLT procedure is better known.

At the 6-8-week follow-up, the doctor should again inspect the anterior chamber for degree of inflammation, and IOP should be measured. Studies indicate it takes anywhere from 4-12 weeks to see the full IOP lowering effect following SLT, with the general consensus being approximately 6-8 weeks.[1,36,37] Decisions regarding any possible glaucoma drop discontinuation or addition are generally made once the full effect of SLT is known.

Potential Complications and Their Treatment

Key Potential Complications to Look For:

- IOP spike
- Inflammation
- Redness, pain, and/or blurred vision
- Peripheral anterior synechiae (rare)
- Bleeding/Hyphema (rare)
- Macular edema (rare)
- Corneal edema/haze (rare)
- Hyperopic or Myopic refractive shifts (rare)

Complications due to SLT are infrequent and their effects are rarely permanent. A transient IOP increase of 5 mmHg or more has been reported in 0% to 28% of eyes.[2] More specifically, a study[20,38] reported transient elevated IOP after SLT of 4.5% which seems consistent with clinical experience. A systematic review found that prophylactic in-office treatment with IOP-lowering medication reduced the incidence of transient IOP elevation.[39] Heavily pigmented TM's may lead to potentially higher rates of IOP spike, with one study[40] reporting a series of 4 cases of severe IOP spike in patients with highly pigmented angle structures; thus, caution should be exercised in these patients. Most IOP spikes are initially detected at the one-hour IOP check and often dissipate within 24 hours either on their own or with topical hypotensive therapy such as brimonidine.

Postoperative inflammation following SLT usually occurs 1–3 days following the procedure. It has been seen in 83% of eyes undergoing SLT and the inflammation is usually transient and resolves in 5 days or less.[20] Conversely, one study[41] looked at 64 patients treated with 360-degree SLT and did not observe any anterior chamber cell or flare or vitreous haze at 24 hours or 14 days after treatment. It is important to remember that due to the mechanism of action of SLT, a certain degree of inflammation is expected, and potentially good, in the hours to days following the procedure. Risk factors for an excessive inflammatory response, possibly leading to IOP elevation, include a heavily pigmented TM or a history of prior ALT treatment.[20] Topical steroids or topical NSAIDS for 3-5 days post-SLT should be considered to ensure the inflammatory response is not excessive.

Other possible side effects, such as redness, pain/ocular soreness, and blurred vision, have also been described as transient and without sequelae in all studies.[15]

Peripheral anterior synechiae have been described but occur rarely after SLT. In a systematic review of 12 studies, PAS were

observed in 2 eyes in 2 separate studies (1.1% and 2.85% of eyes), whereas none were observed in the other 10 studies.[2,39]

Bleeding/hyphema has been reported as a rare complication during SLT.[42,43] If bleeding occurs during an SLT, gentle pressure should be applied with the laser lens to the eye to stop bleeding. All reported cases of hyphema in the literature have resolved without sequela.

Macular edema has been reported in multiple case reports and studies as a rare complication of SLT.[44-46] Pre-existing macular or retinal pathology, such as diabetic retinopathy, retinal vein occlusion, or post-cataract surgery cystoid macular edema (CME), has often been present. Management consists of the typical CME treatment options, including topical steroids and/or NSAIDs.

Multiple corneal changes have been reported following SLT including corneal edema, corneal haze, white spots on the endothelium, decreased endothelial cell count, and SLT-induced keratitis with a hyperopic shift. These changes are usually transient without long term sequalae. The incidence of corneal edema after SLT is 0.8%.[20]

Efficacy – relevant SLT study data

- Efficacy as primary/initial therapy

Generally speaking, the literature indicates that the practitioner can expect 20-35% IOP lowering for patients where SLT is used as primary therapy. The initial study by Latina et al[36] demonstrated a mean IOP reduction of 23.8% at 26 weeks after a single treatment. The SLT: Med study showed the percentage of IOP reduction 9-12 months after treatment was 26.4% for the SLT group and 27.8% in the medical/prostaglandin arm with the two treatment arms being statistically equivalent.[29]

Overall success depends on how it is defined, with one study[30] showing 74.2% of patients being drop free three years after primary SLT treatment. The author educates patients that SLT is effective in 80-90% of patients with the effect tending to wane with time. SLT has repeatedly been shown to be equivalent to prostaglandins for first line therapy,[29,30,47] with one study concluding SLT should be offered as a first-line treatment for open angle glaucoma and ocular hypertension, supporting a change in clinical practice.[30]

- Efficacy as secondary/adjunctive therapy

SLT has also been investigated as an adjunct treatment for patients on concurrent topical therapy as a means of further IOP reduction. Weinand et al[48] reported clinical outcomes of 52 POAG eyes that received adjunct SLT while on topical medical treatment. Average IOP reduction from baseline was 24.3% at 1 year, 27.8% at 2 years, 24.5% at 3 years, and 29.3% at 4 years. Similar to medications, the effect of SLT as adjunctive therapy is likely not as robust as primary therapy with the average IOP reduction being approximately 10-25% depending on number of medications the patient is on and the baseline IOP prior to the laser.

- Use with topical glaucoma medications

When used as adjunctive therapy, SLT pairs well with most all medications. A retrospective review found no difference between specific classes of antiglaucoma medications in regard to SLT success.[49] These findings confirm a role for SLT as an adjunct to antiglaucoma medications, including prostaglandin analogs, which have been suggested to possibly impair the effectiveness of SLT by competing for a common pathway to lower pressure.[8]

- Efficacy in different patient populations

SLT has been shown to have positive, but varying effects in different ethnicities.

Analyzing different ethnic groups, one study[50] found a reduction of IOP of at least 20% at 1 year in 90% of African patients compared with 54% in the Indian subgroup and 83% in the Caucasian subgroup. At 1-year, African patients showed a reduction in their mean IOP of 52% from baseline compared with a reduction of 30% in the Indian group. Another study[51] showed a 20% reduction in IOP was sustained at 12 months in 90% of African eyes but in only 50% of Indian eyes. This supports the theory that SLT directly targets melanocytes in the trabecular meshwork, leading to the conclusion that while SLT works well for nearly all, darker pigmented angles tend to have the most robust results.

- Predictive factors for success

While SLT works well for most, it does not work for all, and selecting patients based on factors that most likely lead to success of the SLT is critical. Several studies have shown that the strongest predictor of SLT success is higher pre-operative IOP.[2,13,49]

Intuitively, the number of medications a patient is on likely affects the percentage of IOP reduction after SLT, with the more pre-operative medications likely leading to a lower percentage of IOP reduction, and vice versa. Lee et al[52] described results after analysis of 111 eyes treated with 360-degree SLT, finding that the use of 3 topical IOP-lowering medications was associated with SLT failure. Conversely, Woo et al[31] described the 5-year success rates of SLT and found no significant difference in success rate on the basis of the number of preoperative glaucoma eye drops patients were using. There was, however, an increased likelihood of patients requiring a second procedure (SLT or trabeculectomy) during the 5-year follow-up period in those who were taking 2 or more preoperative IOP lowering drops.

Increased angle pigmentation may correlate with SLT efficacy.[2] In a study by Wasyluk et al[53], patients were subdivided into 3 groups on the basis of angle pigmentation. Mean IOP fell by 2.06, 2.46, and 4.75 mm Hg in subgroups with low, marked, and high angle pigmentation, respectively. Conversely, other studies have shown that angle pigmentation is not predictive of SLT success.[25] Considering the mechanism of action of SLT, pigmentation in the angle is an important variable to consider, however angles with low pigmentation likely will still show clinically significant IOP lowering effects provided treatment protocols are adjusted properly (increasing treatment energy).

Multiple other factors have been investigated yet were not found to be significant predictors of success including age, sex, previous ALT, angle grade, lens status, and central corneal thickness.[49]

- How long does the effect of SLT last?

SLT treatment efficacy is known to diminish with time. Survival analysis indicates that the time for 50% of eyes to fail after SLT treatment is approximately 2 years.[48,54] The more recent LIGHT trial showed 74.2% of patients being drop free three years after primary SLT treatment.[30] It is recommended that patients be educated that the likely effectiveness of the procedure is somewhere between 1-5 years, with the option available to repeat the SLT when the IOP elevates or progression is shown.

- Repeatability of SLT

As SLT causes minimal structural damage to the TM, retreatment is a viable option in patients that need further IOP reduction. Although this benefit of SLT was

theoretical for many years, the body of evidence now supports the efficacy of repeat SLT.[55] It achieves a similar absolute level of IOP control with mean percent IOP reduction following repeat SLT perhaps slightly lower than the initial treatment. This is possibly related to the retreatment being done at an overall lower level of IOP. For example, an initial SLT was done at a baseline IOP of 24mmHg with a 30% IOP reduction to achieve a post-SLT treatment IOP of 17 mmHg. The IOP elevated in the years following the initial SLT to 22 mmHg. Repeat SLT achieved a 25% IOP reduction taking the IOP back to 17 mmHg. The repeat SLT achieved the same IOP endpoint with a slightly lower percentage of IOP reduction.

One study demonstrated that repeat SLT can maintain IOP at or below target IOP in medication naive POAG and OHT eyes requiring retreatment with at least an equivalent duration of effect to the initial laser.[56]

Repeat treatments are not usually performed in the first 6 months after initial treatment, as the need for repeat treatment that early would indicate initial SLT failure.

Overall, repeat SLT appears to be comparable to initial SLT in regard to efficacy, duration of effect, and rate of complications.

- Efficacy after prior ALT

Just as repeat SLT after initial SLT has been shown to be comparable to the initial treatment, SLT after prior ALT has shown similar findings. SLT can be performed after prior ALT.

- Diurnal control benefits of SLT

IOP fluctuation has been shown to be an independent risk factor for glaucomatous progression.[57] The ability to decrease IOP fluctuations is a significant benefit of SLT treatment, with the blunting of IOP fluctuations possibly being more evident at night.[12] The diurnal control with SLT likely is better with 360º treatment compared to 180º [27], although even the 360º treatment may not offer as much diurnal control as prostaglandin therapy.[58]

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CONTINUING EDUCATION QUIZ

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Continuing Education Quiz

1. Which of the following is NOT a type of glaucoma where an ALT or SLT is usually indicated?
    a. POAG
    b. Low-tension glaucoma
    c. Angle-recession glaucoma
    d. Pigment dispersion glaucoma

2. All of the following are absolute or relative contraindications to performing an ALT or SLT. Which one is not?
    a. Neovascular glaucoma
    b. Acute angle closure
    c. Pseudoexfoliative glaucoma
    d. Inflammatory glaucoma

3. The mechanism of action by which the Selective Laser Trabeculoplasty (SLT) works is:
    a. Biologic activation of macrophages and phagocytes which clean up the targeted melanin containing cells in the TM
    b. Mechanical photocoagulation burns which open up adjacent areas of the TM
    c. Burning a hole in the TM through which aqueous flows more easily
    d. Photodisruption laser pulses which open up areas of the TM for aqueous to flow through

4. The typical starting power when performing an SLT is:
    a. 200 mW
    b. 1200 mW
    c. 0.8 mJ
    d. 1.5 mJ

5. With an SLT, there is typically one factor that influences whether you need to turn your energy up or down before starting the procedure. That factor usually is:
    a. TM pigmentation
    b. CB pigmentation
    c. How many iris strands are present
    d. Whether you are doing 180 degrees or 360 degrees

6. The spot size to be used when performing an SLT is:
    a. 50 microns

b. 100 microns
c. 400 microns
d. 500 microns

7. The thermal relaxation time of melanin is:
    a. 3 nanoseconds
    b. 1 microsecond
    c. 0.01 second
    d. 0.1 second

8. The duration of burn/treatment when performing the SLT is:
    a. 3 nanoseconds
    b. 1 microsecond
    c. 0.01 second
    d. 0.1 second

9. Approximately how many treatment spots/burns should be performed on 180 degrees of an eye when performing an SLT?
    a. 25-30
    b. 50-60
    c. 100-120
    d. 180-200

10. What is the tissue endpoint that the doctor usually sees while performing an SLT?
    a. Charring of the tissue with champagne bubble formation
    b. Blanching of the tissue with champagne bubble formation
    c. Champagne bubble formation only
    d. A hole forming in the TM through which aqueous flows through

11. Which of the following drops is not recommended to be used during the post-operative period of an SLT?
    a. Any glaucoma drops the patient was using before the SLT
    b. Alphagan
    c. Topical NSAID (Nevanac)
    d. Topical antiviral (Zirgan)

12. On average, how much does ALT and SLT lower intraocular pressure (IOP)? Assume the laser was done as primary therapy in a patient with POAG and 1+ pigmentation in the TM.
    a. 10-15%
    b. 20-35%
    c. 40-50%
    d. 60-70%

13. On average, how long does it take to see the full effect of how well the SLT or ALT laser works?
    a. 1 day
    b. 1-2 weeks
    c. 4-6 weeks
    d. 3-4 months

14. SLT has numerous advantages over ALT. They include all of the following except:
    a. SLT is considered an easier laser to perform due to its mechanism of action and the fact that treatment spacing is less difficult
    b. SLT has been shown scientifically and clinically to be more repeatable over time
    c. SLT induces much less structural damage to the TM
    d. The SLT effect does not wear off over time whereas the ALT effect does

15. Which of the following types of glaucoma is the SLT most likely to be effective, while at the same time the energy needs to turned down to minimize potential complications?
    a. POAG
    b. Low-tension glaucoma
    c. Pseudoexfoliative glaucoma
    d. Pigmentary glaucoma

16. The SLT:MED study specifically studied prostaglandins vs. SLT as first line therapy in the United States. Its findings were:
    a. SLT was superior to prostaglandins in terms of IOP reduction and therefore SLT should now be first line therapy over prostaglandins
    b. Prostaglandins were superior to SLT in terms of IOP reduction and therefore SLT remains only a secondary therapy after drops have been tried first
    c. SLT and prostaglandins were statistically equal in terms of IOP reduction and number of treatment steps
    d. SLT was superior to prostaglandins in terms of IOP reduction but the SLT had to be repeated every 3 months to maintain IOP reduction

17. The recent LiGHT trial showed that what % of patients following primary SLT were drop free 3 years later?
    a. 25%
    b. 50%
    c. 75%
    d. 100%

18. Which of the following is likely the biggest predictor factor for success in SLT?
    a. Amount of pigment in the TM
    b. Age of the patient
    c. Cataract surgery status
    d. Pre-laser IOP

19. Which of the following is not one of the potential complications seen with SLT?
    a. IOP spike
    b. Inflammation
    c. Retinal detachment
    d. Redness and pain following the procedure

20. What is the wavelength of the SLT laser?
    a. 193 nm
    b. 532 nm
    c. 1065 nm
    d. 10,000 nm