

Hemi Le Fort III Fracture with Subdural and Subarachnoid Pneumocephalus with a Mild Mount Fuji Sign

Fractura de Hemi Le Fort III con Neumoencéfalo Subdural y Subaracnoideo con Signo Leve del Monte Fuji

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ABSTRACT: Extensive fractures in the fixed facial skeleton combined with traumatic brain injury can cause functional and esthetic impairments, possibly threatening the patient's life. Male patient, 50-year-old, victim of physical aggression, presented with persistent headache and dizziness, fractures in the naso-orbito-ethmoidal, zygomatic-maxillary and right pterygoid process regions, among other minor patterns of facial fracture, with mobility to maxillary traction of the third midface unilaterally. Clinical-imaging findings revealed a Hemi Le Fort III fracture and subdural and subarachnoid pneumocephalus with a mild Mount Fuji Sign. The proposed treatment was facial osteosynthesis and conservative intravenous drug treatment of the pneumocephalus. The patient had a good recovery, with no postoperative motor or functional deficits. The correct management of the patient with facial trauma associated with craniotrauma offers benefits, restoring stability of facial architecture and preventing or correcting neurosurgical complications.

KEY WORDS: conservative therapy, head trauma, osteosynthesis, skull fractures.

INTRODUCTION

Extensive fractures of the facial skeleton associated with traumatic brain injuries (TBIs) can generate functional and esthetic impairments, possibly threatening the patient's life. Accidents caused by motor vehicles are one of the leading causes of complex facial fractures and TBIs, followed by assaults, interpersonal violence and falls (Silva *et al.*, 2011; Feldman *et al.*, 2017; Phillips & Turco, 2017; Roccia *et al.*, 2019). Middle third trauma has a significant prevalence in the literature, however not superior to mandibular fractures (Kummoona, 2011; Silva *et al.*, 2011).

At the same time, a trauma in the middle and upper thirds may be associated with significant TBIs, with a statistical increase in morbidity and mortality. In particular, Hemi Le Fort fractures are likely to occur,

not complying with the classic bilaterality of Le Fort fractures, and may be correlated with encephalic complications, such as the pneumocephalus (PNM) observed in this study. Thus, clinical-imaging propaedeutics is essential to define the order of therapeutic approach to patients (Rajandram *et al.*, 2014; Feldman *et al.*, 2017; le Roux *et al.*, 2021).

Mount Fuji sign is an imaging alteration in brain CT scan that suggests a Tension Pneumocephalus. The literature exposed for a long time an emergency need to neurosurgical decompression due to the risk of complications, such as the brain herniation (Lasoff *et al.*, 2019). Currently, a few authors have proposed a conservative therapy in cases that no intracranial hypertension or hemodynamic instability are detected (Dabdoub *et al.*, 2015; Ryan *et al.*, 2017; Sebastian &

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Moideen, 2018; Baradaranfar *et al.*, 2018; Li *et al.*, 2020). Regardless of the treatment chosen, the main objective is guaranteeing recovery of the patient's signs and symptoms with constant evaluation and preventing a lowered level of consciousness.

CASE REPORT

Male patient, 50-year-old, victim of physical aggression, reported previous syncope with spontaneous recovery, persistent dizziness and mild frontal headache. On physical examination (Fig. 1A), he presented emphysema in the right zygomatic-maxillary region, crackling and painful on palpation. Bilateral periorbital ecchymosis was added, with impairment of spontaneous eye-opening, diplopia and chemosis in the right orbit with significant medial canthal bleeding. There was no ophthalmoplegia. Bone exposure was observed in the region of the nose through a cut-blunt wound, which extended to the region of the right medial canthal ligament and right infraorbital arch. There was mild epistaxis, pain and nasal crackling, but no rhinoliquorrhea. Upon intraoral traction of the maxilla, bone movement was noted in the region of the frontonasal and right frontozygomatic sutures, suggestive of a Hemi Le Fort III fracture. The patient was bimaxillary dental prosthesis user, presented masticatory impairment and needed in-hospital paste-liquidized diet.

CT scans showed fracture of the anterior and posterior walls of the frontal sinuses without significant displacements, fracture of orbital walls with involvement of the infraorbital canals and enlargement of the continent in the right orbit. Furthermore, comminuted fracture of the nose, frontal processes of the maxilla, nasal process of the frontal bone and ethmoidal trabeculate. Besides that, comminuted fracture of the anterior, medial and posterolateral walls of the maxillary sinuses with hemosinus. Fractures of the anterior, middle and posterior thirds of the right zygomatic body and arch, plus fracture of the right pterygoid process were also shown. Facial CT scans were reconstructed, demonstrating the main imaging findings (Fig. 2A). Add to that, pneumocephalus foci in the frontal subdural space bilaterally and in the subarachnoid space in the sulci on the inferior surface of the frontal lobes associated with multiple air pockets in the form of bubbles visible in face (Fig. 3) and high parietal region (Fig. 4). Contusion foci were also observed in the basal portion and in the poles of the frontal lobes bilaterally. The remainder of the encephalic parenchyma showed usual attenuation, with a ventricular system of normal shape and dimensions, and centromedial structures without significant deviations.

On admission, the cut-blunt wound was sutured with Vycril 4.0 and Nylon 5.0 and the pneumocephalus therapy was started, by means of post-traumatic anticonvulsant prophylaxis, based on Phenytoin 100 mg intravenously every 8 hours, and Dipyron 1000



Fig. 1. Clinical analysis of the middle and upper thirds of the face. A: patient on admission, in a preoperative situation, showing extensive cut-blunt wound with bone exposure, diplopia and bilateral periorbital ecchymosis. B: patient 14 days after surgery with correction of diplopia and regression of ecchymosis and emphysema.

mg intravenously every 6 hours. Facial fractures were treated surgically, under general anesthesia and orotracheal intubation, using intraoral vestibular access and access through the previous cut-blunt wound in the middle third. Osteosynthesis plates 1.5 and 2.0 mm were used in the right zygomatic pillar, right infraorbital

arch, right frontozygomatic suture, front maxillary sutures and nasofrontal sutures (Fig. 2B). The sutures performed were Vycril 3.0 and 4.0 and Nylon 5.0. Dexamethasone 4 mg, every 12 hours and Ketoprofen 100 mg, every 12 hours, were added to the post-surgical prescription for 3 days.

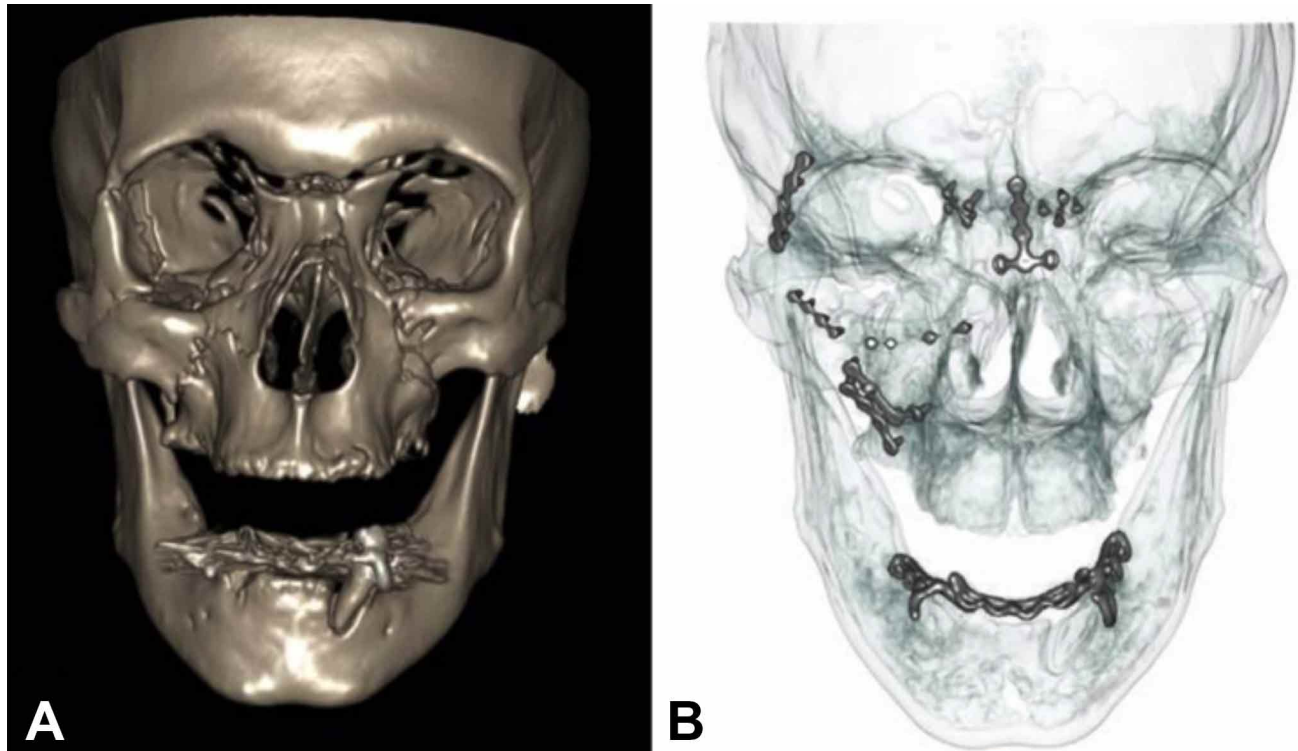


Fig. 2. 3D reconstruction and osteosynthesis. A: preoperative. B: postoperative.

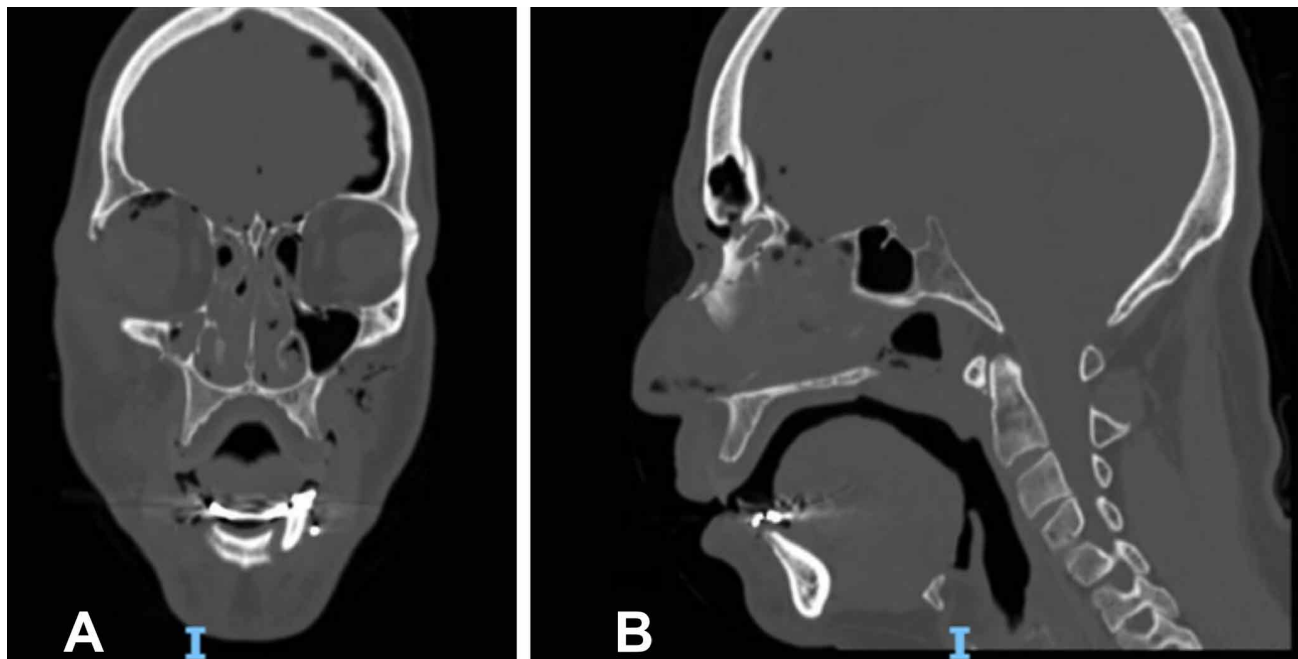


Fig. 3. Bone window CT showed air foci in the face and brain region. A: front view. B: sagittal view.

The patient had an excellent postoperative evolution and had undergone TBI conservative therapy. He had no seizures or more headache and remained in follow-up, through which we made new CT acquisitions. The pneumocephalus's complete imaging regression occurred within 22 days, without sequelae

or other cerebral impairments. Clinically, there was a correction of bone mobility and diplopia, reduction of edema and emphysematous areas, improvement in face symmetry and improvement in eyelid opening bilaterally (Fig. 1B). The patient demonstrated satisfaction with the proposed treatment.

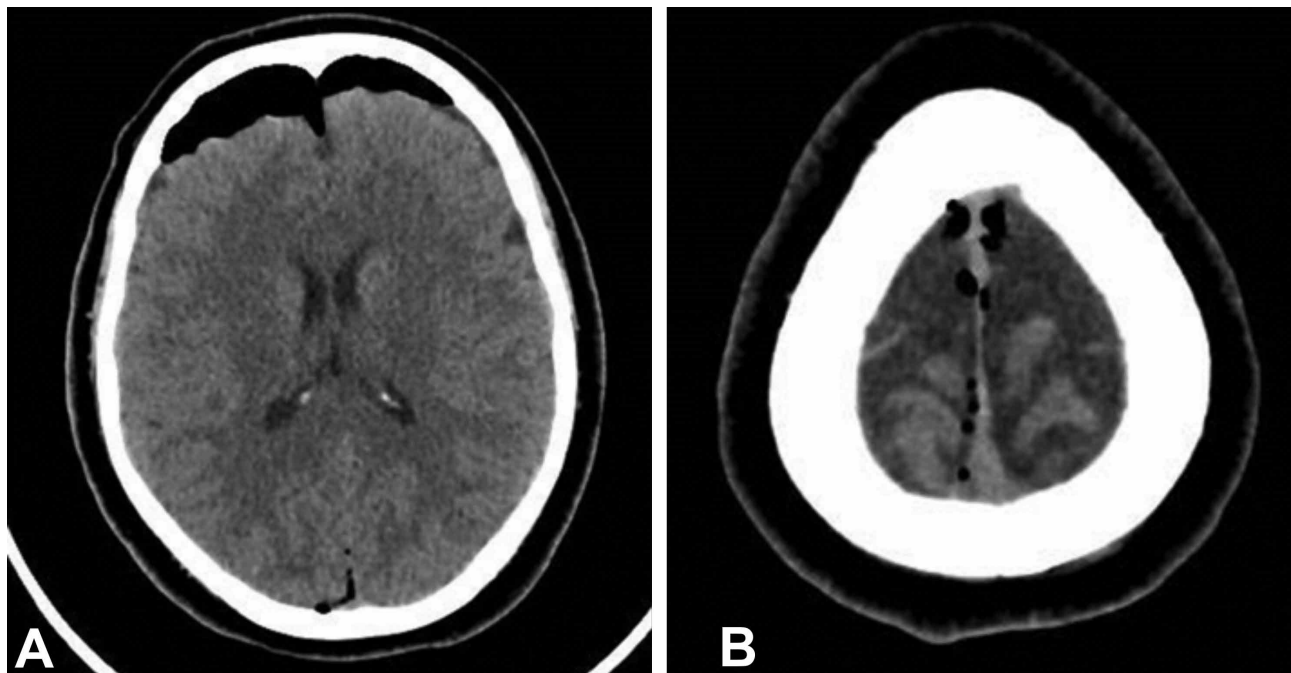


Fig. 4. CT in brain window. A: Mount Fuji sign. B: bubble-shaped air spots in high parietal region.

DISCUSSION

Rigid internal or external fixation is required to correct facial skeletal fractures. Therefore, the use mainly of computed tomography allows in-depth analysis for precise installation of osteosynthesis plates. Also, the face has small and fragile laminar bones articulated to a pyramidal center, which can be fractured more easily compared to other bones in the human body (Kummoona, 2011). Frontobasal fractures pose a high risk to the patient due to direct kinetic transmission to the brain. Furthermore, there is an anatomical correlation between middle and upper third fractures, especially Le Fort II and III, with cranial base fractures. For Silva *et al.* (2011), in a single-center study, the frequency of TBI associated with facial fractures corresponds to 21 %, and the incidence of Le Fort fractures is around 1.5 %. Meanwhile, in the review by Le Roux *et al.* (2021), the association of Le Fort II and III fractures with frontobasal injuries is not only possible, but varies from 14.7 % to 25 %. Pneumocephalus is a

possible complication in this type of association. Thus, fractures in the frontal sinus and the naso-orbito-ethmoidal region explain the appearance of PNM in this case report (Le Roux *et al.*, 2021).

PNM is the accumulation of air in the cranial cavity mainly due to TBI, detected by neuroimaging (Cunqueiro & Scheinfeld, 2018). Previous neurosurgeries, head tumors and pneumococcal meningitis are other possible etiologies. It has different approaches depending on the patient's clinical characteristics and causes. In most cases, the air is reabsorbed and management is usually conservative. Determining the location of the gas and the entry route is critical. PNMs can be epidural, subdural, intraparenchymal, intravascular, subarachnoid and intraventricular. Also, they can arise through head trauma, spine and transvascular mechanisms. Symptoms include motor changes, decreased mental function,

nausea, headache, vomiting, unconsciousness, irritability, dizziness, seizures and hemiparesis (Alves *et al.*, 2012; Dabdoub *et al.*, 2015; Cunqueiro & Scheinfeld, 2018; Kumar *et al.*, 2020).

The formation of a subdural and subarachnoid PNM depends on the difference in extra and intracranial pressures and dura mater defect, mainly due to trauma (Dabdoub *et al.*, 2015; Young *et al.*, 2018). Although the subdural is the most common type (Dabdoub *et al.*, 2015; Cunqueiro & Scheinfeld, 2018), the degree of penetration of the traumatological agent in TBIs may explain the other sites of involvement, such as the subarachnoid seen in our report (Cunqueiro & Scheinfeld, 2018). The patient presented on the first skull CT island-shaped hypodensity restricted to the anterior cranial segment and air bubbles, suggesting subdural and subarachnoid subtypes (Gorissen *et al.*, 2019; Das & Bajaj, 2022). A second CT scan, taken three days after the first, showed an increase in gas extension with slight separation of the frontal lobes, compatible with the coined Mount Fuji sign (Fig. 4), which could specifically indicate the formation of a tension pneumocephalus (Bhoil *et al.*, 2020; Kumar *et al.*, 2020; Li *et al.*, 2020; Oley *et al.*, 2021). In this differential diagnosis, the symptoms are similar to non-hypertensive PNM, but an increase in intracranial pressure is detected and there may be hemodynamic instability associated with subdural PNM (Ryan *et al.*, 2017; Cunqueiro & Scheinfeld, 2018; Kumar *et al.*, 2020; Bhoil *et al.*, 2020). Furthermore, the tension pneumocephalus therapy can consist of craniotomies, endoscopic closure of skull defect and burr holes (Li *et al.*, 2020; Oley *et al.*, 2021). The patient did not show changes in the level of consciousness or other signs of intracranial hypertension, nor hemodynamic instability, remaining stable with intravenous medication and follow-up.

Due to the mainly anteriorized extension of the PNM, the patient's stability, absence of symptoms and mild displacement of the brain parenchyma, it was decided to follow up the case without using neurosurgical decompression. The conservative treatment of PNM with the Mount Fuji sign, as chosen in this article, has already been evaluated as possible and favorable by some authors. However, it depends on a careful evaluation of the patient, ensuring the absence of suggestive symptoms of intracranial hypertension (Dabdoub *et al.*, 2015; Ryan *et al.*, 2017; Baradaranfar *et al.*, 2018; Li *et al.*, 2020; Sethi & Ali, 2020).

The use of analgesics and anticonvulsants, such as Phenytoin, is common in non-surgical, prophylactic or conservative neurological treatments, such as the one in this report (Enicker & Madiba, 2014; Baradaranfar *et al.*, 2018; Koo & Cho, 2020). The PNM regressed on a subsequent examination, which was compatible with the deadlines in the literature, which range from 2 days to 3 weeks (Alves *et al.*, 2012; Baradaranfar *et al.*, 2018; Cunqueiro & Scheinfeld, 2018; Gorissen *et al.*, 2019). The correct assessment and consistent planning allow for a safe approach to the patient, without exposing him to greater risks of encephalic impairment and satisfactory post-surgical results. The osteosynthesis performed guaranteed facial stability, rehabilitating the patient and restoring quality of life.

CONCLUSION

Facial fractures can be associated with traumatic brain injury and result in pneumocephalus. The correct management of this association depends on adequate propaedeutics, in which the patient's neurological stability must be ensured and corrective craniofacial surgery and timely medication should be instituted, when necessary. The prognosis can be favorable, as seen in this report, when correct measures are administered, restoring facial architecture and preventing craniofacial complications.

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RESUMEN: Las fracturas extensas en el esqueleto facial combinadas con una lesión cerebral traumática pueden causar deficiencias funcionales y estéticas, que posiblemente pongan en peligro la vida del paciente. Paciente de sexo masculino, 50 años, víctima de agresión física, que presentó cefalea persistente y mareos, fracturas en las regiones naso-orbito-etmoidal, cigomático-maxilar y pterigoides derecha, entre otros patrones menores de fractura facial,

con movilidad a tracción maxilar del tercio medio facial unilateralmente. Los hallazgos de las imágenes clínicas revelaron una hemifractura de Le Fort III y neumocefalia subdural y subaracnoidea con un leve signo del Monte Fuji. El tratamiento propuesto fue la osteosíntesis facial y el tratamiento farmacológico intravenoso conservador de la neumocefalia. El paciente tuvo una buena recuperación, sin déficit motor ni funcionales postoperatorios. El manejo adecuado del paciente con trauma facial asociado a craneotrauma ofrece beneficios, devolviendo la estabilidad de la arquitectura facial y previniendo o complicaciones neuroquirúrgicas.

PALABRAS CLAVE: terapia conservadora, traumatismo craneal, osteosíntesis, fracturas de cráneo.

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