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Case Study

A Local Protocol for Cranioplasty (Case study)

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Abstract

In this case-series we discuss about 136 cases of skull bony defect to different causes traumatic and non-traumatic (from Jan./2015- Dec./2024) done in local hospital (Sohar Hospital).

Inclusion criteria were: cause of defect, size of defect, material closing the defect

Patient population as 73 M and 63 F (age from 2-72 years)

In this report we evaluate the therapeutic results retrospectively.

The treatment was with autograft in 102 patients where the bone embedded in the abdominal wall (Temporary placement in a subcutaneous pocket (SP).) and the 34 patients were treated artificial bone graft as methacrylate with or without mesh .

Fortunately, we did the traumatic clean and non-traumatic within 2-4 weeks while the traumatic non clean wounds were done after 6-8 weeks after first surgery.

Only 4 cases of post traumatic cranioplasty developed infection so removal of the bone flap done and replaced by artificial bone after 12 weeks,

That of non-traumatic cases are mostly stroke patients with 2 cases registered of infection so also removal of the bone flap done and replaced by artificial bone after 12 weeks,

Keywords: *decompressive craniectomy, Cranioplasty, autograft, artificial graft.*

Materials and Method

This is a retro prospective study was conducted for evaluating the indications, materials used, complications, and outcome of cranioplasty.

This study was prospective from Jan./2015 to Dec./ 2024.

In this study, abstracted data included age at the time of cranioplasty (years), sex (male or female), indications for craniectomy (trauma, stroke, or tumors), time between craniectomy and cranioplasty (less than 6 weeks), type of graft (autologous or artificial), type of prosthesis if used (methyl methacrylate, titanium), storage of bone flap if used (subcutaneous or deep freezer), operative time (minutes), and complications following cranioplasty.

After decompressive craniectomy for brain swelling, bone flaps if intact need to be stored in a sterile fashion

until Cranioplasty and in contaminated broken bones or bony tumors, bone need to be removed and then replaced by artificial bone.

Temporary placement in a subcutaneous pocket -(SP) usually abdominal wall and cryopreservation (CP) are the two commonly used methods for preserving clean bone flaps.

In this study we did the first method (subcutaneous pocket) and not the second.

There are many indications for cranioplasty which is usually done post operatively after craniectomy and indications of craniectomy are:

1/Post head injuries due to road traffic accidents, accounts 2% of all head injuries fall from height (FFH) and physical assault (5)

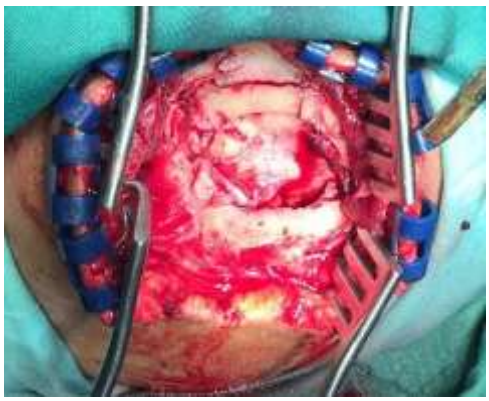

Fig 1: Sever skull bone fractures

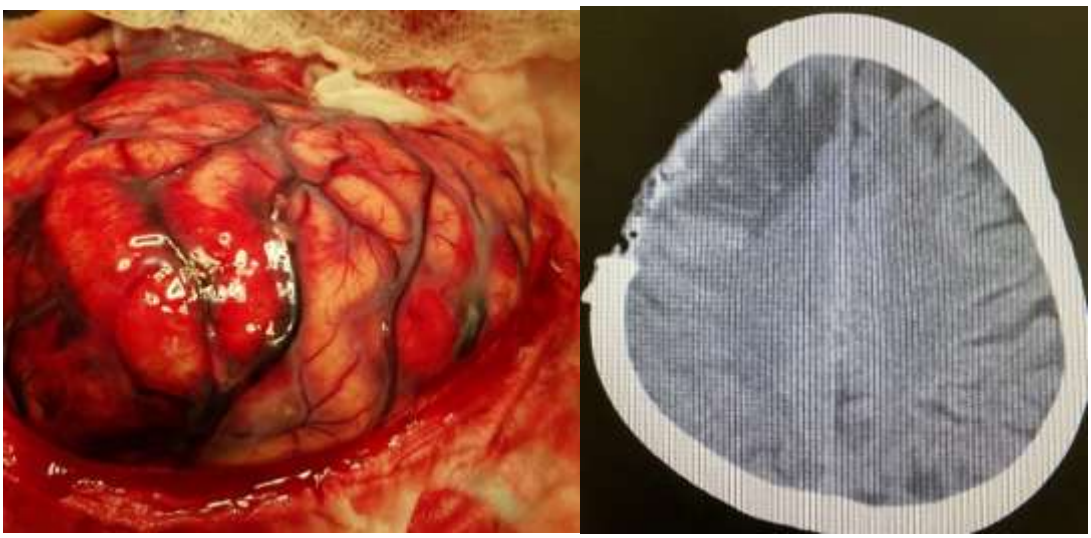

Fig 2 &3: Post head injuries with massive brain contusion so Decompressive craniectomy done

2/Decompressive craniectomy due to stroke (as spontaneous intra cranial haemorrhage or infarction).

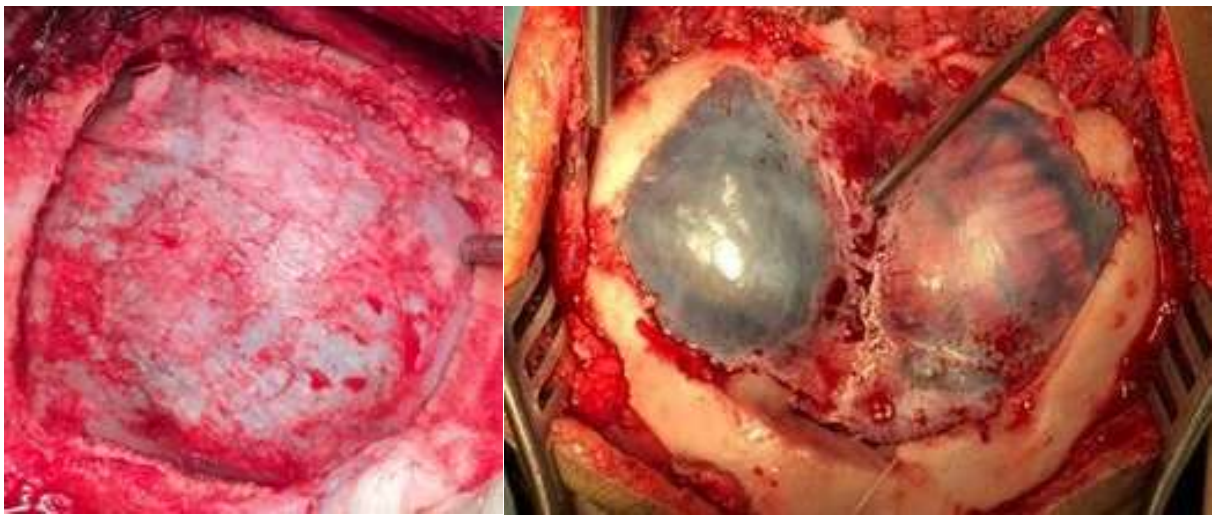

Fig 4 and 5 Craniectomy for stroke patients

Fig 6 &7: Free bone flap embedded in the anterior abdominal wall(subcutaneous pocket) .

3/Skull bony tumors like haemangiomas and osteoid osteoma.

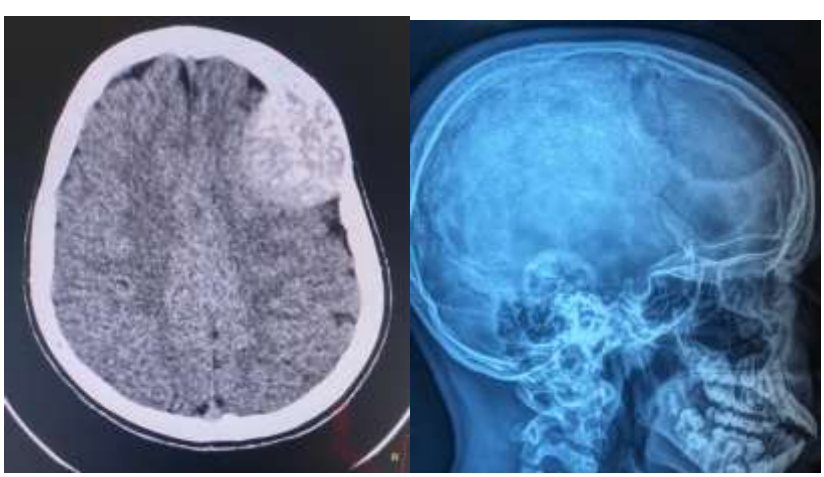

Fig 8 &9 Skull haemangioma (pre- and post-operative craniectomy with excision of the tumour)

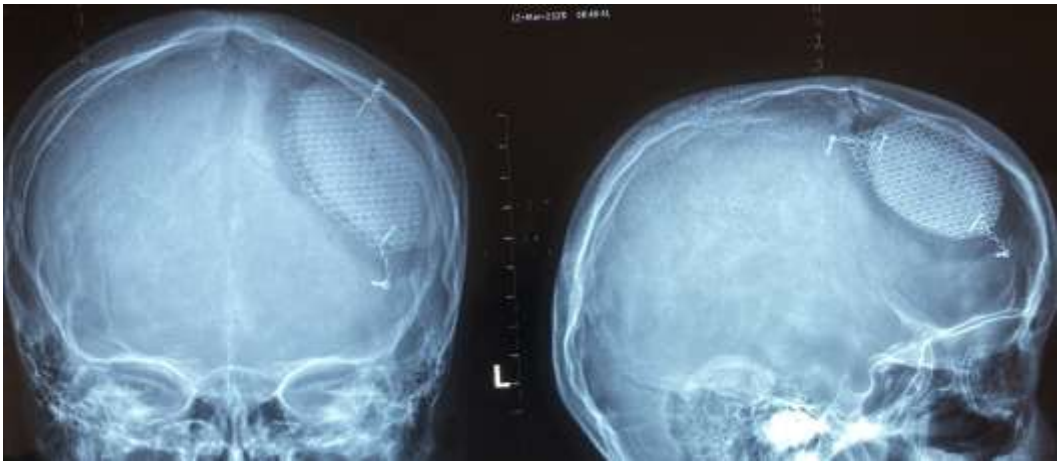

Fig 10: Cranioplasty with mesh and acrylic bone cement

Fig: 11,12: Cranioplasty with auto graft and acrylic bone cement

We performed a retrospective analysis using data collected from medical records of all patients admitted in the surgical ward under neurosurgical team during the period from (from Jan./2015- Dec./2024)

The inclusion criteria were:

- ❖ Patients of both genders (73 M.and 63 F.)
- ❖ Age (between 2 years and 72 years).
- ❖ Post Traumatic, post stroke, and post skull tumour excision.

The time between craniectomy and cranioplasty (less than 6 weeks), type of graft (autologous or artificial), type of prosthesis if used (methyl methacrylate, titanium), storage of bone flap if used (subcutaneous or deep freezer), operative time (minutes), and complications following cranioplasty.

Surgeon removes the portion of the skull that is causing the pressure on the brain. This is usually the area of the skull that covers the injury.

After surgery, the bone taken from the skull is usually stored in a freezer (previously) but now since more than 10 years, the bone can be embedded in the abdomen -subcutaneous pocket (SP). **(Our procedure).**

Results: A total of 136 patients were included in the study.

The most common cause of the bone flap removal was stroke (50 %n = 68), trauma (38% =n 52) because of road traffic accident followed by Fall from a heigh (8%, n = 11), and skull bone tumors (4%, n = 5)., as depicted in Table 1.

Table 1. Indications for removal of bone flaps

Type of insult	**No of patient**
stroke	68
Road traffic accident	52
FFH	11
Tumor	5
Total	136

Table 2. Age and gender distribution of the studied patients is shown:

Age (years)	**Male**	**Female**	**Total**
01-10	5	3	8
11-20	15	9	24
21-30	13	12	25
31-40	11	11	22
41-50	12	10	22
51-60	10	7	17
>60	7	11	18
Total	73	63	136

Of the 136 patients included in the study, maximum was in the age group of 11–50 years, among all the patients, 53.67% (n = 73) were males and 46.32% (n = 63) were females

Type of the graft used

Of the 136 procedures, 102 (75%) were autologous and 34 (25%) were artificial.

Out of the 34 patients who underwent artificial cranioplasty, 28(20.58%) had methyl methacrylate graft and 6 (4.4%) had titanium mesh implant.

Type of the preservation method

Bone was preserved in subcutaneous tissue in abdominal wall in (all autograft cases). Other cases used as artificial bone to close the bone defect after trauma/ tumor or infection.

Time of the surgical procedure:

With respect to the time of surgical procedure, most patients were operated between 2-4 weeks from the first operation (2 weeks for clean surgeries and 4 weeks for trauma surgeries) The mean operative time was 100 minutes for autologous and 125 minutes for artificial cranioplasty respectively. (18)

Discussion

Cranioplasty is a commonly performed neurosurgical procedure, which is a surgical repair of bony defects in the skull resulting from previous surgery or injury. (1)The skull is the bone that surrounds and protects the brain.

The operation is a repair of a skull vault defect by insertion of an object (bone or nonbiological materials such as metal or plastic plates), is a well-known procedure in modern neurosurgery.

Brain protection and cosmetic aspects are the major indications of cranioplasty. [8]

Our study here in brief summarized that we can cover the bony defect especially from previous clean cranial surgery with less than 6 weeks (From 2 weeks and on)

The studies mentioned "It is generally recommended that an interval of three to six months after craniectomy is appropriate for cranioplasty surgery." (15,16,20)

This type of surgery is common after traumatic head injury or previous cranial surgery mostly due to stroke, or skull bone tumor.

A cranioplasty treats damage following a traumatic injury or a defect of the skull caused by previous surgery, areas of the skull where the brain may be vulnerable to injury. It reduces headaches and can improve brain function.

What material does a surgeon use during a cranioplasty? (3)

will use one of the following materials during a cranioplasty to repair your skull:

A piece of the skull that a previous surgery removed.

A bone from another part of body (bone graft from iliac crest,12th rib or fibula).

Synthetic material that mimics bone (calcium phosphate, hydroxyapatite).

A customized implant (polymethyl methacrylate) or a metal (titanium) plate or mesh. (17)

Results: There was a low incidence of surgical site infection and osteomyelitis (2%)

Note: some neurosurgeons use both methods according to surgeon preferences but more used as cryopreservation (CP) but here we used only subcutaneous pocket (SP) (6).

Note: Here we are using subcutaneous pocket (SP) and not cryopreservation (CP), because e.g., when a patient involves in decompressive craniectomy DC and then kept the bone outside the body (means cryopreservation (CP) there is a high risk of bone infection and bone necrosis. (8,9,12)

Cranioplasty after decompressive craniectomy DC with a patient's autologous skull flap is a worldwide practice. (1) The increase of DC leads to an increase of cranioplasty.

The craniectomy indications are could be due to trauma, stroke or tumors. (4)

The primary goals of cranioplasty after decompressive craniectomy DC are to protect the brain, achieve a natural appearance and prevent sinking skin flap syndrome (or syndrome of the trephined). Furthermore, restoring patients' functional outcome and supplementing external defects helps patients improve their self-esteem. Although early cranioplasty is preferred in recent year, optimal timing for cranioplasty remains a controversial topic. Autologous bone flaps are the most ideal substitute for cranioplasty. Complications associated with cranioplasty are also variable, however, post-surgical infection is most common with cryopreservation (CP) .(7)

Many new materials and techniques for cranioplasty are introduced.

Cost-benefit analysis of these new materials and techniques can result in different outcomes from different healthcare systems. (13)

The pediatric population differs from the adult population as the skull keeps growing and needs special consideration. So, we try to use autograft if possible otherwise we can mesh and metallic graft (2).

The repair of cranial defects gives relief to psychological drawbacks and increases social performance. It is important not only for cosmoses and protection of underlying brain but also for restoring the dynamics of a closed cavity, which are disturbed when in the absence of overlying bone, the atmospheric pressure is allowed to exert an influence. (9). The sinking brain and scalp syndrome associated with neurological deterioration after decompressive craniotomy in traumatic brain edema is an uncommon condition. (19) The recovery of neurological and imaging deficits following cranioplasty is well known.[5]

Cranioplasty can avoid the recurrence of brain damage, can achieve the plastic effect, can protect the patient from cerebral seizures, can relieve the syndrome of trephine (i.e., headaches, dizziness, intolerance of vibration and noise, irritability, fatigability, loss of motivation and concentration, depression, and anxiety) increase the brain blood flow, improve the brain energy metabolism and promote the resumption of brain tissue, and treat the skull defects with neurological cognition and mental syndrome.(10,14).

In Conclusions

Patients who undergo decompressive craniectomy for intracranial hypertension often require interval cranioplasty. Many cranioplasty agents are currently in use. The authors suggest that storage of the patient's own bone flap in the subcutaneous tissue of the abdominal wall, is a safe, efficacious and cost-effective alternative to use of synthetic cranioplasty materials.

However, subcutaneous pocket SP may be the storage method of choice for both traumatic and non-traumatic brain injury . It remains to be verified in a prospective fashion whether SP is a truly the better method of storing bone flaps in both.(15)

Cranioplasty after decompressive craniectomy DC (For any reasons traumatic or non-traumatic) is a familiar surgical process to neurosurgeons. It is an essential surgery not only to satisfy patients' external defects, but also to improve patients' functional outcome**.** It is probable that many complications will arise because patients are in an immune-compromised state. New synthetic materials and techniques are introduced, and surgical results will also be improved clinically. (11,21)

In summary our study proved that using cranioplasty (for post Decompressive craniectomy DC clean surgeries need only 2-4 weeks while non clean surgeries (i.e., especially post traumatic need maximum 6 weeks unless the primary cause is skull bone infection then this needs from 3 months and above according to the pathology of infection and the response to anti biotics. (22)

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