Opinion

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Selective laser trabeculoplasty: The physics behind the laser

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Amrita Samanta Dhakal, Pratyush Dhakal
Chattanooga Eye Institute, Chattanooga, Tennessee, India

Correspondence: Pratyush Dhakal, Chattanooga Eye Institute, Chattanooga, Tennessee, USA

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Introduction

Selective Laser Trabeculoplasty (SLT) is a minimally invasive laser procedure used to treat open- angle glaucoma; a condition that damages the eye's optic nerve due to increased pressure within the eye. This article reviews SLT treatment, including its benefits, risks, and how it works.

Selective laser trabeculoplasty (SLT) has been established as an effective treatment to lower intraocular pressure in people with glaucoma and ocular hypertension.[4]

What is SLT?

SLT is a laser treatment that targets the trabecular meshwork, the tissue in the eye responsible for draining fluid. By applying low-energy laser pulses to this tissue, SLT triggers a biological response that improves drainage and lowers intraocular pressure (IOP). In addition to IOP reduction, SLT may decrease IOP fluctuation and can be successfully used as primary or adjunctive therapy for the management of both early and advanced glaucoma.[1]

Benefits of SLT:

a) Minimally invasive: SLT is a non-surgical procedure performed in the doctor's clinic/hospital.[1]

b) Quick procedure: The treatment typically takes only a few minutes.

c) Effective: SLT can significantly lower IOP and slow the progression of glaucoma.

d) Safe: SLT has a low risk of complications and minimal side effects.

e) Repeatable: The treatment can be repeated as needed.[1,2]

How does SLT work?

During SLT, a laser is used to deliver short bursts of energy to the trabecular meshwork (TM). This energy targets the pigment in the cells of the tissue, causing them to release growth factors. These growth factors stimulate the cells to remodel and improve drainage, leading to a reduction in IOP.[5]

Using Q-switched frequency-doubled 532 nm Nd:YAG laser, SLT targets the pigmented TM cells selectively without damaging the adjacent non-pigmented cells or other structures of the TM.[5]

If required, Repeat SLT can maintain IOP at or below target IOP in medication-naive OAG and OHT eyes requiring retreatment with at least an equivalent duration of effect to initial laser.[2]

Who is the candidate for SLT?

SLT is a suitable treatment option for patients with open-angle glaucoma who:

i. Are not achieving adequate IOP control with medications.

ii. Experience side effects from glaucoma medications.

iii. Prefer a non-surgical treatment option.

Risks and side effects:

SLT is generally safe, but potential risks and side effects include:

a) Temporary eye discomfort: Mild discomfort or irritation may occur after the procedure.

b) Increased IOP: In rare cases, IOP may temporarily increase after SLT.

c) Eye inflammation: Mild inflammation may occur, but it usually resolves quickly.

Laser technology:

A. Light Amplification: SLT utilizes a laser, a device that amplifies light to produce a focused beam of high-intensity light.

B. Wavelength Selection: The laser emits light at a specific wavelength (typically around 532 nanometers) that is well-absorbed by the pigment melanin in the trabecular meshwork cells.[5]

Interaction with tissue:

a) Photothermal Effect: When the laser light strikes the pigmented cells, it is absorbed, causing a localized increase in temperature. This heat energy triggers a biological response within the cells.[5]

b) Selective Targeting: The specific wavelength of the laser is chosen to maximize absorption by melanin, ensuring that the energy is delivered precisely to the target tissue.[5]

Biological response:

1) **Cell stimulation:** The heat generated by the laser stimulates the trabecular meshwork cells.

2) **Growth factor release:** This stimulation leads to the release of growth factors, which promote tissue remodeling and improved drainage function.

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3) **Reduced intraocular pressure:** The enhanced drainage capability of the trabecular meshwork effectively lowers the pressure within the eye, reducing the risk of optic nerve damage.

Key points:

a) Precision: The focused laser beam allows for precise targeting of the trabecular meshwork, minimizing damage to surrounding tissues.

b) Minimal Invasiveness: The low-energy laser pulses used in SLT cause minimal tissue damage, making it a safe and well-tolerated procedure.

c) Long-lasting Effects: The biological response triggered by SLT can lead to sustained improvements in intraocular pressure control.

d) Selective laser trabeculoplasty should be offered as a first-line treatment for open angle glaucoma and ocular hypertension, supporting a change in clinical practice.[3]

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Conflict of interests

The authors declare that there are no conflicts of interest.

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