

# Reconstruction of depressed skull fracture in school patients. Technique description

## Reconstrucción de fractura de cráneo deprimida en pacientes escolares. Descripción de la técnica

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### Abstract

**Objective:** Depressed skull fractures are the result of trauma injuries. They are present in approximately 3% of patients who arrive to an emergency room with skull trauma. The main objective of surgical repair in depressed fractures is correction of cosmetic deformity and the prevention of infections. **Material and methods:** A retrospective and transversal study was performed by our department between April 2016 and May 2017. Sixteen patients that underwent a craniotomy for skull trauma with depressed fracture were included in the study. The diagnosis was made by simple cranial CT scan alongside a three-dimensional reconstruction. **Results:** Of the sixteen patients included, 5 were females (31.2%) and 11 males (68.8%). Twelve of the cases were an exposed fracture. In 7 cases, the fracture was located at parietal bone; 5 were located at frontal bone and 4 at the temporal bone. The average Glasgow coma score in the sample was 13. There were no complications nor deaths. **Conclusions:** The remodeling and repositioning of the autologous bone graft allow an adequate cosmetic result and it also avoids the placement of implants without increasing the costs and additional risks.

**Keywords:** Depressed skull fracture. Traumatic brain injury. Cranial fracture reconstruction

### Resumen

**Objetivo:** las fracturas de cráneo deprimidas son el resultado de lesiones traumáticas. Se encuentran en aproximadamente el 3% de los pacientes que se presentan en salas de emergencia con traumatismo craneal. El objetivo principal de la reparación quirúrgica en fracturas deprimidas es la corrección de la deformidad cosmética y la prevención de infecciones. **Pacientes y métodos:** se realizó un estudio retrospectivo y transversal en nuestro departamento entre abril de 2016 y mayo de 2017. Se incluyeron 16 pacientes que se sometieron a una craneotomía por traumatismo craneal y fractura deprimida. El diagnóstico se realizó mediante tomografía computarizada craneal simple con reconstrucción 3D. **Resultados:** se incluyeron 16 pacientes, 5 casos femeninos (31,2%) y 11 masculinos (68,8%). En 12 casos se observó fractura expuesta. En 7 casos la fractura se localizó en el hueso parietal; 5 casos en el hueso frontal y 4 casos en hueso temporal. El puntaje promedio en la Escala de Coma de Glasgow fue 13. No hubo complicaciones o muertes. **Conclusiones:** la remodelación y el reposicionamiento del injerto óseo autólogo permite un resultado cosmético adecuado evitando la colocación de implantes sin aumentar los costos y riesgos adicionales.

**Palabras clave:** Fractura craneal deprimida. Traumatismo cerebral. Reconstrucción de fractura craneal.

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## Objectives

Depressed skull fractures are the result of traumatic injuries. They are found in approximately in 3% of patients who arrive to emergency room with cranial injury. About 70% of skull fractures are the result of motor vehicle accidents, followed by falls, sports accidents, and aggressions<sup>1</sup>.

A depressed skull fracture occurs when the outer table of one or more of the fractured segments is below the level of the surrounding intact inner table. Most depressed fractures are exposed. It is important to pay attention to the integrity of the dura mater underlying the injury. Depressed fractures often produce focal neurologic deficits due to injury of the underlying cerebral cortex. The main objective of surgical treatment in depressed fractures is not the neurological recovery, but the correction of cosmetic deformity and the prevention of infections. Lesions that result in depressed fractures are often associated with altered alertness and focal neurologic deficits in atonement with the subjacent damage in the cerebral cortex; however, many depressed fractures are not recognized at the time of the injury. The cranial computed tomography (CT) scan is the diagnostic method of choice; the axial images usually show most of the surface area of the skull. Nevertheless, three-dimensional (3D) reconstruction allows for a better analysis of depressed fractures. The most common indication for surgical treatment in closed depressed fractures is cosmetic since more than 50% of them are frontal and are visible. Another indication for the surgical repair of a depressed closed fracture is the suspicion of a dural rupture. Open depressed fractures are considered a neurosurgical emergency due to contamination of the wound, the presence of lacerated dura and the risk of meningitis. The incidence of infections is approximately 10%. Surgical repair of depressed skull fractures is essential during the first 24 h after the injury. The main objectives of the surgery are the removal of the fracture, complete debridement, repair of dural lacerations, drainage of associated hematoma, and the elimination of contaminated bone fragments or any foreign material<sup>2,3</sup>.

## Material and Methods

A retrospective, longitudinal, and transversal study was performed in the neurosurgery service during the period between April 2016 and May 2017. Sixteen patients were included who underwent craniotomy

because of the diagnosis of skull trauma and depressed fracture. Of the total number of patients an open fracture was found in 12 cases and a closed fracture in four cases. The patient group age was 6-11 years.

The variables analyzed were: Age of presentation, mechanism of injury, fracture site, type of fracture (exposed or closed), presence of dural laceration, and associated hematomas. The diagnosis was made clinically and confirmed by simple CT scan with 3D reconstruction. Patients with exposed fracture routinely received antibiotics.

In the 16 cases, surgery was performed in the first 6 h following the trauma, using the technique described (Fig. 1).

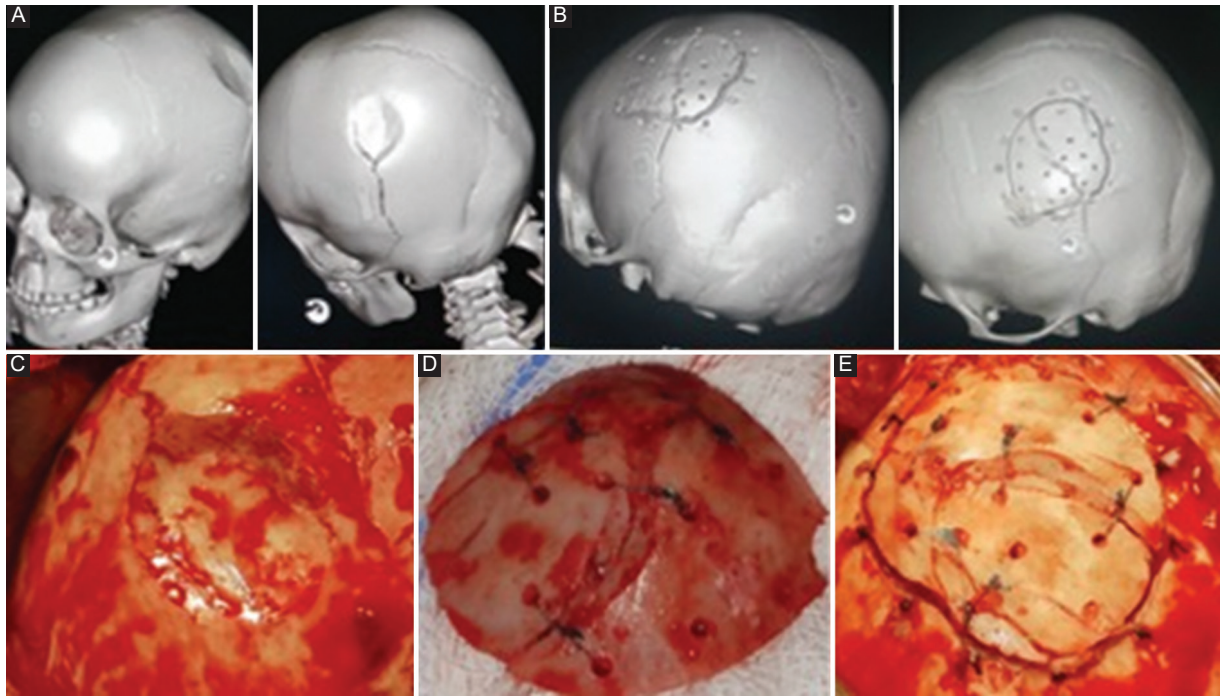
The incision was planned depending on the location of the fracture, then surgical cleaning and placement of sterile fields was performed in a regular manner. An incision of skin and galea is made following skin flap dissection and pericranium dissection maintaining its irrigation. The skull is cut with a high power burr surrounding the fracture. Single lateral trepan is performed lateral to the fracture with a high-speed drill and an initiating bit then the fracture is surrounded with a lateral cut proceeding to the removal of the bone flap, dural uplift with perforations to the cranial edges and hard suspension with vascular suture (polypropylene) 4-0.

The reduction and alignment of fragments of the fracture are made with hammer and polypropylene 2-0. The repaired bone flap was cleaned and finally fixed to the skull with 2-0 polypropylene. Drainage of the associated hematomas and duraplasty was performed when required. Finally, hemostasis was verified, drains were placed and the surgical wound was closed in a conventional manner.

## Results

Sixteen patients were included, five cases (31.2%) corresponded to female patients and 11 (68.8%) to male cases. The age of presentation was 6-11 years with an average of 7 years. In 11 patients the trauma mechanism was falling, in 4 due to aggression and one case secondary to accident in motor vehicle. In 12 cases, the depressed fracture was exposed and in four was closed. All patients underwent surgery in the first 6 h subsequent of the trauma. Third-generation cephalosporin was indicated in all open cases.

In seven cases, an epidural hematoma was found, in two a parenchymal hematoma and three cases with



**Figure 1.** A: preoperative three-dimensional (3D) computed tomography (CT) scan. B: Post-operative 3D CT scan. C: Depressed fracture at the moment of surgery. D: Reconstruction, alignment, and fixation of fracture with polypropylene 2-0. E: Fixation at the skull also with polypropylene 2-0.

subdural hematoma. Of the total cases, eight patients presented with a dural laceration. According to its location: Parietal: Seven cases; frontal: five cases and temporal: Four cases. The average of GCS was 13. There were no complications nor deaths. All patients were followed up during 12 months without presenting osteomyelitis signs (Figs. 2 and 3).

## Discussion

Historically, depressed fractures and even more exposed ones undergo two procedures: the first one, an urgency where the surgical cleaning is performed, drainage of the associated hematomas and the involved bone segments, which are considered in many cases not viable and the second one the elective cranioplasty for the repair of the bone defect, dividing it in two surgical times to reduce the risk of infection in the surgical site. Nevertheless, we propose an alternative that has shown both safety and a single surgical procedure, unlike other authors who use this same principle of unique surgery with the use of alloplastic materials<sup>4,5</sup> which in our environment is difficult to use due to the cost. We use an alternative technique that in our experience is safe and offers

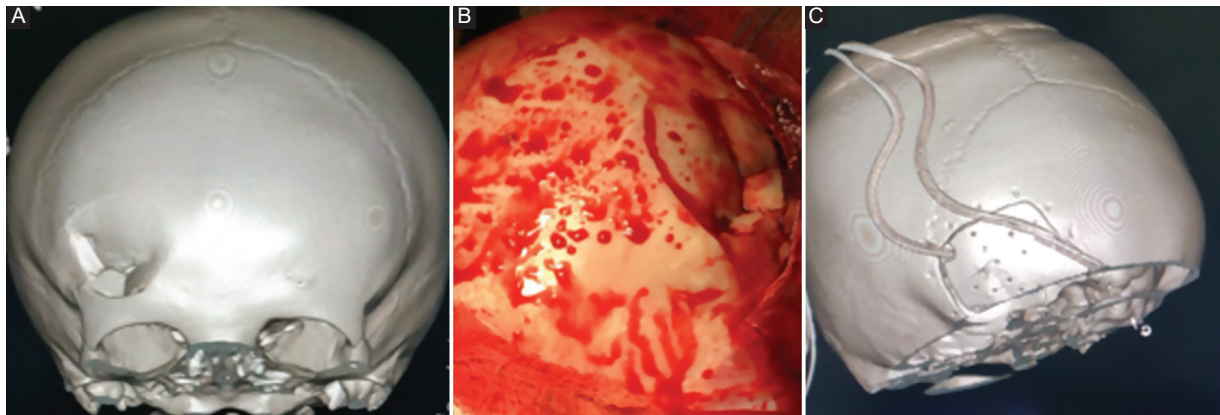
results comparable to other materials with a lower cost.

The objective of using bone in an autologous way in children is to improve tissue integration, osteogenesis and osteoconduction<sup>6</sup>. Many authors have already described that conserving bone even in cases of depressed fractures is an alternative that in some cases can be used. In the particular case of pediatric patients, certain considerations should be noted, emphasizing that at 7 years-old there is already 95% of the size of the skull and before that age, so we must use materials that do not limit the cranial growth<sup>6,7</sup>.

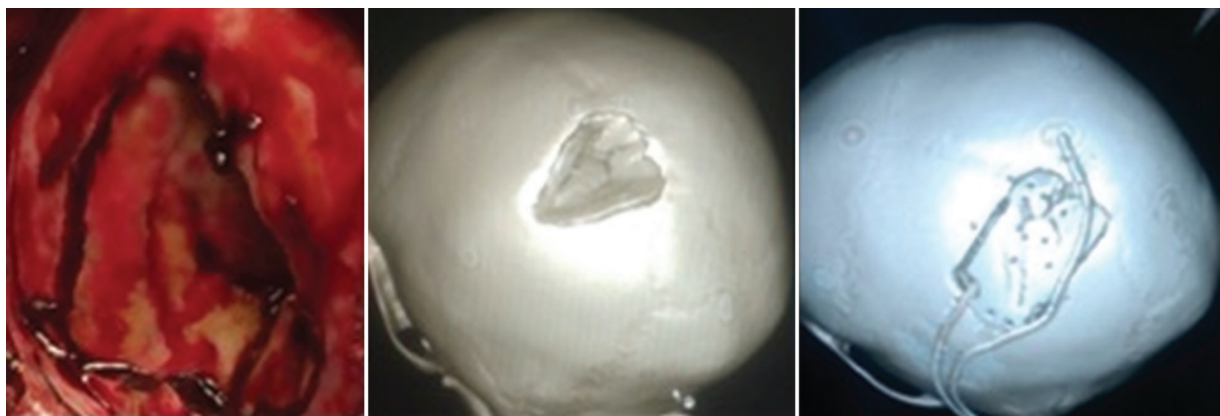
The use of antibiotic is widely applied in cases of exposed fractures. Whereas in our environment we use third generation cephalosporins, other authors have described favorable results with the use of second generation cephalosporins 7-10 days<sup>1</sup>. We conferred our results and the absence of infectious complications to the use of antibiotics and the rapid attention we provided alongside surgical treatment in the first 6 h after the trauma.

In addition to having a good therapeutic result, the cosmetic outcome is also important<sup>8</sup>. A cranial defect directly impacts in children's self-esteem. With the alternative that we propose, in a single surgical time,





**Figure 2.** A: preoperative three-dimensional (3D) computed tomography (CT) scan. B: Depressed fracture at surgery. C: Post-operative 3D CT scan.



**Figure 3.** Preoperative and post-operative three-dimensional computed tomography scan.

both therapeutic and esthetic results can be satisfactorily accomplished in many cases. The use of 3D CT is very useful for the evaluation of fractures, as well as for postoperative and aesthetic evaluation, thus being able to compare our results with those who use alloplastic material<sup>9</sup>.

## Conclusion

Skull trauma in the school-age population has increased, being always a priority to save the life of the patient in cases that require it over the esthetic. There are multiple cranial reconstruction techniques described in the literature which allow adequate reconstruction, however, most are implants, involving an additional cost for the patients or the institutions, being difficult to afford them in the majority of the cases, for which we consider that the technique described in

our series allows to maintain an adequate reduction of the fracture, without raising costs for the patient or health institutions and allowing to obtain satisfactory medical, surgical and aesthetic results without generating additional risks.

## Conflicts of interest

The authors declare that does not exist a conflict of interest.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** The authors declare that no patient data appear in this article.

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