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*Technical Note*

# In-situ Cranioplasty after Microvascular Decompression: A Technical Note

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**ABSTRACT**

Cranioplasty is not only performed for cosmetic reasons but also for physiological requirements to balance the cerebral hemodynamics and to protect the brain from external traumas. Methyl methacrylate is one of the most preferred materials for cranioplasty. It is usually prepared out of the surgical site and therefore modelling of the cranioplasty material to fit the bone defect is sometimes difficult. In this technical note, we present our new technique of cranioplasty with methyl methacrylate in which the material is prepared on site of the bone defect and very easily shaped. Fixation materials are not needed. This technique is especially suitable for posterior fossa surgeries after craniectomy.

**KEYWORDS:** Cranioplasty, Microvascular decompression, Methyl methacrylate

## INTRODUCTION

Cranioplasty is a surgical technique used to repair cranial bone defects (2-5, 7, 9). The purposes of cranioplasty are mostly to improve the aesthetic cranial appearance, to protect the brain from trauma and prevent seizures, and to maintain the cerebrospinal fluid dynamics. The main reason is the treatment of "trephined syndrome" which is characterized by headache, dizziness, irritability, loss of concentration, depression, anxiety, noise and vibration intolerance (3, 5). The underlying mechanism of this syndrome is the direct pressure effect of atmosphere onto the scalp and dura, which cause changes in the cerebral hemodynamics by subarachnoid space obliteration and decreased pressure of perfusion of brain tissue (3, 5). It was previously shown by transcranial Doppler sonography that the hemodynamic characteristics of the brain improve after cranioplasty (5).

In this technical report, we describe the application of polymethyl methacrylate (PMMA) immediately after preparing it on-site and modelling the graft manually. We want to emphasize the uneventful follow-up period against warnings of thermal injury of the brain tissue due to the PMMA graft.

## SURGICAL TECHNIQUE

In the literature, PMMA is usually modelled and shaped before installing it on the bony defect. In the standard cranioplasty technique, after semiliquid PMMA is obtained, the cranioplasty material is made up outside the surgical area. When the material becomes hard and solid, it is necessary to place it in its own place and to secure it by miniplates, screws or by silk sutures. But in our new technique after microvascular decompression operations, in order to repair the craniectomy defect (Figure 1), the powder and liquid monomer were mixed in a cup and then the semiliquid PMMA applied to the bone defect immediately and shaped in-situ by the help of the surgeon's fingers and instruments (Figure 2). The material was left in its own place and continuously irrigated by physiological saline to prevent heating on the dura mater (Figure 3). By this technique, this semiliquid

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mixture penetrates into the spongiose bone and there is no need for any fixing materials such as miniplates and screws. This technique allows the surgeon easier and rapid shaping of the cranioplasty material and also cheaper and stronger cranioplasty. We used this technique in 25 patients. The area of craniectomy for trigeminal neuralgia was a circle with a mean diameter of 3 cm. So, the mean surface of craniectomy was about 7 $cm^2$ . The thickness of the cranioplasty material was approximately 0.5 cm. Therefore, the volume of PMMA was 3.5-4 $cm^3$ for each patient. Because the volume of PMMA was low, thermal injury was prevented by in-situ irrigation of the material. CT examinations after surgery were performed by 16 row multidetector computed tomography (Figure 4).

Acrylic graft materials were hypodense in appearance in contrast to encircling cranial bones. There was no extension into the posterior cranial fossa, in other words passing the imaginary concave line between starting and end points touching the limits of the acrylic graft. The adjacent cerebellar parenchyma was intact showing no hypodense or hyperdense foci corresponding to edema or hemorrhage respectively. There was also no indicator of tissue damage in the late postoperative period.

Patients were followed for 18 months postoperatively and no heat injury, no pull out or no any other complications were observed on clinical evaluation. In 2 of these patients, reoperation was needed because of continuing trigeminal pain

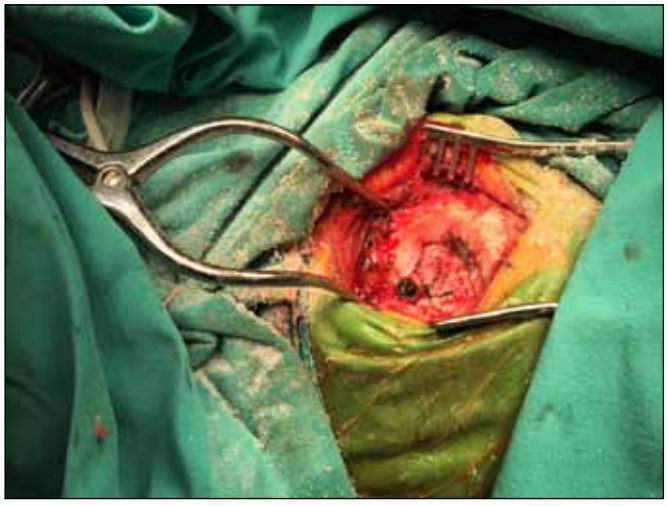

**Figure 1:** Craniectomy site after dura was sutured.

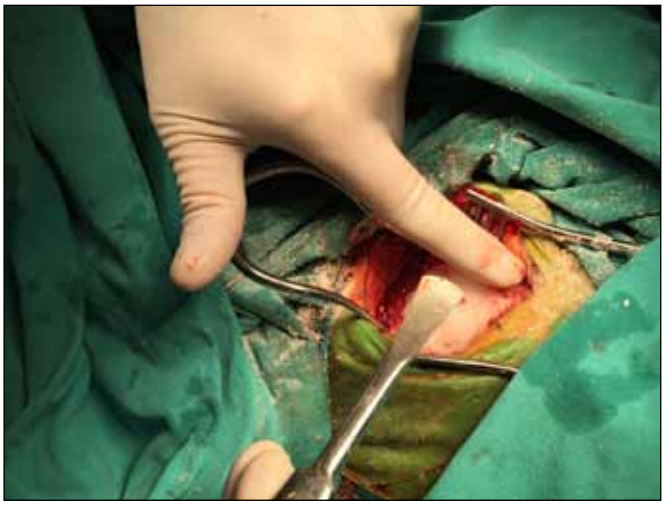

**Figure 2:** Semiliquid PMMA is being shaped in-situ (on site) by the help of finger and surgical tool.

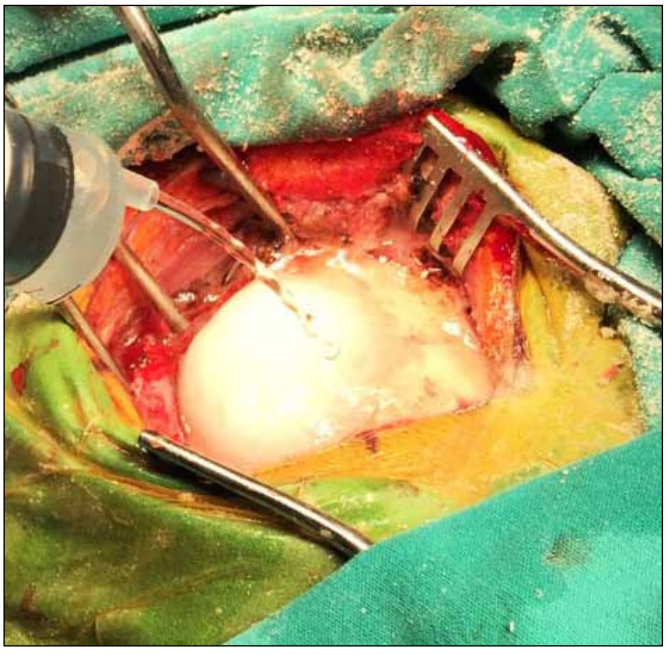

**Figure 3:** Irrigation of in-situ PMMA to prevent heat and associated injury.

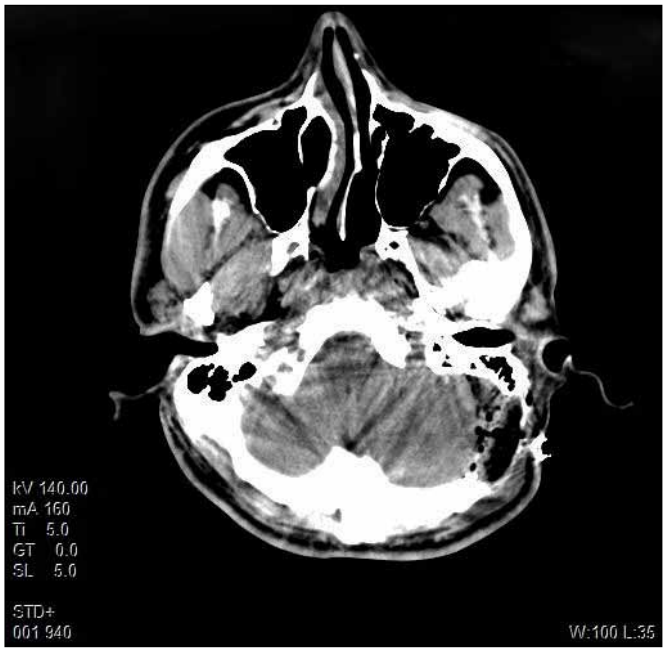


**Figure 4:** Postoperative CT scan of a patient with in-situ cranioplasty showing complete closure of the defect.

in the 24-hour postoperative period. It was almost impossible to remove the PMMA cranioplasty material. The craniectomy area was enlarged by the help of high-speed drill to remove the PMMA cranioplasty material.

## DISCUSSION

In this technical report, we described a different method to model and shape the cranioplasty material after microvascular decompression surgery. This technique may also be used in cerebellopontine angle and posterior fossa tumors.

PMMA is a thermoplastic, transparent plastic, and chemically called "acrylic" (1). The reasons that make PMMA popular for cranioplasty are its low cost, easy handling, easy to process structure, and its low weight. It is supplied as a powdery polymer and a liquid monomer (methylmethacrylate). After these two components come together, a semiliquid structure develops. After polymerisation in approximately 6-8 minutes, it hardens and during hardening an exothermic process occurs. The temperature may increase up to 70 degrees Celsius (1, 8). Because of possible side effects due to increased local heat, in-situ application of PMMA is limited in the literature in order to prevent heat damage to tissues. It is also recommended to irrigate with cool water to decrease the temperature.

We described a new technique, in-situ (on site) PMMA cranioplasty, for posterior fossa craniectomies, which has been used safely without any complication in 25 patients to date. Since PMMA is one of the most frequently used cranioplasty materials, by our technique, the cranioplasty will be easier, natural, faster and cheaper.

Gibbons et al. (6) described a similar technique in 1999. In their technique, they produced a series of notches in the cancellous margin of the surrounding cranium, preserving the inner and outer tables, in order to let the semiliquid PMMA penetrate into the bone. However, in our technique, there is no necessity to burr notches into the bone, because of the structure of the posterior fossa cranium.

Although some authors stated that in-situ use of PMMA can lead to heat injury of the dura or brain (1), there is no case report in the literature for heat injury due to in-situ PMMA cranioplasty.

There are 2 limitations of the in-situ cranioplasty technique. One is the risk of hematoma below the PMMA. A few small holes may be created on the cranioplasty material in order to prevent the risk of hematoma. The second is the need to determine the thickness of the material. It is difficult to determine the thickness of methylmethacrylate before the insertion. The appropriate thickness should therefore be guessed before the insertion of the material.

## CONCLUSION

In order to obtain a more natural shape and to prevent the usage of miniplates, screws or different fixing material, PMMA can be used in-situ (on site) safely in selected patients after posterior fossa craniectomies, without any notches in the surrounding cranium.

## REFERENCES

1. Aydın S, Kucukyuruk B, Abuzayed B, Aydin S, Sanus GZ: Cranioplasty: Review of materials and techniques. J Neurosci Rural Prac 2(2):162-167, 2011
2. Chang V, Hartzfeld P, Langlois M, Mahmood A, Seyfried D: Outcomes of cranial repair after craniectomy. J Neurosurg 112:1120-1124, 2010
3. Chiarini L, Furelli S, Pollastri G, Torcia E, Ferrai F, Albanese M, Nocini PF: Cranioplasty using acrylic material: A new technical procedure. J Cranio-maxillofac Surg 32: 5-9, 2004
4. Dujovny M, Aviles A, Agner C, Fernandez P, Charbel FT: Cranioplasty: Cosmetic or therapeutic? Surg Neurol 47: 238-241, 1997
5. Erdogan E, Duz B, Kocaoglu M, Izci Y, Sirin S, Timurkaynak E: The effect of cranioplasty on cerebral hemodynamics: Evaluation with transcranial Doppler Sonography. Neurol India 51(4): 479-481, 2003
6. Gibbons KJ, Hicks WL, Guterman LR: A Technique for rigid fixation of methyl methacrylate cranioplasty: The vault-locking method. Surg Neurol 52(3): 310-314, 1999
7. Moreira-Gonzalez A, Jackson IT, Miyawaki T, Barakat K, Di Nick V: Clinical outcome in cranioplasty: Critical review in long-term follow-up. J Craniofac Surg 14(2):144-153, 2013
8. Spetzger U, Vougioukas V, Schipper J: Materials and techniques for osseous skull reconstruction. Minim Invasive Therapy 19: 110-121, 2010
9. Werndle MC, Crocker M, Zoumprouli A, Papadopulos MC: Modified acrylic cranioplasty for large cranial defects. Clin Neurol Neurosurg 114: 962-964, 2012