

# EFFECT OF SELECTIVE LASER TRABECULOPLASTY SHOT COUNT AND PULSE ENERGY ON INTRAOCULAR PRESSURE REDUCTION IN A REAL-WORLD NATIONAL HEALTH SERVICE (NHS) COHORT.

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glaucoma treatment, intraocular pressure reduction, iop management, laser energy, laser therapy, nhs cohort, pulse energy, selective laser trabeculoplasty, shot count, trabecular meshwork

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## Abstract

**Objective:** This study investigates the relationship between selective laser trabeculoplasty (SLT) treatment parameters, specifically shot count and pulse energy, and intraocular pressure (IOP) reduction in a real-world National Health Service (NHS) cohort.

**Methods:** A retrospective analysis was conducted on 114 eyes with complete baseline and first follow-up IOP data. The total shot count and mean pulse energy were documented, with energy ranges averaged for each eye. Correlations between shot count, pulse energy, and IOP reduction, both absolute and percentage, were assessed using Pearson's correlation coefficients.

**Results:** The mean baseline IOP was 23.1 mmHg, and the mean follow-up IOP was 16.2 mmHg, representing a mean reduction of 6.9 mmHg (22.0%). The mean shot count was  $111.0 \pm 28.4$ , and the mean pulse energy was  $0.65 \pm 0.16$  mJ. The correlation between shot count and percentage IOP reduction was minimal ( $r = 0.03$ ), and the correlation between pulse energy and percentage reduction was also weak ( $r = -0.08$ ).

**Conclusion:** In this NHS cohort, variability in SLT shot count and pulse energy did not significantly influence IOP reduction. These findings suggest that biological factors, such as trabecular meshwork responsiveness, may play a more important role in treatment outcomes than adjustments in laser parameters. Once a standard SLT treatment is applied, increasing shot count or pulse energy does not appear to substantially enhance efficacy and may increase discomfort or risk.

## INTRODUCTION

Selective laser trabeculoplasty (SLT) is an established intervention to reduce intraocular pressure (IOP) in ocular hypertension and open-angle glaucoma. Randomized controlled trial evidence supports SLT as an effective first-line and adjunctive option, including the LiGHT trial, which demonstrated

sustained IOP control using pragmatic clinical protocols. [1]

Despite widespread clinical use, it remains uncertain whether modifiable SLT delivery parameters, particularly shot count and pulse energy, meaningfully influence the magnitude of IOP

reduction. Systematic reviews have confirmed SLT efficacy overall but highlight heterogeneity in protocols and outcome definitions, which complicates interpretation of parameter-response relationships. [2] Studies specifically exploring energy or dosage effects have reported mixed findings, with some suggesting a relationship between delivered energy and response and others finding limited association. [3]

Mechanistically, SLT selectively targets pigmented trabecular meshwork cells and triggers biological responses that enhance aqueous outflow rather than producing coagulative thermal damage. This supports the concept that biological responsiveness may be a stronger determinant of outcome than modest variation in routine laser settings. [4] Longer-term trial follow-up continues to support SLT as a durable treatment strategy, reinforcing its role in modern glaucoma pathways. [5] Contemporary reviews emphasize variability in real-world delivery, including parameter titration to clinical endpoints. [6] Evidence-based guidance also supports laser trabeculoplasty as an effective intervention for open-angle glaucoma and ocular hypertension. [7]. In this real-world NHS cohort, we evaluated whether shot count and pulse energy, within routine clinical ranges, were associated with the magnitude of IOP reduction following SLT.

## MATERIALS AND METHODS

This retrospective observational study evaluated patients who underwent selective laser trabeculoplasty (SLT) as part of routine clinical care at a single NHS centre. Data were collected from existing clinical records and laser treatment logs. Patients who underwent SLT for the management of glaucoma (Normal tension and primary open angle glaucoma) or ocular hypertension were eligible for inclusion. Inclusion criteria required documentation of baseline intraocular pressure (IOP) prior to SLT and at least one post-treatment IOP measurement. Eyes with incomplete records or missing post-laser IOP data were excluded. Repeat SLT procedures during the study period were also excluded to avoid duplication.

For each included eye, demographic and clinical data were anonymised prior to analysis. The total number of laser shots delivered and the pulse energy

used during SLT were recorded from procedural records. Baseline IOP was defined as the most recent measurement prior to laser treatment, and post-treatment IOP was taken from the first documented follow-up visit after SLT. The primary outcome measure was the change in intraocular pressure following SLT. Secondary analyses assessed the relationship between IOP reduction and SLT treatment parameters, including shot count and pulse energy.

Data was analysed through SPSS version 27. Descriptive statistics were used to summarize patient and treatment characteristics. Correlation analysis was performed to evaluate the association between SLT parameters and IOP reduction. Statistical analyses were conducted using standard methods, and a p-value of  $<0.05$  was considered statistically significant.

## RESULTS

A total of 114 eyes were included in the study. The baseline characteristics and treatment parameters are summarized in Table 1. Table 1 presents the mean values for baseline and follow-up intraocular pressure (IOP), SLT treatment parameters (shot count and pulse energy), and correlation coefficients for shot count and pulse energy with percentage IOP reduction.

The mean baseline intraocular pressure (IOP) was 23.1 mmHg, and the mean follow-up IOP was 16.2 mmHg, resulting in a mean IOP reduction of 6.9 mmHg (22.0% reduction). The mean number of SLT shots applied was  $111.0 \pm 28.4$ , and the mean pulse energy used was  $0.65 \pm 0.16$  mJ.

Correlation analysis revealed a very weak correlation between shot count and percentage IOP reduction ( $r = 0.03$ ), indicating that the number of shots had minimal impact on the degree of IOP reduction. Similarly, the correlation between pulse energy and percentage IOP reduction was also weak ( $r = -0.08$ ), suggesting that variations in pulse energy within the clinical treatment range did not significantly affect IOP reduction.

Figure 1 illustrates the relationship between pulse energy and percentage IOP reduction. Despite variability in the data, there is no strong trend between pulse energy and the resulting IOP reduction. Figure 2 shows the relationship between

shot count and percentage IOP reduction, which further supports the minimal effect of shot count on treatment efficacy.

Table 1: Summary of key outcome and treatment parameters

Parameter	Value
Number of eyes	114
Mean baseline intraocular pressure (mmHg)	23.1
Mean follow-up intraocular pressure (mmHg)	16.2
Mean absolute intraocular pressure reduction (mmHg)	6.9
Mean percentage intraocular pressure reduction (%)	22.0
Mean number of laser shots	111.0 ± 28.4
Mean pulse energy (mJ)	0.65 ± 0.16
Correlation coefficient (shots vs percentage IOP reduction)	0.03
Correlation coefficient (energy vs percentage IOP reduction)	-0.08

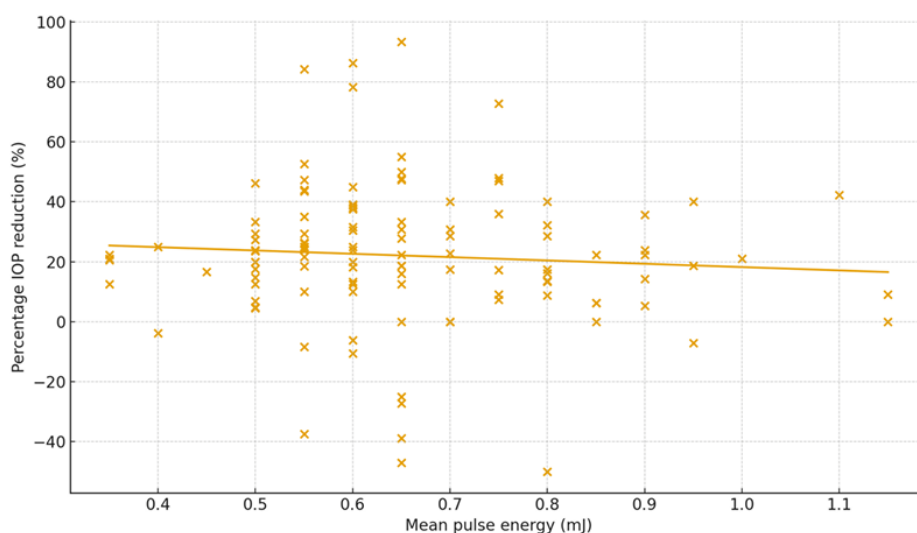
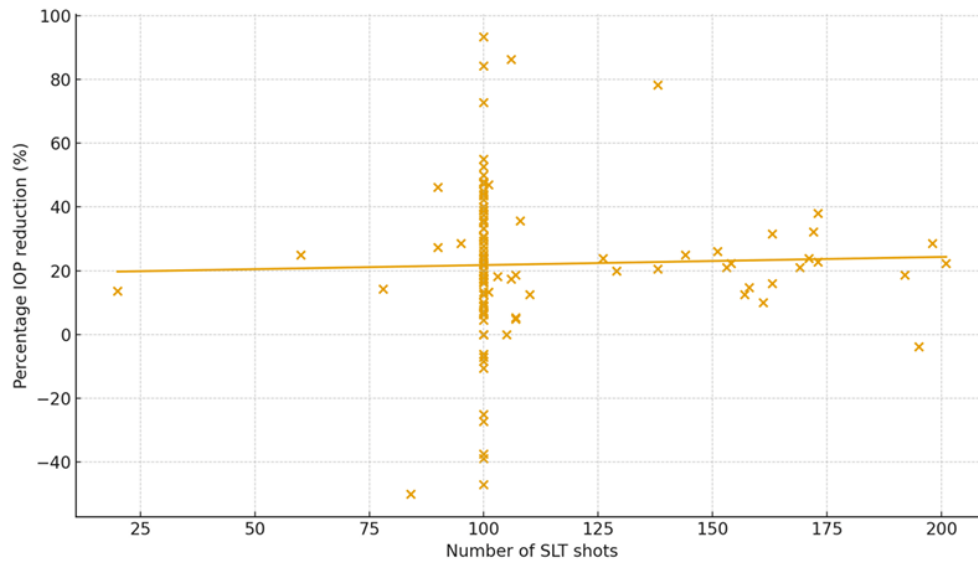


FIGURE 1: Illustrates the relationship between mean pulse energy and percentage IOP reduction. Despite variability, there is no significant trend indicating that higher pulse energy leads to greater IOP reduction



**FIGURE 2:** Shows the relationship between the number of SLT shots and percentage IOP reduction, highlighting the wide variability in response to the number of shots applied, with no obvious correlation between higher shot counts and larger reductions in IOP

**DISCUSSION**

In this real-world NHS cohort, SLT produced a clinically meaningful reduction in IOP at first recorded follow-up, with an average reduction of approximately 22%. Within the parameter ranges used in routine clinical practice, neither pulse energy nor shot count showed a strong relationship with the magnitude of IOP reduction. These findings suggest that, once SLT is delivered within standard settings, variation in these individual parameters alone may not be a reliable predictor of short-term response.

Our overall IOP reduction is consistent with the broader evidence base supporting SLT efficacy. Randomized trials comparing SLT with argon laser trabeculoplasty (ALT) demonstrate similar IOP lowering, supporting SLT as a practical alternative laser approach in open-angle disease [8,9]. Prospective studies also support SLT as an effective option both as initial therapy and as adjunctive treatment, with outcomes comparable to topical medical therapy in selected patients [10,11].

A key question is whether laser “dose” predicts response. Although some evidence suggests energy dosage may correlate with IOP reduction under certain conditions, the literature remains heterogeneous in design, parameter definitions, and

follow-up intervals [3]. In addition, dose-response signals may be difficult to detect when routine practice involves relatively narrow parameter ranges and clinician titration to a visible endpoint [6]. In our analysis, pulse energy and shot count were evaluated independently rather than as total delivered energy, which may also reduce sensitivity for detecting a cumulative energy effect.

Clinical predictors may therefore be more informative than small differences in routine settings. Evidence from randomized trial datasets suggests baseline IOP is a strong predictor of achieving conventional success thresholds after SLT [12]. Mechanistic synthesis further supports this, as SLT is thought to act through cellular and cytokine-mediated remodeling and changes in outflow facility rather than direct tissue ablation, implying that patient-specific trabecular meshwork responsiveness may dominate outcomes once a response threshold is reached [13].

From a practical perspective, these findings support a pragmatic approach to routine SLT delivery. A comprehensive clinical review emphasizes SLT’s established role while noting that variability in response remains common in practice [14]. Another clinical review similarly highlights the broad

effectiveness and safety of SLT, including the importance of appropriate follow-up and management of transient post-laser effects [15]. Our study is limited by its retrospective design, variation in follow-up timing, and potential confounding from medication changes and regression to the mean. Future prospective work that standardizes follow-up intervals, records total delivered energy and treatment extent explicitly, and adjusts for baseline predictors may better clarify whether a clinically meaningful dosing relationship exists in routine settings.

## CONCLUSIONS

In this real-world NHS cohort, selective laser trabeculoplasty (SLT) resulted in a meaningful reduction in intraocular pressure (IOP). However, variability in SLT parameters, including shot count and pulse energy, did not significantly impact IOP reduction. These findings suggest that biological factors, such as trabecular meshwork responsiveness, may play a more critical role in treatment outcomes than adjustments in laser settings. This study supports the pragmatic application of SLT, where standard treatment protocols are effective, and increasing shot count or pulse energy does not appear to substantially enhance efficacy. Future studies focusing on patient-specific biological responses and total energy delivery may provide further insight into the optimisation of treatment outcomes.

## DISCLOSURES

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Not applicable – retrospective service evaluation issued approval N/A. This study was classified as a retrospective service evaluation by Stockport NHS Foundation Trust. It involved analysis of routinely collected, fully anonymised clinical data with no patient contact and no deviation from standard clinical care. In accordance with UK Health Research Authority guidance, formal NHS Research Ethics Committee approval was not required. Institutional governance approval was obtained. . Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of

interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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2. The authors used artificial intelligence-based tools to assist with language editing and formatting of the manuscript. The authors reviewed and edited all content and take full responsibility for the accuracy, integrity, and originality of the work.

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