

## Evolutionary Skull Fracture in the Child: About a Case

Luis Horta Clavero\* and Exer Zambrano Mendoza

Neurosurgery Service, Baca Ortiz Pediatric Hospital, Quito, Ecuador

\*Corresponding Author: Luis Horta Clavero, Neurosurgery Service, Baca Ortiz Pediatric Hospital, Quito, Ecuador.

Received: November 01, 2017; Published: November 25, 2017

### Abstract

Evolutionary cranial fracture (GFS), also called leptomeningeal cyst or bone absorption, is a rare late complication of cranioencephalic trauma but significant and occurs almost exclusively in children under 3 years of age. The most frequent location is in the parietal or fronto-parietal region. We present a case of an evolutive cranial fracture, with extensive subgaleal parieto-temporo-right occipital cyst. The cause of the traumatic brain injury (TBI) was the fall of his own feet. A progressive epicranial bulge motivated the medical evaluation after 22 days of TBI. Computed tomography (CT) was the key in the diagnosis. The patient underwent plastic repair of the dura mater and placement of titanium mesh over the skull defect. The complete resolution of the swelling of the scalp was achieved. Detection and early treatment are a fundamental fact to prevent neurological injuries.

**Keywords:** Traumatic Brain Injury; Evolutionary Fracture of the Skull; Leptomeningeal Cyst; Computed Tomography

### Introduction

Linear or non-linear skull fractures in children that enlarge over time are called growing or evolving skull fractures [1].

Over time, various names were used to identify this condition as: traumatic cephalohydrocele, cranial malacia, fibrosing osteitis, spurious meningocele, pseudomeningocele, traumatic meningocele, cranial brain erosion, expansive fracture, leptomeningeal cyst and, until the term fracture was finally adopted evolutionary or crescent of the skull [2].

Described for the first time by the British surgeon, Dr. John Howship, in 1816 [3], evolutionary skull fractures are rare complications of severe head trauma in childhood, occurring in 90% of cases in children under three years of age [4] and represent 0.05% -1.6% of all childhood fractures [4,5].

Due to a delay in diagnosis and/or inadequate management this condition can be aggravated, so early identification of symptoms and rapid management are critical to achieve a good outcome [6,7].

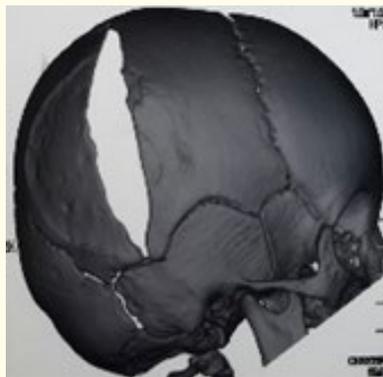
### Presentation of the case

Male patient, 13 months of age, with negative pre-peri and postnatal antecedents and previous health history. The mother reports that, 3 months prior to admission, the child suffered a fall from his own feet receiving head trauma, with the edge of a wood, in the right parietal temporo region, without unconsciousness, immediate crying and no vomiting. He was evaluated in his health area and when the clinical examination was normal, they did not perform any imaging studies and were discharged with analgesics. However, 22 days after the cranial trauma, it began with an increase in volume in the trauma region, which progressively increased in size, being valued in several health centers and finally assessed and admitted to the Neurosurgery Service of this house. of health on 10/15/2017. There was no history of seizures, vomiting, fever, irritability, or any neurological deficit, and there was great epicranial swelling on the right side (parieto-temporo-occipital), approximately 10 x 10 cm in diameter and 4 cm in height, renitent and non-painful to the palpation (Figure 1).



**Figure 1:** Right side view of the patient.

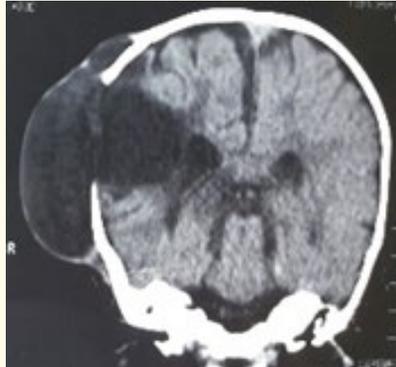
CT (Figure 2) showed a large cranial, linear and vertical bone defect in the right parietal, approximately 8.5 x 2 cm in length, as well as: asymmetry of the lateral ventricle, underlying cerebral parenchymal lesion (poroencephaly) and leptomeningeal cyst (Figure 3 and Figure 4).



**Figure 2:** CT in 3D reconstruction, lateral view, showing the right parietal evolutionary cranial fracture.



**Figure 3:** CT scan in axial section, showing the poroencephalic cavity and the subgaleal leptomeningeal cyst.



**Figure 4:** CT scan in coronal section showing the ventricular asymmetry, the poroencephalic cavity, the left parietal cranial bone defect and the subgaleal leptomenigeal cyst.

With laboratory studies within normal values, surgery was performed on 10/17/2017 (Figure 5 and Figure 6). A vertical and linear cutaneous incision was made in fusiform form (Figure 7), for posterior plastic closure of the excess skin, a pericranial flap was obtained to perform the duroplasty (Figure 8), the content of the cyst was evacuated, after obtaining sample to perform laboratory studies and its capsule was resected (Figure 9). Exposure of the bone defect showing the poroencephaly cavity and communication with the ipsilateral lateral ventricle (Figure 10). The edges of the dura were attached to an area of gliosis, glia tissues were resected, the edges of the bone defect were exposed by dissection of the dura to a well-defined dural margin, duroplasty with pericranial flap (Figure 11), exhaustive haemostasis, placement of titanium mesh and fixation with 4 mm self-drilling screws (Figure 12), no drainage was left and flat closure was carried out, without difficulty (Figure 13). CT control was performed 24 hours postoperatively (Figure 14 and Figure 15). The patient was discharged from the hospital seven days after surgery.



**Figure 5:** Preoperative image, right side view.



**Figure 6:** Surgical preparation.



**Figure 7:** Fusiform cutaneous incision and leptomeningeal cyst exposure.



**Figure 8:** Obtaining a pericranial flap to perform the duroplasty.



**Figure 9:** Evacuation of the cyst and resection of the capsule, note the cranial defect in the depth.



**Figure 10:** Bone defect, edges of the dura stuck to an area of gliosis, poroencephalic cavity and communication with the right lateral ventricle.



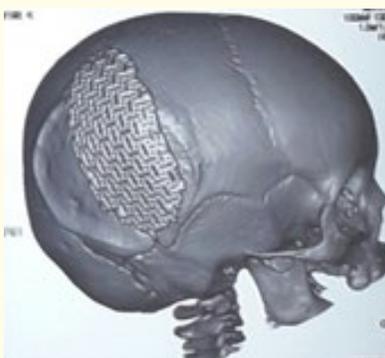
**Figure 11:** Duroplasty with pericranial flap.



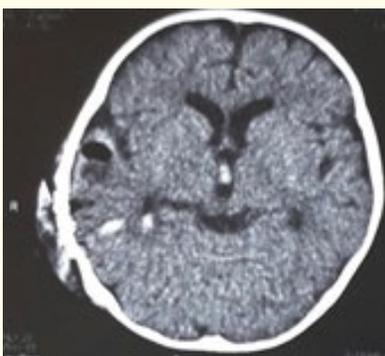
**Figure 12:** Cranioplasty with titanium mesh and self-drilling screws.



**Figure 13:** Final result.



**Figure 14:** Postoperative control. CT in 3D reconstruction, side view, showing the titanium mesh covering the skull defect.



**Figure 15:** Postoperative control. TC sagittal view.

## Discussion

FEC is a complication that, according to different series, represents about 1% of patients suffering from a linear fracture of the skull after a head injury [8].

The most frequent causes of the traumatic brain injury are first the fall to the ground from height (93%) and secondly the traffic accident [9]. There is unanimity in that for the formation of this growing bone defect there must coexist a cranial fracture and a dural laceration. In this patient, the kinematics of the traumatism was of low intensity, apparently, when the fall from its own height, on a wooden object and did not present unconsciousness, neurological symptoms or alterations in the clinical examination, which caused that it was not performed Initial imaging studies and therefore cranial fracture will not be diagnosed from the beginning. Simple skull radiographs initially show a fracture line, which over time can be transformed into a large bone defect.

The condition was detected when the parents noticed the increase in cystic volume (soft and soft) in the head of their baby. Initially, the condition can be confused with a cephalohematoma but the correct diagnosis will be made in a simple skull x-ray.

Classically, the diagnosis is made during follow-up, after the original trauma, when a palpable cranial defect or protruding mass is clinically discovered.

The herniation of the meninges and / or the brain through the dural defect is seen favored by the pulsations of cerebrospinal fluid (CSF) without an increase in intracranial pressure has been associated. With the growth of the herniation, the bone margins on both sides of the fracture line are eroded, extending the initial bone defect [10,11]. Often the adjacent part of the brain suffers atrophy. Alterations in the morphology and passive dilation of the ipsilateral lateral ventricle are also common, coinciding with the findings found in this patient.

Brain growth in children pulses through the dura and bone defects, eroding the bone, increasing the width of the fracture and creating characteristic scalloped edges [12,13].

Cranial CT was the diagnostic method used, where it was evidenced porencephaly underlying the growing fracture, as well as discrete ventriculomegaly at the expense of the right lateral ventricle, retraction and leptomeningeal cyst.

The CT allows a greater information of the bony structures together with the adequate study of the cerebral parenchyma. MRI may show an area of the same intensity as the bruised brain or CSF that is introduced through the bone margins of the fracture [14]. In our case, no MRI study was performed due to the evident nature of the lesions.

According to the appearance of the computed tomography scan, Naim-Ur-Rahman subdivided GSF into three types: type 1: GSF with a Leptomeningeal cyst, which can be seen to herniate through the skull defect in the subgaleal space. Type 2: associated brain damage or gliosis. Type 3: Associated porencephalic cyst [15,16]. Our patient presented a type 3.

The exact pathogenesis of GSF is unknown. The combined dural and arachnoid rupture is necessary to produce bone erosion and the additional brain injury does not increase the incidence of GSF.

Once the surgical procedure was decided upon, all the necessary information was provided to the parents and it was explained that the resection of the cystic lesion, the hermetic closure of the dura mater, the cranioplasty with titanium mesh and the skin plasty would be performed.

The standard surgical approach includes the resection of the leptomeningeal cyst and the herniated brain, the repair of the dural defect with graft and cranial plasty [17,18].

In the current times, the materials commonly used to perform cranioplasty include silicone prostheses, titanium implants and a variety of artificial bones [19].

The reconstruction must respect the topography of the cranial surface by creating harmonic contours. For this purpose a great variety of techniques and materials are described, including auto, homo and xenografts, metallic and acrylic materials and even calcium cements derived from calcium. All of these possibilities have varying success rates, depending on the location and size of the lesion [20].

The ideal material must be biocompatible, resistant, lightweight, non-magnetic and stable in the long term [21]. All these characteristics limit the use of cranioplasty techniques.

In our patient, we used fine titanium mesh and 4 mm self-drilling screws, taking into account the cranial thickness, despite the child's age. The transposition of the bone flap was evaluated, but it involved a very extensive surgical approach, taking into account the size of the subgaleal cystic lesion and the extension of the cranial fracture.

Other authors have used bones of divided cranial vault, ribs, iliac crest and metallic materials with satisfactory results [22,23]. However, children under 2 years of age have a thickness of skull bone that is too difficult to divide to repair the defect [23].

Titanium is a chemical element discovered in 1796. Its most outstanding characteristics are its biocompatibility and its resistance [24].

The patient was discharged seven days after surgery, with excellent clinical status and favorable resolution of the leptomenigeal cyst.

### Conclusions

Adverse events after a mild non-surgical traumatic injury are rare, but the existence of an evolving skull fracture should be suspected in all children younger than 3 years of age, starting late with a bump on the scalp and progressively growing or a huge defect in the bone.

The total consolidation of a skull fracture, in children under 3 years, should always be checked, to avoid the appearance of this complication.

The earlier diagnosis allows for less complex repair and decreases the appearance of permanent neurological sequelae.

### Recommendations

Skull fractures should be examined radiologically every two or three months after the diagnosis of a linear fracture of the diastase skull in children under 3 years of age.

If the increased fracture of the skull is confirmed, a surgical repair should be recommended.

The use of titanium mesh in the cranioplasty of an evolutionary cranial bill is useful, but each patient must be evaluated individually.

### Revelation

The authors report that there is no conflict of interest with respect to the materials or methods used in this study or the findings specified in this document.

### Bibliography

1. Scarff TB and Fine M. "Growing skull fractures of childhood". In: Wilkins RH, Rengachary SS, eds. *Neurosurgery*. Volume 2. New York: McGraw Hill (1985): 1627-1628.
2. Ersahin Y, *et al.* "Growing skull fractures (craniocerebral erosion)". *Neurosurgical Review* 23.3 (2000): 139-144.
3. Howship J. "Practical observations in surgery, and morbid anatomy: Illustrated by cases". London: Longman, Hurst, Rees, Orme, and Brown (1816).
4. Lenthall R and Penney C. "Growing skull fracture extending posteriorly to the superior sagittal sinus with intradiploic extension". *British Journal of Radiology* 72.859 (1999): 714-716.

5. Leung GK, et al. "Growing skull fracture in an adult nine years after blunt head trauma". *Journal of Clinical Neuroscience* 18.6 (2011): 855-857.
6. Bonfield CM, et al. "Pediatric skull fractures: the need for surgical intervention, characteristics, complications, and outcomes". *Journal of Neurosurgery Pediatrics* 14.2 (2014): 205-211.
7. Mihajlovic MH, et al. "Growing skull fracture". *Vojnosanitetski Pregled* 63.8 (2006): 761-764.
8. Muhonen MG, et al. "Pathogenesis and treatment of growing skull fractures". *Surgical Neurology* 43.4 (1995): 367-373.
9. Gupta SK, et al. "Growing skull fractures: a clinical study of 41 patients". *Acta Neurochirurgica* 139.10 (1997): 928-932.
10. Lende RA and Erickson TC. "Growing skull fractures of childhood". *Journal of Neurosurgery* 18.4 (1961): 479-489.
11. Scarff TB and Fine M. "Growing skull fractures of childhood". In: Wilkins RH, Rengachary S, editors. *Neurosurgery*. New York: McGraw-Hill (1985): 1627-1628.
12. Sanford RA. "Prevention of growing skull fractures". *Journal of Neurosurgery: Pediatrics* 5.2 (2010): 213-218.
13. Kutlay M, et al. "Untreated growing cranial fractures detected in late stage". *Neurosurgery* 43.1 (1998): 72-76.
14. Nalls G, et al. "Leptomeningeal cyst: non-enhanced computed tomography findings". *American Journal of Emergency Medicine* 8.1 (1990): 34-35.
15. Diyora B, et al. "Surgical treatment and results in growing skull". *Neurology India* 59.3 (2011): 424-428.
16. Naim-Ur-Rahman, et al. "Growth of skull fractures: classification and management". *British Journal of Neurosurgery* 8.6 (1994): 667-79.
17. Long DM, et al. "Leptomeningeal cyst". In: Youmans JR. *Neurological surgery*. Philadelphia: Saunders (1982): 3245-3250.
18. Bruce DA. "Growing skull fracture: special considerations of the pediatric age group". In: Cooper PR. *Head injury*. Baltimore: Williams & Wilkins (1982): 318-319.
19. Wang M, et al. "Visualización de los implantes de Med por utilizando renderizado de superficie". *Chinese Medical Journal* 124 (2011): 2890-2893.
20. Grenberg BM and Schneider SJ. "Alloplastic reconstruction of large cranio-orbital defects: a comparative evaluation". *Annals of Plastic Surgery* 55.1 (2005): 43-51.
21. Genecov DG, et al. "Norian craniofacial repair system: compatibility with resorbable and nonresorbable plating materials". *Plastic and Reconstructive Surgery* 120.6 (2007): 1487-1495.
22. Guyuron B, et al. "Management of extensive and different cranial defects". *Journal of Neurosurgery* 69.2 (1988): 210-212.
23. Posnick JC, et al. "Reconstruction of skull defects in children and adolescents by the use of fixed cranial bone grafts: Long-term results". *Neurosurgery* 32.5 (1993): 785-791.

24. Vignes JR, *et al.* "Cranioplasty for repair of a large bone defect in a growing skull fracture in children". *Journal of Cranio-Maxillo-Facial Surgery* 35.5 (2007): 185-188.

**Volume 9 Issue 1 November 2017**

**©All rights reserved by Luis Horta Clavero and Exer Zambrano Mendoza.**