

Primary reconstruction of depressed skull fracture - The changing scenario

P K Nayak M Ch, A K Mahapatra M Ch*

Asst Prof of Neurosurgery Hi-Tech Medical College, Bhubaneswar

*Prof of Neurosurgery and Director

Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow

Abstract: Approximately 25% of all skull fractures are compound and merit immediate attention. Inadvertently fracture segments are removed in emergency to worsen the cosmetic problem. To analyze the benefit of primary reconstruction of depressed fracture and compare the various options available today. Thirty two patients underwent primary fracture reconstruction, from a study period of Feb2005 to Nov 2007 were analyzed retrospectively. The various techniques adopted by the author like simple elevation, apposition by nylon suture; or rigid fixation by titanium and absorbable mini plate were undertaken. Twenty two patients were male and ten were female. Eighteen (56%) cases underwent titanium miniplate fixation and eleven (34%) apposition using nylon sutures. In two cases simple elevation of fracture segments was carried out and in one fixation with absorbable (Poly-L- lactide) miniplate, was performed. Infection and Plate rejection were not encountered in this study. Cosmetic deformity correction to acceptable level was achieved better with miniplate. Primary reconstruction of fracture segment should be attempted as and when possible. Even in India, titanium mini plate is cost effective and better option to any other available measures.

Keywords: Head injury, depressed fracture, reconstruction, good outcome.

INTRODUCTION

Approximately 25% of skull fracture are compound and merit immediate attention¹. The etiology is usually post-traumatic either following a traffic accident². Compound depressed fracture poses significant challenges to Neurosurgeon regarding their definite management. Cranioplasty of the front orbital are a major challenge to the surgeon because of the proximity to the globe, the sinuses, and the eyebrows and eyelids³. Inadvertently fracture segments are removed in emergency to worsen the cosmetic problem. Rarely, pulling out the fracture segment may damage the vital are of the brain and lead to neurological deficit or may cause profuse bleeding, if it is in the vicinity of a major dural sinus.

AIM OF STUDY

The aim of the study was to analyze, the benefits of primary reconstruction of the depressed fracture of skull and to compare the various methods of fracture reconstruction with that of titanium miniplate.

Address for Correspondence:

Dr. P. K. Nayak

B-6/6, Chandrama appt., Kharvel Nagar,

Bhubaneswar-751001, INDIA

E-mail-drmichaelpn@rediffmail.com

MATERIALS AND METHODS

Thirty two patients underwent primary fracture reconstruction, from Feb2005 through Nov 2007, were analyzed retrospectively. The various techniques adopted by the authors were simple elevation, apposition by nylon sutures; titanium wire, titanium and absorbable mini plate.

Technique: All cases were subjected to surgery within 24 hours of injury. In most of the cases Midas Rex pneumatic drill system was used to detach the fracture segments, taking utmost care to prevent further damage of the underlying brain. The bone fragments were washed with antiseptic solution. Primary closure of dural defect was tried in all cases. Application of fibrin glue and pericranial patch was performed wherever it was indicated. Reconstruction of the fracture segments was carried out by using C-1 drill point, for fixation. The implants used to for reconstruction were nylon suture, titanium wire, titanium mini plates and screws according to the need in each case. Finally the segment was replaced to maintain the primary contour, and achieved good cosmetic results (Fig 1)

Concept: The concept of primary reconstruction was to close the defect and preserve the anatomical barrier, to avoid a later cranioplasty and to prevent further complications like CSF leak, pneumocephalus, brain



Fig 1: Intra operative picture showing titanium miniplate fixation of depressed skull fracture

fungus and meningitis etc. The second reason for rigid fixation was to achieve good cosmetic results.

CRITERIA FOR NEUROSURGICAL INTERVENTION

- A. When the fracture was lying over the motor area and or displaced fracture segments like migration of bone segments in to brain parenchyma.
- B. It was also indicated in patients with CSF leak, underlying hematoma.
- C. The reconstruction was done exclusively for cosmetic purpose in some cases.

INDICATION FOR TITANIUM MINIPLATE

The titanium miniplate were used in case, (a) fracture over lying frontal region producing cosmetic deformity, (b) fracture involving the basifrontal region producing instability and (c) grossly comminuted fracture with significant bone loss.

RESULTS

Twenty two patients were male and ten were female. Road traffic accident was the major mode of injury, encountered in 22 patients, followed by fall from height, assaults and in one case it was due to blast of pressure cooker.

The age ranged between 18 to 32 years. All patients were conscious with Glasgow coma scale of 13- 15, at

the time of admission.

Plain CT scanning of brain was performed, which revealed fracture involving basifrontal region in 11(34%) patients, fronto-parietal region 17(54%), temporal bone and other location were involved in 2 patients each(6%).

Simple depressed fractures with no underlying pathology were noticed in two patients. Compound depressed fracture with underlying pathology like haematoma in 8 patients, dural tear in 22, CSF rhinorrhoea and pneumocephalus were observed in 3 and 6 patients respectively.

The dural repair was carried out by simple closure in 3, by application of pericranium patch and fibrin glue in 13. Duraplasty alone was performed in 6 patients.

Eighteen (56%) cases underwent titanium miniplate fixation. In eleven (34%) patients, apposition of bone was done by using nylon suture /titanium wire. In two cases only elevation of fracture segments were carried out. Only in one case it was possible to put absorbable (Poly-L- lactide) miniplate.

The correction of deformity was up to an acceptable level, which is more than 90% correction as compared to contra lateral site (Fig 2). A better cosmetic result was noticed whenever miniplate was used (Fig 3). Infection and plate rejection was not observed in this study. In one case persistent CSF rhinorrhoea required endoscopic closure, subsequently.



Fig 2: Skull x ray showing excellent cosmetic correction of Fracture

DISCUSSION

In a depressed skull fracture, the outer table of one or

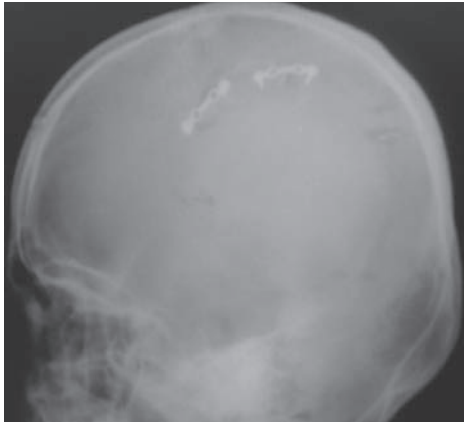


Fig 3: Miniplates holding the fracture segments in position

more of the fracture edges lies below the normal anatomical level of the inner table as determined by the surrounding intact skull^{4,5}. At the site of impact mostly the inner table fracture first and get depressed inside. The fracture segment produces dural tear and underlying bone damage. The locations of depressed skull fractures are fronto-parietal in 75% cases, temporal location in 10%, occipital in 5% and others 10%. As high as, in 75-90% of cases, the depressed fractures are compound in nature⁶.

A free piece of bone should be depressed greater than the adjacent inner table of the skull to be of clinical significance and requiring elevation. Most surgeons prefer to elevate depressed skull fractures if the depressed segment is more than 5 mm below the inner table of adjacent bone.

Elevation of bone fragments occasionally improves a focal neurological deficit originating in the cortex directly under a depressed bone fracture. The brain dysfunction generally undergoes a neurological recovery over a period of several weeks to months, similar to that after a stroke or a head injury without a depressed fracture⁷.

The treatment of serious cranial defects has always been a fascinating and controversial issue for craniofacial surgeons⁸. Reconstruction of the craniofacial defects can be carried out with autogenous tissue (calvarium, rib and iliac crest), allogeneic implants (AAA-bone, lyophilized cartilage) or alloplastic material (methacrylate, hydroxyapatite, titanium implants and mesh systems). Selection of the implant material used for reconstruction is still controversial⁹.

Retaining loose bits of bone fragments helps to prevent

a second operation of cranioplasty and the risk of infection is not significantly higher by such retention¹⁰. In our study, no infection was recorded. Implant rejection were also nil in this study.

To repair depressed fractures of the skull, wire ligatures are usually sufficient. However, complex depressed fractures of the skull in which the bone is smashed into several fragments are difficult to reconstruct by wiring. Therefore, bone flaps tend to be mobile and may result in deformed appearance. The authors have used bone fragments combined with titanium miniplates to repair depressed skull fracture. These miniplates were originally developed for maxillofacial surgery, and are biologically quite stable. The rigid fixations of bone fragments in the repair of depressed skull fractures can be a problem, especially if not all fragments are replaceable. Usually, in these cases mini or microplates are used¹¹.

Similarly, the titanium micro-mesh was used by Kuttenger et al, with the following indications: (1) immediate reconstruction in the primary treatment of comminuted fractures with bone loss in non load-bearing areas, (2) treatment of contour irregularities⁹.

Setsuko et al¹², had described bone flaps that were broken into fragments. They could achieve sufficient stability, to resume the original cranial shape by using titanium miniplates. An extra advantage is that titanium miniplates rarely interfere with postoperative imaging.

Frontal bone contour defects causes marked facial deformity, which is instantly obvious to the observer¹². Reconstruction of large defects of the frontal bone and bony orbit may be required following trauma¹³.

In this study we achieved acceptable cosmetic results in correcting deformity, which is more than 90% correction as compared to contra lateral site.

The conventional methods of stabilizing fragments in cranial depression fracture include the use of threads, wires and plates¹⁴. Titanium is an useful tool in the fixation of bone fragments in the repair of depressed skull fractures⁸. Implant rejection was not observed and no delayed healing or infection occurred, as reported by Stendel et al¹⁵. Similarly, in other study, no wound infections, exposures or loss of the mesh have been observed. Long-term stability of the reconstructions was excellent⁹. Similar observation is recorded in our study. We feel a larger number of cases are required to be studied for statistical data analysis.

CONCLUSIONS

Primary reconstruction of depressed fracture segment should be attempted whenever possible. The biodegradable miniplates are implant of choice, but the titanium mini plates are cost effective and better option to any other available measures. Further technological advance and larger studies are required to investigate the usefulness of titanium miniplates/biodegradable devices in neurosurgery and to obtain long-term good results.

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