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Original Article

Different Uses of Titanium Mesh in Cranial Surgeries - A Cross Sectional Descriptive Multicenter Study

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Abstract

This was a cross sectional descriptive multicenter study on uses of titanium mesh in cranial surgeries. This was a multicenter study. Data were collected from King Faisal Hospital of Taif, Saudi Arabia, King Fahad Hospital of Taif, Saudi Arabia, Al Haramain Hospital Private Limited of Sylhet, Bangladesh and Sylhet Women's Medical College Hospital, Bangladesh. Number of participants were 43 and study period 38 months. The aim of the study was to evaluate the uses of titanium mesh in different types of cranial surgeries including their complications. Two-third patients were male in gender. Highest number of patients were in 20 to 29 year and 40 to 49 year age groups, each of them were 21% of the whole 43 patients. Highest number of patients (44%) underwent cranioplasty for decompressive craniectomy. About one-third (30%) patients underwent cranioplasty for skull fracture bone gap. Regarding complications, 4.5% patients suffered from infection and exposure of implant.

Keywords: Titanium mesh; Cranioplasty; Decompressive craniectomy.

Introduction

Since 7000 BC physicians started the procedure of cover the skull gap in order to improve cognitive and neurological problems [1]. Over last few decades neurosurgical emergencies and the procedure cranioplasty have increased markedly. This surgery has become one of the common procedures for neurosurgery department now a days [2]. However, using the proper material for cranioplasty is still a challenge. The ideal implant is supposed to be biocompatible, widely available, long lasting durable and obviously low rate of infection. Autologous grafting was the pioneer in case of cranioplasty but eventually metals, acrylics and plastics were added to the list [3].

Due to good mechanical strength, low infection rate, standard biocompatibility and relatively low cost titanium mesh are used for cranial reconstruction more recently. In order to achieve better cosmesis, computer assisted three- Dimensional (3D) titanium mesh modelling was used which gained a huge popularity [4]. Few cases were associated with allergic reaction, erosion of the overlying scalp leading to implant exposure. Due to the temperature conducting property some cases were reported with scalp paresthesia [5].

The skull gap could be calvarial and skull base. There are different causes of this condition which includes congenital, traumatic, iatrogenic and sepsis. Some skull defects are associated with exposure of brain matter or dura. In lots of cases overlying soft tissue could be affected too. Titanium (Ti22) was discovered in England by William Gregor in 1791. Titanium is usually used in military weapons, aerospace and increasingly more in medical prosthetics. Titanium is a soft metal, strongly resistant to corrosion, used in different alloys of iron, vanadium, aluminum, etc. One of the characteristics of this metal is the ratio strength/weight. It has been proved that pure titanium (unalloyed) has greater resistance to the same strength as steel and 45% less mass, so it is considered as a soft metal. This is very resistant to the mechanical forces and fully biocompatible and corrosion resistant. These properties of titanium has made it a choice in cranial and spinal prosthesis now a days [6].

Figure 1: Showing use of titanium mesh for repairing bone gap after decompressive craniectomy.

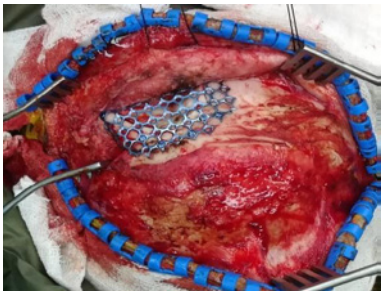

Figure 2: Showing repair & strengthening of frontal PNS wall by titanium mesh.

This was a multicenter cross sectional descriptive study on uses of titanium mesh in cranial surgeries. The aim of the study was to evaluate the uses of titanium mesh in different types of cranial surgeries including their complications. Study period was from 1st January of 2017 to 31st January of 2020 a total period of 37 months. Patient's data were collected from four hospitals of two countries,

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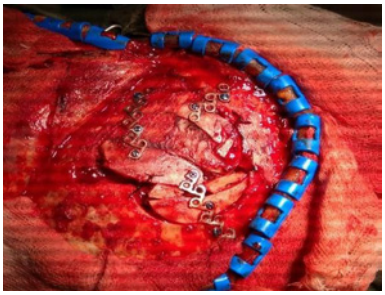

Figure 3: Showing stabilizing and fixation of depressed bone pieces by titanium mesh.

they are King Faisal Hospital of Taif, Saudi Arabia, King Fahad Hospital of Taif, Saudi Arabia, Al Haramain Hospital Private Limited of Sylhet, Bangladesh and Sylhet Women's Medical College Hospital, Bangladesh. Sample size was 43. All the patients underwent cranial surgeries with titanium mesh were included in to this study. The data were collected and tabulated in excel sheet and percentage of different tables were calculated. The result of this study was compared with that of different international studies.

Results

This is a cross sectional descriptive study on uses of titanium mesh in cranial surgeries. Total 43 patients were included in this study. The results of the study were tabulated according to different parameters.

Discussion

Cranioplasty is a commonly practiced neurosurgical operation. Different types of materials have been used to fill the cranial gaps. Titanium mesh is a modern inclusion of the cranioplasty material list. This cross-sectional study showed the results of 43 patients underwent cranioplasty by titanium mesh. The result of this study was compared with few international studies.

Ehrlich G et al. Published their study on titanium mesh implantation after craniotomy [7]. Total 24 patients were included in the study. There cases were infected after use of Stainless Steel Implants (SSI). They found risk factors for SSI infection were previous steroid medications, cerebrospinal fluid fistula, diabetes mellitus and cranial radiotherapy. Three months follow up after titanium mesh implant did not show any infection. When patients were asked about the cosmetic satisfaction then the result was highly satisfied. Only titanium meshes were used in this study. Infection rate was reported 4.5%.

Rosinski CL et al. Reported their retrospective analysis study on titanium mesh and custom implants [8]. The case group received titanium mesh, 36 in number and there were 18 patients in the control group who received custom implants. Infection rates in titanium mesh and custom implants groups were respectively 0% and 27.8% which was significant. In this study no custom implants were used and there was no control group to compare with titanium implants had 4.5% post-operative infection rate.

Han-song Sheng et al. Reported two pediatric cases on titanium mesh exposure after cranioplasty [9]. Two boys aged 12 years and 7 years underwent cranioplasty after decompressive craniectomies.

Table 1: Distribution of patients according to sex.

Sex	No. of cases	Percentage (%)	Total (n)
Male	29	67.50%	43
Female	14	32.50%	

Table 1 shows the distribution of all patients according to the sex. About two-third of the patients were male, where as one-third of the patients were female out of total 43 patients.

Table 2: Distribution of patients according to the age group.

Age frequency	No. of cases	Percentage (%)	Total (n)
Below 20 years	6	14	43
20 – 29 years	9	21	
30 – 39 years	7	16	
40 – 49 years	9	21	
50 – 59 years	8	18.7	
60 and above	4	9.3	

Table 2 illustrates distribution of the patients according to the age group. Highest number of patients were in 20 to 29 year and 40 to 49 year age groups, each of them were 21% of the whole 43 patients. Second highest was the 50 to 59 year (18.7%) age group. Age group 30 to 39 year and age group below 20 year had respectively 16 and 14 percent among the whole patient group. Lowest number (9.3%) was in above 60 year age group.

Table 3: Distribution of patients according to types of surgeries.

Indication	No. of cases	Percentage (%)	Total (n)
Cranioplasty for decompressive craniectomy	19	44	43
Cranioplasty for skull fracture bone gap	13	30	
Repair & strengthening of frontal PNS wall.	3	7	
Stabilizing and fixation of depressed bone pieces.	8	19	

Table 3 demonstrates distribution of the patients according to the types of surgeries. Most of the patients (44%) underwent cranioplasty for decompressive craniectomy (Figure 1). Nearly one-third (30%) patients underwent cranioplasty for skull fracture bone gap. Stabilizing and fixation of depressed bone pieces (Figure 1) were performed for nearly one-fifth (19%) patients and repair & strengthening of frontal PNS wall (Figure 2) was done for seven percent patients.

Table 4: Distribution of patients according to the post-operative complications.

Complication	No. of cases	Percentage (%)	Total percentage
Seizure	0	0	4.50%
Infection and exposure of implant	2	4.50%	
Hemorrhage	0	0	
Others	0	0	

Table 4 shows distribution of patients according to the post-operative complications. Among the common complications like seizure, infection or hemorrhage in this study 4.5% patients suffered from infection and exposure of implant. Other patients did not have any complication.

Both of them developed surgical site wound gap after 11 and 7 months respectively. The titanium meshes were exposed. Microbiological studies did not show any evidence of infection but there were presence of osteogenesis in both the cases. In this study only few pediatric patients were enrolled. No osteogenesis was detected in any case.

Leonard I. Malis shared their experience on the uses of titanium mesh and acrylic cranioplasty [10]. They had 100 cases in their series. In their series they did not find any infection or any other complication. Lester Lee et al. Presented their research result on complications of cranioplasty [11]. It was a retrospective analysis with

total number of 243 cases. The study period was 10 years. Fischer's T-test and direct logistical regression were performed to identify factors that contributed to the rate of complications which was considered significant. Commonest post-operative complications were seizure (14.81%) followed by infection and exposure of implant (9.05%), hemorrhage (1.65%) and others (0.82%). Most of the seizures occurred in post-traumatic and scar epilepsy cases. In contrast, in this study the infection rate was nearly half of that of the study of Lester Lee et al. No other complication was detected.

Sophie Vijfejjken et al. Publishe their systemic review on 2 randomized, 14 prospective, and 212 retrospective studies, totaling 10,346 cranioplasty patients [12]. Age group range was from 0 to 90 year. In the autologous group the patient's own bone was used to cover the cranial bone gap. Among the autologous and alloplastic material a total infection rate was 5.6%. Autologous grafts were reported of resorption and more infection (6.9%). When we compared the result of this study with the systemic review it was found that the infection rate was nearly same in both series.

After comparing with the international studies it was found that the outcome was fairly similar in most of the series including our one. Titanium mesh could be used not only filling up the gap but also to strengthen frontal paranasal sinus wall and also in fixation of fractured bone pieces in traumatic cases.

Conclusion

Cranioplasty is one of the commonest neurosurgical procedures now a days. Titanium mesh is the most popular choice for its biocompatibility, wide availability, long lasting duration and low infection rate. Apart from the cranioplasty for decompressive craniectomy it can be used for few other cranial surgeries also.

References

1. Di Stefano C, Rinaldesi ML, Quinquinio C, Ridolfi C, Vallasciani M and Sturiale C, et al. Neuropsychological changes and cranioplasty: a group analysis. Brain Inj 2016; 30: 164–171.
2. Ashayeri K, Jackson ME, Huang J, Brem H and Gordon CR. Syndrome of the Trephined: a systematic review. Neurosurgery 2016; 79: 525–534.
3. Shah AM, Jung H and Skirboll S. Materials used in cranioplasty: a history and analysis. Neurosurg Focus 2014; 36: 1-7.
4. Sun Y, Hu Y, Yuan Q, Yu J, Wu X and Du Z, et al. Association between metal hypersensitivity and implant failure in patients who underwent titanium cranioplasty. J Neurosurg 2018; 131: 40-46.
5. Yoshioka N and Tominaga S. Titanium mesh implant exposure due to pressure gradient fluctuation. World Neurosurg 2018; 119: 734–739.
6. Elephterios B, Dobrin N and Chiriac A. Titanium mesh cranioplasty for patients with large cranial defects – technical notes. Romanian Neurosurgery. 2010: 4: 456–460.
7. Ehrlich G, Kindling S, Wenz H, Hänggi D, Schulte DM and Schmiedek P, et al. Immediate Titanium Mesh Implantation for Patients with Post craniotomy Neurosurgical Site Infections: Safe and Aesthetic Alternative Procedure? World Neurosurg. 2017; 99: 491-499.
8. Rosinski CL, Patel S, Geever B, Chiu RG, Chaker AN and Zakrzewski J, et al. A Retrospective Comparative Analysis of Titanium Mesh and Custom Implants for Cranioplasty. Neurosurgery. 2020; 86: 15-22.
9. Sheng HS, Fang S, Wang MD, Lin J, Lin FC and Yin B, et al. Titanium mesh implants exposure after cranioplasty in two children: involvement of osteogenesis? Chinese Neurosurgical Journal. 2017; 3: 8.
10. Leonard I and Malis MD. Titanium Mesh and Acrylic Cranioplasty. Neurosurgery 1989: 25: 351–355.
11. Lee L, Ker J, Quah BL, Chou N, Choy D and Tseng Tsai Yeo. A retrospective analysis and review of an institution's experience with the complications of cranioplasty. 2013; 27: 629-635.
12. van de Vijfeijken SECM, Münker TJAG, Spijker R, Karssemakers LHE, Vandertop WP and Becking AG. Autologous Bone Is Inferior to Alloplastic Cranioplasties: Safety of Autograft and Allograft Materials for Cranioplasties, a Systematic Review. World Neurosurgery.2018: 117: 443-452.