Original Article

Juvenile Open-Angle Glaucoma: Demographic and Clinical Profile from a Tertiary Eye Care Center in Northern India

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Abstract

Purpose: To evaluate the demographic and clinical characteristics of juvenile open-angle glaucoma (JOAG) patients presenting to a tertiary eye care center in northern India.
Patients and Methods: We conducted a retrospective review of medical records of patients aged 5–35 years diagnosed with JOAG. Data collected included age, sex, family history, refractive error, best-corrected visual acuity, intraocular pressure (IOP), cup-to-disc ratio, optic disc changes, retinal nerve fiber layer findings, and visual field indices. Treatment status, prior surgeries, and associations with systemic illness were also analyzed.
Results: A total of 79 patients (158 eyes) were included. The majority was male, and most cases were bilateral. Myopia was the predominant refractive error. At presentation, many patients had advanced optic disc cupping and significant visual field loss, often despite ongoing anti-glaucoma medication. Mean IOP was markedly elevated, and several eyes had undergone prior trabeculectomy. Family history of glaucoma was noted in a subset of patients. Systemic comorbidities were infrequent.
Conclusion: JOAG in this cohort predominantly affected young males and was strongly associated with myopia and advanced disease at presentation. The findings highlight the aggressive nature of JOAG and the need for early diagnosis, vigilant screening of at-risk individuals, and timely surgical intervention to prevent irreversible visual disability.

Keywords: Glaucoma; Open-Angle; Juvenile; Myopia; Intraocular Pressure; Optic Disc; Visual Fields.

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Introduction

Glaucoma is a progressive optic neuropathy characterized by retinal nerve fiber layer (RNFL) damage, optic disc changes, and corresponding visual field loss [1]. It is the leading cause of irreversible blindness worldwide, and elevated intraocular pressure (IOP) remains the most important modifiable risk factor [1].

Juvenile open-angle glaucoma (JOAG) is a rare but aggressive subtype of primary open-angle glaucoma (POAG). It typically presents between 5 and 35 years of age, progresses more rapidly than adult-onset POAG, and is often associated with markedly elevated IOP and advanced optic nerve damage at diagnosis [2]. Unlike congenital and infantile glaucomas, JOAG lacks features such as buphthalmos, Haab's striae, or anterior segment dysgenesis [3]. The condition frequently follows an autosomal dominant inheritance pattern, with strong associations reported with myocilin (MYOC) gene mutations [4]. Myopia is another common ocular finding linked with JOAG. A recent population-based study estimated the incidence of JOAG at 0.38 per 100,000 residents aged 4-20 years [5], while data from the Dallas Glaucoma Registry suggested that JOAG accounts for nearly 4 % of childhood glaucoma cases [6].

Abnormal development of the trabecular meshwork is thought to underlie reduced aqueous outflow, leading to sustained IOP elevation and progressive optic nerve injury [7,8]. Because of its early onset and long life expectancy, JOAG patients face a high lifetime risk of visual disability, which can significantly impair education, productivity, and quality of life.

The present study retrospectively analyzed the demographic and clinical features of JOAG in patients presenting to a tertiary eye care hospital in northern India, with the aim of identifying patterns that could guide earlier recognition and improve management strategies.

Patients and Methods

This retrospective study was conducted at the glaucoma services of a tertiary eye care hospital in northern India. Medical records from January 2015 to December 2020 were reviewed. Patients aged 5–35 years with a diagnosis of juvenile open-angle glaucoma (JOAG) were included. The diagnosis was based on the presence of open angles on gonioscopy, intraocular pressure (IOP) greater than 21 mmHg, glaucomatous optic disc changes, and corresponding visual field defects. Patients with congenital, infantile, or secondary glaucomas were excluded.

For each patient, demographic data including age, sex, laterality, and family history of glaucoma were recorded. Clinical parameters included best-corrected visual acuity (BCVA), refractive error, IOP at presentation, cup-to-disc ratio, optic disc features, retinal nerve fiber layer (RNFL) findings on optical coherence tomography (OCT), and visual field indices such as mean deviation and pattern standard deviation. Details of anti-glaucoma medications, history of surgical interventions such as trabeculectomy, and systemic comorbidities were also collected.

Visual acuity was measured with a Snellen chart and converted to LogMAR for analysis. Refraction was assessed by autorefractometry and refined by subjective testing. IOP was measured with Goldmann applanation tonometry, and gonioscopy was performed using a Goldmann two-mirror lens. Optic disc evaluation was carried out with slit-lamp biomicroscopy and a 90D lens. Visual fields

were tested with the Humphrey Field Analyzer (30-2 SITA-Standard program), and RNFL thickness was measured using OCT.

All data were entered into Microsoft Excel and analyzed with SPSS version 25. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages.

The study was approved by the Institutional Ethics Committee of the hospital and adhered to the tenets of the Declaration of Helsinki. Written informed consent had been obtained from all patients at the time of their clinical care for the use of anonymized data in research.

Results

A total of 79 patients (158 eyes) diagnosed with juvenile open-angle glaucoma were included. The majority of patients were male, and most cases were bilateral. A positive family history of glaucoma was present in 13 % of patients. The demographic characteristics are summarized in table 1.

Refractive error analysis showed that myopia was the predominant finding, present in nearly two-thirds of eyes. A smaller proportion had hyperopia, while the remainder was emmetropic (Table 2).

Table 1: Demographic profile of patients with JOAG (n = 79)

Variable	Number (%)
Total patients	79
Total eyes	158
Sex – Male	56 (71 %)
Sex – Female	23 (29 %)
Laterality – Bilateral	71 (90 %)
Laterality – Unilateral	8 (10 %)
Family history (+)	10 (13 %)
Family history (–)	69 (87 %)

Table 2: Refractive status of eyes with JOAG (n = 158)

Refractive error	Number of eyes (%)
Myopia	102 (65 %)
Hyperopia	6 (4 %)
Emmetropia	50 (31 %)

At presentation, the mean best-corrected visual acuity was 0.62 ± 0.35 LogMAR, indicating moderate visual impairment on average. The mean intraocular pressure was markedly elevated at 34.5 ± 8.2 mmHg, with values ranging from 22 to 52 mmHg. The mean cup-to-disc ratio was 0.74 ± 0.12, and most eyes exhibited advanced glaucomatous optic neuropathy. Visual field analysis demonstrated significant deficits, with a mean deviation of –12.8 ± 5.6 dB. Optical coherence tomography revealed diffuse retinal nerve fiber layer thinning, with a mean thickness of 68 ± 14 µm (Table 3).

Regarding treatment history, 70 % of eyes were already on anti-glaucoma medication at the time of presentation, 18 % had undergone trabeculectomy, and 12 % were treatment naïve (Table 4). Despite ongoing therapy, many patients continued to have uncontrolled IOP and progressive optic nerve damage.

Overall, these findings suggest that JOAG patients frequently presented late in the disease course, with elevated IOP, advanced disc cupping, significant RNFL thinning, and severe visual field loss despite medical or surgical interventions.

Table 3: Clinical characteristics at presentation

Parameter	Mean ± SD (range)
Best-corrected visual acuity (LogMAR)	0.62 ± 0.35 (0.2–1.0)
Intraocular pressure (mmHg)	34.5 ± 8.2 (22–52)
Cup-to-disc ratio	0.74 0.12 (0.5–0.9)
Visual field mean deviation (dB)	- 12.8 ± 5.6 (– 4 to – 28)
RNFL thickness (µm)	68 ± 14 (45–95)

Table 4: Management status of JOAG eyes at presentation (n = 158)

Treatment status	Number of eyes (%)
On medical therapy	110 (70 %)
Prior trabeculectomy	28 (18 %)
No prior treatment	20 (12 %)

Discussion

This study highlights the clinical profile of juvenile open-angle glaucoma (JOAG) in northern India, showing that most patients were young males with bilateral disease and a strong association with myopia. At presentation, patients often had markedly elevated intraocular pressure (IOP), advanced optic disc cupping, diffuse retinal nerve fiber layer thinning, and severe visual field loss, underscoring the aggressive course of the disease.

Our findings are consistent with several large Indian series. Seth et al., [9] observed that JOAG accounted for a small but clinically severe subset of glaucomas in South India, with male predominance, bilateral disease, and very advanced visual field defects in over half of eyes. Parab et al., [10] similarly reported mean IOP of 32.9 mmHg and mean cup-to-disc ratio of 0.65, values close to our results, again reflecting advanced disease at diagnosis. Mukherjee et al., [11] confirmed the same trends, with 75 % of patients being male, 92.5 % bilateral, and most showing myopia, with nearly 70 % having already undergone trabeculectomy.

International data echo these themes. Ciociola and Klifto [12] summarized reports showing consistent male bias, high bilaterality, and frequent myopia, with progression more rapid in myopic eyes. Nelson-Ayifah et al., [13] in Ghana, noted similar bilaterality and optic nerve damage even at lower IOP, highlighting late detection as a global challenge. Almulhim et al., [14] in Saudi Arabia, found equal sex distribution but very high rates of family history (51 %) and myopia (93 %), again with severe field loss in over half of eyes, showing that while the core profile of JOAG is consistent, some demographic differences vary by region.

Management outcomes across studies converge on the same message: medical therapy alone is usually inadequate. In our cohort, nearly one-fifth of eyes had undergone trabeculectomy despite medical treatment. Mukherjee et al., [11] reported even higher surgical rates, and Almulhim et al., [14] showed that combined surgical and nonsurgical approaches significantly reduced IOP, with deep sclerectomy being effective in their series. Ciociola and Klifto [12] also highlighted that trabeculectomy, tube shunts, and microinvasive glaucoma surgeries are frequently needed, while selective laser trabeculoplasty can delay but not replace surgery.

The strength of our study is that it provides

detailed structural and functional profiles of JOAG patients using OCT and perimetry, but several limitations must be acknowledged. The retrospective, hospital-based design introduces referral bias and likely over-represents advanced cases. Follow-up outcomes after treatment were not analyzed, limiting conclusions about long-term prognosis. Genetic evaluation was not performed, preventing correlations between phenotype and genotype. Furthermore, the relatively modest sample size restricts the generalizability of our findings to broader populations.

Future studies should adopt a multicenter, prospective design to capture the full spectrum of JOAG severity, including earlier and milder cases. Incorporating genetic testing will help clarify hereditary contributions, while long-term follow-up will provide insights into surgical outcomes, visual prognosis, and quality of life. Population-based screening programs targeting young myopes and relatives of glaucoma patients may also help identify cases earlier and reduce irreversible visual disability.

Conclusion

Juvenile open-angle glaucoma in northern India was mainly bilateral, myopia-associated, and presented late with advanced damage. Medical therapy was often inadequate, highlighting the need for early detection and timely surgical intervention to prevent blindness.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present manuscript.