Traumatic Globe Luxation Associated with Orbital Fracture in a Child: A Case Report and Literature Review

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Abstract Orbital fracture associated with traumatic globe luxation is rare, as it generally requires trauma with high energy for this to occur. The present case report focused on a child who had been hit by a motorcycle, leading to a globe luxation of the left eye and fractures of the superolateral orbital walls. The patient presented initial cosmetic and psychological benefits from the repositioning of the intact globe and the reduction of the orbital fractures. However, a subsequent evisceration of the globe was required due to persistent proptosis and pain. An ocular prosthesis was also implanted, thus recovering the patient's aesthetics. Thirty-four well-documented cases of traumatic globe luxation could be found in the English literature since 1970. The mean age of patients presenting traumatic globe luxation was

29.5 years. The male gender proved to be more prevalent, with traffic collisions representing the most common accident etiology. Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus represented the most common injury mechanism (38.2 %), followed by an elongated object entering the orbit (26.5 %). Optical nerve avulsion is the most serious complication seen in association with traumatic globe luxation, with the repositioning of the initial globe, with no enucleation or evisceration, representing the main form of management.

Keywords Facial injuries · Globe luxation · Orbital trauma

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Introduction

Traumatic globe luxation is quite uncommon [1]. Only 34 cases have been reported in the English-language literature indexed in PUBMED. This form of injury commonly occurs as a result of a high energy trauma [2]. Traffic accidents are the main cause of the traumatic globe luxation, with complete loss of vision representing the most serious complication [3]. The present article aims to describe a rare case of traumatic globe luxation, coupled with an orbital fracture, in a child. The clinical-tomographic features and management, as well as a thorough review of cases found in English-language literature from 1970 to 2012 are also presented here.

Case Report

A 5-year-old boy, with noncontributory cultural, social, and medical records, was referred to the emergency unit of

Hospital João XXIII/FHEMIG, Belo Horizonte, Brazil, after having been hit by a motorcycle. In the clinical examination, the patient presented an intact left globe luxation, an extensive eyebrow laceration, no visual acuity, no perception of light, and a complete limitation of extra-ocular motility in all directions. Laceration could not be observed in the cornea, sclera, or extra-ocular muscles (Fig. 1A). Indirect ophthalmoscopy demonstrated a vitreous hemorrhage, which obscured the view of the optic disc and fundus. The pupil was dilated and non-reactive. On palpation, the left orbital rim presented a fracture in the superolateral walls (Fig. 1B). Computed tomography (CT) was performed, which showed (1) proptosis of the left globe; (2) intraconal retrobulbar hematoma; (3) stretching of the optic nerve suggesting, optic nerve avulsion; (4) stretching of the extraocular muscles; and (5) fractures in the lateral and superior walls, with medial dislocation into the left orbit (Fig. 2A, B). The patient also presented closure fractures of right tibia and left humerus, which were stabilized. Five hours after the injuries, and after having received ratings from both the trauma surgeon and the neurosurgeon, the patient was transferred to an operating room to treat maxillofacial fractures and ocular lesions. Retrobulbar hematoma drainage was done, and the optic nerve avulsion was confirmed in the orbital exploration. The orbital fracture walls were reduced and fixed set with one bone titanium miniplate of 1.5 mm (Figs. 1C, 2C, D).

The globe was repositioned, lacerations were repaired, and a temporary tarsorrhaphy was performed (Fig. 1D). After 1 month of postoperative follow-up, the patient presented a left eye with slight proptosis, no light perception, no visual acuity, restricted ocular movement, and orbital contours, which were reestablished without signs of infection (Fig. 3A, B). By contrast, the right eye presented all normal physiological features. The left eye was eviscerated 3 months after the initial injury, due to the patient's level of pain and unsatisfactory aesthetic results (Fig. 3C). An ocular prosthesis was inserted to recover the aesthetics (Fig. 3D). The patient has undergone 12 months of follow-up with satisfactory cosmetic results.

Discussion

Previous cases reports of traumatic globe luxation, published between 1970 and 2012, were researched by means of a detailed investigation of the English-language literature across PUBMED, by searching for the following keywords: traumatic luxation of the globe and traumatic evulsion of the globe. All cases that used clinical-radio-graphic diagnoses were included in this review [1–30]. Together with the present case report, a total of 34 cases were selected. The data from all cases are presented in Table 1.

Fig. 1 Clinical features of patient with traumatic globe luxation. **A** Left proptotic globe with eyelids closed behind it and extensive eyebrow laceration. **B** Fractures in left orbital rim and lateral wall.

C Fixation of the orbital fracture with 1.5 mm titanium bone plate and screws. **D** Lacerations repaired and temporary tarsorrhaphy performed after initial globe repositioning

Fig. 2 Computed tomography (CT) shows the traumatic globe luxation. **A** CT shows proptosis of the left globe, intraconal retrobulbar hematoma (yellow head arrow), and stretching of the optic nerve, suggesting optic nerve avulsion (head arrow red). **B** 3D CT shows fractures in the lateral and superior walls with medial

dislocation into the left orbit, reducing the orbital volume. **C** Axial CT shows that the reduction of the lateral wall of the left orbit reestablished the orbital volume. **D** Coronal CT shows the orbital volume after bone fixation

The current case presents the clinical-tomographic features of the diagnosis and the management of traumatic globe luxation and orbital fractures. Thirty four cases of traumatic globe luxation could be found in the literature, mostly as single reports. Reuling and Hadlund [10], and Morris et al. [8] described two and three cases, respectively. The mean age of patients with traumatic globe luxation was 29.5 years, ranging from 5 to 74 years of age. The ratio of male to female patients was 4.7:1. The majority of cases of traumatic globe luxation could be found in patients who had suffered traffic accidents (52.9 %), followed by falls (8.8 %), hitting (5.9 %), and assaults (5.9 %). Other diverse causes accounted for the remaining cases (26.5 %). The data demonstrated that traumatic globe luxation is more prevalent in young male adults, who had suffered a traffic

accident. These results are in accordance with data from epidemiological studies in which maxillofacial trauma were evaluated [31].

Traumatic globe luxation can be divided in two types: (1) when the globe is displaced forward the orbit [1–14]; and (2) when the globe is displaced into the paranasal sinuses [15–30].

Three hypothetical causes of globe luxation were proposed by Morris et al. [8]: (1) an elongated object enters the medial orbit using the nasal sidewall as a fulcrum, propelling the globe forward; (2) a wedge shaped object enters the orbit medially and displaces the globe anteriorly; and (3) direct transaction of the optic nerve occurs due to the penetrating object. Displacement of the globe into the paranasal sinuses can be explained

Fig. 3 Clinical features of the patient after initial postoperative follow-up. **A** Ocular aspects of the patient after one month of postoperative follow-up, with slight proptosis in the left eye, no visual acuity, and no light perception. **B** Restricted ocular moments in the

left eye and orbital contours reestablished. **C** Globe evisceration of the left eye after three months of postoperative follow-up, due to pain and poor aesthetic results. **D** Ocular prosthesis inserted to recover the patient's cosmetic appearance after 12 months of follow-up

by mechanism of blowout fracture [25] when strong blunt forces are applied to the globe fracturing the thin orbital walls displacing the globe. Direct orbital trauma with fractures of medial and floor walls displacing the globe into the paranasal sinuses proved to be the most common cause of traumatic globe luxation (38.2 %) followed by the first mechanism, proposed by Morris et al. [8], (26.5 %). However, other possible mechanisms of injury were related in the English-language literature, such as a narrowing of the posterior orbit by orbital fractures which reduced the orbital volume and displaced the globe [3, 4, 13] (11.8 %), deceleration force [12], sudden intraorbital pressure rise [14], and direct traction of the globe [5]. The mechanism of causing the injury in the present case was a narrowing of the posterior orbit by orbital fracture. Moreover, data gathered from the English-literature demonstrated that unilateral traumatic globe luxation was far more prevalent [1–11, 13–30] (97 %). The avulsion of the optic nerve represents the most serious complication of the traumatic globe luxation, as it leads to a complete loss of vision. This complication occurred in 38.2 % of the published cases. In the same way, 38.2 % of cases presented no avulsion of the optic nerve with the recovery of the visual acuity in the majority of cases [6, 13–15, 18, 22, 26, 28–30]. In the present case, optic

nerve avulsion occurred with consequent loss of visual acuity. Orbital fractures were associated with traumatic globe luxation in 67.6 % of the cases. Traumatic globe luxation without orbital fractures proved to be less infrequent (26.5 %).

If the globe is still intact, the initial globe repositioning is the first choice of treatment for traumatic globe luxation. This management was carried out in 73.5 % of the cases analyzed and proved to provide better functional, aesthetic, and psychological outcomes for the patient [3]. Posterior enucleation or evisceration was performed in 5.9 % of the cases, due to pain, phthisis, or unsatisfactory cosmetics [1, 9]. In the current case, initial globe repositioning was performed, but the patient continued to complain of pain and an unsatisfactory cosmetic result. Therefore, a posterior evisceration was deemed necessary, and an ocular prosthesis was performed 3 months later.

Traumatic globe luxation is a severe kind of trauma which leads to a loss of vision in the great majority of cases. However, initial globe repositioning is necessary and allows for the patient's psychological recovery and increases the cosmetic results of a later ocular prosthesis if a posterior enucleation or evisceration has been carried out in the patient.

Table 1 Clinical profile of traumatic globe luxation

Authors	Age (years)	Gender	Type of accident	Unilateral or bilateral	Probably mechanism of injury	Optic nerve avulsion	Association with orbital fractures	Treatment
Reuling and Handlund [10]	56	M	Traffic accident	Unilateral	Not available	Not related	Not related	Initial globe repositioning with no enucleation or evisceration
	22	M	Stock car accident	Unilateral	Not available	Not related	Not related	Initial globe repositioning with no enucleation or evisceration
Pillai et al. [9]	17	M	Traffic accident	Unilateral	Piece of glass pushed the globe forward	Yes	Not associated	Initial globe repositioning with posterior enucleation
van der Wal and van der Pol [13]	30	M	Traffic accident	Unilateral	Narrowing of the posterior orbit reducing the orbital volume displacing the globe	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration and preservation of the visual acuity
Zengin et al. [14]	5	M	Fall	Unilateral	Sudden intraorbital pressure rise	No	Not associated	Initial globe repositioning with no enucleation or evisceration and preservation of the visual acuity
Arkin et al. [5]	25	M	Assault	Unilateral	Direct traction of the globe	Yes	Not associated	Initial globe repositioning with no enucleation or evisceration
Pelton et al. [15]	19	M	Traffic accident	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	Not available	Left orbital fractures	Initial globe repositioning with no enucleation or evisceration with visual acuity
Tung-Chain et al. [16]	17	M	Traffic accident	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration with no visual acuity
Kiratli et al. [7]	29	M	Traffic accident	Unilateral	Not available	Yes	Le Fort III fracture	Initial globe repositioning with no enucleation or evisceration
Saleh and Leatherbarrow [17]	29	M	Assault	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	Not available	Left orbital fracture	Initial enucleation post-misdiagnosed
Bajaj et al. [3]	17	M	Dropped a heavy mechanical pump	Unilateral	Narrowing of the posterior orbit reducing the orbital volume displacing the globe	Yes	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration
Tranfá et al. [18]	58	M	Fall of tree	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the ethmoid sinus	No	Left orbital fractures	Initial globe repositioning with no enucleation or evisceration with visual acuity
Alp et al. [4]	26	M	Traffic accident	Unilateral	Narrowing of the posterior orbit reducing the orbital volume displacing the globe	Yes	Left orbital fractures	Initial globe repositioning with no enucleation or evisceration
Morris et al. [8]	29	M	Fall	Unilateral	Elongated object entering the medial orbit to the globe	Yes	Not associated	Initial enucleation
	28	M	Traffic accident	Unilateral	Elongated object entering the medial orbit to the globe	Yes	Right orbital fractures	Initial enucleation
	74	M	Traffic accident	Unilateral	Elongated object entering the medial orbit to the globe	Yes	Left orbital fractures	Initial enucleation

Table 1 continued

Authors	Age (years)	Gender	Type of accident	Unilateral or bilateral	Probably mechanism of injury	Optic nerve avulsion	Association with orbital fractures	Treatment
Bajaj et al. [2]	28	F	Traffic accident	Unilateral	Elongated object entering the medial orbit to the globe	Not related	Not associated	Initial globe repositioning with no enucleation or evisceration
Hsu and Lai [19]	7	F	Traffic accident	Unilateral	Elongated object entering the medial orbit to the globe	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration without visual acuity
Kim and Baek [20]	68	M	Traffic accident	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration without visual acuity
Song and Carter [12]	41	F	Traffic accident	Bilateral	Deceleration force	Yes	Panfacial fractures	Initial globes repositioning with no enucleation or evisceration
Lelli et al. [1]	27	M	Traffic accident	Unilateral	Elongated object entering the medial orbit to the globe	Yes	Not associated	Initial globe repositioning with posterior enucleation
Roldan-Valadez et al. [11]	35	F	Hit by a car	Unilateral	Elongated object entering the medial orbit to the globe	Yes	Not associated	Initial enucleation
De Saint Sardos and Hamel [6]	6	F	Playing with a tube of gift wrap	Unilateral	Elongated object entering the orbit	No	Not associated	Initial globe repositioning with no enucleation or evisceration and preservation of the visual acuity
Abrishami et al. [21]	18	M	Traffic accident	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration without visual acuity
Muller-Richter et al. [22]	62	M	Blunt injury by a machine planning timber	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration with visual acuity recovery
Tunçbilek and Işçi [23]	23	M	Traffic accident	Unilateral	Narrowing of the posterior orbit reducing the orbital volume displacing the globe	Yes	Right orbital fractures	Initial enucleation
Jellab et al. [24]	24	M	Traffic accident	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	Not available	Left orbital fractures	Initial globe repositioning with no enucleation or evisceration without visual acuity
Kreiner et al. [25]	50	M	Collapsing wall	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	Not available	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration without visual acuity
Ramstead et al. [26]	32	M	Stepped on by a bull	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	No	Left orbital fractures	Initial globe repositioning with no enucleation or evisceration with visual acuity
Akhaddar et al. [27]	62	M	Traffic accident	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	Not available	Right orbital fractures	Not available

Table 1 continued

Authors	Age (years)	Gender	Type of accident	Unilateral or bilateral	Probably mechanism of injury	Optic nerve avulsion	Association with orbital fractures	Treatment
Pereira et al. [28]	0.7	M	Gunshot	Unilateral	Fluid collection displacing the globe	No	Right orbital fractures	Drainage of the fluid collection and initial globe repositioning with no enucleation or evisceration
Thapa [30]	15	F	Bumped on into a door corner	Unilateral	Elongated object entering the orbit	No	Not associated	Initial globe repositioning with no enucleation or evisceration with visual acuity
Zhang-Nunes et al. [29]	20	M	Blunt trauma from a dirt bike handlebar	Unilateral	Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus	No	Right orbital fractures	Initial globe repositioning with no enucleation or evisceration with visual acuity recovery
Current study (2012)	5	M	Hit by a motorcycle	Unilateral	Narrowing of the posterior orbit reducing the orbital volume displacing the globe	Yes	Left orbital fractures	Initial globe repositioning with posterior evisceration
Total	Mean: 29.5 years Range 5–74 years	82.4 % M 17.6 % F Ratio M/F 4.7:1	52.9 % traffic accident 8.8 % Fall 5.9 % Hit 5.9 % Assault 26.5 % Others	97 % Unilateral 3 % Bilateral	38.2 % Direct orbital trauma with fractures of medial and floor walls displacing the globe into the maxillary sinus 26.5 % Elongated object entering the orbit 14.7 % Others 11.8 % Narrowing of the posterior orbit 8.8 % Not available	38.2 % Optic nerve avulsion 38.2 % Without optic nerve avulsion 14.7 % Not available 8.9 % Not related	26.5 % Not associated 67.6 % Associated with orbital fractures 5.9 % Not related	73.5 % Initial globe repositioning with no enucleation 17.6 % Initial enucleation 5.9 % Initial globe repositioning with posterior enucleation or evisceration 3 % Not available

M Male, F Female

Conflict of interest The authors declare that they have no conflict of interest.

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