ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 07 | July - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SURGICAL RECONTOURING OF DEPRESSED FRONTAL BONE FRACTURE USING HYDROSET CEMENT- A CASE REPORT

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ABSTRACT

Skull fracture refers to a fracture of one or more bones of the cranial vault or skull base. They are categorized according to the appearance, location, degree of depression, and if they are open or closed. Open fractures communicate with the skin through a wound, a sinus, the ear, or the oropharynx. Skull fractures may be linear or comminuted; comminuted fractures are complex with multiple fracture lines. The presence of skull fracture on patients sustaining traumatic brain injury is an important risk factor for intracranial lesions, such as hematomas, contusions, unfavourable outcome, and death. Depressed skull fractures (DSF), one of the types of compound cranial fractures, usually resulting from blunt injuries, occur when the extent of bone displacement is greater than the full thickness of the adjacent calvarium. Compound DSF are fractures with an overlying scalp laceration and galeal disruption. Frontal DSF exhibits some peculiarities such as frequent involvement of frontal sinus and olfactory nerve and tract, which lie on the floor of the anterior cranial fossa. Frontal DSF with involvement of the inner table of the frontal bone can lead to particular complications such as central nervous system (CNS) infections in up to 15% to 30% of the patients (e.g., meningitis and brain abscess), mucocele cyst, chronic sinusitis, cerebrospinal fluid (CSF) leakage, late posttraumatic epilepsy (LPE), and smell and taste disturbances (STD). It is worth emphasizing that CNS infections are associated with permanent neurological sequelae and other unfavourable outcomes. We highlight a case of surgical recontouring of a depressed frontal bone fracture using Hydro set, a fast-setting calcium phosphate bone cement

KEYWORDS

Frontal bone, bone cement, depressed fracture, recontouring, skull fractures.

INTRODUCTION-

Depressed skull fractures, a very serious type of trauma occurring in 11% of severe head injuries, are comminuted fractures in which broken bones are displaced inward. This type of fracture carries a high risk of increasing pressure on the brain, crushing the delicate tissue. Complex depressed fractures are those in which the dura mater is torn. Depressed skull fractures may require surgery to lift the bones off the brain if they are causing pressure on it.[1]

Elevation and repair of an open depressed skull fracture is often thought of as an emergency procedure. Common indications for emergency elevation of a depressed skull fracture have been dural tear, seizure, gross contamination or mass effect from bone or a sizable underlying intracerebral hematoma.[4]

There are various modalities available for the reconstruction of frontal bone defects. The materials used for cranioplasty should fulfill several criteria such as the material should be biologically inert, moldable, nonreactive, noncorrosive, nonresorbable, nonantigenic, stable, durable, and ability to withstand impact.[2]

The search for a universal reconstructive material and the application of a routine approach leaves the surgeon limited in cranial reconstruction. Facility with a variety of implant materials and approaches helps optimize surgical management. The variability of surgical defects and challenges in cranial reconstruction highlights the importance of a strategic approach to evaluate both the defect and the clinical circumstance.[3] Among the numerous alloplastic materials available, the utility of titanium mesh, hydroxyapatite cement, and prefabricated custom acrylic implants have remained at the forefront.

HydroSet™ is a self-setting, calcium phosphate cement intended for use in the repair of neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects as well as in the augmentation or restoration of bony contour in the craniofacial skeleton.[5]

Case Report-

A 47year old male patient reported to the hospital, with an alleged history of road traffic accident_ (skid and fall) from two-wheeler and had sustained injuries to the facial region. The patient did not present with any active signs of intracranial bleed or injury. Extraorally, Periorbital edema and ecchymosis noted in relation to his Left eye and a sutured lacerated wound was noted in left frontal region and depression was noted. Tenderness on palpation was evident over the left frontal region.Paresthesia evident in the left fronto-parietal region. Intraorally, Mouth opening was adequate.Occlusion was stable Bilaterally. No segmental mobility noted in upper and lower arch. CT facial bones with 3D reconstruction revealed depressed left frontal bone fracture with hemosinus (Figure 1 and 2). Neurosurgery opinion was taken and fitness for surgery obtained . After obtaining anaesthetist fitness, patient was planned for ORIF and reconstruction under GA. The existing laceration was utilized to approach the fracture site and the fracture site was exposed (Figure 3). Communited fracture involving outer table extending from supraorbital region to 4cm superior to supraorbital notch is visualised (Figure 4). Fracture fixed using titanium plate (12hole plate without gap-1 and screws-1.7x 6mm screws) (Figure 5). A calcium phosphate-based cement (HydroSet™) which is a synthetic bone graft substitute was used in the reconstruction of the depressed frontal bone fracture.

The bone cement,consisting of powder and liquid components, was mixed to attain a flowable consistency(Figure 6 and 7) and then was applied over the defect and was manipulated to achieve the desired aesthetic contour of the forehead . Once the cement had set, closure was done in layers with Vicryl 3-0 and Ethilon 4-0 . The patient was assessed postoperatively for any pain or swelling from the surgical site. A postoperative computed tomography done to evaluate the adaptation and contour of the bone cement placed over the defect (Figure 8), which highlighted the attained aesthetic contour.

Pre-operative Radiographic Evaluation

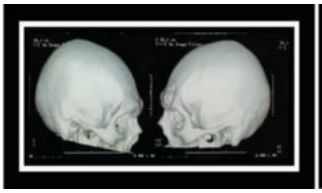

Figure 1

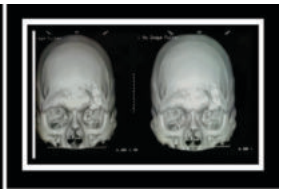

Figure 2

Intra Operative Pictures

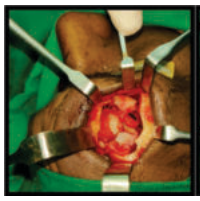
Figure 3


Figure 4


Figure 5

Hydroset Manipulation

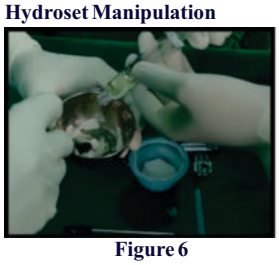
Figure 6

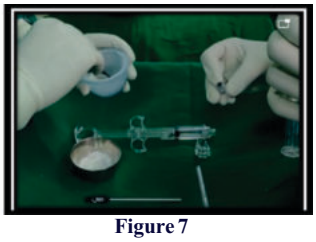
Figure 7

Post-operative Xray-PNS

Figure 8

DISCUSSION-

Skull fractures are break in one or more bones of the skull, following head injury. Fractures of the skull can be linear, comminuted, diastatic or depressed. Depressed skull fractures result from a high energy direct blow to a small area of the skull. Comminution in depressed skull fractures usually start from the point of impact, and spread centrifugally[3]. Most common area of skull to be involved is the fronto-parietal region, owing to the thin bone present .

Depressed fractures may be open or closed, wherein the open fractures are associated with existing skin lacerations overlying the fracture or the fracture line running through paranasal sinuses, resulting in communication between the cranial contents and the environment[6].

As reported by Al Haddad SA, the most common cause of depressed skull fractures is alleged assault, followed by road traffic accidents; with a preponderance of males over females in a ratio of 9:1[9].

Plain X-ray skull will demonstrate the fracture, type, its location, its degree of depression. CT (Computed Tomography) scan is helpful in the diagnosis of skull fracture and associated intracranial lesion. CT is more useful in demonstrating depressed fractures of the skull[4].

Surgical treatment is a good option for depressed skull fracture. Perioperative anticonvulsant use effectively reduces the chance of post traumatic seizure. Prophylactic antibiotic use reduces the risk postoperative / posttraumatic infection. Elevation of depressed fragment of bone over the sinus reduces the risk of benign intra-cranial hypertension[5].

The use of surgical treatment for depressed skull fractures that are located over major venous sinuses is a matter of controversy. However, if clinical and radiological findings of sinus obliteration and related intracranial hypertension are present, surgical decompression is indicated.[10]

However, during the surgical recontouring procedure, it is very challenging to successfully achieve the desired results intraoperatively depending on visual exposure and the surgeon's own assessment and experience. To overcome such challenges, Kang et al[7] developed a method of bone recontouring applying 3D printing technology using CT scans and screws as a guide. However, the surgeon might not be able to implant the screws exactly where they should be placed intraoperatively, in addition to the limited number of implants that cannot fully guide bone recontouring. Most importantly, inserting screws in the region near the orbit and neighbouring nerves can be dangerous. Wang et al, used CT scanning and 3D printing technology to make a template to guide bone recontouring.[8]This template could provide precisely anatomic specific of the lesion preoperatively, and directly serve as guide intraoperatively.

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