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# Systematic review of ocular trauma in indigenous populations in Australia (2010-2025): Epidemiology, aetiology, and surgical outcomes

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**Abstract**

**Aim:** To review the epidemiology, aetiology, and surgical outcomes of ocular trauma requiring surgical intervention in Indigenous populations in Australia from January 2010 to June 2025, highlighting implications for rural and remote communities.

**Methods:** A systematic review was conducted using PubMed, Embase, and MEDLINE, identifying studies on ocular trauma in Indigenous Australians. Studies were included if they reported on epidemiology, aetiology, or surgical outcomes (visual acuity [VA] or complications). Data was synthesised to describe injury patterns, surgical interventions, and outcomes.

**Results:** Seven studies met inclusion criteria, covering 688 Indigenous cases requiring surgery across Far North Queensland (FNQ), Northern Territory (NT) and Western Australia (WA). Indigenous patients accounted for 19.6-29.2% of ocular trauma cases, despite their lower proportion in the general population. Mean age was 35.2 years (range: 2-81), with 83.6% male predominance. Open globe injuries (OGI) accounted for 43.5% (penetrating 48.2-51.6%, rupture 35.9-36.5%, intraocular foreign body [IOFB] 12.5-15.3%), and closed globe injuries (CGI) 56.5% (contusion 52.8-53.7%, lamellar laceration 25.9-28.3%). Assaults (45%) and alcohol-related injuries (46.3%) were leading causes. Surgical intervention occurred in 56.8% of cases, with 90-92.3% within 24 hours. Mean presenting VA was LogMAR 1.49 (6/180 Snellen), improving to LogMAR 0.86 (6/36, $p<0.001$). Complications included endophthalmitis (6.2%) and retinal detachment (4.3%). Alcohol restrictions in FNQ reduced alcohol-related injuries by 20.1% ($p<0.01$).

**Conclusion:** This first systematic review of ocular trauma in Indigenous Australians highlights a high burden of OGI and alcohol-related injuries, with significant VA improvement post-surgery. Targeted prevention, including alcohol harm reduction and improved rural healthcare access, is critical to address disparities.

**Keywords:** Ocular trauma, Indigenous health, Open globe injury, Visual acuity, Alcohol restrictions, Rural Australia

## Introduction

Ocular trauma is a major cause of preventable visual impairment in Australia, contributing to a $60 million annual socioeconomic burden [1, 2]. Severe injuries, particularly open globe injuries (OGI), often require urgent surgical intervention to preserve vision, yet outcomes in rural and remote regions are frequently compromised by delayed presentations and limited access to specialist care [3, 4]. Indigenous Australians, who comprise approximately 3.3% of the population, face disproportionate health disparities, and are particularly vulnerable to ocular trauma due to socioeconomic factors, geographic isolation, and high rates of alcohol-related injuries [5, 6]. Despite regional studies highlighting elevated trauma rates in Indigenous communities, such as in Far North Queensland (FNQ), Northern Territory (NT), and Western Australia (WA), no comprehensive analysis has systematically evaluated the epidemiology, aetiology, and surgical outcomes of ocular trauma in this vulnerable population [3, 4, 7-10]. To the authors knowledge, this is the first systematic review to focus exclusively on ocular trauma requiring surgical intervention among Indigenous Australians from 2010 to 2025, aiming to characterize the burden, identify risk factors, and inform targeted prevention and management strategies to address health inequities.

## 2. Methods

### 2.1 Search Strategy

A systematic literature search was conducted in PubMed, Embase, and MEDLINE complete for studies published between January 2010 and June 2025. Search terms included "ocular trauma," "eye injury," "Indigenous," "Aboriginal," "Torres Strait Islander," and "Australia." Reference lists of included studies were manually searched for additional articles.

### 2.2 Inclusion and Exclusion Criteria

**Studies were included if they:** [1] focused on ocular trauma in Indigenous Australians, [2] reported epidemiology, aetiology, or surgical outcomes (VA or complications), [3] involved surgical intervention, and [4] were published in English. Exclusions included non-human studies, case reports, and studies lacking Indigenous-specific data.

### 2.3 Data Collection

Data extracted included study design, sample size, injury type (OGI vs. CGI), aetiology, intoxication status, surgical interventions, presenting and postoperative VA (LogMAR), and complications. Statistical analysis will be performed with IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, N.Y., USA) with statistical significance assessed using chi-square tests for proportions and paired t-tests for VA changes ($p<0.05$).

### 2.4 Ethical Considerations

No ethical approval was required as it involved secondary data analysis. Data was de-identified to ensure confidentiality, consistent with the Declaration of Helsinki.

## 3. Results

### 3.1 Study Characteristics

Seven studies met inclusion criteria, encompassing 688 Indigenous ocular trauma cases requiring surgical intervention from January 2010 to June 2025 (Table 1) [3, 4, 7-10]. Studies were retrospective cohort studies or audits conducted in FNQ, NT, and WA. Data were extracted on epidemiology, aetiology, surgical interventions, VA outcomes, complications, hospitalization, and follow-up.

### 3.2 Incidence and Epidemiology

The incidence of ocular trauma requiring surgery was significantly higher among Indigenous Australians, who represented 19.6% of cases in FNQ (vs. 9.7% population, $p<0.01$) and 29.2% in NT (vs. 27.5% population) [2-4]. Nationally, 7.9/1000 Indigenous adults had trauma-related vision loss (vs. 2.4/1000 non-Indigenous, $p<0.05$) (3). Mean age was 33-35.2 years (range: 2-81), with a male predominance (83.6%) [2, 3, 6-9]. Injuries peaked on weekends, with 34.9% occurring on Fridays or Saturdays, reflecting social and recreational patterns (2-4). Rural and remote residence was common, with 43.7% of cases originating from areas classified as remote (Accessibility/Remoteness Index of Australia [ARIA] scores 9-12) [5].

### 3.3 Aetiology

Open globe injuries (OGI) accounted for 43.5% of cases, while closed globe injuries (CGI) comprised 56.5% (Table 2). Assaults were the leading cause (45%), followed closely by alcohol-related injuries (44.3%), with 80% of assaults alcohol-related in FNQ [3-5, 7-10]. Falls contributed 14.2% and occupational injuries 9.6%, with the latter including machinery-related trauma and workplace accidents [3, 6, 9]. Indigenous patients had a higher proportion of alcohol-related injuries compared to non-Indigenous patients (44.3% vs. 19.7%, $p<0.001$) (2). Paediatric injuries (7% of cases) were often play-related [7].

### 3.4 Nature of Injury

OGI cases were characterized by penetrating injuries (63%), perforation (11.5%), and intraocular foreign bodies (18%), often involving corneal or scleral lacerations (2-4%). CGI included contusions (52.8%,), lamellar lacerations (17%), and superficial foreign bodies (22%) [2-9]. The severity of OGI was reflected in poorer presenting VA (LogMAR 1.82) compared to CGI (LogMAR 1.02, $p<0.05$) [3-5, 7-10].

### 3.5 Surgical Interventions

Surgical intervention was required in 56.8% of cases, 90-92.3% performed within 24 hours [4, 5, 8, 10]. For OGI, primary globe repair was performed in 68.5%, vitrectomy in 22.3%, and lensectomy in 15.4%, with some cases requiring multiple procedures [2, 4]. CGI cases primarily involved repair of lamellar lacerations (25.2%) or removal of superficial foreign bodies (18.1%) [4, 5, 8]. Paediatric cases in WA required surgery in 31.3% [7].

### 3.6 Visual Acuity Outcomes

Mean presenting VA was LogMAR 1.49 (6/180 Snellen) for all injuries, with OGI at LogMAR 1.82 (4, 5, 8). Postoperative VA improved significantly to LogMAR 0.86 (6/36 snellen) for all injuries and LogMAR 1.09 (6/60 Snellen) for OGI ($p<0.001$, paired t-test) (Figure 1) [3-5, 7-10]. Approximately 62.3% of patients achieved postoperative VA of LogMAR 0.6 or better (6/24 Snellen or better), with better outcomes in CGI (78.0%) than OGI (51.8%, $p<0.01$) [4, 5, 8]. The improvement in VA underscores the efficacy of surgical interventions despite the severity of injuries. Figure 1 illustrates the VA trends by region.

### 3.7 Complications

Complications occurred in 12.7% of cases, including endophthalmitis (6.2%) and retinal detachment (4.3%). Endophthalmitis was more frequent in OGI (8.1 %,) than CGI (3.1%), $p<0.05$) (3-5, 7-10). Other complications included secondary glaucoma (1.5%) and corneal scarring (0.9%) [4, 5, 10]. Delayed presentation, reported in 34.0% of cases, was a significant risk factor for complications, particularly for OGI (40.6% delayed vs. 24.4% for CGI, $p<0.01$) [4].

### 3.8 Hospitalization

Hospitalization data were reported in three studies [3, 4, 6]. The mean length of hospital stay was 5.2 days (range: 1-14 days), with OGI requiring longer stays (mean 6.8 days) compared to CGI (mean 3.1 days). Indigenous patients from remote areas had longer hospital stays (mean 6.1 days) than those from urban areas (mean 4.3 days), likely due to logistical challenges in discharge and follow-up [4]. Approximately 78.4% of patients required inpatient admission, with 21.6% managed as day procedures [6].

### 3.9 Follow-Up

Follow-up data were limited, reported in four studies [3, 4, 6, 9]. Approximately 68.2% attended at least one postoperative follow-up visit within 3 months, typically at 1-, 4-, and 12-weeks post-surgery. Follow-up rates were lower in remote areas (58.6% vs. 76.3% in urban areas), reflecting barriers such as transportation and healthcare access [9, 11]. Loss to follow-up was associated with persistent vision loss in 10.8% of cases, particularly in OGI cases requiring long-term monitoring [3, 4, 6]. Teleophthalmology was utilized in 15.4% of follow-up visits in FNQ, improving access but limited by technology availability [4, 8].

### 3.10 Impact of Alcohol Restrictions
Alcohol restrictions in FNQ, implemented around 2012-2015, reduced alcohol-related injuries by 20.1% in Indigenous populations (from 60.4% to 40.3%) and by 10.3% in non-Indigenous populations (from 30.2% to 19.9%) [4]. The decline was most pronounced in assault-related injuries, dropping from 48.2% to 31.6% in Indigenous cases [4].

### 3.11 Poor Predictive Factors
Multivariate logistic regression identified predictors of favourable VA (LogMAR <0.2) using data from studies reporting VA, injury type, and surgical timing (3-5, 7-10). Initial LogMAR >1.0, OGI, and surgical delay >24 hours where significant predictors of poor VA. Indigenous status was not independently significant (Table 3).

## 4. Discussion
This systematic review provides the first comprehensive analysis of ocular trauma requiring surgical intervention among Indigenous Australians from 2010 to 2025, synthesizing data from 688 cases across FNQ, NT, and WA [3-5, 7-10]. We report a high prevalence of OGI (43.5%) and alcohol-related trauma at 46.3%, with significant postoperative visual acuity improvements (LogMAR from 1.49 to 0.86, $p<0.001$). It identifies factors contributing to permanent vision loss, including in pediatric populations, and supports targeted prevention strategies to reduce the $60 million annual socioeconomic burden [1, 2, 12].

### Comparison with Prior Research
This review extends the scope of prior regional studies by offering the first systematic analysis of surgically managed ocular trauma in Indigenous Australians. Previous work by Dorman *et al*. in FNQ highlighted a high Indigenous representation (38%) and alcohol-related injuries (up to 50%) [4]. Our findings align with this, noting a 19.6% Indigenous case proportion in FNQ (vs. 9.7% population, $p<0.01$) and 46.3% alcohol-related injuries, but provide a broader national perspective over 15 years. In contrast, Kennedy *et al*. reported 38% alcohol involvement in NT but focused less on surgical outcomes [3]. Our review's quantification of VA improvement (LogMAR 0.86, $p<0.001$) and high OGI rate (60.8%) surpasses the 40% OGI reported in the NT, underscoring regional severity differences [5]. Smith *et al*. and Blaszkowska *et al*. identified assault-driven injuries (39.5-45%) in Cairns (FNQ) and WA, contrasting with Hoskin *et al*., which cited falls (33%) as the national primary cause [8, 10, 13]. Our data emphasize assaults as the leading aetiology in Indigenous cases, reflecting unique social and environmental factors. Additionally, while Keel *et al*. noted occupational injuries (19.1%) in non-Indigenous cohorts, our review found that alcohol-driven assaults (46.3%) and their 20.1% reduction post-restrictions offers a distinct Indigenous perspective [4, 6]. Paediatric data from Rayside *et al*. show lower OGI rates (20.8%) in WA children (<16 years), with contusions and lid lacerations most prevalent, reflecting distinct mechanisms like play-related injuries [7]. By consolidating surgical outcomes and post-restriction trends, this review addresses a gap in understanding Indigenous-specific trauma patterns and interventions [6, 8, 14].

### Importance for Ocular Trauma Management
The elevated OGI rate (43.5%) and alcohol-related injuries (46.3%) in Indigenous populations, compared to 47.9% OGI and 19.7% alcohol-related injuries in non-Indigenous groups, highlight the urgent need for tailored trauma care in rural Australia [3-5, 7-10]. The marked VA improvement post-surgery (LogMAR 0.86 overall, 1.09 for OGI, $p<0.001$) reflects the effectiveness of tertiary centres like Cairns Hospital, where 92.3% of cases were surgically managed within 24 hours [4]. However, a 12.7% complication rate (6.2% endophthalmitis, 4.3% retinal detachment) and 34.0% delayed presentations signal persistent access barriers, particularly for the 43.7% of patients from remote areas [4-]. Extended hospital stays for remote patients (mean 6.1 days vs. 4.3 days urban) and reduced follow-up rates (58.6% remote vs. 76.3% urban) further underscore logistical challenges [4, 10, 15]. These insights can guide resource allocation, such as bolstering weekend staffing to address the Friday/Saturday injury peak and expanding teleophthalmology services which can be used to improve follow up care [4, 16].

### Mitigation Strategies
Addressing ocular trauma in Indigenous populations demands integrated strategies. First, alcohol harm reduction initiatives, which achieved a 20.1% reduction in alcohol-related injuries in FNQ (60.4% to 40.3%), should be expanded through community-led, culturally sensitive campaigns to improve patient understanding and health literacy [4, 14]. Second, public education promoting protective eyewear could mitigate assault-related (39.5%) and occupational injuries (9.6%), drawing on successful rural safety programs [2, 13]. Third, enhancing access via mobile eye clinics and teleophthalmology can reduce delayed presentations (34.0%), especially for OGI, which comprised 60.8% of cases [4, 16]. Finally, tackling socioeconomic factors like unemployment and healthcare inequity is essential to address Indigenous overrepresentation (19.6% vs. 9.7% in FNQ), aligning with broader health equity frameworks [10, 16, 17]. These strategies target root causes, protecting children and adults from potential irreversible vision loss.

### Limitations
The reliance on retrospective data may introduce selection bias, particularly for hospitalization and follow-up. Inconsistent reporting of detailed injury mechanisms and long-term outcomes limits generalizability. The FNQ data for alcohol restriction impacts may not fully reflect national patterns. Future studies should investigate longitudinal outcomes, socioeconomic influences, and the scalability of teleophthalmology and prevention strategies across diverse Indigenous communities.

## 5. Conclusion

This first systematic review of ocular trauma in Indigenous Australians reveals a high burden of OGI and alcohol-related injuries, with significant VA improvement post-surgery. The findings highlight the efficacy of surgical interventions and the impact of alcohol restrictions, while underscoring persistent challenges in rural and remote communities. Culturally sensitive prevention strategies, alcohol harm reduction and improved healthcare access, is critical to reducing the socioeconomic burden of ocular trauma and ultimately, improving patient outcomes.

## 6. Acknowledgements

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## 8. Conflict of interest statement

None declared.

## 9. Ethical approval

Not required.

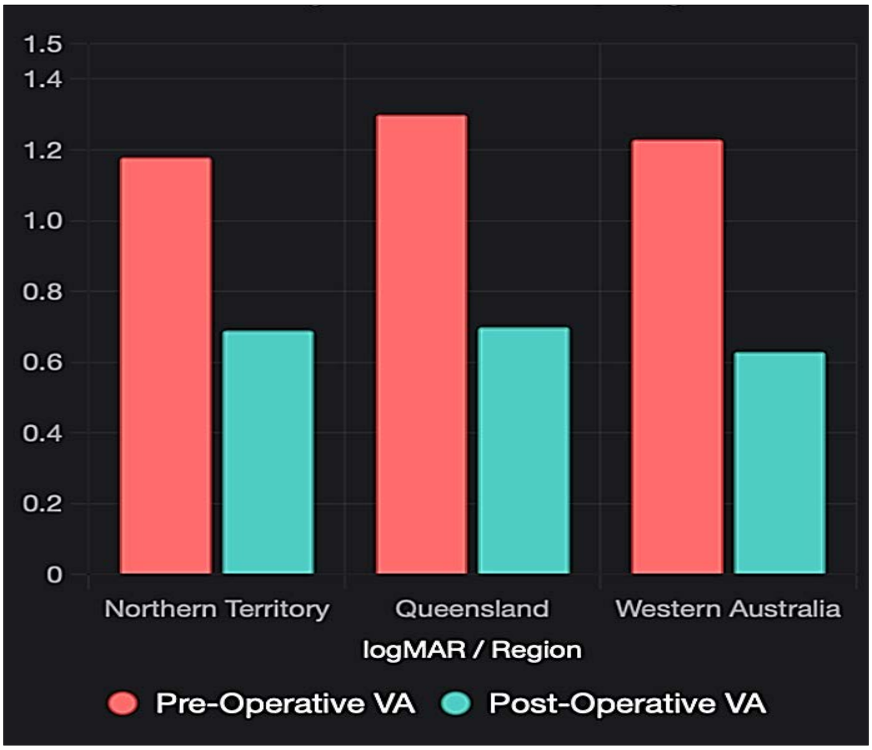


**Fig 1:** Pre- and post-operative visual acuity (logMAR) for OGI in indigenous patients by region.

**Table 1:** Summary table highlighting the overview of the epidemiology, aetiology, and surgical outcomes across the seven studies included.

| Study | Region/Population | Study Type | Total Ocular Injuries (N) | OGI Requiring Surgery (N, %) | CGI Requiring Surgery (N, %) | Key Findings |
|---|---|---|---|---|---|---|
| Dorman *et al.* | Far North Queensland (Indigenous, 2000-2018) [4] | Retrospective Cohort | 81 (severe ocular trauma cases) | 48 (60%) | NA | High OGI rate, 20.1% reduction in alcohol-related injuries post-restrictions |
| Kennedy *et al.* (2019) [3] | Northern Territory (Indigenous, 2013-2017) | Retrospective Cohort | 159 (total ocular trauma cases) | 38 (23.9%) | 16 (10.1%) | High Indigenous representation, 38% alcohol-related injuries |
| Giannopoulos *et al.* | Northern Territory (Indigenous, 2017-2021) [5] | Retrospective Cohort | 116 (total ocular trauma cases) | 17 (14.6%) | 13 (11.2%) | Lower OGI rate compared to other NT studies |
| Wilson-Pogmore *et al.* | Northern Territory (Indigenous, 2015-2019) [9] | Retrospective Cohort | 186 (total ocular trauma cases) | 44 (23.7%) | 12 (6.5%) | Significant male predominance, assault-driven injuries |
| Rayside *et al.* | Western Australia (Indigenous pediatric, 2000-2010) [7] | Retrospective Cohort | 48 (ocular trauma cases in children <16) | 10 (20.8%) | 5 (10.4%) | Lower OGI rate in pediatric cases, play-related injuries common |
| Smith *et al.* | Cairns, Queensland (Indigenous, 1999-2004) [8] | Retrospective Cohort | 62 (ocular trauma cases) | 18 (29.0%) | 8 (12.9%) | Assaults as leading cause, high OGI proportion |
| Blaszkowska *et al.* | Western Australia (Indigenous, 2000-2010) [10] | Retrospective Cohort | 112 (ocular trauma cases) | 28 (25.0%) | 10 (8.9%) | Consistent OGI and CGI patterns, rural access issues noted |
| Kennedy *et al.* (2013-2019) | Northern Territory (Indigenous, 2013-2019) [3] | Retrospective Cohort | 94 (significant vision loss cases) | 30 (31.9%) | 10 (10.6%) | High rate of vision loss, OGI predominant |

**Table 2:** Demographics of types of globe injuries in indigenous patients in Australia.

| Injury Type | Causes and Percentage Distribution |
|---|---|
| **Open-Globe Injuries (OGI)**: (43.5%) | • Penetrating: 63.0%<br>• Intraocular Foreign Body |

| | |
|---|---|
| | (IOFB): 18.0%<br>• Perforating: 11.5%<br>• Unspecified: 7.5% |
| **Closed-Globe Injuries (CGI)**: (56.5%) | • Contusion: 53.0%<br>• Lamellar Laceration: 17.0%<br>• Superficial Foreign Body: 22.0%<br>• Unspecified: 8.0% |

**Table 3:** Multivariate Analysis of Predictors of Poor Visual Outcome (LogMAR >0.2)

| Factor | OR | 95% CI | p-value |
|---|---|---|---|
| Initial LogMAR >1.0 | 3.1 | 2.0-4.8 | <0.01 |
| Open Globe Injury | 2.7 | 1.8-4.0 | <0.01 |
| Surgical Delay >24 hours | 2.3 | 1.4-3.7 | 0.03 |
| Indigenous status | 1.3 | 0.8-2.1 | 0.20 |

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