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PHACOEMULSIFICATION AFTER LASER PERIPHERAL IRIDOTOMY IN ACUTE PRIMARY ANGLE CLOSURE: DOES LENS EXTRACTION IMPROVE SIX-MONTH INTRAOCULAR PRESSURE CONTROL?

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ABSTRACT

Acute primary angle closure (APAC) is an ophthalmic emergency requiring rapid intraocular pressure (IOP) control. Laser peripheral iridotomy (LPI) relieves pupillary block but does not address lens-related angle crowding. We compared six-month outcomes after LPI alone with those after LPI followed by early phacoemulsification. Fifty eyes of 50 patients treated for APAC between January 2019 and May 2025 were reviewed retrospectively. All eyes received IOP-lowering medical treatment followed by Nd:YAG LPI within 24 to 36 hours of admission. Group A (n = 25) received LPI alone; Group B (n = 25) underwent phacoemulsification with intraocular lens implantation at day 7. Visual acuity, IOP, gonioscopic angle width, anterior chamber depth (ACD), medication burden, therapeutic response and complications were assessed. At six months, mean IOP was 24.01 ± 3.60 mmHg in Group A and 15.32 ± 0.68 mmHg in Group B, reductions of 46.18 % and 66.05 % ($p < 0.001$). An optimal response (IOP < 22 mmHg, with or without medication) was recorded in 32 % and 76 % of eyes ($p = 0.004$) and treatment failure in 52 % and 16 % ($p = 0.016$). Mean LogMAR acuity improved from 1.530 to 0.972 and from 1.650 to 0.693. ACD increased from 1.90 ± 0.20 mm to 3.20 ± 0.30 mm in Group B but was unchanged in Group A; angle widening was sustained only after lens extraction. Phacoemulsification seven days after LPI was associated with better six-month IOP control and greater anatomical opening of the angle than LPI alone.

Keywords: Acute Primary Angle Closure; Phacoemulsification; Laser Peripheral Iridotomy; Intraocular Pressure; Lens Extraction; Angle-Closure Glaucoma

1 INTRODUCTION

Acute primary angle closure (APAC) is a vision-threatening ophthalmic emergency characterised by sudden obstruction of aqueous humour outflow and a rapid rise in intraocular pressure (IOP). Severe ocular pain, blurred vision, corneal oedema and marked shallowing of the anterior chamber are typical, and prolonged pressure elevation may cause irreversible optic nerve damage. The underlying anatomical mechanisms are heterogeneous and include pupillary block, lens-related crowding of the anterior segment, plateau iris configuration and peripheral anterior synechiae (PAS) [1,2].

Laser peripheral iridotomy (LPI) is the cornerstone of acute management because it relieves the pupillary-block component by creating an alternative pathway between the posterior and anterior chambers. Nevertheless, a patent iridotomy does not necessarily normalise the angle in every eye. Persistent angle closure after LPI may reflect non-pupillary-block mechanisms or established PAS, and both contribute to later IOP elevation [2,3].

The crystalline lens is an important determinant of anterior segment crowding in angle-closure disease. Lens extraction deepens the anterior chamber, widens the iridocorneal angle and reduces the anatomical resistance to aqueous outflow. Randomised trials in APAC have reported more sustained IOP control and lower medication requirements after early phacoemulsification than after LPI alone [4,5]. Longer-term evidence has reinforced this concept: ten-year follow-up of a randomised APAC cohort showed that eyes initially treated with early phacoemulsification required fewer medications and had less extensive PAS and better gonioscopic grading than eyes treated with LPI [6]. Comparative data have also suggested that both early and delayed phacoemulsification provide better pressure and anatomical outcomes than LPI alone [7].

However, the randomised evidence base remains small, the optimal timing of lens extraction after an acute attack is still debated, and data from North African populations are scarce. The present study therefore compared six-month functional, pressure-related and anatomical outcomes between LPI alone and LPI followed by phacoemulsification with intraocular lens (IOL) implantation performed seven days later.

2 MATERIAL AND METHODS

2.1 Study design and setting

This single-centre retrospective comparative study was conducted in the Department of Ophthalmology of Omar Drissi Hospital, Hassan II University Hospital Center, Fez, Morocco. Consecutive patients admitted with APAC between January 2019 and May 2025 were identified from hospital admission and operating theatre records. The planned follow-up period was six months. The study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional ethics committee.

2.2 Eligibility criteria

Eyes were eligible if they presented with clinical features compatible with APAC: a painful red eye with reduced or blurred vision, corneal oedema, a fixed or poorly reactive mid-dilated pupil, a shallow anterior chamber graded by the Van Herick method, elevated IOP on Goldmann applanation tonometry, and an occludable or closed angle on gonioscopy.

Eyes were excluded in the presence of recent ocular trauma, previous intraocular surgery, previous LPI, a secondary cause of acute ocular hypertension or angle closure (including phacomorphic, neovascular, uveitic and lens-subluxation mechanisms), or loss to follow-up before the six-month visit.

Of the 68 eyes screened, 18 were excluded because the acute pressure rise was attributable to a secondary mechanism or because the record was incomplete, leaving 50 eyes of 50 patients. Only one eye per patient was included; when both eyes were affected, the first to present with an acute attack was analysed.

2.3 Treatment protocol and group allocation

All patients initially received IOP-lowering medical treatment to abort the acute attack, comprising systemic acetazolamide with intravenous mannitol where required, a topical beta-blocker or a carbonic anhydrase inhibitor–beta-blocker fixed combination, a topical alpha-2 agonist, topical corticosteroids and pilocarpine, during an inpatient stay of five to seven days on average.

Once the cornea was sufficiently clear, and within 24 to 36 hours of admission, Nd:YAG LPI was performed at the 11 o'clock or 1 o'clock meridian, with a power setting of 2 to 5 mJ and a total of 5 to 15 pulses until iris penetration was

achieved. Every eye in the study, in both groups, therefore received the same initial medical regimen followed by a patent LPI.

Patients were subsequently classified according to the definitive therapeutic strategy documented in their medical records. Group A comprised eyes treated with LPI alone. Group B comprised eyes that underwent phacoemulsification with in-the-bag posterior chamber IOL implantation, performed uniformly seven days after LPI once the acute attack had settled. Surgery was carried out by senior surgeons under local anaesthesia, through a clear corneal incision of 2.0 to 2.4 mm, with continuous curvilinear capsulorhexis, hydrodissection, phaco-chop nucleus disassembly, cortical aspiration, capsular polishing and implantation of a hydrophobic acrylic single-piece IOL (mean power 26 D), followed by intracameral cefuroxime; iris retractors were used when pupillary dilation was inadequate. Postoperative treatment comprised a tapering topical corticosteroid–antibiotic combination over four weeks, a topical non-steroidal anti-inflammatory agent for two months and ocular lubricants, with IOP-lowering medication adjusted at each visit.

Because the study was retrospective, allocation was not randomised. The decision to proceed to lens extraction was based on the density of the cataract and on the level of best-corrected visual acuity assessed once the acute attack had settled: eyes with a visually significant lens opacity and correspondingly reduced acuity were offered phacoemulsification, whereas eyes with a clear or minimally opacified lens were managed with LPI alone. This decision process is reported explicitly because it is the principal source of selection bias in the present analysis.

2.4 Outcome measures and timing of assessments

The evaluated outcomes were best-corrected visual acuity (BCVA, converted to LogMAR), IOP, gonioscopic angle width, the qualitative mechanism of angle closure, anterior chamber depth (ACD), axial length, preoperative crystalline lens thickness, the number of IOP-lowering medications, the therapeutic response, the vertical cup-to-disc ratio and treatment-related complications.

Assessments were performed at baseline (before any intervention), at day 1, at day 7 (referred to throughout as one week) and at six months. In Group A these time points were indexed to the LPI; in Group B, day 1 and day 7 were indexed to the phacoemulsification procedure, so that the postoperative anatomical effect of lens extraction is captured. The "one-week" BCVA and IOP values reported below therefore correspond to one week after the definitive intervention in each group.

Gonioscopy was performed with a Goldmann-type lens under standardised low ambient illumination, in static mode for angle width and with indentation for the closure mechanism; angle width was recorded in degrees as the mean of the four quadrants. Anterior segment biometry was obtained by A-scan ultrasound and corneal topography. Crystalline lens thickness was analysed as a preoperative parameter only, since the lens had been removed in Group B.

2.5 Outcome definitions

The therapeutic response at six months was graded in three mutually exclusive categories. An optimal response was an IOP below 22 mmHg, whether or not medication was required; an intermediate response was an IOP remaining at the upper limit of the target range and maintained only under continued treatment; failure was an IOP of 22 mmHg or higher at the end of follow-up, no light perception, or the need for additional glaucoma surgery. Medication independence was analysed separately and is reported in section 3.7.

2.6 Statistical analysis

Analyses were performed with IBM SPSS Statistics. Continuous variables are summarised as mean ± standard deviation and categorical variables as counts and percentages. Continuous variables were compared with the independent-samples Student t-test and categorical variables with the Pearson chi-square test, or the Fisher exact test when any expected cell count was below five. Mean differences are reported with 95 % confidence intervals (CI) and a two-sided p value below 0.05 was considered significant. Because several outcome domains were analysed, p values are interpreted descriptively and no adjustment for multiplicity was applied.

3 RESULTS

3.1 Study population and baseline characteristics

Fifty eyes of 50 patients were analysed, 25 in each group. The mean age was 62.16 years (range 41–80 years), with a peak in the 51–65 year band, and women accounted for 36 of the 50 patients (72 %). Ocular or periocular pain was present in all patients and reduced vision in 82 %; nausea and vomiting were reported in 46 % and 36 %. Hypermetropia (88 %) and a shallow anterior chamber (100 %) were the dominant risk factors, and no precipitating factor was identified in 74 % of cases.

Baseline characteristics of the two groups are presented in Table 1. Baseline IOP, BCVA, gonioscopic angle width and ACD did not differ significantly between groups. Three baseline imbalances were observed: crystalline lens thickness was greater in Group B than in Group A (4.70 ± 1.50 mm versus 4.04 ± 0.53 mm; p = 0.043), the mean number of IOP-lowering medications was higher in Group A (3.40 ± 1.08 versus 2.80 ± 1.22), and peripheral anterior synechiae were the identified closure mechanism in 6 eyes of Group A against 9 eyes of Group B. All three imbalances are considered in the interpretation of the results. Age and sex were recorded for the cohort as a whole only, so demographic comparability between the arms could not be formally tested.

Table 1: Baseline characteristics of the two treatment groups.

Parameter	Group ALPI alone (n = 25)	Group BLPI + phaco/IOL (n = 25)	p value
Age (years), whole cohort	62.16 (range 41–80)		—
Female sex, whole cohort, n (%)	36 (72)		—
Baseline IOP (mmHg)	44.61 ± 4.30	45.13 ± 4.30	0.671
Baseline BCVA (LogMAR)	1.530 ± 0.702	1.650 ± 0.705	0.549
Baseline gonioscopic angle (°)	16.33 ± 0.34	16.27 ± 0.50	0.599
Baseline ACD (mm)	1.87 ± 0.25	1.90 ± 0.20	0.642
Axial length (mm)	21.88 ± 2.24	21.50 ± 1.30	0.467
Crystalline lens thickness (mm)	4.04 ± 0.53	4.70 ± 1.50	0.043
IOP-lowering medications at baseline (n)	3.40 ± 1.08	2.80 ± 1.22	—
PAS as identified closure mechanism at baseline, n (%)	6 (24)	9 (36)	—

BCVA: best-corrected visual acuity; ACD: anterior chamber depth; PAS: peripheral anterior synechiae. Age and sex were available for the cohort as a whole only and are therefore reported across both groups.

3.2 Visual acuity

Mean LogMAR BCVA improved progressively in both groups, from 1.530 ± 0.702 to 0.972 ± 0.150 in Group A and from 1.650 ± 0.705 to 0.693 ± 0.450 in Group B (Table 2, Figure 1). Baseline acuity did not differ between groups (p = 0.549), whereas acuity was significantly better in Group B at one week and at six months (mean difference 0.279 LogMAR at both time points; p < 0.001 and p = 0.005).

Table 2: Evolution of mean best-corrected visual acuity (LogMAR). Lower values indicate better acuity.

Time point	Group ALPI alone (n = 25)	Group BLPI + phaco/IOL (n = 25)	Mean difference (95 % CI)	p value
Baseline	1.530 ± 0.702	1.650 ± 0.705	−0.120 (−0.520 to 0.280)	0.549
1 week	1.200 ± 0.203	0.921 ± 0.305	0.279 (0.132 to 0.426)	< 0.001
6 months	0.972 ± 0.150	0.693 ± 0.450	0.279 (0.088 to 0.470)	0.005

A positive mean difference indicates better acuity in Group B. CI: confidence interval.

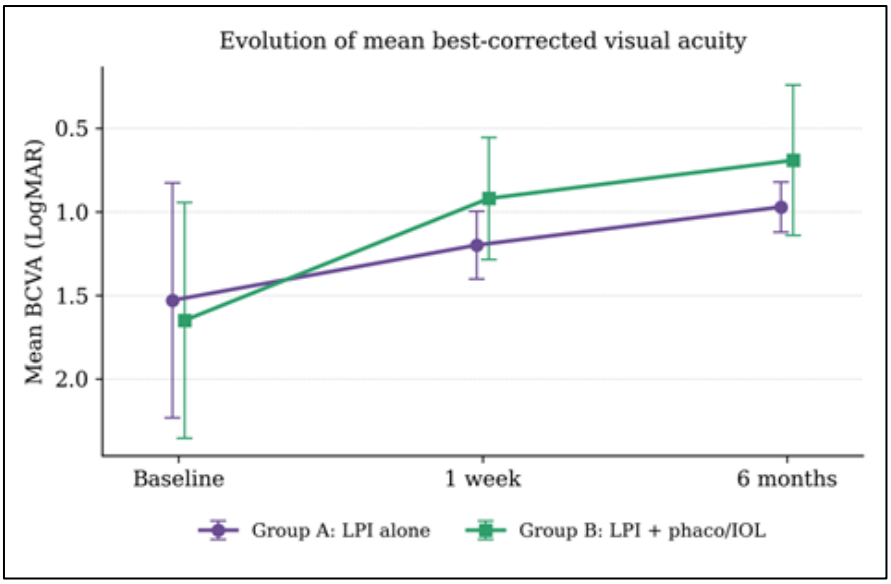

Figure 1: Evolution of mean best-corrected visual acuity (LogMAR) from baseline to six months. Error bars represent one standard deviation. The vertical axis is inverted so that an upward trend corresponds to visual improvement. Mauve: Group A (LPI alone); green: Group B (LPI + phaco/IOL).

3.3 Intraocular pressure

Table 3: Evolution of mean intraocular pressure (mmHg).

Time point	Group A LPI alone (n = 25)	Group B LPI + phaco/IOL (n = 25)	Mean difference (95 % CI)	p value
Baseline	44.61 ± 4.30	45.13 ± 4.30	−0.52 (−2.97 to 1.93)	0.671
1 week	29.30 ± 5.40	16.80 ± 0.10	12.50 (10.33 to 14.67)	< 0.001
6 months	24.01 ± 3.60	15.32 ± 0.68	8.69 (7.22 to 10.16)	< 0.001
Reduction at 6 months	46.18 %	66.05 %	—	—

A positive mean difference indicates lower pressure in Group B.

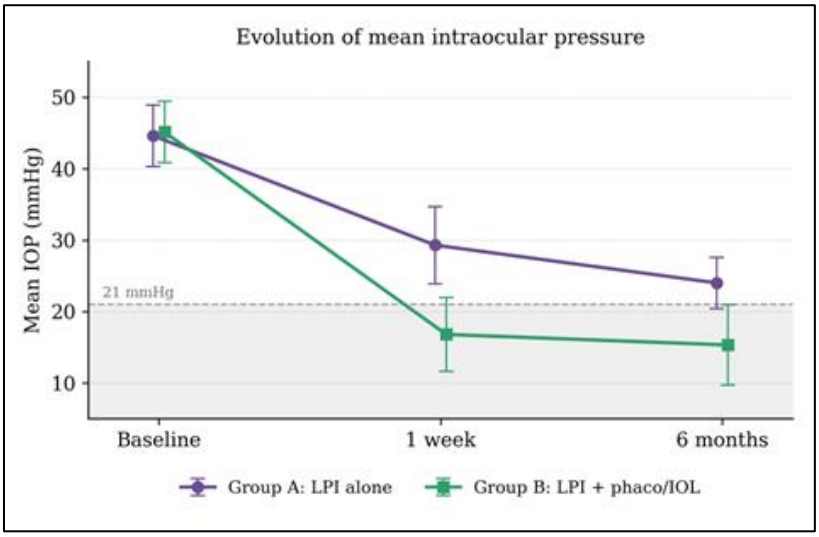

Figure 2: Evolution of mean intraocular pressure from baseline to six months. Error bars represent one standard deviation; the dashed line marks 21 mmHg. Mauve: Group A (LPI alone); green: Group B (LPI + phaco/IOL).

Baseline IOP was comparable between groups (p = 0.671). Mean IOP fell from 44.61 ± 4.30 mmHg to 24.01 ± 3.60 mmHg in Group A and from 45.13 ± 4.30 mmHg to 15.32 ± 0.68 mmHg in Group B, corresponding to reductions of 46.18 % and

66.05 %. The between-group difference was significant at one week (12.50 mmHg, 95 % CI 10.33–14.67) and at six months (8.69 mmHg, 95 % CI 7.22–10.16; both p < 0.001). Data are presented in Table 3 and Figure 2.

3.4 Gonioscopic angle width

Angle widening was observed in both groups after treatment, but the improvement was sustained only after phacoemulsification (Table 4). In Group A the mean angle rose from 16.33 ± 0.34° to 27.22 ± 0.38° at day 7, then fell to 20.65 ± 0.24° at six months. In Group B it rose from 16.27 ± 0.50° to 35.55 ± 2.15° at day 7 and remained stable at 35.33 ± 2.23°. Baseline values were comparable (p = 0.599), whereas all subsequent comparisons were highly significant (p < 0.001), the angle being 14.68° wider in Group B at six months (95 % CI 13.78–15.58°).

Table 4: Evolution of mean gonioscopic angle width (degrees, mean of four quadrants).

Time point	Group A LPI alone (n = 25)	Group B LPI + phaco/IOL (n = 25)	Mean difference (95 % CI)	p value
Baseline	16.33 ± 0.34	16.27 ± 0.50	−0.06 (−0.31 to 0.18)	0.599
Day 1	27.55 ± 0.57	35.26 ± 3.56	8.71 (7.26 to 10.16)	< 0.001
Day 7	27.22 ± 0.38	35.55 ± 2.15	8.33 (7.45 to 9.21)	< 0.001
6 months	20.65 ± 0.24	35.33 ± 2.23	14.68 (13.78 to 15.58)	< 0.001

A positive mean difference indicates a wider angle in Group B. Day 1 and day 7 are counted from the laser peripheral iridotomy in Group A and from the phacoemulsification in Group B, which was itself performed seven days after the iridotomy.

3.5 Mechanism of angle closure

The qualitative mechanism of closure was documented by indentation gonioscopy at baseline and at six months (Table 5). Pupillary block was predominant at baseline in both groups, and the number of eyes in which it remained the operative mechanism fell by 7.7 % in Group A and by 62.5 % in Group B. Conversely, PAS became the identified mechanism in an increasing number of eyes in both groups, rising from 6 to 8 in Group A and from 9 to 14 in Group B. A plateau iris configuration was unchanged in Group B and decreased marginally in Group A.

Table 5: Mechanism of angle closure on indentation gonioscopy, at baseline and at six months.

Mechanism	Group A baseline → 6 months	Group A change	Group B baseline → 6 months	Group B change
Pupillary block	13 → 12	−7.7 %	8 → 3	−62.5 %
Peripheral anterior synechiae	6 → 8	+33.3 %	9 → 14	+55.6 %
Plateau iris configuration	6 → 5	−16.7 %	8 → 8	0 %

Values are numbers of eyes; each group comprised 25 eyes.

3.6 Anterior segment biometry

Table 6: Anterior segment biometric parameters. Lens thickness is reported as a preoperative parameter only.

Parameter	Group A LPI alone (n = 25)	Group B LPI + phaco/IOL (n = 25)	Mean difference (95 % CI)	p value
ACD at baseline (mm)	1.87 ± 0.25	1.90 ± 0.20	0.03 (−0.10 to 0.16)	0.642
ACD at 6 months (mm)	1.89 ± 0.25	3.20 ± 0.30	1.31 (1.15 to 1.47)	< 0.001
Within-group change in ACD (mm)	+0.02	+1.30	—	—
Axial length at baseline (mm)	21.88 ± 2.24	21.50 ± 1.30	−0.38 (−1.42 to 0.66)	0.467
Axial length at 6 months (mm)	21.87 ± 2.24	21.60 ± 1.30	−0.27 (−1.31 to 0.77)	0.605
Crystalline lens thickness, preoperative (mm)	4.04 ± 0.53	4.70 ± 1.50	0.66 (0.02 to 1.30)	0.043

A positive mean difference indicates a higher value in Group B.

The principal biometric change after lens extraction was a marked increase in ACD (Table 6). ACD was essentially unchanged in Group A (1.87 ± 0.25 mm to 1.89 ± 0.25 mm) but increased from 1.90 ± 0.20 mm to 3.20 ± 0.30 mm in Group B, a between-group difference of 1.31 mm at six months (95 % CI 1.15–1.47; $p < 0.001$). Axial length was short in both groups, consistent with the anatomical profile of angle-closure eyes, and did not change over follow-up. Preoperative lens thickness was greater in Group B (4.70 ± 1.50 mm versus 4.04 ± 0.53 mm; $p = 0.043$).

3.7 IOP-lowering medication burden

Medication requirements decreased in both groups but far more markedly in Group B (Table 7). The mean number of medications fell only marginally in Group A, from 3.40 ± 1.08 to 2.96 ± 1.37, whereas in Group B it fell from 2.80 ± 1.22 to 1.44 ± 1.42, the number of eyes requiring four medications falling from 10 to 3 and the number requiring none rising from 1 to 9. The proportion of medication-free eyes at six months was 8 % in Group A and 36 % in Group B ($p = 0.037$, Fisher exact test).

Table 7: Distribution of IOP-lowering medication burden at baseline and at six months.

Number of medications	Group A baseline	Group A 6 months	Group B baseline	Group B 6 months
Four	17	13	10	3
Three	4	5	5	3
Two	2	2	6	5
One	1	3	3	5
None	1	2	1	9
Total	25	25	25	25
Mean ± SD	3.40 ± 1.08	2.96 ± 1.37	2.80 ± 1.22	1.44 ± 1.42

SD: standard deviation.

3.8 Therapeutic response

At six months, an optimal response was achieved in 8 eyes (32 %) of Group A against 19 eyes (76 %) of Group B, an intermediate response in 4 eyes (16 %) and 2 eyes (8 %), and failure in 13 eyes (52 %) and 4 eyes (16 %) (Table 8). The overall distribution differed significantly between groups ($p = 0.007$): an optimal response was more than twice as frequent after phacoemulsification ($p = 0.004$, Fisher exact test) and failure more than three times as frequent after LPI alone (odds ratio 5.69; $p = 0.016$). Medication independence, analysed separately, was achieved in 2 eyes (8 %) and 9 eyes (36 %), respectively.

Table 8: Therapeutic response at six months. An optimal response denotes an IOP below 22 mmHg with or without medication; medication independence is reported separately.

Therapeutic response	Group A LPI alone (n = 25)	Group B LPI + phaco/IOL (n = 25)	p value
Optimal response, n (%)	8 (32)	19 (76)	0.004
Intermediate response, n (%)	4 (16)	2 (8)	0.667
Failure, n (%)	13 (52)	4 (16)	0.016
Overall distribution	—	—	0.007
Medication-free at 6 months, n (%)	2 (8)	9 (36)	0.037

3.9 Complications

Most eyes did not experience a major treatment-related complication (Table 9). In Group A, 4 eyes (16 %) developed blood streaks or a small hyphaema at the iridotomy site, which resolved without sequelae, and every iridotomy remained patent throughout follow-up. In Group B, 17 eyes (68 %) had no intraoperative or postoperative complication; subconjunctival haemorrhage occurred in 4 eyes (16 %), corneal burns in 2 eyes (8 %) and posterior capsular rupture in 2 eyes (8 %). No IOL decentration, subluxation or dislocation was recorded.

Table 9: Treatment-related complications over six months

Complication	Group A LPI alone n (%)	Group B LPI + phaco/IOL n (%)
None	21 (84)	17 (68)
Blood streaks or small hyphaema at the iridotomy	4 (16)	—
Subconjunctival haemorrhage	—	4 (16)
Corneal burn	—	2 (8)
Posterior capsular rupture	—	2 (8)
Total	25 (100)	25 (100)

3.10 Optic disc and glaucomatous conversion

At six months, the mean vertical cup-to-disc (C/D) ratio was 0.79 ± 0.05 in Group A and 0.65 ± 0.18 in Group B (mean difference 0.14, 95 % CI 0.07–0.22; $p < 0.001$). A C/D ratio above 0.5, taken as the threshold for conversion to chronic angle-closure optic neuropathy, was present in 14 eyes (56 %) of Group A and 4 eyes (16 %) of Group B (Table 10). Because group-specific baseline C/D ratios were not documented, these are differences measured at follow-up rather than evidence of differential glaucomatous progression.

Table 10: Vertical cup-to-disc ratio and glaucomatous conversion at six months.

Parameter	Group A LPI alone (n = 25)	Group B LPI + phaco/IOL (n = 25)	p value
Mean C/D ratio	0.79 ± 0.05	0.65 ± 0.18	< 0.001
C/D ≤ 0.5, n (%)	11 (44)	21 (84)	—
C/D > 0.5 and ≤ 0.7, n (%)	8 (32)	1 (4)	—
C/D > 0.7, n (%)	6 (24)	3 (12)	—
C/D > 0.5 (conversion), n (%)	14 (56)	4 (16)	—

C/D: cup-to-disc ratio.

4 DISCUSSION

4.1 Main findings

In this retrospective comparative cohort, phacoemulsification performed seven days after LPI was associated with substantially better six-month pressure and anatomical outcomes than LPI alone. Mean IOP fell by 46.18 % after LPI alone and by 66.05 % after LPI followed by lens extraction, leaving an absolute difference of 8.69 mmHg at six months. An optimal pressure response was achieved in 76 % of operated eyes versus 32 % of eyes treated with LPI alone, treatment failure occurred in 16 % versus 52 %, and 36 % versus 8 % of eyes were free of all IOP-lowering medication. These functional differences were accompanied by a 1.31 mm deepening of the anterior chamber and by a divergence in the behaviour of the angle: the operated group retained 99 % of the angle width gained by day 7, whereas the LPI-alone group lost 60 % of its initial gain by six months.

4.2 Comparison with published evidence

The magnitude and persistence of the IOP reduction observed here are directionally consistent with randomised data. Lam et al. randomised 62 eyes with APAC and reported IOP elevation above 21 mmHg at 18 months in 46.7 % of eyes treated with LPI versus 3.2 % after early phacoemulsification [4]. Husain et al. randomised 37 patients with APAC and coexisting cataract and reported a two-year cumulative success rate of 89.5 % after phacoemulsification versus 61.1 % after LPI [5]. Ahmad et al. found significantly lower IOP and better BCVA, ACD and angle width after lens extraction than after LPI over 12 months in 50 eyes [8]. Our optimal response rate of 76 % at six months is consistent in direction with these series, although direct numerical comparison is not appropriate because definitions of failure, follow-up and protocols differed.

The most informative comparison is with pooled data. In a meta-analysis of eight randomised trials, Xie et al. found IOP six months after intervention to be 3.39 mmHg lower after phacoemulsification than after LPI (95 % CI −4.15 to −2.63) and the anterior chamber 1.59 mm deeper (95 % CI 1.10 to 2.09) [9]. Our anatomical result aligns closely with that estimate (1.31 mm), whereas our pressure difference of 8.69 mmHg is roughly two and a half times the pooled value. The pattern is instructive: the anatomical effect of lens extraction is a direct mechanical consequence of removing the lens and is largely independent of study design, while the pressure outcome depends on baseline severity, medication policy and the definition of failure, all susceptible to selection in a non-randomised cohort. We therefore consider our anatomical findings the more reliable, and interpret our pressure difference as inflated by residual confounding rather than as a larger true treatment effect.

Two further sources place these results in context. The EAGLE trial, which randomised 419 participants with chronic primary angle closure or primary angle-closure glaucoma, reported at three years an IOP 1.18 mmHg lower after clear-lens extraction [13]; its population did not present with an acute attack, and the modest size of that advantage supports cautious interpretation of ours. The 2023 Cochrane review found only two randomised trials comparing lens extraction with LPI in APAC (99 participants) and concluded that lens extraction may improve IOP control at 18–24 months and reduce the need for further surgery, while rating the certainty of the evidence as low [14]. Our findings are directionally consistent with this evidence and illustrate the need for larger prospective studies outside East Asian populations.

4.3 The crystalline lens and the regression of angle widening after iridotomy alone

The rationale for lens extraction rests on the volume and position of the crystalline lens rather than on its opacity. In angle-closure eyes the lens is thicker, sits more anteriorly and vaults further forward relative to the plane joining the scleral spurs; Nongpiur et al. showed that lens vault is independently associated with angle closure and discriminates it from open-angle eyes more strongly than anterior chamber depth alone [10]. Our cohort is anatomically typical of that phenotype: mean axial length was below 22 mm in both groups, baseline ACD under 1.9 mm, and preoperative lens thickness averaged 4.04 mm in Group A and 4.70 mm in Group B. Replacing a crystalline lens of four to five millimetres with an intraocular lens of approximately one millimetre removes most of the volume occupying the posterior chamber: the iris–lens diaphragm moves posteriorly, the peripheral iris falls away from the trabecular meshwork, and both the pupillary-block and lens-crowding components are addressed by a single procedure. The 1.31 mm deepening measured in Group B expresses this displacement directly, and explains why the widening produced by lens extraction is structural and durable, whereas that produced by iridotomy is conditional on the lens remaining in place.

The most instructive finding is accordingly not the between-group difference at six months but the divergence of the two trajectories. Both groups widened substantially in the first days after LPI, confirming a pupillary-block component in both. Thereafter they separated: the LPI-alone group lost 6.57° between day 7 and six months, that is 60 % of everything the iridotomy had achieved, whereas the operated group changed by only 0.22°. Three mechanisms plausibly account for this regression. The crystalline lens continues to thicken and move anteriorly with age, so an angle only marginally open after iridotomy narrows again. Residual appositional contact behind a patent iridotomy tends to organise into synechial closure; Sawada and Yamamoto showed that the extent of pre-existing organic angle closure is the principal determinant of long-term outcome after LPI [3], and our gonioscopic data support this, since the number of eyes in which PAS were the identified mechanism rose in both groups. Finally, the sequelae of the attack itself — iris atrophy, pigment dispersion and low-grade inflammation — favour adhesion formation. None of these is addressed by an iridotomy and only the first two are attenuated by lens extraction, which explains why the benefit of LPI is genuine but transient and supports a sequential rather than competing view of the two procedures.

4.4 Residual trabecular dysfunction and adjunctive angle surgery

Reopening the angle does not by itself guarantee pressure control. Four operated eyes (16 %) failed despite an anatomically wide angle at six months, and sixteen of the twenty-five still required at least one medication. The acute attack damages the trabecular meshwork through direct pressure injury, inflammatory infiltration and endothelial dysfunction, and this is not reversed by relieving the mechanical obstruction. Established synechial closure is a second explanation, since lens extraction does not lyse existing adhesions, consistent with the rise documented in Table 5. Where synechial closure is extensive, combining phacoemulsification with goniosynechialysis is a logical extension: in a meta-analysis of eight randomised trials comprising 460 eyes, Yu et al. found a significantly greater reduction in synechial extent at twelve months with adjunctive goniosynechialysis, although IOP and medication requirements did not differ [12]. Its anatomical benefit is demonstrable but its translation into pressure control uncertain, and it is best reserved for eyes with substantial synechial closure. Two consequences follow: a wide angle on postoperative gonioscopy is not evidence that pressure monitoring can be relaxed, since outflow facility may remain impaired in a structurally open angle; and the interval between symptom onset and effective IOP reduction is likely to be a strong determinant of outcome, a variable not documented in our records and a priority for prospective collection.

4.5 Timing of lens extraction

Performing phacoemulsification seven days after LPI was a pragmatic component of our departmental protocol. During the acute phase, corneal oedema, inflammation, a very shallow anterior chamber and poor pupillary dilation make lens surgery technically demanding and increase the risk of capsular complications, whereas initial medical treatment followed by LPI allows the attack to settle without prolonged exposure of an already compromised trabecular meshwork to a crowded angle. The literature does not establish a single optimal interval: Lin et al. compared early phacoemulsification, delayed phacoemulsification after LPI and LPI alone in 81 eyes and found at 12 months that both surgical groups outperformed LPI alone, without a clear disadvantage of delaying surgery once the attack had settled [7]. Our uniform seven-day interval is an intermediate strategy whose standardisation is a methodological strength, since surgical timing is heterogeneous in most published cohorts.

4.6 Medication burden and visual outcome

The reduction in medication requirements is clinically meaningful, since long-term topical therapy carries costs in adherence, ocular surface health and expense. Nine eyes in Group B were medication-free at six months against two in Group A. This mirrors the randomised evidence of Lam et al. [4] and the ten-year follow-up of Chan et al., in which the early-phacoemulsification group used fewer medications, had less extensive PAS and better Shaffer grading, with persistent IOP elevation and blindness observed only in the LPI group [6]. The value of this reduction is arguably greater in our setting than in those trials: where distance, cost and irregular follow-up limit adherence to chronic topical therapy, a single definitive procedure that leaves more than a third of patients free of medication removes a recurring point of failure.

Visual acuity improved in both groups, more so after lens extraction, but the absolute figures deserve emphasis. A mean of 0.693 LogMAR corresponds to approximately 20/100 and 0.972 LogMAR to approximately 20/190, so even the more successful group completed follow-up with substantially impaired vision. Recovery after APAC reflects resolution of corneal oedema, refractive change, pre-existing lens opacity and, above all, the extent of optic nerve injury sustained during the attack. Because preoperative lens thickness was greater in Group B, part of the additional visual gain there is likely attributable to removal of a more intumescent lens rather than to the pressure benefit. The principal determinant of visual prognosis in APAC therefore appears to be the delay before effective IOP reduction, which neither procedure compensates for.

4.7 Safety considerations specific to post-attack eyes

The advantages of lens extraction must be balanced against the technical difficulty of operating an eye that has recently sustained an acute attack. Posterior capsular rupture occurred in 2 of 25 operated eyes (8 %), appreciably higher than the rate expected in routine cataract surgery. This is not unexpected: a very shallow anterior chamber reduces the working space, poor pupillary dilation from post-ischaemic iris atrophy restricts visualisation and required iris retractors in some eyes, zonular weakness may follow the acute pressure rise, and residual corneal oedema degrades the surgical view. Lens extraction after an acute attack should therefore be undertaken by an experienced surgeon and not regarded as routine cataract surgery. The corneal endothelium is a second concern. Yeom et al. measured a preoperative endothelial cell density of 1,818 ± 490 cells/mm^2 in eyes with a previous acute attack against approximately 2,670 cells/mm^2 in normal eyes, but found no greater proportional cell loss after phacoemulsification and no corneal decompensation at three months [11]. The reserve of a post-attack eye is nevertheless roughly two-thirds of normal, which justifies preoperative specular microscopy — unavailable in our cohort — and the liberal use of dispersive viscoelastic. A third consideration is refractive: eyes with axial lengths near 21.5 mm require high-power intraocular lenses, a mean of 26 D here, for which biometric error is proportionally greater.

4.8 Strengths and limitations

The principal strengths of this study are the evaluation of several complementary outcome domains — pressure, function, quantitative and qualitative gonioscopy, biometry, medication burden, therapeutic response and optic disc status — whose internal consistency strengthens the plausibility of the association, and the uniform seven-day interval between LPI and phacoemulsification in every operated eye. Every eye in both groups received the same initial medical regimen and a patent LPI, so the arms differ by the addition of lens extraction alone. The cohort also adds North African data to an evidence base derived overwhelmingly from East Asian patients.

Several limitations must be acknowledged. First, the retrospective design and non-randomised allocation introduce selection bias. Because eyes were selected for surgery on the density of the cataract and the level of visual acuity, those with a thicker and more opaque lens were preferentially operated, which favours the surgical group both anatomically and visually, whereas eyes in the LPI group carried a higher baseline medication burden, suggesting a more refractory presentation. Both imbalances bias the comparison in the same direction and probably inflate the apparent treatment effect, consistent with our pressure difference exceeding pooled randomised estimates while our anatomical difference matches them closely. Second, the sample was small and drawn from a single tertiary centre. Third, follow-up was

restricted to six months, insufficient to characterise glaucomatous progression; the title and conclusions are accordingly framed in terms of six-month outcomes. Fourth, several parameters were incompletely recorded: synechial extent was graded qualitatively rather than in clock hours, symptom duration before presentation was not documented, specular microscopy was unavailable, and baseline optic disc parameters were not recorded separately by group. Finally, age and sex were retrievable only for the cohort as a whole, so demographic comparability between the arms could not be formally verified, although both groups were drawn consecutively from the same admission stream.

4.9 Clinical implications

LPI remains indispensable in the emergency setting, since it can be performed rapidly, requires no operating theatre and relieves the immediate obstruction; lens extraction addresses the anatomical component that frequently persists once the iridotomy is patent, and our data suggest this component re-asserts itself within months in most eyes treated by iridotomy alone. The decision to proceed to lens extraction should therefore rest on a structured reassessment once the attack has settled rather than on the presentation itself. Gonioscopy repeated one week after a patent iridotomy, combined with anterior chamber depth, lens thickness and the IOP achieved on the smallest tolerable number of medications, identifies the eyes in which the lens remains the dominant obstacle: a thick or cataractous lens, an ACD below approximately 2 mm, persistent angle narrowing, or inadequate pressure control on medication. Eyes with a wide, stable angle and controlled pressure after iridotomy may reasonably be observed, provided surveillance continues, since a structurally open angle does not exclude residual trabecular dysfunction.

5 CONCLUSION

In this retrospective cohort of 50 eyes with acute primary angle closure, phacoemulsification with posterior chamber IOL implantation performed seven days after laser peripheral iridotomy was associated with better six-month IOP control, a higher rate of optimal therapeutic response, a lower rate of treatment failure, a reduced medication burden, greater anterior chamber deepening and more sustained gonioscopic angle widening than LPI alone. LPI remains essential for the acute pupillary-block component, while lens extraction may provide a more definitive anatomical intervention in appropriately selected eyes. Because the design was retrospective and follow-up limited to six months, these results should be interpreted as an association rather than as proof of superiority. Prospective randomised studies with standardised surgical timing, systematic quantification of synechial extent and longer follow-up are needed to define which patients benefit most from early lens extraction.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Statement of ethical approval

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of the Faculty of Medicine, Pharmacy and Dentistry of Fez, Sidi Mohamed Ben Abdellah University. The de-identified data supporting the findings are available from the corresponding author upon reasonable request.

Statement of informed consent

Because the study was retrospective and based on previously collected, de-identified clinical data, the requirement for individual written informed consent was waived by the ethics committee in accordance with institutional policy for chart-review research. Patient confidentiality was preserved throughout.

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