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Global avulsion of the globe associated with frontal sinus and naso-orbital-Ethmoid (FSNOE) complex fracture. A rare case report and short literature review

INTRODUCTION: *Post-traumatic avulsion of the globe is a rare and uncommon pathology with serious morpho-physiological, cosmetic and aesthetic implications. The association with complex fractures of the skull increases the morbidity and complexity of the case.*
CASE REPORT: *We present a rare case of FSNOE complex fracture associated with avulsion of the left globe, with complete sectioning of the optic nerve and loss of vision.*
DISSCUSION: *The prompt diagnosis and the immediate establishment of a correct multidisciplinary treatment, led to the favorable evolution of the case. Three-dimensional reconstruction of the skull architecture and resizing of the orbital contour, as well as successful prosthesis of the eyeball concured for a satisfactory anatomic and cosmetic result.*
CONCLUSION: *The therapeutic decision to reposition the globe in the case of complete avulsion should be made depending on the severity of associated lesions, the patient's general state, age, and the risk of potential postoperative complications.*

KEY WORDS: Word, Post-traumatic, Avulsion of the globe, Frontal sinus, Naso-orbito-ethmoid (NOE, Fracture

Introduction

Frontal sinus and naso-orbital-ethmoid (FSNOE) complex fractures are a complex pathology in maxillofacial surgery both from a clinical and a therapeutic point of view [1]. FSNOE complex fractures have major cosmetic and aesthetic implications by altering cranial and nasal convexity, interorbital distance and orbital wall architecture [2]. Post-traumatic malpositioning of the medial canthal tendon (MCT) insertion leads to telecanthus and rounding of the palpebral fissure [2,3]. The involvement of the posterior wall of the frontal sinus can be associated with severe intracranial lesions, such as cerebral lacerations, subdural or subarachnoid hemorrhage or hematomas, cerebrospinal fluid (CSF) leaks or pneumocephalus [3,4]. This type of fracture is frequently associated with intra- or peri-orbital lesions; however, avulsion of the globe is extremely rarely reported in the literature [5]. When this occurs, it is caused by maxillofacial traumas with a high kinetic energy such as from road traffic accidents, gunshot wounds, or falls from height [6,7]. The severity of this type of lesions varies from incomplete luxation of the globe to complete avulsion [8].

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Sectioning of the optic neurovascular bundle is followed by definitive loss of vision and if extraocular muscle disinsertion is associated, sometimes globe enucleation is imposed [8-10]. The treatment of this type of pathology is complex and multilateral, close collaboration between the maxillofacial surgeon, the neurosurgeon, the ophthalmologist and the intensive care specialist is mandatory [1-10]. The objective of surgery in this case is the anatomical reconstruction of the bone and soft tissue architecture and the prevention of late complications such as chronic frontal sinusitis, frontal sinus mucocele, osteomyelitis, meningitis or cerebral abscess [1,4]. The indication of globe repositioning depends on the clinical features of avulsion, the integrity of the globe and neurovascular bundle, as well as on the time elapsed from the trauma to the presentation to the doctor, the opinions of different authors varying [5,10].

In this paper, we present the rare case of a 25-year-old patient, the pedestrian victim of a traffic accident, with FSNOE complex fracture and post-traumatic avulsion of the left globe, with complete sectioning of the optic nerve and loss of vision. Subsequently, we analyze the literature related to this pathology.

Case Presentation

A 25-year-old patient, the pedestrian victim of a traffic accident, was transported to the territorial emergency service. As a result of clinical examination, the presumptive diagnosis of multiple cranio-maxillofacial fractures with globe avulsion was established. The patient complained of moderate headache and loss of vision in the left eye at the moment of first clinical evaluation. The episode of acute trauma happened 3 hours before the presentation, the patient being hit by a car when he was crossing the street. The patient declares that after the car-hit, he hit his head on the road without losing consciousness. The patient had a free previous medical history.

At the time of examination, the patient was neurologically and hemodynamically stable (blood pressure 126/86 mmHg, pulse 78 beats/min, saturation (Sa02) 99%), oriented in time and space, with a Glasgow Coma Score (GCS) = 15/15.

On extra-oral clinical examination, an asymmetry of the upper face was observed, the patient presenting an increase in the interorbital distance with major glabellar intrusion and displacement of the nasal pyramid to the left, complete avulsion of the left globe outside the palpebral fissure, blepharospasm, bilateral palpebral hematomas, bilateral periorbital, midfacial and frontal edema, transfixing contused glabellar wound about 10 cm in size, right frontal contused wound, excoriated nasal, upper and lower lip and chin wounds. Telecanthus, with rounding of the left palpebral fissure could be observed. Clinical and functional examination of the left globe evidenced total detachment of oculomotor muscles, total absence of light perception, dilated pupil with the absence of the photomotor reflex, chemosed, lacerated, hyperemic conjunctiva, exposure keratitis and absent fundal glow (Fig. 1). On palpation of bony landmarks we observed the following: comminuted fracture with displacement of the nasal bones, left medial orbital wall, left supraorbital margin, glabella and the frontal bone squama. Crepitations suggestive of soft tissue emphysema could also be evidenced. In order to evaluate the maintenance of the MCT insertions, we performed the bilateral bow-string test which confirmed the bilateral preservation of MCT insertions in some fractured bone fragments, the fracture thus being classified as a type II naso-orbital-ethmoid (NOE) complex fracture, based on Manson and Markowitz classification. The patient presented no clinical cerebrospinal fluid (CSF) leakage (negative halo sign) nor epiphora.

Following evaluation of biological blood parameters, several changes were observed: hyperglycemia 256 mg/dl (normal values 74-106), increase in C-reactive protein 1.09 mg/dl (<5), iron deficiency 48 ug/dl (70-18), leukocytosis 12.81 10^9/L (4-10), hematocrit 36.8% (40-54), hemoglobin 12.4 g/dl (13-17).

Computed tomographic (CT) examination with 3D reconstruction of the viscerocranium (Fig. 2) evidenced displaced nasal bone fracture, comminuted nasal septal fracture, displaced comminuted left medial orbital wall fracture, non-displaced right medial orbital wall fracture, depressed comminuted fracture of the bilateral frontal sinus anterior wall and the left supraorbital margin, min-

Fig. 1: Preoperative clinical appearance.

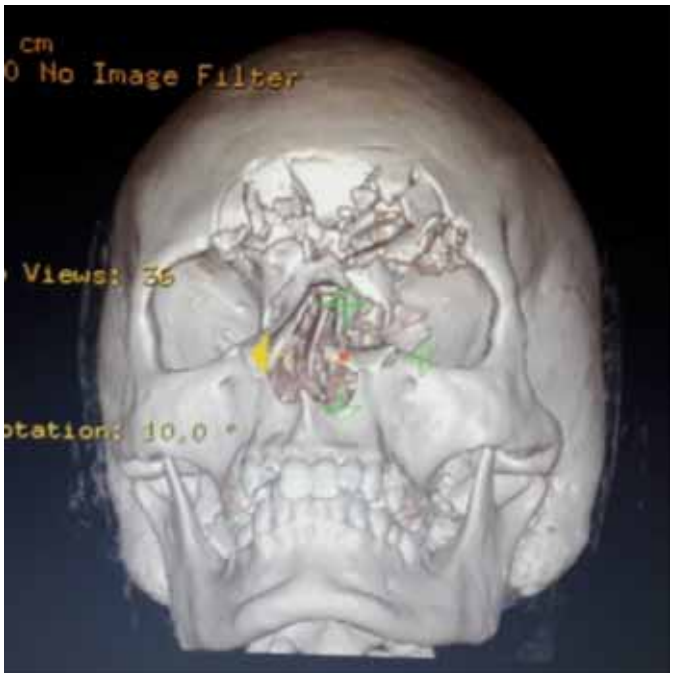

Fig. 2: Preoperative computer tomograph (CT) image with 3D reconstruction of the viscerocranium.

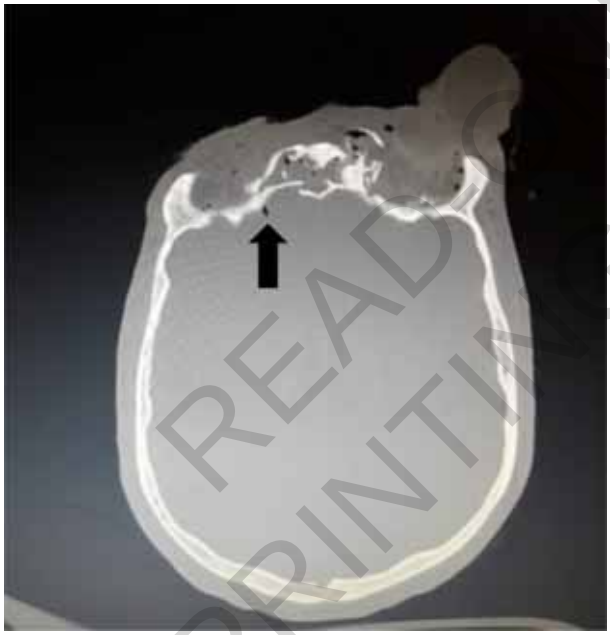

Fig. 3: Preoperative CT image of axial sections minimally displaced frontal sinus posterior wall fracture, the arrow indicates the pneumocephalus region; complete extrapalpebral avulsion of the left globe can be seen.

imally displaced fracture of the frontal sinus posterior wall. Frontal and ethmoidal hemosinus could be observed. A minimal pneumocephalus could be observed in the right frontal lobe. Soft tissue emphysema of frontal, periorbital and left intraorbital regions was identifiable (Fig. 3). Complete sectioning of the left optic nerve could also be observed (Fig. 4).

Fig. 4: Preoperative CT image of axial section; the absence of the left globe from the orbital cavity is observed, the full black arrow indicates the sectioned optic nerve at the orbital apex; Contralaterally, the arrow indicates the intact right optic nerve.

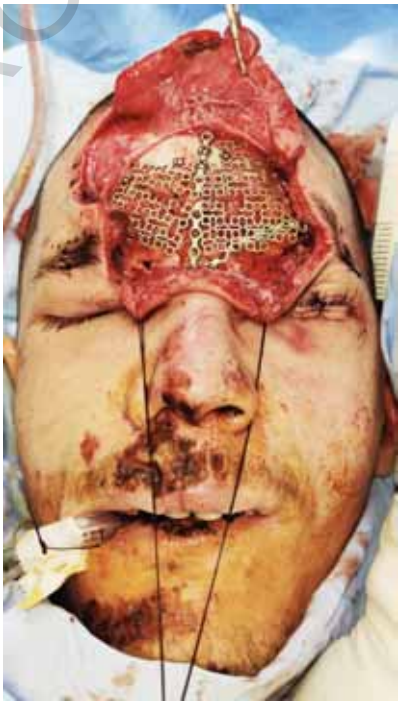

Fig. 5: Intraoperative appearance-obliteration of the frontal sinus with cellular adipose tissue taken from the abdominal flanks and reconstruction of the fronto-glabellar projection with a titanium mesh.

Given the stable neurological and hemodynamic status of the patient, the case was immediately taken over by the Department of Oral and Maxillofacial Surgery, and

Fig. 6: Clinical appearance at 8 months postoperatively.

Fig. 7: CT appearance with 3D reconstruction at 8 months postoperatively.

surgery was performed 24 hours after the first examination. Preoperatively, the patient received the following intravenous drug treatment over 24 hours: Cefort 2x1g, Meropenem 2x1g, Dexamethasone 2x8mg.2ml, Ringer's Solution 500 ml 3x1 fl, NaCl 0.9% 100ml-9mg/ml 3x1 fl, Kabiven 1 fl, Vitamin C 2x750 mg/5ml.

Fig. 8: CT appearance at 8 months postoperatively highlighting the stability over time of the adipose tissue used for obliteration of the frontal sinus.

The patient has given written consent for undergoing the surgery and also to the inclusion of material pertaining to themselves for scientific publication, including all facial features. Therefore this communication has been performed in accordance with the ethical standards laid down in the Declaration of Helsinki and its later amendments.

The surgical approach was performed through the existing transfixing wound that was surgically extended in order to gain direct acces to the entire frature site. The deperiosted fractured fragments of the frontal sinus anterior wall and those of the left supraorbital margin were completely removed. Radical surgery of the bilateral frontal sinus was performed. The fracture focus in the posterior wall was stable, without signs of CSF leak or meningeal herniation, requiring no surgical manipulation in this context. The NOE bone complex was reduced by anterior traction with the Walsham forceps. The adherence of the fractured fragments of the medial orbital walls to the periosteum, as well as preservation of the bilateral MCT insertion facilitates closed reduction of the fractures, medial orbital wall reconstruction with titanium meshes being unnecessary. The nasal bones were immobilized with a long osteosynthesis plate fixed superiorly to the frontal bone. The repositioning of the nasal septum on the midline was also practiced and its immobilization in this position with 2 internal conformers. Obliteration of the two frontal sinuses being necessary, it was performed with adipose tissue harvested from the abdominal region. The entire glabellar region was reconstructed using a conformed titanium mesh. Wound suturing was performed in separate points with non-resorbable nylon 5.0. Enucleation of the left was carried out and tarsoraphy in 3 points was performed (Fig. 5).

The patient had a favorable evolution on the 6th postoperative day, the internal nasal conformers being removed. The patient was discharged on the 7th postoperative day with medical prescription for nasal decongestants 3x1 per day for 7 days.
At 8 months postoperatively, the patient was completely healed, with the contour of the frontal bone, glabellar region and supraorbital margins within anatomical limits, left palpebral mobility within normal limits, left ocular prosthetic restoration, adequate nasal projection and permeable nasal fossae (Figs. 6, 7, 8).

Discussion

Post-traumatic avulsion of the globe is extremely rare and most frequently occurs following road traffic accidents [5,6,9,11-21]. Some authors report such cases following falls [22,23], interpersonal violence (gouging) [24-26], animal attacks [27], or water jet [28]. Cases of avulsion of the globe through self-harm, called "oedipism", are reported among patients with severe paranoid schizophrenia, psychosis induced by drug use, mental retard or severe depression [29-32]. Associated diseases with retrobulbar granulomatous proliferation (Grave's syndrome, histiocytosis X), retrobulbar tumors or floppy eyelid syndrome are factors favoring this pathology because of chronic globe luxation [33,34].
The patient in this study was involved in a road traffic accident, being hit by a car, but in fact this injury was secondary to fall and direct impact of the nasofrontal region with a kerb. Certainly, the force of impact with the ground was increased compared to that resulting from a gravitational fall, due to the speed of the vehicle involved. In this case, no factors favoring avulsion of the globe such as those previously mentioned were identified.
Avulsion of the globe can be secondary to several mechanisms: direct orbital trauma with fractures of medial and floor walls displacing the globe [18,20-22,25], narrowing of the posterior orbit reducing the orbital volume, displacing the globe [5,6], elongated object entering the medial orbit to the globe [17,23], deceleration force [35], sudden intraorbital pressure [36] or direct traction of the eye[24]. In this study, avulsion of the globe was secondary to the posteriorly displaced fracture of the medial and superior orbital walls, with sudden reduction of the orbital volume and brutal anterior displacement of the globe.
Pathomorphologically, the globe can be luxated (the optic nerve being only elongated) or avulsed (complete sectioning of the optic nerve) [5,11-35]. In the case of luxations greater than 40 mm, recovery of vision has an extremely reserved prognosis, while in the case of avulsion, vision is unrecoverable [8,10-18]. Avulsion of the globe is classified as follows: partial with sectioning of the neurovascular bundle but maintenance of oculomotor muscle insertions; total with sectioning of the neurovascular bundle and detachment of oculomotor muscle insertions [10,15,16]. Hughes [37] classified avulsion of the optic nerve depending on the anatomotopographic location of post-traumatic sectioning: anterior marginal tearing, anterior optic nerve, canalicular optic nerve, optochiasmal, and chiasmal. Complete avulsion with optochiasmal or chiasmal nerve sectioning has an increased risk of immediate complications: intracranial hemorrhage, pituitary and contralateral chiasmal lesions or immediate CSF fistulae [5,6,26]. In this case, the patient had anterior sectioning of the neurovascular bundle, therefore the risk of developing immediate or late intracranial complications is reduced [5,6,26,37]. CT imaging or magnetic resonance imaging (MRI) examination is crucial for final diagnosis and the classification of the type of eye avulsion, as well as for detecting possible concomitant intracranial lesions, influencing the therapeutic approach [10-16,26].
Regarding the ideal management of this type of pathology, opinions are divided in the literature [12-35]. The objectives of management are facial and cosmetic reconstruction by anatomical repositioning of the globe, resumption of eye movements and, if possible, recovery of vision [12-35]. Luxation of the globe with the maintenance of optic nerve integrity requires its repositioning; partial or total recovery of vision in these conditions is reported by a number of authors [9,36-40]. This procedure can be hindered most of the times because of post-traumatic blepharospasm, lateral canthotomy with secondary tarsoraphy being indicated this context [36-41]. In partial avulsion, some authors indicate repositioning of the globe for aesthetic considerations [9,17,20,24,25,35,36]. However, subsequent enucleation can be necessary due to occurrence of phthisis bulbi, pain, infection or poor cosmetic outcome [5,42]. In the case of complete avulsion, loss of muscle insertions predisposes to ischemia and secondary necrosis of the globe [5,6,23,26,42,43]. In this context, preservation of the globe may predispose in case of necrosis to intraorbital infections, meningitis or brain abscess [5,6,23,26,42,43]. Thus, we decided primary enucleation of the globe in the current case, an approach similar to that of other authors. In contrast, some authors recommend repositioning of the globe even in complete avulsion [9,17,20,24,25,35,36]. Preservation of the globe in these conditions minimizes the mental impact of the trauma on the patient and contributes to conforming intraorbital tissues for subsequent prosthetic restoration [9,17,20,24,25,35,36].
In the case of children, preservation of the globe is recommended whenever possible, in order to assure an adequate development of the viscerocranium [11]. However, laceration, crushing or anatomical impairment of the globe requires its immediate enucleation [11-30].
Given the complexity of the current case, with a high risk of postoperative complications particularly due to the frontal sinus posterior wall fracture, we consider that assuming additional infectious risks through preservation of the completely avulsed globe was unnecessary.
Frontal sinus wall fracture treatment is challenging, multilateral and difficult [1]. The surgeon must ensure that

after reconstruction of the orbital contour and frontal bony landmarks, the postoperative concept of "safe-sinus" was also achieved [2-4]. In the present case, due to the comminuted fracture of the bilateral sinus anterior wall, the glabellar region and the supraorbital margin, obliteration of the maxillary sinus was required. Because of minimal sinus posterior wall displacement, absence of CSF leak and exposure of the dura mater in the fracture focus, we considered that in this case cranialization was unnecessary. This approach is also described in the literature [1-4,44-47]. Frontal sinus obliteration can be performed either with anterior pedicled galeal flap or with several grafts classified as autogenous (fat, medullary bone, cortical bone or muscle), xenografts (bovine bone granules) or different surgical biomaterials (biovitroceramics, polytetrafluoroethylene, calcium phosphate cement, etc.) [44-48]. Due to post-traumatic laceration of the epicranial aponeurosis, to the large sinuses and high costs of biomaterials, we decided the obliteration of frontal sinuses with autologous cellular fat tissue. Cellular fat tissue has the disadvantage of potential resorption over time, the incidence of resorption being 2-3% of cases according to the literature [44-48]. In this case, at 8 weeks postoperatively, CT examination showed integrity of the cellular adipose tissue for frontal sinus obliteration, without any signs of resorption or liquefaction.

Conclusions

Post-traumatic avulsion of the globe is a rare, complex and challenging pathology, which most frequently leads to definitive blindness. The therapeutic decision to reposition the globe in the case of complete avulsion should be made depending on the severity of associated lesions, the patient's general state, age, and the risk of potential postoperative complications. The treatment of associated viscerocranial fractures should be initiated as early as possible, in order to ensure acceptable functional, cosmetic and aesthetic results with the three-dimensional reconstruction of the bone and soft tissue architecture. Multidisciplinary collaboration between the neurosurgeon, the ophthalmologist, the intensive care physician and the maxillofacial surgeon throughout the duration of hospitalization in such cases is vital.

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The authors have equal contribution in preparing and writing this manuscript.

Riassunto

L'avulsione post-traumatica del globo oculare è una patologia rara e non comune con gravi implicazioni morfofisiologiche, cosmetiche ed estetiche. L'associazione con fratture complesse del cranio aumenta la morbilità e la complessità del caso.
Presentiamo un raro caso di frattura complessa FSNOE associata ad avulsione del globo oculare sinistro, con sezione completa del nervo ottico e perdita monolaterale della vista.
La tempestiva diagnosi e l'immediata instaurazione di un corretto trattamento multidisciplinare, hanno portato all'evoluzione favorevole del caso. La ricostruzione tridimensionale dell'architettura del cranio e il ridimensionamento del contorno orbitale, nonché la riuscita protesi del bulbo oculare hanno consentito un risultato anatomico ed estetico soddisfacente.
In conclusione la decisione terapeutica di riposizionare il globo in caso di avulsione completa dovrebbe essere presa in base alla gravità delle lesioni associate, allo stato generale del paziente, all'età e al rischio di potenziali complicanze postoperatorie.

References

1. Arora R, Rao S, Rao S, Nagarkar NM: *Transnasal stabilization in naso-orbito-ethmoid fractures: The easy way*! Indian J Otolaryngol Head Neck Surg. 2017; 69(2):248–51.

2. Baliga SD, Urolagin SB: *Transnasal fixation of Noe fracture: minimally invasive approach*. J Maxillofac Oral Surg, 2011; 11(1):34-37.

3. Liau JY, Woodlief J, Van Aalst JA: *Pediatric nasoorbitoethmoid fractures*. J Craniofac Surg, 2011; 22:1834-838.

4. Pawar SS, Rhee JS: *Frontal sinus and naso-orbital-ethmoid fractures.* JAMA Facial Plast Surg. 2014; 16(4):284-89. PMID:24788607.

5. Amaral MB, Carvalho MF, Ferreira AB, Mesquita RA: *Traumatic globe luxation associated with orbital fracture in a child: A case report and literature review*. J Maxillofac Oral Surg. 2015; 14(Suppl 1):323-30.

6. Tunçbilek G, Işçi E: *Traumatic evulsion of the globe: A very rare complication of maxillofacial trauma*. J Craniofac Surg. 2008; 19(2):313-15.

7. Lelli GJ JR, Demirci H, Frueh BR: *Avulsion of the optic nerve with luxation of the eye after motor vehicle accident*. Ophthal Plast Reconstr Surg, 2007; 23:158Y160.

8. Roka N, Roka YB: *Traumatic luxation of the eye ball with optic nerve transection following road traffic accident: Report of two cases and brief review of literature.* Nepal J Ophthalmol, 2018; 10(20):196-202.

9. Ersan I, Adam M, Oltulu R, Zengin N, Okka M: *Traumatic luxation of the globe*: *A 6-year follow-up. Orbit*. 2016; 35(2):69-71.

10. Osman EA, Al-Akeely A: *Luxation of eyeball following trauma: Novel simple treatment*. Indian J Ophthalmol, 2014; 62(7):812-13.

11. De Santana Santos T, Vajgel A, Ribeiro CF, De Santana Júnior JR, Andrade Filho ES: *Avulsion of globe following maxillofacial trauma*. J Craniofac Surg, 2012; 23(4):1097-100.

12. Norazah AR, Akmal HZ, Hashima H, Vasantha T, Samsudin A: *Globe avulsion secondary to maxillofacial trauma*. Med J Malaysia, 2011; 66(4):359-60.

13. Gupta H, Natarajan S, Vaidya S, Gupta S, Shah D, Merchant

R, Deshpande S: *Traumatic eye ball luxation: A stepwise approach to globe salvage*. Saudi J Ophthalmol, 2017; 31(4):260-65.

14. Tok L, Tok OY, Argun TC, Yilmaz O, Gunes A, Unlu EN, Sezer S, Ibisoglu S, Argun M: *Bilateral traumatic globe luxation with optic nerve transection. Case Rep Ophthalmol*, 2014; 10:5(3):429-34.

15. Unal S, Argin A, Arslan E, Demirkan F, Aksoy A: *Bilateral complete avulsion of ocular globes in a Le Fort III maxillofacial fracture: A case report and review of the literature*. Eur J Ophthalmol, 2005; 15(1):123-25.

16. Kelahmetoğlu O, Şimşek T, Beden Ü, Aydoğdu İO, Cömert Hamzaoğlu E: *Rarely seen complication of motor vehicle accidents: Bilateral globe avulsion.* Ulus Travma Acil Cerrahi Derg, 2015; 21(4):297-99.

17. Hsu HC, Lai JP:*Surgical management of traumatic luxation of the ruptured eyeball*. Injury 2004;35:1055–58.

18. Kim S, Baek S: *Traumatic dislocation of the globe into the maxillary sinus associated with extraocular muscle injury*. Graefe's Arch Clin Exp Ophthalmol, 2005; 243:1280-283.

19. Abrishami M, Aletaha M, Bagheri A, Salour SH, Yazdani S: *Traumatic subluxation of the globe into the maxillary sinus*. Ophthal Plast Reconstr Surg, 2007; 23:156-58.

20. Jellab B, Baha At, Moutaouakil A, Khoumiri R, Raji A, Ghannan EH, Samkaoui MA, Ait BS: *Management of a severe cranio-orbito-facial trauma with a dislocation of the globe into the maxillary sinus*. Bull Soc Belge Ophtalmol, 2008; 309-310:37-41.

21. Akhaddar A, Elmostarchid B, Boucetta M: *Traumatic intraorbital stone with globe displacement into the maxillary sinus*. Emerg Med J, 2010; 27:828.

22. Tranfa F, Di Matteo G, Di Salle F, Strianese D, Bonavolontà G: *Traumatic displacement of the globe into the ethmoid sinus*. Am J Ophthalmol, 2000; 130:253-54.

23. Morris WR, Osborn FD, Fleming JC: *Traumatic evulsion of the globe*. Ophthal Plast Reconstr Surg, 2002; 18:261-67.

24. Arkin MS, Rubin PA, Bilyk JR, Buchbinder B: *Anterior chiasmal optic nerve avulsion*. AJNR Am J Neuroradiol, 1996; 17(9):1777-781.

25. Saleh T, Leatherbarrow B: *Traumatic prolapse of the globe into the maxillary sinus diagnosed as traumatic enucleation of the globe*. Eye (Lond), 1999; 13:(Pt 5):678-80.

26. Plumacker A, Mazairac G, Namasale S, Jadoul B, Jissendi Tchofo P, Bartiaux M: *Enucléation traumatique bilatérale des yeux : Une prise en charge multidisciplinaire s'impose: Eye's traumatic enucleation: Need for a multidisciplinary management.* Published online ahead of print, 2018; 31; Rev Med Brux, 2018; 10.30637/2018.18-018.

27. Roka YB, Roka N, Shrestha M, Puri PR, Adhikari HB: *Penetrating head injury with bilateral eye avulsion due to Himalayan bear bite*. Emerg Med Australas, 2012; 24(6):677-79.

28. Deangelis DD: *Traumatic enucleation from a high-pressure water jet.* Arch Ophthalmol, 1999; 117:127Y128.

29. Straßburger P, Váradi G: *Traumatic enucleation. Accident or self-mutilation*? Ophthalmologe, 2013; 110(5):451-4.

30. Large MM, Nielssen OB. *Self-enucleation: Forget freud and oedipus, it's all about untreated psychosis.* Br J Ophthalmol, 2012; 96(8):1056-7.

31. Krauss HR, Yee RD, Foos RY: *Autoenucleation*. Surv Ophthalmol, 1984; 29(3):179-87.

32. Patton N: *Self-inflicted eye injuries: A review*. Eye, 2004; 18(9):867-72.

33. Wood CM, Pearson AD, Craft AW, et al.: *Globe luxation in histiocytosis X*. Br J Ophthalmol, 1988; 72:631-33.

34. ???ezra DG, Derriman L, Mellingtion FE, et al.: *Spontaneous globe luxation associated with shallow orbits and floppy eyelid syndrome*. Orbit, 2008; 27:55-58.

35. Song A, Carter KD: *Bilateral traumatic globe subluxation*. Ophthal Plast Reconstr Surg, 2006; 22:136-37.

36. Zengin N, Karakurt A, Gultan E, Kural: *Traumatic globe luxation*. Acta Ophthalmol (Copenh), 1992; 70:844-846.

37. Hughes B.: *Indirect injury to the optic nerves and chiasm*. Johns Hopkins Hosp Bull, 1962; 111:98-126.

38. De Saint Sardosa, Hamel P.: *Traumatic globe luxation in a 6-year-old girl playing with a tube of wrapping paper*. J AAPOS, 2007; 11:406-407.

39. Ramstead C, Mccabe J, Alkahtani M, Leong-Sit J, Morhart M: *Traumatic dislocation of the globe into the maxillary sinus*. Can J Ophthalmol, 2008; 43:364-66.

40. Zhang-Nunes SX, Jarullazada I, Mancini R: *Late central visual recovery after traumatic globe displacement into the maxillary sinus*. Ophthal Plast Reconstr Surg, 2011; 28:E17-E19.

41. Thapa R: *Luxation of eye ball following trauma: A rare case presentation*. J Nepal Med Assoc, 2011; 51:79-81.

42. Roldan-Valadez E, Corona-Cedillo R, Rojas-Marin C, Valdiviezo-Cardenas G, Sanchez-Sanchez JM, Quiroz-Mercado H: *Tomographic findings in traumatic globe evulsion caused by blunt head trauma*. Br J Radiol, 2007; 80:247-49.

43. Tabatabaie SZ, Rajabi M-T, Khakbaz M, et al.: *Traumatic avulsion of the globe: report of a rare case and brief review of literature*. Iranian J Ophthalmol, 2008; 20:46-49.

44. Strong EB: *Frontal sinus fractures: Current concepts.* Craniomaxillofac Trauma Reconstr, 2009; 2(3):161-75, doi: 10.1055 /s-0029-1234020.

45. Gossman DG, Archersm, Arosarena O: *Management of frontal sinus fractures: A review of 96 cases*. Laryngoscope, 2006; 116(8):1357-362.

46. Metzinge RSE, Guerra AB, Garcia RE: *Frontal sinus fractures: Management guidelines*. Facial Plast Surg, 2005; 21(3):199-206.

47. Rice DH. *Management of frontal sinus fractures.* Curr Opin Otolaryngol Head Neck Surg, 2004; 12(1): 46-48.

48. Mickel T, Rohrich R, Robinson J: *Frontal sinus obliteration: A comparison of fat, muscle, bone and spontaneous osteogenesis in the cat model.* Plast Reconstr Surg, 1995; 95:586-592.