

Leprosy Through a New Lens: Shedding Light on Leprosy's Impact on Vision-A Cross Sectional Observational Study in a Tertiary Care Hospital

Anbulakshmi J¹, Mohanasundari PS², Jayanthi NS³, Vijayabhaskar C⁴,
AV Guruprakash⁵

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Leprosy (Hansen's disease) is a chronic granulomatous infection caused by *Mycobacterium leprae*, which often involves ocular tissues and may lead to visual impairment if not detected early. This study has been carried out to determine the prevalence and pattern of ocular manifestations in Hansen's disease, comparing both disease spectrum and reactional status. This cross-sectional observational study enrolled 70 patients diagnosed with Hansen's disease, either on multidrug therapy (MDT) or post-MDT, from February 2024 to January 2025. Patients were classified by the Ridley-Jopling spectrum and by history of lepra reaction. Comprehensive dermatologic, neurologic and ophthalmic evaluations were conducted. Data were analysed; categorical variables expressed as frequencies/percentages and associations tested by Fisher's exact test; significance set at $p < 0.05$. Among 70 patients (44 males, 26 females), 28 were on MDT, 42 post-treatment; 27 had lepra reactions while 43 had no reactional history. Most of the patients belonged to lepromatous spectrum (18) and least to tuberculoid spectrum (12). Ocular manifestations were more frequent and severe in the reaction group: madarosis (8/27 vs 5/43), lagophthalmos only in reaction group, Koeppe and Busacca nodules only in reaction group, iris atrophy and cataract significantly higher. Cataract was the most common ocular finding (36/70 = 51.4%). Spectrum-wise, tuberculoid and borderline tuberculoid groups showed more nerve-related complications (lagophthalmos, exposure keratitis), while lepromatous forms exhibited more chronic inflammatory lesions (iris atrophy, nodular uveitis). Ocular involvement in Hansen's disease was found to be common in HD patients at our tertiary care centre. Both disease spectrum and reactional episodes influence ocular morbidity, but reactional status appears more dreaded. Early ophthalmic screening and screening during lepra reactions is crucial to prevent irreversible vision loss.

Keywords: Leprosy; Hansen's Disease; Ocular Manifestations; Lepra reactions; Preventable Blindness

Introduction

Leprosy is a chronic granulomatous infection caused by *Mycobacterium leprae*, an intracellular acid-fast bacillus with a predilection for

skin, peripheral nerves, ocular tissues and mucosa of the upper respiratory tract. Ocular complications in leprosy have been attributed to four main mechanisms: (i) direct invasion of

¹ Anbulakshmi J, Senior Resident

² Mohanasundari PS, Assistant Professor (Presently: Associate Professor, Madras Medical College, Chennai)

³ Jayanthi NS, Associate Professor

⁴ Vijayabhaskar C, Professor and Head

⁵ AV Guruprakash, Postgraduate

Department of Dermatology, Venereology and Leprosy, Stanley Medical College, Chennai- 600001, Tamil Nadu, India

Corresponding Author: Dr Ambulakshmi J, **Email:** anbu.jeyarajan@gmail.com

lepra bacilli into ocular structures such as the ciliary body; (ii) secondary involvement due to facial and trigeminal nerves; (iii) immune-mediated hypersensitivity reactions triggered by fragmented or dead bacilli; and (iv) secondary changes in adnexal tissues including lids and lacrimal drainage systems (Grzybowski et al 2015). The eyes can be affected before, during, or even after completion of multidrug therapy (MDT), including bacteriologically cured patients. If unrecognized, ocular complications may progress to severe visual impairment or blindness, making leprosy one of the leading infectious causes of preventable blindness in endemic regions. The spectrum of ocular manifestations is wide, ranging from subtle signs such as madarosis, lagophthalmos, and corneal hypoesthesia, to sight-threatening complications such as chronic iridocyclitis, exposure keratitis, cataract and blindness. Many of these conditions may remain asymptomatic in early stages, often leading to under-diagnosis and delayed intervention. Early recognition of ocular signs is therefore crucial to prevent irreversible blindness. A collaborative approach between dermatologists and ophthalmologists is essential for early diagnosis, appropriate management and visual rehabilitation of affected individuals. While the profile of leprosy cases has changed in the community after implementation of MDT, ocular afflictions/complications in leprosy have been published during the last 25 years (Courtright et al 2002; Daniel et al 2002, 2006, 2007; Daniel SJ et al 2019, Rather et al 2022, Narendra et al 2023, Katoch et al 2025). This study was undertaken to determine the prevalence and pattern of ocular manifestations in Hansen's patients currently on MDT and those who have completed treatment with and without history of reactions.

Materials and Methods

This cross-sectional observational study was

conducted in the Departments of Dermatology and Ophthalmology at Government Stanley Medical College in Chennai between February 2024 and January 2025. The study was approved by the Institutional Ethics Committee of Government Stanley Medical College, Chennai. (IEC NO:123/ME1/EC/2025-164).

Seventy patients diagnosed with Hansen's disease either currently on MDT or released from MDT were enrolled after getting written informed consent. All patients treated during February 2024 to January 2025 were included. Patients were treated as per WHO guidelines with paucibacillary (6 months) or multibacillary (12 months) multidrug therapy. Patients with ocular conditions unrelated to leprosy, such as congenital ocular anomalies, traumatic eye injuries, or pre-existing non-leprosy ocular diseases, were excluded from the study. Patients were classified according to the Ridley-Jopling spectrum and also grouped by history of lepra reaction. A detailed dermatological and neurological evaluation was done then followed by ophthalmic examination.

All patients underwent a structured ocular screening protocol (Bairappagari et al 2017). Visual acuity was assessed using Snellen's chart. Eyelid function and facial nerve involvement were evaluated by examining eye closure. Corneal sensation was tested using a cotton wisp. Slit-lamp examination was performed to identify anterior segment changes including keratic precipitates, iris atrophy, and uveitis. Intraocular pressure was measured using Schiotz tonometry. Fundus examination was carried out using indirect ophthalmoscopy to detect posterior segment involvement. Patients with significant ocular findings were referred for further ophthalmological management and follow-up. Data were recorded in a structured proforma and analysed using IBM SPSS version

XX. Categorical variables were expressed as frequencies and percentages. Associations between ocular findings and clinical groups (spectrum and reactional status) were tested using Fisher's exact test. A *p*-value of <0.05 was considered statistically significant.

Results

Out of 70 patients with Hansen's disease included in the study, 44 were males and 26 were females, showing a clear male predominance. Most of the patients had already completed MDT at the time of examination. Among the total participants, 28 patients (40%) were on MDT, while 42 patients (60%) were post-MDT. With regard to reaction status, 27 patients (38.6%) had a history of lepra reaction, and 43 patients (61.4%) had no reaction (Table 1). The age of the study population ranged from 18 to 82 years. The mean age was 54.8 ± 13.6 years, and the median age was 56 years. Most of the patients belonged to the 46 – 60-

year age group, followed by the 61 – 75-year group, and only a small number of patients were younger than 30 years (Table 2).

Ocular manifestations were observed in both groups, with a higher frequency in the reaction group (Table 3). Madarosis was noted in 8 (29.6 %) patients with reactions and 5 (11.6 %) patients without reactions. Lagophthalmos, a potentially sight-threatening complication, was seen exclusively in the reaction group (2 cases). Corneal hypoesthesia was recorded in 5 patients with reactions and 4 patients without reaction. Nodular changes such as Koeppe nodules (6 cases) and Busacca nodules (2 cases) occurred only in the reaction group. Iris atrophy was more frequent in the reaction group that is 12 cases and 3 cases in non-reactional group. Cataract was the most common ocular manifestation overall, observed in 36 patients (51.4 %), with a higher burden in the reaction

Table 1: Demographic data of study participants.

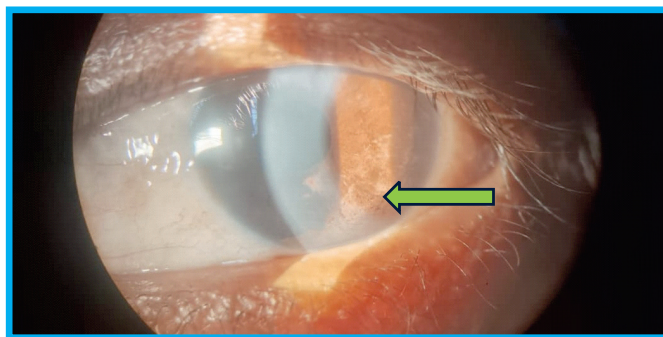
Variable	Category	Number	Percentage
Gender	Male	44	62.86%
	Female	26	37.14%
Treatment Status	On MDT	28	40.00%
	Post-MDT (RFT)	42	60.00%
Reaction Status	With Reaction	27	38.57%
	Without Reaction	43	61.43%

Table 2 : Age distribution of study participants.

Age Group (years)	Number of Patients	Percentage
18–30	6	8.6%
31–45	14	20.0%
46–60	28	40.0%
61–75	18	25.7%
>75	4	5.7%

Table 3 : Ocular manifestations in patients with and without lepra reactions.

Ocular Manifestation	With Reaction (n=27)	Without Reaction (n=43)	p-value
Madarosis	8 (29.6%)	5 (11.6%)	0.078
Lagophthalmos	2 (7.4%)	0 (0%)	0.142
Corneal hypoesthesia	5 (18.5%)	4 (9.3%)	0.288
Refractive error	8 (29.6%)	9 (20.9%)	0.398
Koeppe nodules	6 (22.2%)	0 (0%)	0.004**
Busacca nodules	2 (7.4%)	0 (0%)	0.142
Iris atrophy	12 (44.4%)	3 (7.0%)	0.0002**
Iris pigmentation	1 (3.7%)	1 (2.3%)	0.76
Festooned pupil	1 (3.7%)	0 (0%)	0.42
Chalky deposits	3 (11.1%)	1 (2.3%)	0.14
Keratic precipitates	1 (3.7%)	0 (0%)	0.42
Band-shaped keratopathy	1 (3.7%)	0 (0%)	0.42
High IOP	2 (7.4%)	2 (4.7%)	0.69
Retinopathy	3 (11.1%)	2 (4.7%)	0.36
Cataract	21 (77.8%)	15 (34.9%)	0.0008**
Blindness	2 (7.4%)	0 (0%)	0.14

**Fig. 1 : Iris atrophic patch.**

group (21 cases). Blindness was recorded in 2 patients, both belonging to the reaction group. Other anterior segment changes included chalky white deposits, band-shaped keratopathy, keratic precipitates, iris pigmentation, and festooned

pupil, predominantly in patients with a history of reactions.

Different types of ocular morbidities are summarised in Table 4 and depicted in Figs. 1-8. When analysed according to the Ridley-Jopling

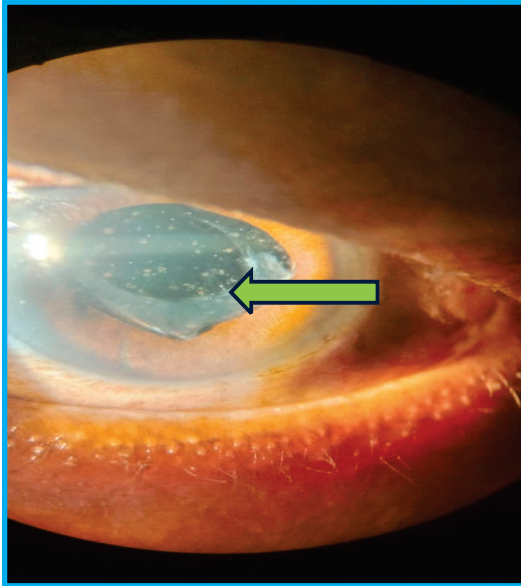


Fig. 2: Iris pigmentation over lens.

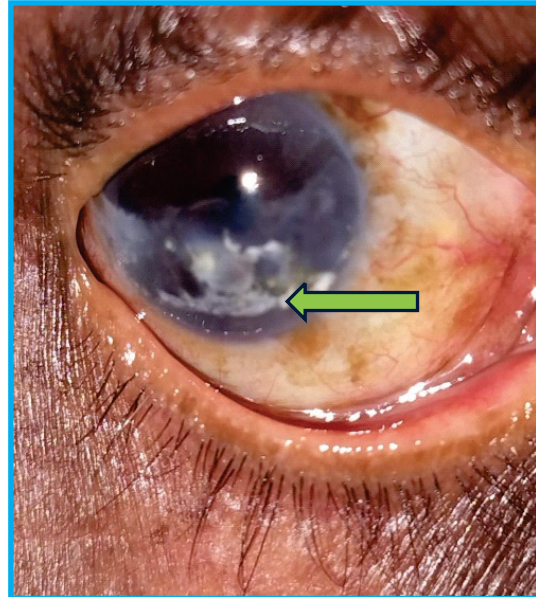


Fig. 3: Keratopathy.

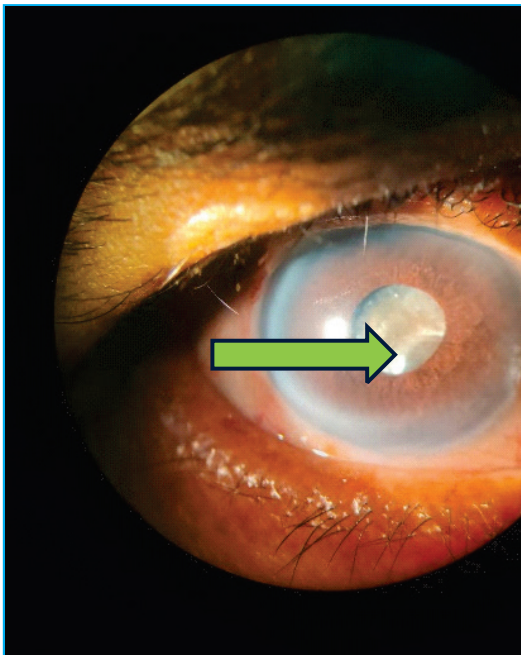


Fig. 4: Mature senile cataract.

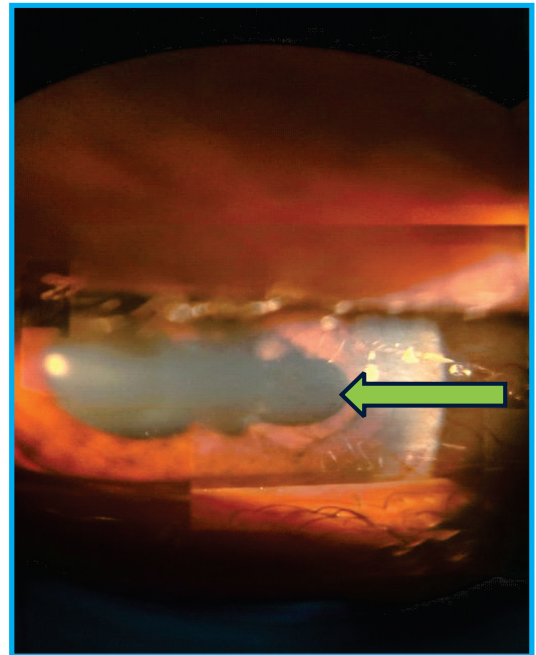


Fig. 5: Festooned pupil with posterior synechiae.

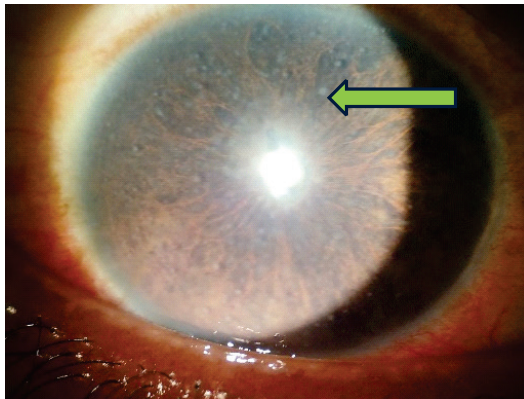


Fig. 6: Busacca nodules.

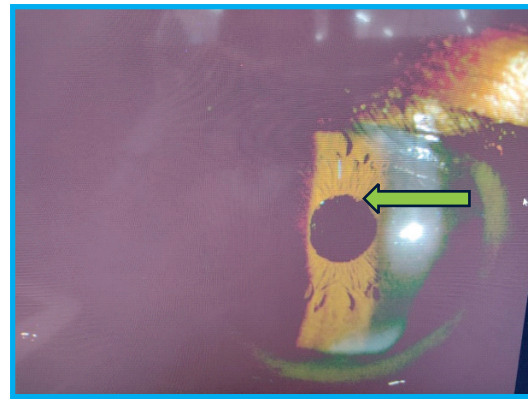


Fig. 7: Koeppe nodules.

Table 4 : Spectrum-wise distribution of ocular manifestations.

Ocular Manifestation	TT (n=17)	BT (n=13)	BL (n=18)	LL (n=22)	p-value
Madarosis	0 (0%)	0 (0%)	4 (22.2%)	9 (40.9%)	0.0026**
Lagophthalmos	0 (0%)	2 (15.4%)	0 (0%)	0 (0%)	0.093
Corneal hypoesthesia	1 (5.9%)	2 (15.4%)	2 (11.1%)	4 (18.2%)	0.701
Refractive error	2 (11.8%)	4 (30.8%)	5 (27.8%)	6 (27.3%)	0.578
Koeppe nodules	0 (0%)	0 (0%)	3 (16.7%)	3 (13.6%)	0.169
Busacca nodules	0 (0%)	0 (0%)	1 (5.6%)	1 (4.5%)	0.664
Iris atrophy	0 (0%)	2 (15.4%)	4 (22.2%)	9 (40.9%)	0.0196**
Iris pigmentation	0 (0%)	1 (7.7%)	0 (0%)	1 (4.5%)	0.503
Festooned pupil	0 (0%)	0 (0%)	1 (5.6%)	0 (0%)	0.402
Chalky deposits	0 (0%)	1 (7.7%)	1 (5.6%)	2 (9.1%)	0.661
Keratic precipitates	0 (0%)	0 (0%)	1 (5.6%)	0 (0%)	0.402
Band-shaped keratopathy	0 (0%)	0 (0%)	0 (0%)	1 (4.5%)	0.529
High IOP	0 (0%)	1 (7.7%)	1 (5.6%)	2 (9.1%)	0.661
Retinopathy	0 (0%)	1 (7.7%)	2 (11.1%)	2 (9.1%)	0.601
Cataract	3 (17.6%)	9 (69.2%)	13 (72.2%)	11 (50.0%)	0.0057**
Blindness	0 (0%)	0 (0%)	0 (0%)	2 (9.1%)	0.213

spectrum, ocular changes were seen across all clinical types. Lagophthalmos was more frequently encountered in the tuberculoid and borderline tuberculoid groups, while corneal

hypoesthesia, iris atrophy, and cataract were more prevalent in lepromatous leprosy. Nodular lesions such as Busacca nodules (Fig. 6) and Koeppe (Fig. 7) were confined to the lepromatous

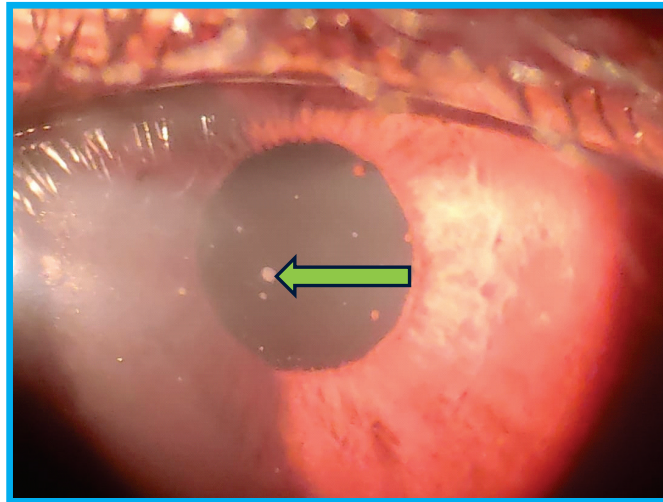


Fig. 8: Chalky white deposits.

and borderline lepromatous spectrum. Exposure keratitis was noted mainly in tuberculoid patients with lagophthalmos. Significant associations ($p < 0.05$) included Koeppe nodules (Fig.7), iris atrophy (Fig. 1) and cataract (Fig. 4), and were significantly more common in patients with lepra reactions (Table 4).

Discussion

The present cross-sectional study evaluated 70 patients with Hansen's disease, comparing the distribution of ocular findings both across the clinical spectrum and between reactional and non-reactional groups — a dual analytical approach rarely addressed in earlier literature. Sight-threatening complications such as lagophthalmos, corneal hypoesthesia, uveitis sequelae and cataract were more frequent among patients with lepra reactions. The occurrence of cataract in these patients may be multifactorial, including direct effects of leprosy, lepra reactions, steroid therapy used for reactions, and age-related changes, making it difficult to attribute to a single etiology. Madarosis, iris atrophy,

nodular uveitis (Koeppe and Busacca nodules), and cataract were markedly higher in patients with reactions. These findings are consistent with Katoch et al (2025) and Mahajan et al (2021).

When analysed across the Ridley–Jopling classification, ocular lesions were seen across all clinical types, though their nature varied with polarity. Narendra et al (2023) observed that ocular changes were significantly higher among lepromatous patients, attributing this to the prolonged disease course and higher bacterial load. Lagophthalmos and exposure keratitis were more dominant in tuberculoid (TT) and borderline tuberculoid (BT) forms, likely due to localized involvement of facial and trigeminal nerves similar to findings of Kusagur et al (2013). Conversely, chronic inflammatory lesions such as iris atrophy and Koeppe/Busacca nodules were more frequent in lepromatous (LL/BL) disease — similar to findings by Narendra et al (2023) and Katoch et al (2025). Ocular complications are known to be more frequent in multibacillary forms of leprosy (Courtright et al 2002). There

could be unusual ocular presentation of histoid leprosy (Patelet al 2021). Optic nerve involvement has been reported in a BL case during treatment (Prabha et al 2013).

The prevalence of cataract (51.4%) in our study approximates 48% reported by Daniel et al (2006), 54% by Narendra et al (2023), and 25% by Reddy & Reddy (2019) suggesting persistent lens involvement beyond MDT treatment. Madarosis (18.6%) and corneal hypoesthesia (12.9%) rates were similar to those reported by Reddy & Reddy (2019) and Kusagur et al (2013). Koeppe and Busacca nodules were observed exclusively in patients with reactions in our cohort.

Most earlier publications focused solely on ocular manifestation patterns across the disease spectrum (tuberculoid vs lepromatous). Few studies evaluated the additional role of lepra reactions as an independent determinant of ocular morbidity. In contrast, our study provides evidence that ocular complications are not only spectrum-dependent but also closely linked to reactional episodes, highlighting the additive role of immune-mediated damage. The current study bridges this gap by analysing both spectrum polarity and reactional status within a single cohort. Eye involvement in leprosy continues to be an important issue even in recent years (Rather et al 2022). Focusing on preventive aspects including eye, hands and feet has been emphasized by Reyila et al (2019). This dual-comparison model reveals that while spectrum polarity determines the type of ocular involvement, the severity and sight-threatening potential of lesions are strongly influenced by the presence of lepra reactions. Such an approach offers a more comprehensive understanding of ocular risk stratification in Hansen's disease. Ophthalmologists have an important role to play in management of leprosy (Ahluwalia et al 2022).

The presence of sight-threatening lesions such as lagophthalmos, corneal hypoesthesia, and uveitis underscores the need for integrated dermatology–ophthalmology screening at diagnosis, during reactions, and in follow-up.

Limitations

Being a single-centre study with a modest sample size and absence of bacteriological index correlation, the findings may not be generalisable. The age-related ocular changes could be associated with the leprosy induced ocular changes which could not be excluded.

Conclusions

Ocular involvement in Hansen's disease remains an important cause of preventable blindness, even in the post-MDT era. Iris atrophy, uveitis and cataract were notably higher in reactional group, emphasising that immunological activity during reactions contributes substantially to visual morbidity. When analysed across the disease spectrum, tuberculoid forms showed more nerve-related complications such as lagophthalmos and exposure keratitis, whereas lepromatous forms exhibited chronic inflammatory lesions including nodular uveitis and iris atrophy — highlighting that both disease polarity and reactional episodes play complementary roles in determining the clinical presentation. The results strongly advocate for early ophthalmic screening and timely intervention, especially in patients presenting with type 1 or type 2 lepra reactions. Prompt recognition and management of reactional episodes can prevent progression to sight-threatening complications such as corneal ulceration, cataract or blindness. Regular follow-up of patients even after completion of MDT is essential, as ocular changes may persist or newly emerge due to residual nerve dysfunction and immune sequelae.

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