Shedding Light on Laser-Induced Maculopathy: A Systematic Review

Doctor Charles O'Donovan MBChB MSc PGCert FRCOphth
Ophthalmology ST5 Registrar, Moorfields, Croydon, London.

Moorfields Eye Hospital NHS Foundation Trust

BACKGROUND

Laser-related maculopathy is an increasingly recognised retinal condition resulting from intentional or inadvertent exposure to laser radiation.

This condition encompasses a broad spectrum of retinal injuries, ranging from transient photoreceptor disruption to irreversible structural damage and vision loss. The nature and severity of injury are influenced by factors such as laser wavelength, power output, exposure duration, and proximity.
Despite growing clinical awareness, guidance on diagnosis and management remains inconsistent.

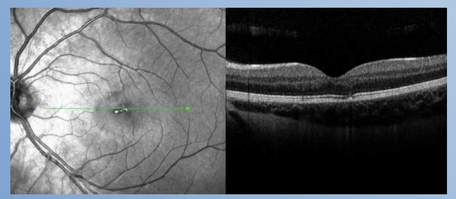


Figure 1: OCT of the left macula showing parafoveal ellipsoid zone disruption

AIM

This systematic review aims to synthesise the current evidence on the aetiology, clinical manifestations, diagnostic modalities, therapeutic approaches, and prognostic indicators associated with laser-induced maculopathy.

METHODS

- A systematic literature search was conducted across PubMed, Embase, Scopus, and Web of Science for studies published between 2000 and 2023.
- Search terms included: *"laser maculopathy," "laser-induced retinal injury," "retinal burns,"* and *"retinal phototoxicity"*
- Study selection followed the PRISMA 2020 guidelines, with data extraction and synthesis conducted accordingly.

PubMed Scopus® Embase®

Inclusion Criteria	Exclusion Criteria
Original research articles	Non-English publications
Case series	Studies without quantitative outcomes
Systematic reviews and clinical guidelines	Studies not involving macular injury
Focus specifically on laser-related macular injuries	

RESULTS

A total of **68 studies** met the inclusion criteria:
- **30** case reports
- **20** observational studies
- **18** experimental investigations

AETIOLOGY & RISK FACTORS

Most commonly linked to:
- High-powered laser pointers
- Cosmetic and medical lasers
- Industrial laser equipment

Risk factors included:
- Direct retinal exposure
- Inappropriate use
- Absence of protective eyewear
- Unsupervised recreational use

Devices emitting >**150 mW**, especially at **shorter wavelengths**, posed the **highest risk** of permanent damage.

DIAGNOSTIC MODALITIES

1. OCT: Most commonly used; showed outer retinal disruption (ellipsoid zone, RPE)
2. FAF & FA: additional insights into lesion extent and metabolic stress - window defects

CLINICAL PRESENTATION

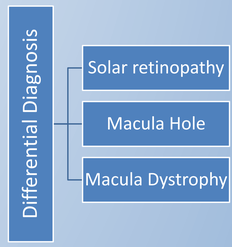
Symptoms	Examination findings
Central scotomas	Focal retinal whitening
Metamorphopsia	Subretinal haemorrhage
Reduced visual acuity	Macular oedema

TREATMENT

- **No standardised protocol**
- Most acute cases managed conservatively by observation &/or corticosteroids
- Emerging therapies (e.g. neuroprotective agents, laser tissue modulation) show promise but lack robust clinical validation

PROGNOSIS

Majority experienced **partial to full visual recovery within months**
Poorer outcomes associated with:
- Higher initial laser intensity
- Delayed treatment
- Greater autofluorescence intensity
- Worse presenting visual acuity



CONCLUSION

- Laser-related maculopathy is an emerging public health concern with potentially severe visual consequences.
- While advances in imaging, particularly OCT, have improved diagnosis, evidence-based treatment remains limited.
- Current management is largely supportive, and there is a clear need for standardised protocols and clinical validation of novel therapies.
- Prevention through public education, stricter regulation, and protective measures is essential to mitigate the growing risk posed by high-powered laser exposure.
- **Like any other public health concern, it requires a multifactorial approach.**

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