

# Nd: Yag laser iridotomy in Shaffer–Etienne grade 1 and 2: angle widening in our case studies

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## Abstract

• **AIM:** To obtain widening of a potentially occludable angle, in according to Kanski's indications, through preventive Nd:Yag laser iridotomy. The observational study was performed by using gonioscopy for the selection and follow-up of 1165 treated eyes and exploiting Shaffer–Etienne gonioscopic classification as a quality/quantity test of the angle recession.

• **METHODS:** Between September 2000 and July 2012, 586 patients were selected at the Outpatients' Ophthalmological Clinic of the Policlinico Umberto I of Rome in order to undergo Nd: Yag laser iridotomy. A Goldmann type contact lens, Q-switched mode, 2–3 defocus, and 7–9 mJ intensity with 2–3 impulse discharges were used for surgery.

• **RESULTS:** From as early as the first week, a whole 360° angle widening were evident in the patients, thus showing the success of Nd:Yag laser iridotomy in solving relative pupil block. The angle remained narrow by 270° in 14 eyes only, despite repetitions of further treatment with laser iridotomy in a different part of the iris, twice in 10 eyes and three times in 4 eyes.

• **CONCLUSION:** Nd:Yag laser iridotomy revealed itself as being a safe and effective treatment in widening those critical Shaffer–Etienne grade 1 and 2 potentially occludable angles.

• **KEYWORDS:** glaucoma; gonioscopy; intraocular pressure; iridotomy; narrow angle; Nd:Yag laser

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## INTRODUCTION

Angle closure of the anterior chamber can occur in various ways, thus leading to very different clinical pictures<sup>[1]</sup>. Moreover, in the same eye the disease can take on very different aspects and evolve in different ways over time<sup>[2-4]</sup>. As is well known, angle closure occurs in predisposed eyes featuring reduced depth of the anterior chamber, a narrow angle and a number of other typical biometric characteristics—all well-documented in literature, thanks to UBM too<sup>[5]</sup>, such as, in particular: 1) a pathological anterior insertion of the iris root; 2) an anomalous "elbow" profile of the iris root; 3) a greater inclination of the whole iris towards the anterior chamber; 4) a greater iris-lens contact surface; 5) a forward shift of the crystalline.

An "occludable" angle is an angle in which the posterior (pigmented) part of the trabecular meshwork, that is three out of four quadrants of the circumference, is not visible unless an indentation or other manipulation is performed<sup>[4,6,7]</sup> (Table 1).

Various pathogenetic mechanisms are involved in the different forms of glaucoma due to angle-closure<sup>[3,4]</sup>. The onset of a pupil block or crowding of the angle in mydriasis acts in such eyes as a triggering event and brings about a more or less complete closure of the angle, followed by an increase in intraocular pressure (IOP). There is no doubt that most cases present the onset of a pupil block as the central mechanism<sup>[8,9]</sup>: in a predisposed eye a relative pupil block may occur when the margin of the pupil is pushed against the surface of the lens and the passage of the aqueous humour from the posterior chamber to the anterior chamber is prevented. The pressure inside the posterior chamber increases and the root of the iris is pushed forward so as to close the angle. The pupil block mechanism can worsen during medium mydriasis of the pupil or in those conditions in which the sphincter and dilator muscles of the pupil are acting at the same time; this occurs physiologically when reading in poor light, or is caused pharmacologically, as when administering a miotic drug and at the same time stimulating the pupil dilator muscle by using phenylephrine (Mapstone provocative test)<sup>[10-12]</sup>.

The extension of the angle-closure, its rapid onset, a possible regression or, on the contrary, its becoming chronic, will

**Table 1 Shaffer-Etienne gonioscopic classification**

| Grade | Angle width | Description   |
|-------|-------------|---|
| 4     | 35°- 45°    | Wide open: the ciliary body band is visible. Unlikely closure.                              |
| 3     | 20°- 35°    | Moderately open: all angle structures are visible. Unlikely closure                         |
| 2     | 20°         | Moderately narrow: visible as far as the anterior trabecular mesh margin. Possible closure. |
| 1     | 10°         | Very narrow: only the Schwalbe's line is visible. Probable closure.                         |
| 0     | 0°          | Closed: no angle structure is visible.  |

determine clinical pictures that differ greatly from one another<sup>[3,6]</sup>.

This way, six different clinical conditions can be indicated: 1) eyes predisposed to angle-closure but not affected by glaucoma; 2) intermittent angle-closure glaucoma; 3) acute angle-closure glaucoma; 4) regressed acute angle-closure glaucoma; 5) chronic angle-closure following an acute attack; 6) progressive chronic angle-closure glaucoma.

Primary angle-closure glaucoma is more likely to occur in: hypermetropia, elderly patients, diabetics, women, certain races (especially Chino-Mongolian)<sup>[13-19]</sup>.

What we intend to obtain by using Yag laser iridotomy is to widen occludable angles before pupil block and hypertony occur. We acted two stages: 1) an accurate selection of patients at risk by gonioscopy (the results of which, even after surgery, are shown in the form of drawings in the clinical reports of the recruited patients); 2) preventive Yag laser iridotomy.

**SUBJECTS AND METHODS**

**Subjects** In the years between September 2000 and July 2012, 586 patients (7 of which affected by organic monocular vision impairment) for a total of 1165 eyes were selected at the Outpatients' Ophthalmological Department of the Policlinico Umberto I in Rome to undergo Nd:Yag laser iridotomy (Table 2). This study was performed with informed consent and following all the guidelines for experimental investigations required by the Institutional Review Board or Ethics Committee of which all authors are affiliated.

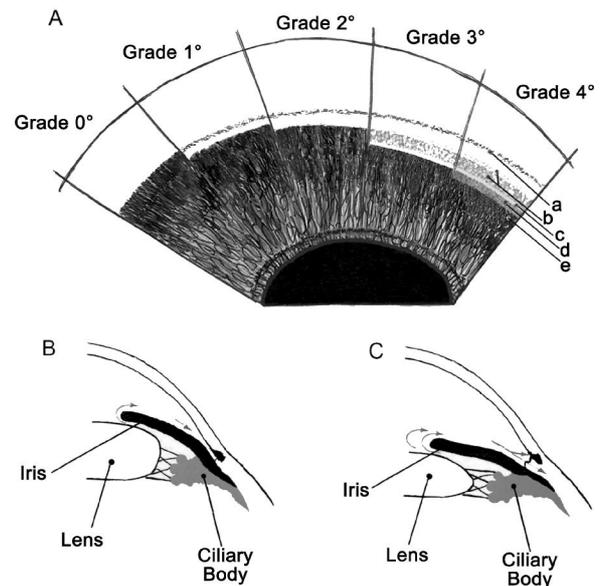
The patients, all between the ages of 35 and 75 (mean age, 53.6±11.3 SD) and mostly female (71%), had come under our observation following non-specific eye symptomatology. With regard to this, we carried out a random selection of patients who had come to our polyclinic for the most varied reasons (eye-test, preventive check-ups, refraction, different kinds of eye trouble, *etc.*).

In order to be included in the group under observation, required conditions were: 1) a narrow chamber angle- grade 1 (47%) and grade 2 (53%), according only and exclusively to Shaffer-Etienne's gonioscopic classification (Table 1; Figure 1).

A normal IOP (less than or equal to 18 mm Hg, 64%), or in the upper limits of the norm (more than 18 and less than or equal to 21 mm Hg, 2%) or slightly above the

**Table 2 Subdivision of selected patients** n (%)

| Group        | Total | Females  | Males    |
|--------------|-------|----------|----------|
| Patients     | 586   | 416 (71) | 170 (29) |
| Eyes treated | 1165  | 827      | 338      |



**Figure 1 Structures visible through gonioscopy** A: Shaffer-Etienne classification: a) Schwalbe's line; b) trabecular mesh: anterior (light), posterior (dark); c) scleral spur; d) ciliary body band; e) iris root; B: Potentially occludable narrow angle: criticality includes I-II classes of Shaffer-Etienne classification; C: Wide open angle: III-IV classes of Shaffer-Etienne classification.

norm (more than 21 and less than 24 mm Hg, 2%). All the patients examined underwent: 1) a measurement of refraction; 2) a measurement of ocular pressure by using Goldmann applanation tonometer; 3) gonioscopy with Goldmann lens; 4) fundus oculi examination; 5) psychophysical and electrophysiological evaluation by using frequency-doubling technology (FDT) perimetry and pattern electroretinography (PERG)<sup>[20]</sup>.

Patients with clear glaucoma, concomitant ocular diseases, significant abnormalities in FDT visual field and/or in PERG responses, brittle diabetes, high bleeding risk, as well as non-collaborative psychotic patients, were excluded from our record of cases; when the indications were valid, however, they were addressed to Yag laser iridotomy.

**Methods** In all cases, one eye at a time was treated, at a week's distance from the contralateral eye; patient's

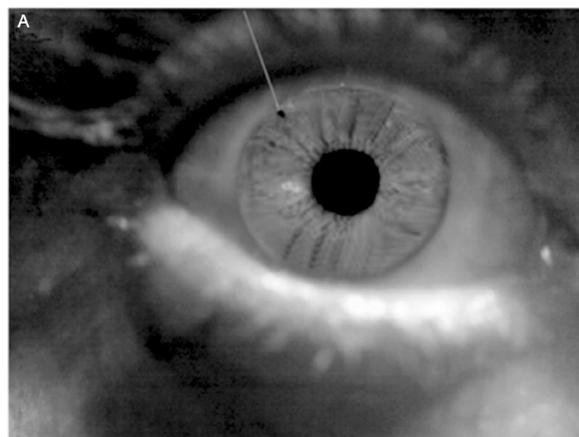
preparation included parasympathomimetic eye drops (0.5%) and topical anaesthesia with oxybuprocaine eye drops (0.4%). When possible, we always performed iridotomy in the superior sections, *i.e.* the ones protected by the eyelid, usually corresponding to 10:00/2:00 hours position, with a preferred location in the iris thinning areas, such as the crypts at the base of the root (Figure 2A).

We used a Goldmann1 type contact lens, Q-switched mode, 2-3 defocus, and 7-9 mJ intensity with 2-3 impulse discharges.

After iridotomy, all patients were prescribed topical timolol (beta-blocker) (0.5%, one drop every 12h) and steroid-antibiotic combination (betamethasone 0.2% +chloramphenicol 0.5%) one drop every 8h for three days. Concurrently with the first check-up (7d after iridotomy) the contralateral eye was also treated; the second check-up was carried out 15d later, while the following ones were after 1, 3, 6mo and 1y.

## RESULTS

From as early as the first week, an increase by 360° in angle width was visible in 1165 eyes and was documented by gonioscopy, thus showing the success of Yag laser iridotomy in solving the problem of a narrow chamber angle. In just 14 eyes the angle remained narrow by 270°, despite performing further repeated treatment with laser iridotomy in a different part of the iris, twice in 10 eyes and three times in 4 eyes; they were 31 Eastern patients, of which the second group (iridotomy repeated three times) had not even turned up for the scheduled follow-up ophthalmic check-ups. We performed iridotomy in 24 eyes in the presence of a slight hypertony (21/24 mm Hg), and obtained a decrease in eye pressure, varying between 1 and 9 mm Hg, in all the treated eyes, with a referred improvement in the symptoms (recurring headaches, temporary eyeball pains, transient blurred vision). These latter patients, whom we followed for two years afterwards, did not have to instil antiglaucoma eye drops. Possible treatment complications (Table 3): slight temporary photophobia, which disappeared on the second check-up 15d after surgery; slight and/or sporadic referred diplopia occurred in non-collaborative patients when performing surgery, with iridotomy in ectopic locations (interpupillary sectors); visual acuity variations-even improvements in longsighted patients, who were the majority-thanks to the progression of a nuclear sclerosis of the crystalline; a negligible decrease in endothelial count. The much-feared decrease of endothelial cells was studied in literature, as it is negligible in those patients that undergo Yag laser iridotomy [21-23]. A dramatic decrease of corneal endothelial cells after an acute glaucoma attack is known to everybody [24]; we want to avoid such damage by using correct preventive Yag laser iridotomy. A poor corneal



B  
**Nd:YAG laser iridotomy**

### Indications

- Primary angle-closure glaucoma: acute, intermittent and chronic.
- Fellow eye of a patient with acute glaucoma.
- \* Narrow "occludable" angles.
- Secondary angle closure with pupil block.
- POAG with narrow angles and combined mechanism glaucoma

**Figure 2 Iridotomy and its indications** A: Iridotomy at 10:00 position: iris base crypt location. Iridotomy is protected by upper eyelid; B: Indications for Nd:Yag laser iridotomy (Kanski 2003) [1].

|   | <i>n</i> (%)     |
|---|------------------|
| No. of patients 586                       | No. of eyes 1165 |
| Slight temporary photophobia 61 (10.41)   | 122              |
| Slight and/or sporadic diplopia 57 (9.73) | 114              |
| Cataract progression 4 (0.68)             | 4                |
| Endothelial damage 3 (0.51)               | 3                |

endothelial count was present in just three eyes, but such a report was already noticeable before iridotomy in these patients who had undergone endothelial microscopy due to the presence of cornea guttata. We hypothesize that a cellular impoverishment might also be related to nocturnal tonometric rises which were not highlighted at the moment of our daytime ophthalmological examination; Bleeding or hyphaema. In our study there were no records of bleeding in the anterior chamber, since we excluded patients with significant coagulation deficits and brittle diabetes, and included, instead, those patients undergoing anticoagulation therapy, though aptly prepared through a 5d oral anticoagulant suspension protocol, which we replaced with subcutaneous heparin therapy.

## DISCUSSION

Nd:Yag laser iridotomy proved to be a safe and efficient treatment in cases of critical angle closure [21,22,25-29]. Gonioscopy showed to be a useful predictive test in the follow-up of the patients we examined and treated, since significant variations occurred mainly in the angle [30,31].

In the case of a narrow angle, it is possible to improve the observation of the angle recess by asking the patient to look towards the mirror being used, thus managing to perform minimum compression without indentation; or rather, by using a Goldmann lens the indentation would be transmitted to the periphery of the cornea and would therefore narrow the angle, thus creating an artefact. Goldmann lens has a 12 mm contact surface and covers the limbus, with the advantage of keeping the eyeball still and not distorting the cornea, so it can also be used for iridotomy<sup>[7,32]</sup>.

Although a Goldmann lens cannot be used for dynamic indentation gonioscopy, by adopting it we avoid the risk that a narrow angle might look artificially wide, as it is likely to happen with other gonioscopy lenses (with a 9 mm contact surface) with which the angle will be forced to widen, even in the presence of a relative pupillary block<sup>[33]</sup>. For the purpose of our present work this plays a purely speculative role, since in Shaffer-Etienne grade 1 and 2 angles the angle stenosis-originally just appositional-could eventually turn into a real non-reversible organic welding<sup>[34]</sup>. As recorded in literature, since appositional narrow angles can evolve into synechial closure, thus establishing a real narrow-angle disease, removing such critical conditions remains valid for us (Figure 1B)<sup>[34]</sup>; if we also consider the fact that, though the incidence of an acute glaucoma attack due to angle closure in the population is truly low-in fact, its prevalence varies between 0.1% and 5%<sup>[34]</sup>-it is impossible to predict if and when an appositional narrow angle will also become synechial in time. Therefore, the performance of iridotomy enables regression of the appositional portion of angle-closure, and prevents further progression of gonioscopic synechiae, though of course it does not eliminate the possible synechiae that have already occurred<sup>[12]</sup>; supported by this firm belief, we started performing Yag laser iridotomy as far back as the year 2000, even before the precious final classification was made by Kanski<sup>[1]</sup> (Figure 2B); we were then encouraged by the latter and by the favourable results we obtained. In our opinion, in those eyes in which a degree of risk is evident, it is highly preferable to run the small risk of iridotomy, than the greater risk of a possible glaucoma attack, of which we ignore whether it can conveniently be kept under control, though it is always potentially destructive<sup>[33,35,36]</sup>. In any case, the patients will have long-term periodical check-ups<sup>[30,37-39]</sup>. It is common experience that iridotomy of occludable angles, without hypertony being under way, is still not performed much in everyday practice; on the contrary, we believe Kanski's<sup>[1]</sup> table is always valid (Figure 2B) as concerns its indications. Once widened, an angle will show all its anatomical structures and possible anomalies (pigment, exfoliation, small haemorrhages, anomalous vessels, *etc.*), therefore providing, at times, precious information concerning previous transient occlusions which have not been observed.

The innovative aspect of our work (not yet coded in the current guidelines of glaucoma-related pathology) lies in the fact that, as a routine in the presence of a potentially occludable angle, iridotomy is not performed, but one waits for an acute glaucoma attack to occur. Unlike what was thought in the past, according to us it is no longer necessary to wait for a pupillary block, hypertony and/or synechiae as indications for performing iridotomy, but the latter must be regarded as a safe and efficient treatment in widening all potentially occludable angles<sup>[1]</sup>.

In conclusion, preventive ND:Yag laser iridotomy in Shaffer-Etienne's grade 1 and 2 potentially occludable angles appears to be useful and effective, and it is to be hoped that prospective multi-centric studies will be carried out in order to randomize the treatment and the follow up of patients.

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