Assessment of Macular Involvement in Patients Presenting with Blunt Ocular Trauma in A Tertiary Eye Care Hospital

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ABSTRACT

Background: Blunt ocular trauma is a major cause of visual impairment worldwide, particularly among young individuals. Macular involvement following trauma plays a crucial role in determining visual prognosis. Optical Coherence Tomography (OCT) enables early detection of subtle microstructural changes in the macula that may be missed clinically.

Material and Methods: This hospital-based cross-sectional study was conducted from October 2018 to September 2019 and included 51 patients above 10 years of age with blunt ocular trauma. Patients with penetrating ocular injuries or pre-existing ocular pathologies were excluded. Detailed ocular examination, including slit-lamp evaluation, fundus examination, intraocular pressure measurement, and OCT imaging, was performed. Radiological imaging (X-ray and CT scan) was done in cases with suspected orbital fractures. Data were analyzed using Microsoft Excel 2007 and expressed as percentages.

Results: Of the 51 patients, 75% were male and 37.25% were aged 11–20 years. The left eye was more commonly affected (60.78%) than the right eye (37.25%). Sports-related trauma, particularly from balls, was the leading cause (23.53%). The most frequently involved anterior structure was the pupil (41.17%), with traumatic mydriasis (21.56%) and cataract (17.64%) as the predominant anterior segment manifestations. Retinal detachment (11.76%) was the most common posterior segment finding. OCT revealed macular changes including Berlin's edema, lamellar macular hole, macular edema, and macular scarring (each 3.92%).

Conclusion: Blunt ocular trauma predominantly affects young males and is commonly sports-related. The extent of ocular damage varies, with pupil involvement and retinal detachment being frequent findings. OCT plays a vital role in identifying macular microstructural changes and should be integrated into routine evaluation for accurate diagnosis and prognosis.

Keywords: Blunt ocular trauma, Macular involvement, Optical coherence tomography, Retinal detachment, Traumatic mydriasis

INTRODUCTION

Ocular trauma remains a significant cause of preventable blindness and visual impairment worldwide.[1] It is estimated that nearly 2.4 million ocular injuries occur annually, with blunt ocular trauma representing a major proportion of these cases.[2] Such injuries can affect any structure of the eye, ranging from the adnexa to the posterior segment, and may result in temporary or permanent visual loss.[3] The socioeconomic impact is considerable, particularly as these injuries are most common in younger, active populations. Blunt ocular trauma is typically caused by direct impact with objects such as balls, fists, sticks, stones, or by accidents involving machinery, road traffic collisions, or agricultural tools.[4]

The pathophysiology involves direct impact forces, compression and decompression waves, as well as coup and contre-coup mechanisms, which collectively contribute to a wide spectrum of ocular damage.[5] While anterior segment manifestations such as traumatic mydriasis, hyphema, and cataract are well recognized, posterior segment injuries including retinal detachment, vitreous hemorrhage, optic nerve damage, and choroidal rupture can pose a serious threat to vision.[6] Macular involvement following blunt trauma is of particular concern because of its decisive role in determining visual outcome.[7]

Subtle macular alterations may be missed on clinical examination, but modern imaging modalities, especially Optical Coherence Tomography (OCT), have revolutionized the ability to detect microstructural changes. OCT allows for non-invasive, reproducible, cross-sectional imaging of the retina, thereby improving diagnostic accuracy and aiding in prognostication.[8] Findings such as commotio retinae, macular holes, cystoid macular edema, or foveal thinning can be identified more reliably with OCT, underscoring its clinical value. Previous studies from India and abroad have described the epidemiology and spectrum of blunt ocular trauma, reporting a predominance in young males and a high incidence of sports- and occupation-related injuries.[9] However, data specifically addressing macular involvement and its detailed OCT-based characterization remain limited in the Indian context.

MATERIALS AND METHODS

This was a hospital-based cross-sectional observational study conducted at a tertiary eye care center from October 2018 to September 2019. A total of 51 patients who sustained blunt ocular trauma and presented to the outpatient department or emergency were included. Patients above 10 years of age with a history of blunt ocular trauma were eligible, while those with penetrating injuries or pre-existing ocular pathologies were excluded.

All patients underwent detailed history taking, including mode of injury, presenting complaints, and relevant past ocular or systemic history. A comprehensive ocular examination was performed in each case. External eye assessment was carried out using torchlight, and visual acuity was recorded with Snellen's chart for distance and near vision. Intraocular pressure was measured using a non-contact tonometer.

Slit-lamp biomicroscopy was performed to evaluate the anterior segment, while indirect ophthalmoscopy was employed for posterior segment assessment. Optical Coherence Tomography (OCT) was carried out in all patients with clear media to detect macular involvement and microstructural changes. Additional investigations such as diplopia charting, orbital X-ray (anteroposterior and lateral views), and orbital computed tomography (CT scan) were performed in cases with suspected orbital wall fractures or peri-orbital trauma. The affected eye was categorized as right eye, left eye, or both eyes, and visual acuity was classified according to WHO criteria.

Data on occupation, cause of trauma, and specific ocular structures involved were recorded systematically. The findings were entered in Microsoft Excel 2007, and results were expressed as percentages and ratios for analysis.

RESULTS

A total of 51 patients with blunt ocular trauma were included in the study. The majority of patients were male (75%), while females accounted for 25%. The most commonly affected age group was 11–20 years, comprising 37.25% of cases, followed by the 21–30 years and 31–40 years groups (19.61% each). The least affected age groups were 41–70 years, each contributing 7.84% of cases. In terms of laterality, monocular involvement was more frequent. The left eye was affected in 60.78% of cases, the right eye in 37.25%, while bilateral trauma was seen in 1.96% of patients. Occupational distribution revealed that students formed the largest group (41.18%), followed by farmers (17.65%) and housewives (11.76%). Other occupations such as businessmen, workers, teachers, and office staff contributed smaller proportions, while retired persons, officers, and vendors were least represented (1.96% each).

Sports-related trauma, particularly due to ball injuries, was the most common cause of blunt ocular trauma, seen in 23.53% of patients. Other causes included trauma by wood stick (17.65%), road traffic accidents and hand injuries (13.73% each), machine-related injuries and other accidents (11.76% each), vegetative material (5.88%), and animal-related trauma (1.96%).

Visual acuity at presentation showed wide variation. In the right eye, 58.82% of patients had visual acuity ranging between 6/6 and 6/18, while 23.53% had vision worse than 3/60 but better than perception of light. Complete loss of perception of light was noted in 3.92% of cases. For the left eye, 41.18% of patients had vision between 6/6 and 6/18, while 35.29% had severe visual impairment with vision below 3/60. One patient (1.96%) had no perception of light in the left eye.

Table 1. Distribution based on anterior ocular structure involved

Ocular Structure	**No. of Patients (%)**
Pupil	21 (41.17)
Eyelid	16 (31.37)
Cornea	15 (29.41)
Conjunctiva	14 (27.45)
Lens	14 (27.45)
Anterior chamber	10 (19.60)
Iris	7 (13.72)
Brow	3 (5.88)
Whole globe	2 (3.92)
Normal (WNL)	7 (13.72)

With regard to clinical manifestations, traumatic mydriasis was the most frequent finding (21.56%), followed by cataract (17.64%), lid tears (11.76%), hyphema (11.76%), corneal edema (11.76%), and relative afferent pupillary defect (11.76%). Other observed conditions included ecchymosis, hypopyon, corneal tear or ulcer, aphakia, pseudophakia, iridodonesis, and a range of miscellaneous anterior segment changes. Posterior segment evaluation showed that retinal detachment was the most common pathology (11.76%), followed by vitreous hemorrhage and vitritis (9.80% each). Optic neuropathy was seen in 5.88% of cases, while optic nerve avulsion, posterior vitreous detachment, and optic atrophy were present in 3.92% each. Less frequent findings included choroidal rupture (1.96%) and retinal tears (1.96%).

OCT evaluation revealed distinct patterns of macular involvement. Berlin's edema, lamellar macular hole, macular edema, and macular scarring were the most frequent changes, each observed in 3.92% of cases. Less common findings included cystoid macular edema, foveal contour thinning, juxtafoveal pigment scar, macular atrophy, macular detachment, macular detachment with age-related macular degeneration, and retinitis pigmentosa with foveal thinning, each seen in 1.96% of patients. Radiological evaluation of the orbit was normal in the majority of cases (50.98%). However, orbital wall fractures were identified in 7.84% of patients, while isolated frontal sinus fracture and medial wall discontinuity were each observed in 1.96% of cases.

DISCUSSION

Ocular trauma is an important cause of visual morbidity, particularly in young, active populations. In the present study, the most common age group affected was 11–20 years (37.25%), which aligns with previous reports. Pai et al. (2013)[10] found the peak incidence at 10–20 years (28.12%), while Suryaprakash et al. (2018)[11] reported the majority of cases in the 20–29 year group (60%). These findings emphasize the vulnerability of younger age groups to trauma, likely due to greater outdoor activity and sports participation. Gender distribution showed a clear male predominance (75%), consistent with global and regional literature. Suryaprakash et al. (2018)[11] and Singh et al. (2017)[12] similarly documented higher rates in males, with Singh et al. (2017)[12] reporting an M:F ratio of 3.39:1.

The predominance in males is often attributed to greater involvement in outdoor occupations and recreational activities. In our series, monocular trauma was more common than bilateral trauma, with the left eye being more frequently affected (60.78%). This differs from Suryaprakash et al. (2018)[11], who found right eye involvement to be more common (60%). Such variation may reflect the influence of dominant hand use or situational differences in exposure. Sports-related injuries, particularly those caused by balls, were the leading cause of trauma in this study (23.53%). Pai et al. (2013)[10] reported road traffic accidents as the most common etiology (28.12%), while Singh et al. (2017)[12] found agricultural and work-related trauma to be predominant. These differences highlight the role of regional lifestyle and occupation in influencing trauma patterns.

With respect to ocular structures, pupil involvement was most frequent (41.17%) in our study, whereas Pai et al. (2013)[10] reported conjunctival injuries (84.37%) as the leading finding, and Singh et al. (2017)[12] found corneal injuries most common (48.01%). This suggests variability in trauma mechanisms and severity between populations. The most common anterior segment manifestation observed in the present study was traumatic mydriasis (21.56%), followed by cataract (17.64%). In contrast, Pai et al. (2013)[10] reported conjunctival congestion and corneal edema as more common, while Singh et al. (2017)[12] emphasized corneal ulcer and abrasion. Posterior segment manifestations in our study included retinal detachment (11.76%), vitreous hemorrhage (9.80%), and optic neuropathy (5.88%). Suryaprakash et al. (2018)[11] noted a higher frequency of foveal involvement (63.3%), commotio retinae (46.6%), and macular hole (13.3%), while Pai et al. (2013)[10] documented fewer posterior segment lesions, mainly vitreous hemorrhage and commotio retinae. These findings reinforce the importance of detailed posterior segment evaluation following blunt trauma.

OCT was particularly useful in detecting subtle macular changes in this series, including Berlin's edema, lamellar macular holes, and macular scarring, each seen in 3.92% of cases. Suryaprakash et al. (2018)[11] similarly emphasized the role of OCT in detecting foveal and extrafoveal alterations, and Unnikrishnan Nair et al.[13] combined OCT with multifocal ERG to demonstrate both structural and functional impact of blunt trauma. The use of OCT thus provides objective evidence of microstructural alterations, many of which may not be clinically apparent. Overall, the present study supports the findings of earlier Indian studies that blunt ocular trauma is most prevalent in young males, with variable causes depending on regional lifestyle, and that OCT adds significant diagnostic value in evaluating macular involvement.

CONCLUSION

Blunt trauma form a major part of ocular trauma. In our study majority of the patients were Males. The commonest age of presentation was 11-20 years. Trauma by ball was commonest mode of blunt ocular injury. The most commonly involved eye structure was pupil, followed by eyelid. Most Common External and Internal Anterior Segment Manifestation include, Traumatic Mydriasis followed by Cataract. Posterior segment involved include Retinal Detachment, Vitreous Haemorrhage, Vitritis, Optic Neuropathy, Optic Nerve Avulsion, Posterior Vitreous Detachment, Optic Atrophy, Choroidal Rupture and retinal tear. Majority of Macular involvement included, Berlin's Oedema, Lamellar Macular Hole, Macular Oedema, Macular Scarring followed by Cystoid Macular Oedema, Foveal Contour thinning, Juxtafoveal

Pigment Scar, Macular Atrophy, Macular Detachment, Macular Detachment +ARMD and RP with Foveal Thinning. Blunt ocular trauma can cause any extent of damage to ocular structure and the final visual outcome depends on the structures injured. OCT plays a vital role in detecting Macular Microstructure changes, thus OCT can be useful in evaluation and management of blunt ocular trauma.

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