




Case Report

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Trapdoor Orbital Fracture in a Pediatric Patient. Case Report and 57-years of Literature Review

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ABSTRACT

The blowout trapdoor fracture is a rare condition with more prevalence in pediatric patients. Surgeons and clinicians should be aware of this condition due to its severity, which can cause ophthalmoplegia, blindness, and even death. The present study reports a unique case of the surgical correction of trapdoor fracture with the incarceration of the inferior rectus muscle in the maxillary sinus associated with a severe oculocardiac reflex, unimproved nausea, and ophthalmoplegia. Together with that, a 57-years literature review is provided. The TF is linked with assaults and playing activities, in a 12,73 years-old mean age. The oculocardiac reflex is not a common association, 29,2%, being one of the most alarming symptoms. It is fundamental to the correct and early diagnosis, together with the forehead surgery, related to success in the first 72 hours.

Keywords: Orbital Fractures, Maxillofacial Trauma, Orbital Trauma.

INTRODUCTION

Pediatric facial fractures are not uncommon injuries. The epidemiology indicates that the leading cause for trauma is sports with 33%, followed by assaults, 31%, Plays, 12%, and Falls with 8%². The periorbital region is the third most affected¹. Smith first described the orbital floor in 1957, leading to signs and symptoms such as diplopia, paresthesia of the infraorbital nerve, and enophthalmos^{1,3}. Soll and Polley first described the trapdoor fracture (TF) in 1965 as a pure orbital floor fracture. The fragments are transiently displaced to the maxillary sinus, allowing herniation of orbital content. It has been well established that pediatric bones respond to external deformation with greater elasticity than adult bones, making these fractures more common in children⁴. Imaging examination with both radiographs and Computed Tomography Scans (CT-Scan) is fundamental to the diagnosis, showing linear fractures with the incarceration of the periorbital tissue. In addition to that, the hanging drop signal is a characteristic of condition⁶.

The trapdoor fractures should be surgically corrected. In pediatric patients, earlier surgical intervention should be considered because studies have shown that prompt intervention may protect these patients from ischemic injury to incarcerated orbital soft tissues and prevent rare but fatal arrhythmias cases of complete oculocardiac reflex^{7,8}. The main goals of the surgical correction of the trapdoor fracture are the isolation of the orbital contents from the maxillary sinus, preventing avascular necrosis, reconstruction of the orbital volume, realignment, and restoration of the orbital floor⁷.

The present study reports a single case of the surgical correction of trapdoor fracture with the incarceration of the inferior rectus muscle in the maxillary sinus associated with a review of English-language literature from 1965 to 2021.

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Authors' contributions

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the [Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors](https://www.icmje.org/). Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

CASE REPORT

A 5-years-old male patient was hit by another kid in a head-to-head collision in a running play at the school. The patient was admitted after 24 hours of trauma, brought by his mother with the complaint of severe nausea, unimproved with common medication, facial pain, and diplopia. No signs of hemodynamic and neurological alterations were noted. On a physical examination, the patient presented small facial swelling, ophthalmoplegia on the right eye with supraduction, increased scleral show on the right eye, and diplopia. CT-Scan demonstrated a small dislocated blow-out orbital floor fracture with displacement of the inferior rectus muscle to the maxillary sinus, with a hanging teardrop signal. The patient went to the operating room for the correction of the fracture. The subtarsal approach was performed to expose the orbital floor, and the inferior rectus muscle was removed from the maxillary sinus under direct vision. In the forced movement test, the eye had no ophthalmoplegia. The orbital floor was reconstructed using a 1.5 mm titanium mesh with screws fixated in the lower orbital frame. The postoperative period was uneventful, and the patient was discharged after three days of hospitalization with no signs of infection. The patient received a high corticoid dose in the immediate preoperative (Hydrocortisone 500mg, attack dose) and a therapeutic dose for three days (Hydrocortisone 100mg, 12/12 hours). After a two-years of strict follow-up, the patient had no vision, ocular movement, or diplopia sequelae. The CT-Scan revealed that the orbital floor had no developmental impairments due to the fixation material.

DISCUSSION

One patient with noncontributory medical, social and cultural records was referred to a public hospital in Brazil. Previous studies of pediatric trapdoor orbital fracture, published between 1965 and 2022, were researched by means of a detailed investigation of English-language literature across PubMed, by searching the following strategy: ~(("trapdoor"[All Fields] OR "trapdoors"[All Fields]) AND ("fractur"[All Fields] OR "fractural"[All Fields] OR "fracture s"[All Fields] OR "fractures, bone"[MeSH Terms] OR ("fractures"[All Fields] AND "bone"[All Fields]) OR "bone fractures"[All Fields] OR "fracture"[All Fields] OR "fractured"[All Fields] OR "fractures"[All Fields] OR "fracturing"[All Fields])) OR (("trapdoor"[All Fields] OR "trapdoors"[All Fields]) AND ("orbit"[MeSH Terms] OR "orbit"[All Fields] OR "orbits"[All Fields] OR "orbit s"[All Fields] OR "orbital"[All Fields] OR "orbital s"[All Fields] OR "orbitals"[All Fields] OR "orbited"[All Fields] OR "orbiter"[All Fields] OR "orbiters"[All Fields] OR "orbiting"[All Fields])) OR (("trapdoor"[All Fields] OR "trapdoors"[All Fields]) AND ("blowout"[All Fields] OR "blowouts"[All Fields]))~. All studies that included trapdoor fractures of the orbital floor in pediatric patients were included in this review. Together with this present study, a total of 198 cases were selected. The data from all studies are presented in Table 1.

In the current literature, the most common causes for TF are Assaults with 28,6%, sports with 13,2%, plays with 10,6%, falls 7,1%, car crash 4%, direct trauma and iatrogenic activities with 0,5%. The majority of the cases published in the studies observed were male patients, with an average of 55% of the cases and a mean age of 12,71 years (From 1 to 53 years).

The signs and symptoms on the admission play an important role in these studies; the ophthalmoplegia was described in 95,9% of the patients, oculocardiac reflex in 29,2%, diplopia in 41,1%. The case reported in this study presented the three symptoms that were not common in the other cases described.

The computed tomography was the preferred image examination for 97,5% of the cases reported on the literature, and the meantime for surgery was 4.18 days from trauma. In this case, the patient received the CT- Scan on the first care, being fastly directed to the oral and maxillofacial surgeon, who immediately made the diagnosis and was referred for the OR.

The surgeons preferred the transconjunctival approaches, 44.6%, followed by the subtarsal 19%. The complication rate was low, with diplopia being the most common with 8,6%, followed by 7,6% of ophthalmoplegia.

The TF is a severe condition and may cause death. It should be treated surgically as earlier as possible to prevent the aggravation of the oculocardiac reflex. Early surgical treatment shows better outcomes for the ophthalmoplegia, with an 85% success rate in the first 72 hours and more than 90% in the first 24 hours 6,11. The early procedure protects these patients from ischemic injury to incarcerated orbital soft tissues 7,8.

There is no consensual opinion in the literature over the most indicated surgical approach for the BOTF correction procedure. The transconjunctival is well indicated because of the less-perceptive scar. Nevertheless, it should promote postoperative entropion. The

subsidiary approach still has shown to be a valid option for the exposure of the orbital floor, although it has a risk of postoperative ectropion.

Regardless of the approach used, exposing the fractured site is mandatory, gently freeing the herniated muscle and other orbital tissues from the maxillary sinus. If not correctly released, the extraocular muscle movement limitation, diplopia, and the oculocardiac reflex can continue 11.

It's essential to address that the orbital floor depth in the infants is no larger than 30mm, two-thirds of the adults, 45mm. The posterior margin of the fracture should be exposed to confirm the complete release of the entrapped muscle and tissue 11,12.



Figure 01: A to D : Photograph of preoperative ocular movement, demonstrating failure in right eye supraduction. E to H: Photograph of postoperative ocular movement, demonstrating recovery of extraocular movements.

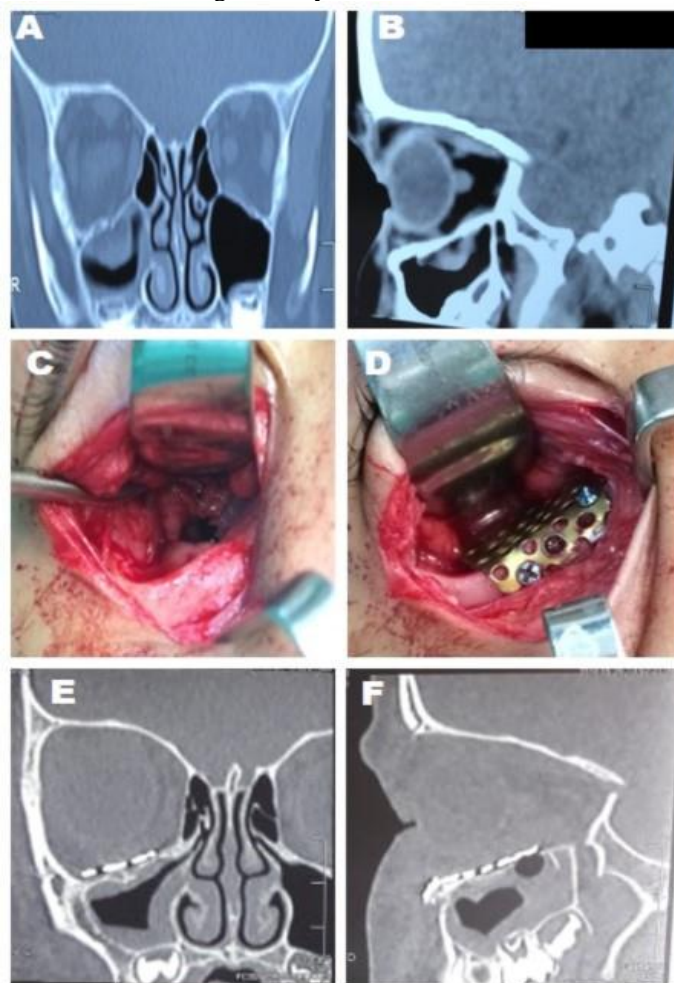


Figure 02: A: Image showing computed tomography in coronal section demonstrating orbital floor fracture with presence of herniated contents in the right maxillary sinus. B: Image showing computed tomography in sagittal section demonstrating orbital floor fracture with presence of herniated inferior rectus muscle in the right maxillary sinus. C: Transoperative photograph demonstrating fracture of the orbital floor with herniated material. D: Transoperative photograph demonstrating reconstruction of the orbital floor with titanium mesh E: Image showing postoperative computed tomography in coronal section demonstrating the reconstructed orbital floor. F: Image showing postoperative computed tomography in sagittal section demonstrating the reconstructed orbital floor.

Table 1: Pediatric Trapdoor.

Author & Year of Publication	Number of Cases	Age (Mean)	Sex	Etiology	Oculocardiac Reflex	Diplopia	Ophthalmoplegia	Days to surgery (Mean)	Computed Tomography	Surgical Approach	Complications
Soll & Poley, 1965	4	13 to 21(17) 2 NA	2- Male 2- NA	3- Assaults 1- Sports Practice	NA	4- Yes 0- No	4- Yes 0- No	7 to 10(7,75)	No	Subtarsal	None
Jordan et al., 1998	8	7 to 18 (12,7)	NA	5- Assaults 1- Fall 1- Sports Practice 1- Playing Activities	NA	8- Yes 0- No	8- Yes 0- No	2 to 17 (8,6)	Yes	NA	2- Ophthalmoplegia
Sires et al., 1998	3	8 to 20 (13,3)	3- Male	3- Assaults	2- Yes 1- No	2- Yes 1- No	3- Yes 0- No	0 to 3 (1,75)	Yes	NA	1- Diplopia
Bansagi et al.,2000	8	12	NA	NA	5- Yes 2- No	NA	8- Yes 0- No	NA	Yes	Transconjunctival	None
Grant 2002	19	5 to 16 (10.3)	NA	NA	None	3- Yes 16- No	17- Yes 2- No	0 to 36 (4.9)	Yes	NA	None
Criden & Ellis, 2007	12	5 to 16 (11,2)	9- Male 3- Female	8- Assaults 4- Sports	2- Yes 10- No	NA	7- Yes 5- No	Same Day	Yes	NA	2- Hypoesthesia
Kum et al., 2009	1	37	Male	Assault	No	Yes	Yes	Same Day	Yes	Trauma Laceration	Oftalmoplegia
Gerbino ,2010	24	6 to 16 (12.7)	20- Males 4- Females	8- Plays 6- Assaults 4- Sports 4- Falls 2- Car Crash	None	24- Yes 0- No	24- Yes 0- No	0 to 8 (2.2)	Yes	Subtarsal	8- Diplopia
Jackson, 2010	1	14	Male	Sport	Yes	No	Yes	Same Day	Yes	NA	None
Kim 2010	18	1 to 13 (9.3)	16- Males 2- Females	12- Assault 4- Sports 2- Car crash	10- Yes 8- No	NA	18- Yes 0- No	0 to 15(6,7)	Yes	Transconjunctival	None
Ethunandan et al.,2011	10	4 to 53 (19 , 6)	6- Males 4- Females	4- Assaults 4- Sports 1- Fall 1- Car Crash	6- Yes 4- No	NA	10- Yes 0- No	0 to 41 (12,32)	9- Yes 1- No	9- Subtarsal 1- Transconjunctival	None
Neinstein et al., 2012	18	8 to 17 (12.6)	13 Males 5 Females	1 Play 17 NA	NA	NA	18- Yes 0- No	1 to 45 (9.7)	Yes	Transconjunctival	2- Ophthalmoplegia
Noh et al., 2013	1	38	Female	Direct Trauma	No	No	Yes	0	Yes	Endoscopic Endonasal Approach	None
Hink et al., 2014	19	10,4	NA	NA	12- Yes 7- No	17- Yes 2- No	19- Yes 0- No	0	Yes	NA	3- Ophthalmoplegia
Maloney 2014	1	8	Male	Car Crash	Yes	Yes	Yes	0	Yes	Subtarsal	Optic Neuropathy
Heggie et al., 2015	3	7 to 13 (9,3)	NA	NA	2- Yes 1- No	3- Yes 0- No	3- Yes 0- No	0	Yes	Transconjunctival	None
Yang 2015	25	9 to 18 (14.0)	23- Males 2- Females	8- Assaults 4- Falls 8- Plays	13- Yes 12- No	NA	25- Yes 0- No	0 to 8.5 (3.9)	Yes	Transconjunctival	4- Ophthalmoplegia 4- Diplopia

				3- Sports 1- Iatrogenic 1- NA							
Yew et al.,2015	1	10	Male	Playing Activities	No	Yes	Yes	Same Day	Yes	Transconjunctival	None
Abumanhal et al., 2018	8	5 to 18 (13,5)	NA	3- Sports 2- Falls 2- Assaults 1- Play	2- Yes 6- No	8- Yes 1- No	10- Yes 0- No	0 to 3(0,95)	Yes	NA	3- Ophthalmoplegia
Karthik et al., 2019	10	9 to 29 (15,3)	10- Males 0- Female	4- Assaults 2- Car Crash 2- Sports 2- Falls	NA	8- Yes 2- No	9- Yes 1- No	0 to 11 (4,02)	10- Yes 0- No	Endoscopic Endonasal Approach	4- Diplopia
Dunphy et al., 2019	1	16	Male	Assault	Yes	Yes	Yes	3	Yes	Transconjunctival	Diplopia
Prasad et al.,2020	1	7	Male	NA	No	No	Yes	4	Yes	Subciliary	No
Brasileiro et al.,2020	1	26	Female	Car Crash	Yes	Yes	Yes	Same Day	Yes	Transconjunctival	No
Guerra et al., 2020	1	6	Male	Fall	No	No	Yes	Same Day	Yes	Subciliary	No
Costa et al, 2022	1	5	Male	Play	Yes	Yes	Yes	2	Yes	Subtarsal	None
Total	198	1 to 53. Mean = 12,71 years	55% - Males 10,7% - Females 34,3% - NA	28,6% - Assaults 13,2% - Sports 10,6% - Plays 7,1% - Falls 4% -Car Crash 0,5% - Direct Trauma 0,5%- Iatrogenic 35,5%- NA	29,2% - Yes 49,7%- No 20,5%- NA	41,1% - Yes 12,3 % - No 46,6% - NA	95,9 %Yes 4,1% No	4,18 Mean	97,5% - Yes 2,5% - No	19% - Subtarsal 44,6% - Transconjunctival 0,05% - Trauma Laceration 0,55% - Endoscopic Endonasal Approach 35,8% - NA	8,6% - Diplopia 7,6% - Ophthalmoplegia 1% Hypoesthesia 0,5% - Optic Neuropathy 82,3% - None

CONCLUSION

The TF is a rare condition with great predilection in the pediatric population. Surgeons and clinicians should be aware of this condition due to its severity, which can cause ophthalmoplegia, blindness, and even death. The patient should be surgically approached within 72 hours of the trauma to prevent ischemic injury to incarcerated orbital soft tissues or the worsening of the ocular reflexes.

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