Interdisciplinary Neurosurgery: Advanced Techniques and Case Management 8 (2017) 64–67

Contents lists available at ScienceDirect

Interdisciplinary Neurosurgery: Advanced Techniques and Case Management

journal homepage: www.inat-journal.com

Case Report & Case Series

Exposure of titanium implants after cranioplasty: A matter of long-term consequences

Takeshi Mikami [a,*], Kei Miyata [a], Katsuya Komatsu [a], Ken Yamashita [b], Masahiko Wanibuchi [a], Nobuhiro Mikuni [a]

[a] Department of Neurosurgery, Sapporo Medical University, Sapporo, Japan
[b] Department of Plastic Surgery, Sapporo Medical University, Sapporo, Japan

ARTICLE INFO

Article history:
Received 10 January 2017
Revised 17 January 2017
Accepted 28 January 2017

Keywords:
Titanium implant
Exposure
Cranioplasty

ABSTRACT

Although the use of titanium implants in cranioplasty has recently become common, long-term results of this strategy are sometimes difficult to manage. The aim of this study was to clarify the characteristics of patients developing exposure of titanium implants. Records of eight patients with exposure of titanium implants were reviewed. Patient ages ranged from 41 to 77 (mean, 56.8) years. Two patients were male, and six were female. The periods from implantation to exposure of titanium implants ranged from 5 to 87 (mean, 30.5) months. In seven cases, titanium mesh cranioplasty was performed after postcraniotomy infections. The titanium implants were removed in all cases. Scalp tissue was closed by applying a primary closure technique in five cases, though scalp reconstruction was performed with a rotation flap in the other three cases involving large scalp ulceration. Although the use of titanium implants is convenient, the indications should be carefully considered, especially in cases with postoperative surgical site infections and in patients with thin scalp skin. For these patients, long-term follow up is necessary.

1. Introduction

A titanium plate for cranioplasty is considered to be safe for implantation in humans, and it is one of the most widely used biomaterials for calvarial fixation or reconstruction in Japan. The infection rate associated with titanium plates in various neurosurgeries for which it has been used is around 5%, and removal is required in <1% of all the cases [1]. The use of titanium mesh cranioplasty is increasing because it avoids cosmetic deformity, reduces the vulnerability of unprotected brain tissues, and minimizes the risks and costs associated with additional procedures [2,3]. We herein report our experiences with patients developing exposure of titanium implants. Clinical characteristics and our management strategies are presented with discussion of the relevant literature.

2. Case series

The study protocol was approved by the ethics committee of Sapporo Medical University Hospital. All of the patients provided written informed consent to participate in the study, and the privacy of the patients was strictly protected. Between September 2008 and December 2016, we treated eight cases with exposure of titanium implants subsequent to cranioplasty. Table 1 summarizes the features of these patients. The eight cases, consisting of seven referrals and one from our series, ranged in age from 41 to 77 (mean, 56.8 ± 11.8) years. Two patients were male, and six were female. The periods from titanium mesh implantation to exposure of the implants ranged from 5 to 87 (mean, 30.5 ± 27.3) months. In terms of the implants, one case involved a fixation plate, and the other seven a mesh plate. As for the primary disease, one case was a skull base tumor, one case was a cerebral hemorrhage due to AVM rupture, and the other six were subarachnoid hemorrhage due to aneurysmal ruptures. In the case of the skull base tumor, a focal radiation dose of 50 Gy had been delivered after the original surgery. The neurological condition at the time the titanium implants were removed was assessed by employing the modified Rankin scale (mRS). The mean mRS was 2.0 ± 1.9: Two cases were grade 0, two grade 1, one grade 2, one grade 3, one grade 4 and one grade 5. In the grade 5 case, nutrition was provided by tube feeding. Type II diabetes mellitus was present in one case. After the treatment of the primary disease, postoperative surgical site infections occurred in seven cases. None of these patients had a past history of allergy to titanium, and no cases had concomitant meningitis at the time of exposure of titanium implants. At the time of surgical removal of the titanium plate, preoperative CRP was <0.1 to 0.94 (mean, 0.28 ± 0.30) mg/dL and WBC was

* Corresponding author at: Department of Neurosurgery, Sapporo Medical University, South 1 West 16, Chuo-ku, Sapporo 060-8543, Japan.
E-mail address: tmikami@sapmed.ac.jp (T. Mikami).

http://dx.doi.org/10.1016/j.inat.2017.01.015

Table 1
Summary of patient features.

No.	Age (years/sex)	Periods until exposure	Titanium implant	Primary disease	Treatment	Postcraniotomy infection	Radiation	mRS
1	77/F	36	Mesh plate	Aneurysmal rupture	Clipping	+	−	5
2	42/M	7	Mesh plate	Olfactory neuroblatoma	Removal of tumor	+	50 Gy	0
3	62/F	5	Mesh plate	Aneurysmal rupture	Clipping	+	−	2
4	59/F	43	Mesh plate	Aneurysmal rupture	Clipping	+	−	3
5	64/F	37	Mesh plate	Aneurysmal rupture	Clipping	+	−	4
6	52/F	8	Mesh plate	Aneurysmal rupture	Clipping	+	−	1
7	41/M	87	Mesh plate	AVM rupture	Removal of AVM	+	−	1
8	57/F	21	Fixation plate	Aneurysmal rupture	Clipping	−	−	0

mRS: modified Rankin Scale, AVM: arteriovenous malformation.

2400 to 7100 (mean, 4963 ± 1435) mm^3. Basically, preoperative three-dimensional (3D) CT angiography was performed, though it could not performed in two cases because of an allergy to the contrast medium. The 3D CT angiography could not demonstrate the superficial temporal arteries (STA) in the six cases for which it was performed, which indicated that the STA on the operative side had been damaged during the initial surgery.

Our strategy for the scalp ulceration due to implantation of a large titanium mesh plate was as follows. First, the titanium plate and any residual foreign bodies were removed, and as much tissue as possible showing granulomatous inflammation was also removed. Thin portions of the scalp with a poor vascular supply were also removed. The scalp tissue was mainly closed using a primary closure technique, though scalp reconstruction was performed with a rotation flap in cases of large scalp ulceration (>5 cm^2). In these cases, a skin graft was placed so as to cover any loose connective tissue, if necessary. Consequently, the titanium plate was removed in all eight cases. A polytetrafluoroethylene sheet was present under the titanium mesh plate in one case, and it was also completely removed. None of these patients had empyema around the titanium plate, and bacterial cultures of the plates were negative for pathogens. We conducted the reconstructions using rotation flaps in three cases and primary closure in the other five. There was one failure due to skin graft intolerance, but this was resolved by an additional procedure. Delayed cranioplasty was performed in four cases using bioceramic implants after 8–12 months. The other four patients did not require this additional procedure because osteogenesis was observed in two cases (No.7 and No. 8), the primary disease had progressed in one case (No. 2), and one patient did not request delayed cranioplasty (No. 4). Prior to delayed cranioplasty, tissue expander insertion was performed in two cases to achieve sufficient scalp expansion.

3. Representative cases

3.1. Case 1

A 77-year-old woman was admitted to a neurosurgical hospital due to subarachnoid hemorrhage. The patient was in poor condition (WFNS grade 5), and clipping of the aneurysm with external decompression

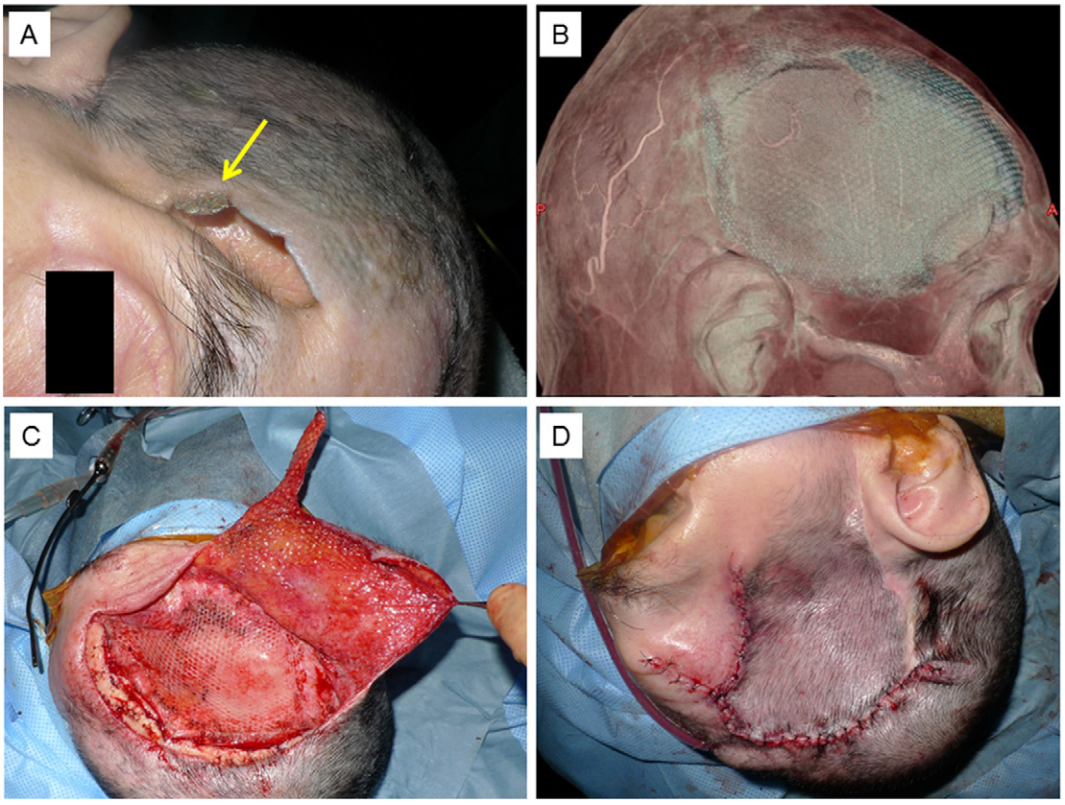

Fig. 1. A: The edge of the titanium mesh plate was exposed at the pterion, and the surrounding skin showed thinning. B: 3D CT angiography shows a titanium mesh plate covering a frontotemporal lesion. The vascular supply from the STA is not recognizable. C: The titanium mesh plate was removed, and wide debridement was then performed. D: The scalp was reconstructed with rotation flaps and closed with a skin graft.