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Case Report

Traumatic Luxation of the Eye Ball with Optic Nerve Transection Following Road Traffic Accident: Report of Two Cases and Brief Review of Literature

Narayani Roka[1], Y.B. Roka[2]
[1]Consultant Ophthalmologist
[2]Senior Consultant Neurosurgeon
Department of Ophthalmology and Neurosurgery
Neuro Cardio and Multi Speciality Hospital, Biratnagar, Nepal

Abstract

Background: Traumatic luxation of the eye ball is rare with only 106 cases reported in PubMed till date. The anatomic location of the eyeball within the socket and the resilience of the globe to pressure force, attachment to extraocular muscles and optic nerve prevents luxation during trauma. **Case:** Road traffic accidents (RTA) is the most common cause for these injuries and the outcome can vary from complete recovery on repositioning to visual loss due to globe perforation or optic nerve injury. We report two unique cases of traumatic right globe luxation and complete optic nerve transection due to RTA and give a brief review of literature. **Conclusion:** RTA leading to eye ball luxation though rare can be a challenging situation when encountered. Given the limited time for the salvage of the eye early intervention is not always possible especially in developing countries where there is delay in reaching the hospital. Despite all these confounding factors attempt must be made to salvage the eye either for functional, cosmetic or psychological reasons.

Key words: globe luxation, optic nerve avulsion, road traffic accidents, trauma

Introduction

Traumatic luxation of the eye ball is rare with only 106 cases reported in literature. The anatomic location of the eyeball within the socket and the resilience of the globe to pressure, attachment to extraocular muscles and optic nerve prevents subluxation during trauma (Ajike et al, 2014). Injury to the face with associated fracture of the orbital wall or the maxilla are often associated leading to displacement of the globe outside the orbit or into the paranasal sinuses. It is more common in males and the mean age of presentation being 29.5 years (Amaral et al, 2013). Road traffic accidents (RTA) is the most common cause for these injuries and the outcome can vary from complete recovery on repositioning to complete visual loss due to globe perforation or optic nerve injury (Tok et al, 2014). We report two unique cases of traumatic luxation of the right eye ball and complete transection of optic nerve with complete visual loss secondary to RTA and give a brief review of literature.

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Corresponding author
Dr. Narayani Roka
MS, Cornea and External Eye Disease Fellow
Consultant Ophthalmologist,
Department of Ophthalmology
Neuro Cardio and Multi Specialty hospital,
Biratnagar, Nepal
E-mail: narayaniroka@yahoo.com

Case summary

Case One

A 19 - years old male was brought to the emergency department of our hospital 5 hours after fall from a motor bike. He was under influence of alcohol and driving without use of helmet. His Glasgow Coma Score (GCS) was 10/15, had abrasion on the face and scalp with bleeding from the right nostril. Multiple open wounds were present over the left frontal orbito-nasal region with bleeding. There was no other external injury to the body or limbs.

On examination of the eyes, the right eye was displaced outside the fissure in the malar eminence, hanging by a thin thread of tissue. There was no perception of light, pupil was dilated and non-reactive to light. Right eyeball was soft with intact sclera without any fluid leak. The conjunctiva was lacerated, chemosed and hyperemic. The optic nerve and extraocular muscle were also detached. The cornea was hazy due to exposure keratitis. Fundal glow was absent. On further examination the left eye showed paracentral adherant leucomatous corneal opacity and traumatic cataract which was due to stick injury at 3 years of age.

Computerized tomography (CT) done showed fracture of orbito-zygomatic and orbital floor on right, lateral orbital wall fracture on left, bilateral nasal bone fractures and subluxation of the right eye ball (Figure 2). There was thin subarachnoid hemorrhage (SAH) intracranially with small cortical contusions.

The patient was intubated admitted to the neuro intensive care unit on a ventilator. The luxated eye ball was kept moist and covered with sterile dressing. On the third day the GCS improved to 15/15 and he could obey commands.

The patient was advised for removal of the eyeball in view of the complete optic nerve avulsion with associated no visual recovery, but the patient party were reluctant as the patient had his left eye already damaged and thus wanted to preserve the right eyeball. The patient was taken to another center, where after further counselling regarding poor prognosis he underwent removal of the right eyeball. Presently at 5 weeks post-operatively he is doing fine with vision of 3/60 in his left eye and has been advised surgery for his post traumatic cataract with hopeful improvement of his vision. Ocular prosthesis has been implanted in his right orbit with satisfactory cosmetic and psychological outcome (Figure 1C).

Case two

A 60-year old female was brought to the emergency with history of RTA 7 hours back in India. She was hit from behind by an Autorickshaw while walking. On examination she had a GCS of 9/15 with blood-soaked scalp dressing. There was curvilinear sutured lacerated wound of 12 cm in the right fronto-temporal region, 3 cm posterior to the lateral orbital wall. No other external injuries were noted. On examination of the eyes, she had no perception of light in the right eye. The right eyeball was luxated 20 mm outside the orbital rim and was partially attached to the optic nerve with surrounding few muscles (Figure 3). There was periorbital swelling and ecchymosis. The eyeball was digitally soft and extraocular movements were absent. The conjunctiva was hyperemic and lacerated. Examination of the anterior segment showed exposure keratopathy inferiorly and anterior chamber was normal in depth. The pupil was nonreactive to light and dilated around 5 mm. The fundal glow was dull due to haziness of the media. The examination of the left eye was normal.

CT scan of the head and orbit showed comminuted fracture of the orbito-zygomatic bone, mandible and nasal bones (Le Fort I). The right eye ball was prolapsed outside and attached by few surrounding muscles and a thinned out optic nerve (Figure 3 A). The eyeball was looking intact with no vitreous hemorrhage however the size of the eyeball

was slightly smaller than its counterpart. There was retro-orbital hematoma and no intracranial finding except for thin SAH.

The patient was intubated for airway protection and admitted to Neuro intensive care unit. Under Midazolam sedation and facial block, the right eyeball was washed for removal of any foreign body. Universal wire speculum was applied and the eyeball was gently repositioned into the orbit using anitseptic soaked cotton swabs. This was followed by medial and lateral tarsorrhaphy. Chloramphenicol eye ointment was applied, and eye padding was done. Next day the patient was opening her left eye and pupil was reacting to light. Torch light examination of the right eye showed ecchymosis and swelling of eyelids and congestion of conjunctiva. The cornea was hazy due to corneal abrasion and striae were seen. Further details of the right eye were not visible. The eyeball was digitally soft. She was treated with topical antibiotics drops, ointment and artificial tear drops frequently.

Ultrasound of the right eye showed deformed globe, buckled optic nerve, detached extraocular muscles and retrobulbar hyperechoic areas suggestive of hematoma and anterior protrusion of right globe. Anterior and posterior chamber of the globe is echo free and lens in normal position.

On the second postoperative day she was responding to commands with GCS of E4M6V-T. The medial tarsorrhaphy suture was removed to examine the eye and it showed ecchymosis and reduced swelling of the eyelids. There was subconjunctival hemorrhage ,corneal edema and further details of the eye was not visible (Figure 3 B). The left eye examination showed a visual acuity of 6/24 with best corrected vision of 6/6. She was mobilized on the fourth day and was planned for mandibular fracture surgery. In view of her poor visual outcome on the right eye she has been advised for secondary enucleation on a later date and lateral tarsorrhaphy suture removal after a week.

Figure 1: Clinical photograph showing the luxated right eyeball in frontal (A), lateral view (B) and the right eye after ocular prosthesis (C).

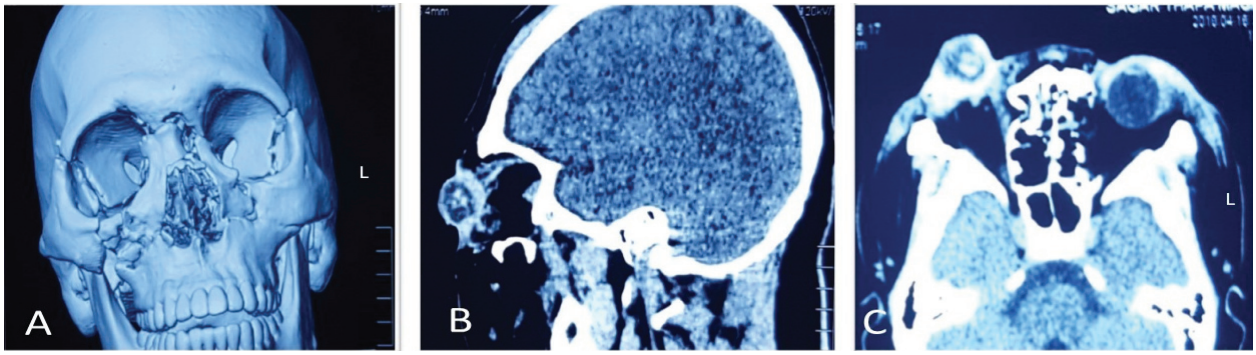

Figure 2: CT showing multiple bilateral orbital and nasal fractures in 3-D (Dimensional) (A) and the luxated abnormal right eye ball in sagittal (B) and axial views (C).

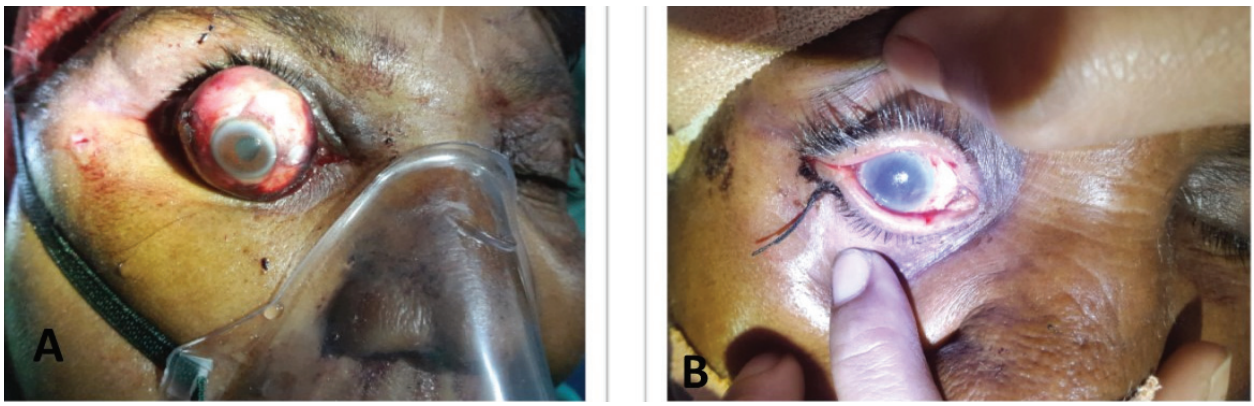

Figure 3: Clinical picture showing the luxated right eyeball resting on malar prominence (A) and the right eye on the third day of reduction of the globe (B).

Figure 4: CT scan of head and orbit showing the fractured mandible, Orbito-Zygomatic and nasal bones along with luxated right eyeball which is attached by a thin string of tissue (A, B) and ultrasound on second day showing damaged right globe (C).

Discussion

Injury to the mid face area are associated with orbital injuries which are usually due to fractures of the orbit floor, medial wall or the roof leading to eye ball herniation into the surrounding structures. Occipital injury can also lead to contra coup injury that can avulse the eye during RTA. Various theories have been proposed to cause eye ball herniation injury like the hydraulic or buckling theory, medial penetration theory of Morris, orbital fractures reducing the orbital space, sudden deceleration force, sudden rise of intraocular pressure, and direct traction on the eye ball (Warwar et al, 2000; Song et al, 2006; van der Wal, 1991; Zengin et al, 1992; Morris et al, 2002; Alp et al, 2001; Fard et al, 1997, Arkin et al, 1996). The study by Warwar et al (2000) demonstrated the amount of pressure needed to fracture the orbit and proposed a mechanism for eye ball injury whereas Morris (2002) elaborately described the medial entry point and three different mechanisms for eye ball luxation.

Trauma is the leading cause for eyeball luxation with cases reported in children and adult secondary to surfboard injury, human bite, trauma by blunt or penetrating injury, animal bite, vehicle crush injury and self-enucleation in psychiatric cases (Hindman et al, 2007; Paya et al, 2012, Roka et al, 2012,2013; Kosaki et al,2018). The overall visual prognosis is poor in such cases and various methods to salvage the eyeball have been proposed including simple reposition by patient relaxation and finger

relocation with cotton swab, repositioning with Desmarres retractor and even elaborate steps of reduction (Gupta et al, 2017; Osman et al, 2014, Thapa, 2011). Good visual outcome has been reported in some of the cases mentioned earlier. Presence of optic nerve avulsion usually at 30-50mm behind the globe is associated with poor outcome. Extraocular muscles may also be avulsed during luxation which commonly include superior, inferior, lateral rectus and oblique (Tok et al, 2014). Luxation can also be associated with other cranio-facial injuries that can be even life threatening like sub arachnoid hemorrhage, intracerebral hematoma or contusion, delayed cerebrospinal fluid leak, meningitis, facial or mandible fractures with airway compromise or other systemic injuries. Hence a complete examination is must for early detection of such injuries.

Clinical examination remains the mainstay of diagnosing avulsion as it is obvious to the naked eye. Preservation of visual function is the primary aim in these cases and urgent diagnosis and action is required to salvage the vision. 3-Dimensional CT once the patient is stable helps to rule out other injuries and defines the extent of intracranial and orbital bony injuries. Whenever possible repositioning of the globe is performed, and the avulsed muscles sutured back which provides aesthetic, functional and psychological outcome (Bajaj et al, 2000). Due to the rarity of such injury there is no clear description of the benefit of repositioning the non-salvageable eye ball. Argument for repositioning claim to have better psychological and cosmetic benefits till posterior enucleation or evisceration is carried out later. Risk of infection is a major concern that may also delay the use of ocular implant.

Our first case describes an unfortunate event in this young male who had his right eye avulsed with poor vision in the opposite eye. It shows the careless attitude of humans towards themselves and may be attributed to the lack of education or proper guidance. This is a common problem in developing countries where due to lack of transportation and medical care availability patients are often brought late to the hospital. Although complete avulsion in this case was contradictory to vision recovery, many similar cases with such injuries can be saved if brought on time. The second case presented earlier than the first and the eye ball was reduced back with an expectation of visual recovery. The latter had a normal left eye and hence secondary enucleation was advised for her damaged right eye.

The orbit has a volume of 30 ml and the eyeball occupies around 7 ml of that volume. Rise in intra-orbital pressure leading to luxation has previously been described in literature (Warwar et al, 2000; Fard et al, 1997; Sanborn et al,1984). There are numerous studies on cadaver, orbital models, monkey skull and dry skull that have shown how a force to the orbit can fracture the orbital floor (Bullock et al, 1999). Bullock et al (1999), Green et al (1990) and Ahmed et al (2006) have shown in some experimental studies how both the hydraulic and the buckling theory could lead to fracture of the orbital floor.

In view of the CT findings of fracture of the lateral orbital wall along with the zygomatic bone in both the above two cases we give a possible explanation for eye ball prolapse. Direct high impact trauma to the face can lead to multiple fractures and in these cases fracture of the lateral orbito-zygomatic (O-Z) wall and its movement inside the orbit can theoretically lead to increase of the intra-orbital pressure. The fronto-zygomatic and the maxillo-zygomatic joint is the weaker part of the lateral orbital wall and will thus fracture to free the O-Z segment. In such a situation unless the weakest part of the orbit, the floor, fractures the pressure will reverse through the postero-medial wall, exerted on the mobile part of the orbit the globe which luxates out to ease the pressure.

The freed O-Z bone can thus be pushed inside which can then return to its previous position pulled by the temporal muscles or remain dislocated within the orbital cavity. Treatment in such situation would necessitate the early reduction of the O-Z bone to prevent persistent raised intro-orbital pressure even after eye ball reduction.

Conclusion

RTA leading to eye ball luxation though rare can be a challenging situation when encountered. Given the limited time for the salvage of the eye as given in the example above early intervention is not always possible especially in developing countries where there is delay in reaching the hospital. Despite all these confounding factors attempt must be made to salvage the eye either for functional, cosmetic or psychological reasons.

Conflict of interest: None.

Informed consent was taken from either patient/ patient relatives regarding publication of these cases.

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