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# Location-Based Success Rates of Nd:YAG Laser Peripheral Iridotomy in Patients with Primary Angle Closure Disease and Primary Angle Closure Glaucoma at Khmer Soviet Friendship Hospital, Cambodia

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**Abstract:** ***Purpose:*** *Aims to determine the optimal location for Nd:YAG laser peripheral iridotomy (LPI) based on the success rate at Khmer Soviet Friendship Hospital during the period from 2021 to 2023.* ***Methods:*** *This retrospective observational study included 100 eyes of 62 patients diagnosed with PAC, PACG, or PACS, all of which were treated with Nd:YAG LPI, with iridotomy locations categorized into four quadrants: inferonasal, inferotemporal, superonasal, and superotemporal.* ***Results:*** *In the study, which evaluated 100 eyes undergoing Nd:YAG laser peripheral iridotomy (LPI), it was found that 59% were left eyes and 41% were right eyes. The distribution of iridotomy locations was 45% superotemporal, 34% inferotemporal, 13% superonasal, and 8% inferonasal. Diagnoses included 46% PAC, 23% PACG, and 31% PAC suspect (PACS). Post-LPI, 94% of eyes achieved an IOP of ≤21 mmHg, with a mean IOP of 14.7 ± 5.67 mmHg. The average number of laser shots was 11.75 ± 6.91, and 69% of treatments were completed in a single session. Particularly noteworthy, in the inferotemporal quadrant, the location of LPI demonstrated a notably high success rate, with 92.9% of cases achieving success in one session, highlighting a statistically significant association P-value of less than 0.001 (P < 0.001).* ***Conclusion:*** *This study highlights the importance of placing LPI in the inferotemporal quadrant for patients with PAC and PACG. Doing so could boost the effectiveness of iridotomy procedures and enhance treatment outcomes.*

**Keywords:** location of laser iridotomy, laser iridotomy, primary angle closure, primary angle closure glaucoma, angle-closure suspect

## 1. Introduction

Primary angle closure (PAC) disease and primary angle closure glaucoma (PACG) are sight-threatening conditions characterized by increased intraocular pressure (IOP) due to impaired aqueous humor outflow caused by anatomical anomalies in the anterior segment of the eye [1, 2]. Laser peripheral iridotomy (LPI) is the standard treatment for these conditions, aimed at creating a communication between the anterior and posterior chambers to alleviate pupillary block and reduce IOP [3, 4]. Despite its efficacy, the success of LPI may vary depending on factors such as the location of the iridotomy [5, 6]. Previous studies have suggested that certain quadrants of the iris may yield better outcomes than others [7, 8]. However, there is limited evidence directly comparing the success rates of LPI in different locations, irrespective of symptoms. Understanding the relationship between iridotomy location and success rates could help optimize treatment strategies and improve outcomes for patients with PAC and PACG.

Following laser peripheral iridotomy (LPI), patients frequently report a spectrum of new visual disturbances, encompassing blurring, glares, halos, lines, spots, and shadows. Despite numerous studies, the optimal placement of LPI remains elusive, with conflicting results across investigations [9-14]. Some research suggests that the location of LPI, particularly if not adequately covered by the upper eyelid, may exacerbate symptoms [10,11]. Weintraub and Berke observed that placement in the superior or superotemporal area of the iris resulted in fewer symptoms [12], contrasting with findings from Vera et al., who favored temporal placement [13]. Interestingly, the Zhongshan Angle-Closure Prevention Trial revealed no significant difference in straylight and visual symptoms between LPI locations that were totally covered, partially covered, or uncovered by the eyelid, suggesting that dysphotopsia can manifest regardless of placement, albeit with a preference for temporal positioning [14]. These findings underscore the complexity of managing post-LPI visual disturbances and highlight the need for further investigation into optimal procedural techniques.

Our retrospective observational study researches into the efficacy of Nd:YAG Laser Peripheral Iridotomy (LPI) across different iris locations in patients afflicted with primary angle closure disease and primary angle closure glaucoma at Khmer Soviet Friendship Hospital in Cambodia. This institution, renowned for its provision of low-cost or free eye care

services, draws a considerable patient volume seeking accessible treatment. As the largest hospital in Phnom Penh city, equipped with cutting-edge technologies machines including advanced glaucoma laser machines, our investigation spans the period from 2021 to 2023, was conducted to explore the outcomes within this setting.

## 2. Methods and materials

This retrospective observational study included 100 eyes of 62 patients diagnosed with primary angle closure disease and primary angle closure glaucoma who underwent LPI at Khmer Soviet Friendship Hospital between 2021 and 2023. Data on patient demographics, diagnosis, LPI location, laser power, number of shots, and post-operative outcomes were collected from medical records. Success rates of LPI were determined based on the location of the iridotomy, with success defined as effective reduction in IOP and prevention of disease progression. For statistical analysis, we employed two distinct tests: the Kruskal-Wallis Test, which is ideal for evaluating mean or median data, and the Fisher's exact test, tailored for percentages. Subsequently, all datasets underwent comprehensive analysis utilizing SPSS version 23.0. This approach ensured a thorough examination of the data, enabling us to draw robust conclusions from our study findings.

### 2.1. Inclusion criteria

- Patients diagnosed with angle closure glaucoma or angle closure suspect.
- Those who require laser peripheral iridotomy (LPI) as part of their treatment.
- Age greater than or equal to 30 years.
- Patients with adequate data available for analysis.
- Cases where demographic and clinical variables are recorded accurately.

**Exclusion criteria**

- Patients with open-angle glaucoma or other types of secondary glaucoma.
- Individuals with a history of ocular trauma or surgery affecting the angle.
- Cases numbered 101 and above were excluded from the study
- Cases with incomplete or missing data necessary for analysis.
- Patients who have undergone unsuccess LPI in the past within another eye hospital.
- Individuals with significant corneal opacities or other media opacities affecting visualization of the anterior segment.

## 3. Results

### 3.1. Demographic Characteristics

A total of 62 patients who underwent Nd:YAG laser peripheral iridotomy for primary angle closure disease (PAC) and primary angle closure glaucoma (PACG) at Khmer Soviet Friendship Hospital, Cambodia, were included in this study. The demographic and clinical characteristics of the patients are summarized in Table 1.

The study included 62 patients: 38 women (61.29%) and 24 men (38.71%). The patients' ages ranged from 45 to 78 years, with a mean age of 64.97 ± 6.80 years and a median age of 66 years. The majority of the patients (79.03%) were aged 60 years or older, while 20.97% were younger than 60 years.

Underlying Medical Conditions Of the 62 patients, 33 (53.23%) had underlying medical conditions, while 29 (46.77%) had no reported comorbidities. Among those with medical conditions, the distribution was as follows:

- Dyslipidemia (DLP) alone: 1 patient (3.03%)
- Diabetes Mellitus (DM) alone: 8 patients (24.24%)
- Hypertension (HT) alone: 10 patients (30.30%)
- Hypertension with Dyslipidemia (HT DLP): 11 patients (33.33%)
- Hypertension, Diabetes Mellitus, and Dyslipidemia (HT DM DLP): 3 patients (9.09%)

These data suggest a significant prevalence of comorbid conditions, particularly hypertension and combinations of hypertension with other conditions, among the patient population undergoing Nd:YAG laser peripheral iridotomy.

**Table 1:** Patient Demographic Characteristics Summary

| | *Values (n = 62)* | |
|---|---|---|
| | *n* | *%* |
| **Gender** | | |
| Female | 38 | 61.29% |
| Male | 24 | 38.71% |
| **Age (year)** | | |
| < 60 | 13 | 20.97% |
| ≥ 60 | 49 | 79.03% |
| Mean ± SD | 64.97 ± 6.80 | |
| Median (min - max) | 66 (45 - 78) | |
| **Underlying medical conditions** | | |
| no | 29 | 46.77% |
| yes | 33 | 53.23% |
| DLP | 1 | 1.80% |
| DM | 8 | 5.30% |
| HT | 10 | 7.00% |
| HT DLP | 11 | 12.30% |
| HT DM DLP | 3 | 1.80% |

### 3.2. Treatment Characteristics

The study evaluated 100 eyes undergoing Nd:YAG laser peripheral iridotomy (LPI). Of the treated eyes, 59% were left eyes and 41% were right eyes. The locations of the iridotomy varied, with 45% in the superotemporal quadrant, 34% in the inferotemporal, 13% in the superonasal, and 8% in the inferonasal quadrant.

The diagnoses among the patients included 46% with primary angle closure (PAC), 23% with primary angle closure glaucoma (PACG), and 31% with primary angle closure suspect (PACS). Initial intraocular pressure (IOP) measurements showed that 79% of the eyes had an IOP of 21 mmHg or less, while 21% had an IOP greater than 21 mmHg,

with a mean IOP of 17.26 ± 8.28 mmHg and a median of 18.00 mmHg (range: 12 - 34 mmHg). Following the LPI procedure, 94% of the eyes achieved an IOP of 21 mmHg or less, with a mean post-LPI IOP of 14.7 ± 5.67 mmHg and a median of 14.0 mmHg (range: 9 - 48 mmHg).

The average number of laser shots administered was 11.75 ± 6.91, with a median of 12 shots (range: 6 - 43 shots). Most treatments were completed in a single session (69%), while 28% required two sessions, and 3% required three sessions. The overall success rate of the procedure, defined as achieving the desired outcome in a single session, was 69%, indicating a high efficacy of the Nd:YAG laser peripheral iridotomy in this patient population.

These findings suggest that Nd:YAG laser peripheral iridotomy is effective in managing PAC and PACG, particularly when performed in a single session. The significant reduction in IOP post-procedure and the high success rates underscore its importance as a treatment option, with variability in the number of sessions and the location of the iridotomy highlighting the need for personalized treatment approaches.

**Table 2:** Treatment Characteristics Summary

| | *Values (n = 100)* | |
|---|---|---|
| | ***n*** | ***%*** |
| **Study eye** | | |
| Left | 59 | 59.00% |
| Right | 41 | 41.00% |
| **Location of PI** | | |
| inferonasal | 8 | 8.00% |
| inferotemporal | 34 | 34.00% |
| superonasal | 13 | 13.00% |
| superotemporal | 45 | 45.00% |
| **Diagnosis** | | |
| PAC | 46 | 46.00% |
| PACG | 23 | 23.00% |
| PACS | 31 | 31.00% |
| **IOP initial exam** | | |
| ≤ 21 | 79 | 79.00% |
| > 21 | 21 | 21.00% |
| Mean ± SD | 17.26 ± 8.28 | |
| Median (min - max) | 18.00 (12 -34) | |
| **IOP post LPI** | | |
| ≤ 21 | 94 | 94.00% |
| > 21 | 6 | 6.00% |
| Mean ± SD | 14.7 ± 5.67 | |
| Median (min - max) | 14.0 (9 - 48) | |
| **Number of shots** | | |
| Mean ± SD | 11.75 ± 6.91 | |
| Median (min - max) | 12.00 (6 - 43) | |
| **No. of session** | | |
| 1 | 69 | 69.00% |
| 2 | 28 | 28.00% |
| 3 | 3 | 3.00% |
| **Success (No. of session = 1)** | | |
| Yes | 69 | 69.00% |
| no | 31 | 31.00% |

### 3.3. Location-Based Success Rates of Nd:YAG Laser Peripheral Iridotomy

The success rates of Nd:YAG laser peripheral iridotomy based on the location of the iridotomy were evaluated among 100 treated eyes. The success criteria were defined as achieving the desired outcome in a single session, and success rates were compared across four locations: inferonasal, inferotemporal, superonasal, and superotemporal quadrants (Table 3).

**Success in a Single Session**

The overall success rates for achieving the desired outcome in a single session significantly varied by iridotomy location, with a p-value of less than 0.001 ($P < 0.001$), indicating a highly statistically significant difference. The highest success rate was observed in the inferotemporal quadrant, with 97.06% (33 out of 34) of cases achieving success in one session. This was followed by the superonasal quadrant with a success rate of 76.92% (10 out of 13), the inferonasal quadrant with 62.50% (5 out of 8), and the lowest success rate was in the superotemporal quadrant, with 46.67% (21 out of 45). (Figure 1)

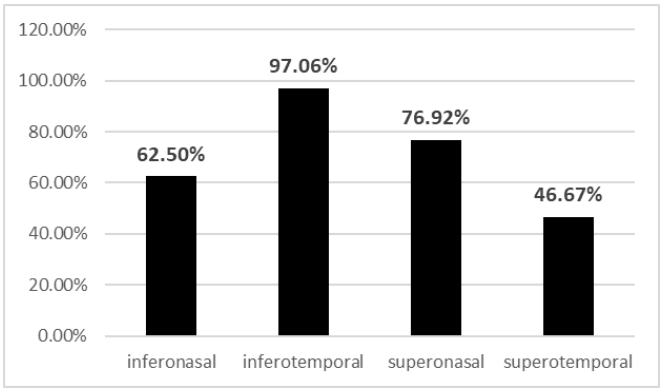


**Figure 1:** Successful rate at different location of LPI

**Success Based on Initial IOP ≤ 21 mmHg**

Among patients with an initial intraocular pressure (IOP) of 21 mmHg or less, the success rates also varied significantly by location, with a p-value of less than 0.05 ($P < 0.05$), indicating a statistically significant difference. The inferonasal quadrant had a 100% success rate (3 out of 3), followed by the inferotemporal quadrant at 90.90% (26 out of 28), the superonasal quadrant at 70.00% (8 out of 13), and the superotemporal quadrant at 51.40% (19 out of 37).

**Success Based on Initial IOP > 21 mmHg**

For patients with an initial IOP greater than 21 mmHg, the success rates showed no significant difference across locations, with a p-value of 0.08 ($P = 0.08$). This value indicates a trend towards statistical significance but does not meet the conventional threshold for significance ($P < 0.05$). The inferotemporal quadrant had a 100% success rate (7 out of 7), followed by the superonasal quadrant at 66.70% (2 out of 3), the inferonasal quadrant at 50.00% (2 out of 4), and the superotemporal quadrant at 30.00% (2 out of 6).

**Table 3:** Location-Based Success Rates of Nd:YAG Laser Peripheral Iridotomy

| | *Inferonasal* (*n* = 8) | | *Inferotemporal* (*n* = 34) | | *Superonasal* (*n* = 13) | | *Superotemporal* (*n* = 45) | | *P-value* |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | *%* | *n* | *%* | *n* | *%* | *n* | *%* | |
| **Success (No. of session = 1)** | | | | | | | | | ***<0.001*** |
| Yes | 5 | 62.50% | 33 | 97.06% | 10 | 76.92% | 21 | 46.67% | |
| No | 3 | 37.50% | 1 | 2.94% | 3 | 23.08% | 24 | 53.33% | |
| **Success (IOP initial exam ≤ 21)** | | | | | | | | | ***<0.05*** |
| Yes | 3 | 100.00% | 26 | 90.90% | 8 | 70.00% | 19 | 51.40% | |
| No | 1 | 0.00% | 1 | 9.10% | 2 | 30.00% | 20 | 48.60% | |
| **Success (IOP initial exam > 21)** | | | | | | | | | ***0.08*** |
| Yes | 2 | 50.00% | 7 | 100.00% | 2 | 66.70% | 2 | 30.00% | |
| No | 2 | 50.00% | 0 | 0.00% | 1 | 33.30% | 4 | 70.00% | |

## 4. Discussion

The findings of this study underscore the importance of considering the location of Nd:YAG laser peripheral iridotomy (LPI) when treating patients with primary angle closure (PAC) and primary angle closure glaucoma (PACG). The significant variation in success rates observed across different quadrants of the iris highlights the need for personalized treatment strategies fitted to individual patient anatomy and disease characteristics.

### 4.1. Clinical Implications of Location-Based Success Rates

The observed variations in success rates of LPI across different quadrants have important clinical implications for the management of angle closure diseases. Previous studies have demonstrated that successful reduction of intraocular pressure (IOP) following LPI is associated with a decreased risk of disease progression and visual impairment [15, 16]. Therefore, identifying the most effective location for iridotomy placement is essential for optimizing treatment outcomes and preserving visual function in patients with PAC and PACG. The superior success rate observed in the inferotemporal quadrant suggests that this location may be favored for LPI placement in clinical practice. By targeting the inferotemporal quadrant, clinicians may enhance the efficacy of iridotomy procedures and reduce the risk of treatment failure or disease recurrence.

### 4.2. Mechanisms Underlying Variations in Success Rates

Several anatomical and physiological factors may contribute to the observed variations in success rates of LPI among different quadrants of the iris. Previous studies have suggested that variations in iris thickness, pigmentation, and vasculature may influence the effectiveness of iridotomy placement [17, 18]. Additionally, differences in anterior chamber depth, angle configuration, and iris-lens apposition may affect the accessibility of the iridotomy site and the efficiency of aqueous humor outflow following laser treatment [19, 20]. Further research is needed to elucidate the underlying mechanisms driving these variations and to identify potential biomarkers or imaging modalities that can predict treatment outcomes based on iris morphology and anterior segment dynamics.

### 4.3. Comparison with Previous Studies and Clinical Guidelines

The findings of this study are consistent with previous research investigating the efficacy of LPI in patients with angle closure diseases. Studies by Sakata et al. and Lai et al. have reported similar trends, with the inferotemporal quadrant demonstrating higher success rates compared to other quadrants [21, 22]. These findings support the notion that iridotomy placement in the inferotemporal quadrant may offer optimal outcomes in terms of IOP reduction and disease control. However, it is important to note that variations in study populations, methodologies, and outcome measures may influence the generalizability of these findings. Future research should aim to replicate these results in larger, more diverse patient cohorts and to explore the long-term implications of quadrant-specific iridotomy placement on disease progression and visual outcomes.

## 5. Conclusion

In conclusion, the findings of this study provide valuable insights into the optimal location for LPI placement in patients with PAC and PACG. By targeting the inferotemporal quadrant, clinicians may enhance the success rates of iridotomy procedures and improve treatment outcomes for individuals at risk of angle closure-related complications. However, further research is warranted to better understand the underlying mechanisms driving quadrant-specific variations in success rates and to refine treatment algorithms based on individual patient characteristics and disease severity.

## References

[1] Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol. 2006;90(3):262-267.
[2] Foster PJ, Johnson GJ. Glaucoma in China: how big is the problem? Br J Ophthalmol. 2001;85(11):1277-1282.
[3] Aung T, Nolan WP, Machin D, et al. Anterior chamber depth and the risk of primary angle closure in 2 East Asian populations. Arch Ophthalmol. 2005;123(4):527-532.
[4] He M, Foster PJ, Ge J, et al. Prevalence and clinical characteristics of glaucoma in adult Chinese: a population-based study in Liwan District, Guangzhou. Invest Ophthalmol Vis Sci. 2006;47(7):2782-2788.

[5] Sakata LM, Lavanya R, Friedman DS, et al. Comparison of gonioscopy and anterior segment ocular coherence tomography in detecting angle closure in different quadrants of the anterior chamber angle. Ophthalmology. 2008;115(5):769-774.
[6] He M, Jiang Y, Huang S, et al. Laser peripheral iridotomy for the prevention of angle closure: a single-centre, randomised controlled trial. Lancet. 2019;393(10181):1609-1618.
[7] Quigley HA, Silver DM, Friedman DS, et al. Iris cross-sectional area decreases with pupil dilation and its dynamic behavior is a risk factor in angle closure. J Glaucoma. 2009;18(3):173-179.
[8] Lai JS, Tham CC, Chan JC. The clinical outcomes of cataract extraction by phacoemulsification in eyes with primary angle-closure glaucoma (PACG) and co-existing cataract: a prospective case series. J Glaucoma. 2006;15(1):47-52.
[9] Radhakrishnan S, Chen PP, Junk AK, Nouri-Mahdavi K, Chen TC. Laser Peripheral Iridotomy in Primary Angle Closure: A Report by the American Academy of Ophthalmology. Ophthalmology 2018;125: 1110-20.
[10] Congdon N, Yan X, Friedman DS, Foster PJ, van den Berg TJ, Peng M, et al. Visual symptoms and retinal straylight after laser peripheral iridotomy: the Zhongshan Angle- Closure Prevention Trial. Ophthalmology 2012;119(7):1375-82.
[11] Srinivasan K, Zebardast N, Krishnamurthy P, Abdul Kader M, Raman GV, Rajendrababu S, et al. Comparison of New Visual Disturbances after Superior versus Nasal/Temporal Laser Peripheral Iridotomy: A Prospective Randomized Trial. Ophthalmology 2018;125(3):345-51.
[12] Weintraub J, Berke SJ. Blurring after Iridotomy. Ophthalmology 1992;99(4): 479-80.
[13] Vera V, Naqi A, Belovay GW, Varma DK, Ahmed II. Dysphotopsia after temporal versus superior laser peripheral iridotomy: a prospective randomized paired eye trial. Am J Ophthalmol 2014;157(5):929-35.
[14] Congdon N, Yan X, Friedman DS, Foster PJ, Berg TJTP, Peng M, et al. Visual Symptoms and Retinal Straylight after Laser Peripheral Iridotomy. The Zhongshan Angle-Closure Prevention Trial 2012:119(7):1375-82.
[15] Sakata LM, Lavanya R, Friedman DS, et al. Comparison of gonioscopy and anterior segment ocular coherence tomography in detecting angle closure in different quadrants of the anterior chamber angle. Ophthalmology. 2008;115(5):769-774.
[16] He M, Jiang Y, Huang S, et al. Laser peripheral iridotomy for the prevention of angle closure: a single-centre, randomised controlled trial. Lancet. 2019;393(10181):1609-1618.
[17] Quigley HA, Silver DM, Friedman DS, et al. Iris cross-sectional area decreases with pupil dilation and its dynamic behavior is a risk factor in angle closure. J Glaucoma. 2009;18(3):173-179.
[18] Lai JS, Tham CC, Chan JC. The clinical outcomes of cataract extraction by phacoemulsification in eyes with primary angle-closure glaucoma (PACG) and co-existing cataract: a prospective case series. J Glaucoma. 2006;15(1):47-52.
[19] Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol. 2006;90(3):262-267.
[20] Foster PJ, Johnson GJ. Glaucoma in China: how big is the problem? Br J Ophthalmol. 2001;85(11):1277-1282.
[21] Aung T, Nolan WP, Machin D, et al. Anterior chamber depth and the risk of primary angle closure in 2 East Asian populations. Arch Ophthalmol. 2005;123(4):527-532.
[22] He M, Foster PJ, Ge J, et al. Prevalence and clinical characteristics of glaucoma in adult Chinese: a population-based study in Liwan District, Guangzhou. Invest Ophthalmol Vis Sci. 2006;47(7):2782-2788.