

*Research Article***Assessment of Cranioplasty using Titanium mesh vs. Hydroxyapatite cement**

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Abstracts

Introduction: Cranioplasty is a reconstructive procedure used to restore skull anatomy and repair skull defects. The most common causes leading to calvarial skull defects include: depressed fractures of the skull, decompressive craniectomies (DC), tumor infiltration of calvarial bones, congenital deformities and inflammatory lesions.⁽¹⁾ **Aim of the work:** The aim of the work is to compare the outcome of two different manufacturing processes in reconstruction of calvarial skull defects using **Titanium mesh** versus **Hydroxyapatite bone cement** with assessment of cosmetic, functional outcome and incidence of complications in both study groups. **Patients and Methods: Study participants:** This is a prospective comparative study on first successive forty patients from December 2017 to December 2018 with calvarial skull defects of different etiologies, sites and sizes. Patients have been admitted and operated in neurosurgery department, Minia university hospital. **Results:** This study included 40 patients with skull defects treated with cranioplasty. We divided patients into 2 groups, **Group 1:** 20 patients were operated upon by cranioplasty using Titanium mesh and **Group 2:** 20 patients were operated upon by cranioplasty using HA bone cement implants. **Discussion:** Cranioplasty is a reconstructive procedure used to restore skull anatomy and repair skull defects. Optimal skull reconstruction is a challenge for neurosurgeons, and the strategy used to achieve the best result remains a topic of debate. **Conclusions:** Regarding cosmetic appearance, functional outcome and improvement of the clinical symptoms (syndrome of trephined), Cranioplasty using Titanium mesh and HA bone cement proved to have non-significant difference between both techniques in the reconstruction of calvarial skull defects despite their different etiologies.

Keywords: CT : Computed Tomography, DC: Decompressive Craniectomy, HA: Hydroxyapatite

Introduction

Cranioplasty is a reconstructive procedure used to restore skull anatomy and repair skull defects. The most common causes leading to calvarial skull defects include: depressed fractures of the skull, decompressive craniectomies (DC), tumor infiltration of calvarial bones, congenital deformities and inflammatory lesions.⁽¹⁾

Many characteristics have been suggested to describe the ideal alloplastic material for cranioplasty such as biocompatibility, tissue tolerance, simplicity of manufacture, ease of sterilization, low thermal conductivity, radiolucency, lightweight, resistance to infections, low cost and ready to use.⁽²⁾

Sinking skin flap syndrome (SSFS) is defined as serious disabling neurologic deficits and

impairment of general status with concave deformity and relaxation of the skin flap and it tends to develop several weeks to months after large craniectomy.⁽³⁾

The neurologic symptoms of SSFS include headache, vertigo, tinnitus, fatigue, loss of concentration, loss of memory, depression, dysphagia, paresis of extremities, and convulsion. Cranioplasty can improve neurological status in patients with skull bone defects.⁽⁴⁾

Titanium is bio acceptable with no inflammatory reaction. It also showed good resistance to infection, even when in contact with the Para nasal sinuses.⁽⁵⁾

Bone cement has gained increasing attraction as materials for calvarial reconstruction over the

past few decades, given their ease of application and ability to conform to most defect shapes with good osteoconductivity.⁽⁶⁾

Aim of the work

The aim of the work is to compare the outcome of two different manufacturing processes in reconstruction of calvarial skull defects using **Titanium mesh** versus **Hydroxyapatite bone cement** with assessment of cosmetic, functional outcome and incidence of complications in both study groups.

Patients and Methods

□ **Study participants:**

This is a prospective comparative study on first successive forty patients from December 2017 to December 2018 with calvarial skull defects of different etiologies, sites and sizes. Patients have been admitted and operated in neurosurgery department, Minia university hospital.

□ **Inclusion criteria:**

- 1) All patients with residual calvarial skull defects which need cranial reconstruction.
- 2) Patients of both genders and all age groups above 2 years old.
- 3) Patients are medically fit for surgery.
- 4) Patients agreed to do operation.

□ **Exclusion criteria:**

- 1) Patients are medically unfit for surgery.
- 2) Recipient site with residual disease.
- 3) History of recent local infection
- 4) Patients refused to do operation.
- 5) Patients under age 2 years old.

The following items were completed for each patient:

A. Complete medical history including:

1) **Personal History**

- Name, age, sex, occupation.

2) **The complaint**

- Any cosmetic problems.
- Symptoms described in the "syndrome of the trephined", which consists of a range of poorly defined symptoms

including headache, anxiety, depression, fatigue, lack of concentration, memory problems, and dizziness.

3) **History of present illness**

- The etiology of the skull defect: history of previous surgery due to head trauma (type: road traffic accidents, falling to the ground or direct trauma to the head), tumors resection or decompressive craniotomy.

- History of progressive weakness, deterioration of conscious level, sphincteric troubles or speech difficulties.

4) **History of seizures.**

- History of chronic illness.
- History of medications especially antiepileptic drugs, anticoagulants and antiplatelet agents.

5) **Past history**

- 6) **Time** of craniotomy in primary operation.
- 7) History of previous cranioplasty operation.

Results

This study included 40 patients with skull defects treated with cranioplasty. We divided patients into 2 groups, **Group 1**: 20 patients were operated upon by cranioplasty using Titanium mesh and **Group 2**: 20 patients were operated upon by cranioplasty using HA bone cement implants.

1) **Age & sex & occupation:**

- The age among group 1 ranged between 10 and 50 years with mean/SD (28.6±12.1) (**table 1**).
- The age among group 2 ranged between 4 and 50 years with mean/SD (27.5±14.9) (**table 1**).
- There is **no statistically significant difference** with p-value >0.05 as regards age, which indicated proper matching between both procedures.
- **as regarding sex**, Group 1 has 17 males with 3 females while group 2 included 11 males and 9 females.
- There is **statistically significant difference** with p-value <0.05 as regards sex distribution with high percentage of males (**Figure 1, Table 1**).

Table (1): Comparisons of age & sex in our study groups.

Variables	Group1 Titanium mesh (n=20)		Group 2 Bone cement (n=20)		p-value	Sig.
Age (years)						
Mean /SD	28.6	12.1	27.5	14.9	0.799	NS
Sex						
Male	85%		55%		0.038	S
Female	15%		45%			

*S: significant

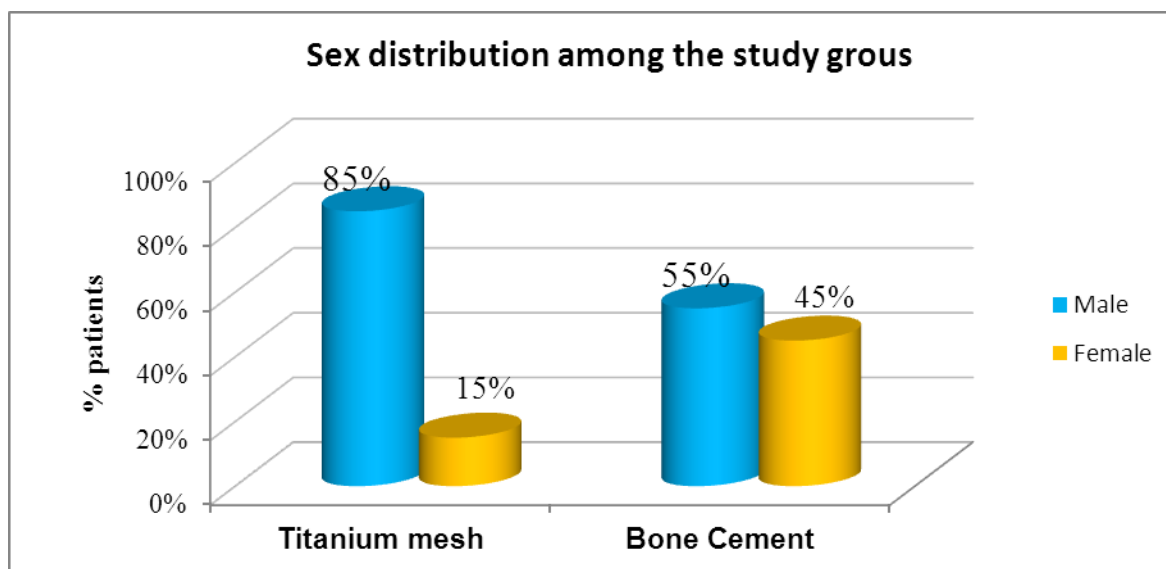


Figure (1): Sex distribution among the study group

- as regarding occupation, Group 1 included 3 patients with no work, 3 patients were students, 5 males patients were workers, 7 males patients were driver and 2 teachers.

Group 2 included 4 patients with no work, 4 patients were students, 3 males patients were workers, 4 males patients were driver, 2 patients were Housewife, 2 patients were lawyers and 1 patient was a teacher.

There is no statistically significant difference with p-value <0.05 (0.011) between study groups as occupation which indicated proper matching between both procedures.

Discussion

Cranioplasty is a reconstructive procedure used to restore skull anatomy and repair skull

defects. Optimal skull reconstruction is a challenge for neurosurgeons, and the strategy used to achieve the best result remains a topic of debate.

In this study, Cranioplasty was done to restore cosmetic appearance and to provide well cerebral protection and functions. using two different techniques in reconstruction of calvarial skull defects by **Titanium mesh** or **HA bone cement implants**. We compare both techniques regarding time of operation, cosmetic and functional outcomes and complications of both of them.

In our study, regarding age of patients, the age among group 1 ranged between 10 and 50 years with mean/SD (28.6±12.1). The age

among group 2 ranged between 4 and 50 years with mean/SD (27.5±14.9).

There is **no statistically significant difference** with p-value >0.05 as regards age, which indicated proper matching between both procedures. Also, most of patients who underwent to cranioplasty due to trauma were of age below 40 years old, and most of patients who underwent to cranioplasty due to tumor resection or DC were of age above 40 years old. Also we found that no relationship between age of patient and post-operative complications or outcome. This agrees with ⁽⁷⁾ who found that no statistically significant associations between post-operative complications and factors, such as age, and sex.

In our study, regarding sex of patients, 28 of our patients (70%) were males and the remaining 12 patients (30%) were females. The male prevalence also was noted in the study done by⁽⁸⁾, with predominance of men with a percentage of (64. 4%). And also a study by ⁽⁹⁾, with predominance of men with a percentage of (60%). This also comes in agree with ⁽¹⁰⁾, ⁽¹¹⁾, ⁽¹²⁾ and ⁽¹³⁾ with predominance of men with a percentage of (70-75%). This disagrees with study of ⁽¹³⁾ in which there was 26 females out of 46 patients underwent cranioplasty. This disagreement could be explained by the fact that his patient were children and the leading cause of cranioplasty was after cranosynostosis. This predominance may be explained by high percentage of traumatic etiology which accounts for (60%) causes of cranial defects in our study that goes with the above mentioned study by ⁽¹⁴⁾

Conclusions

Regarding cosmetic appearance, functional outcome and improvement of the clinical symptoms (syndrome of trephined), Cranioplasty using Titanium mesh and HA bone cement proved to have non-significant difference between both techniques in the reconstruction of calvarial skull defects despite their different etiologies.

Titanium mesh provides less rate of complications than bone cement flaps. There is a statistically significant difference in between both techniques as regards late complications

with large skull defects (≥ 25 cm²). The low incidence of complications with reconstruction of large skull defects using Titanium mesh gives it a high priority on choosing the proper procedure preoperatively. So the procedure is recommended for repairing large (≥ 25 cm²) and complex-shaped cranial defects.

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