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Evaluation of Anterior Segment Changes Following Laser Peripheral Iridotomy Using Pentacam Scheimpflug Imaging System in Eyes with Primary Angle Closure (PAC)

Primary angle-closure glaucoma (PACG) is a major form of glaucoma in Asia.[1] It is a leading cause of blindness worldwide.[2] Laser peripheral iridotomy (LPI) is the standard first-line intervention in both acute and chronic forms[3]. It is successful in preventing recurrence of acute attacks and virtually eliminates the risk of an acute attack in the fellow eye[4]. Peripheral iridotomy eliminates pupillary block, allowing the convex iris to flatten and widening the anterior chamber angle (**Figure 1**). Such changes in anterior chamber angle morphology are difficult to assess. Gonioscopy is difficult to perform in a reproducible fashion, limiting the ability to quantify changes after LPI.

Ultrasound biomicroscopy (UBM) gives reproducible images of the cross-sectional anterior chamber angle anatomy, with very high resolution. The OCULUS Pentacam is a rotating Scheimpflug camera that non invasively assesses the anterior segment of the eye. It takes about 2 seconds to generate an image of the anterior eye. The Pentacam instrument acquires Scheimpflug cross sectional images of the anterior segment. Information from 25,000 data points is used to calculate corneal thickness, corneal curvature, anterior chamber angle, volume, and depth, from the height data it generates from the imaged points. This gives reproducible[5] information for anterior chamber biometry.

In this study, we aimed to know the effects of peripheral laser peripheral iridotomy (LPI) on peripheral anterior chamber depth (PACD), central internal anterior chamber depth (ACD) and anterior chamber volume (ACV) using Pentacam. This is the only instrument which is giving a quantitative estimation of anterior chamber volume.

Materials and Methods

This was a prospective, non randomized, non comparative, interventional study. Twenty five (25) eyes of 15 patients with primary angle closure (PAC) were enrolled from the Glaucoma Clinic of Grewal Eye Institute, Chandigarh. The inclusion criteria included the eyes with PAC only where LPI was done prophylactically. All eyes with acute angle closure, cataract, chronic angle closure glaucoma, open angles, glaucomatous optic neuropathy, previous lasers or surgery were excluded. Primary angle closure (PAC)[6] was defined as raised IOP (>21 mm Hg) associated with non-visibility of the filtering trabecular meshwork for more than 180 degrees on gonioscopy, in the presence of peripheral anterior

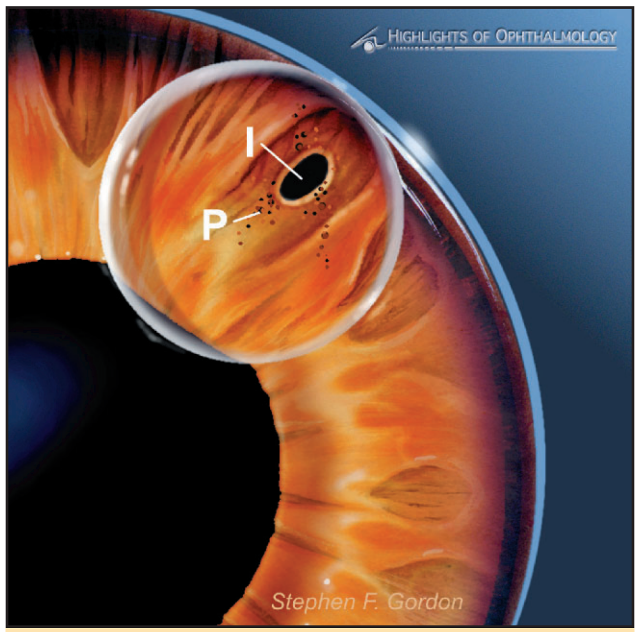

Figure 1: Nd:YAG Laser Iridotomy. The infrared beam is carefully focused to the iris stroma and activated. Penetration of the iris stroma is usually noted by the escape of iris pigment (P) into the anterior chamber and deepening of the chamber. The resulting iridectomy is shown (I). No more than two bursts should be delivered at each site. *(Art of Highlights of Ophthalmology).*

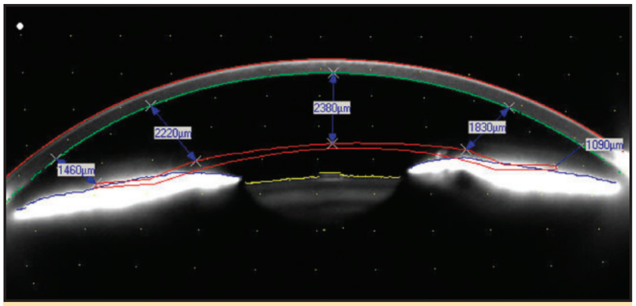

Figure 2: The Pentacam, based on Scheimpflug principle have high reliability and can evaluate PACD non invasively and easily.

synechiae or iris atrophy or glaucomflecken without disc damage, or field changes. Other causes of synechiae were excluded. Gonioscopic grading of the angle was performed in a darkened room with standardized, minimum-possible slit-lamp illumination. The Pentacam scanned the anterior ocular segment with 25 image acquisition scan protocol at 12500 points ranging from the optical axis to the limbus (**Figure 2**). It automatically evaluated the PACD, central ACD and ACV and the values for PACD used included PACD at 4mm and 8mm at 3'0/9'0/12'0/6'0 clock hours. The LPI was done according to a standard protocol using Nd: YAG Laser. The data for PACD, ACD, ACV was analyzed pre iridotomy immediately and 1 week post iridotomy.

The one-sample t-test, paired t test and one- way ANOVA were used for statistical significance. P values of less than 0.05 were considered to be statistically significant. Statistical analysis was performed using Microsoft Excel and SPSS 13.0 software (SPSS Inc, Chicago, Illinois, USA).

Results

Twenty- five eyes of 15 patients were enrolled and seen at 1-week follow-up: 6 males and 9 females. Mean age was 56.54 years (±9.34; range, 45-75 years), mean spherical equivalent refraction +0.5 diopters (D) (±1.14 D; range, “1.5 D to +3.5 D). Best Corrected Visual Acuity was 0.82 (20/25) ±0.32. Mean Angular width 1.47 with average superior angular width (1.05), inferior (2.22), nasal (1.44) and temporal was 1.16 before LPI. After LPI it increased to 2.75. Mean pre LPI IOP was 19.6 (±4.96 mmHg) with 8 out of 25 eyes on topical medication whereas following LPI, mean IOP was 18.15 (±5.01mmHg). LPI significantly increased ACV immediately (27.28mm^3) (**Table 1**) and 1 week post iridotomy (11.94mm^3) ($p=0.000$ and $p=0.014$) but there was no influence on central ACD ($p=0.434$ and 0.936). No significant PACD deepening was observed at 4mm at any clock hour immediately or 1 week post LPI ($p>0.05$).

Significant PACD deepening at 8 mm was observed at each clock hour ($p<0.01$ for all clock hours) immediately post LPI but not at 1 week follow up. The extent of the LPI induced PACD increase was enhanced with increasing distance from the optical axis.

Pre LPI		Immediately after LPI	One week LPI	ANOVA
Central Anterior chamber depth (ACD) (mm)	2.11	2.01	2.006	0.39
Peripheral ACD at 4mm (inferior)	1.63	1.63	1.72	0.02
Peripheral ACD at 4mm (superior)	1.51	1.53	1.62	0.02
Peripheral ACD at 4mm (Nasal)	1.45	1.45	1.52	0.14
Peripheral ACD at 4mm (temporal)	1.75	1.72	1.8	0.28
Peripheral ACD at 8mm (Inferior)	0.95	1.23	1.07	0
Peripheral ACD at 8mm (superior)	0.73	1.07	0.866	0
Peripheral ACD at 8mm (Nasal)	0.65	0.88	0.71	0.01
Peripheral ACD at 8mm (Temporal)	1.18	1.38	1.32	0
Anterior Chamber Volume (mm^3)	91.34	119	103.3	0

Table 1.

Discussion

In the past, there were several studies that measured ACD quantitatively. However, the instruments or methods employed are not widely used today because of expensiveness, handling difficulty, complicated quantitative analysis, and low reproducibility. Those methods are not suitable for screening eyes that are at a high risk of developing PACG or CACG. Some optical methods have been introduced for evaluating PACD. However, these methods also have many disadvantages.

The literature is full of changes in angular width following LPI as analyzed on Ultrasound Biomicroscopy which revealed a significant change in PACD by LPI quantitatively.[7,8,9] Kashiwagi et al[9] reported using newly developed scanning peripheral anterior chamber depth analyzer, although the change in PACD was similar among the measured points, the percentage change was increased with increasing distance from the optical axis. There was no change in the central ACD, agreeing with previous studies.[7] The Pentacam, based on Scheimpflug principle can evaluate PACD non invasively and easily and all parameters of the anterior ocular segment automatically, is free from any operator associated bias and has high reliability[5]. The advantages of this system are mechanical simplicity, quick, non invasive, ease of handling, objectivity, and good quantitative measurement. This system may be useful for detecting eyes with narrow angles and at risk for developing acute attacks during regular eye check ups.

REFERENCES

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