

Polymethyl – Methacrylate Implants in Forehead and Supraorbital Arches Reconstruction: Retrospective Study

I. Luštica¹, M. Velepčič¹, N. Cvjetković¹, M. Bonifačić¹, N. Kirinčić¹, M. Juretić² and Z. Braut³

¹ Clinic of Otorhinolaryngology and Head and Neck Surgery, Clinical Hospital Rijeka, University of Rijeka, Croatia,

² Clinic of Maxillofacial and Oral Surgery,

³ Dental Clinic, Public Health Institute Rijeka, University of Rijeka, Croatia

ABSTRACT

Frontobasal injuries and some other diseases of frontal sinuses sometimes require radical surgery with the obliteration of the sinus. A cosmetic correction of the forehead and supraorbital arches has to be performed after such a procedure. Nowadays, there is a wide choice of alloplastic materials on the market. We tried polymethyl methacrylate implants in correction of the exterior appearance of the forehead and supraorbital arches and followed the behaviour of the implants up to 25 years after surgery. The result was 18 (94,7%) successful implantations and one failure (5,3%) with a mild sagging of the borders of the implant. Polymethyl-methacrylate proved pliable for work and modelling, not invasive for the organism and stable. In conclusion, the cure of some frontobasal injuries and diseases with the first surgical step followed by cosmetic correction of the forehead and supraorbital arches (2nd surgical step) using this alloplastic material provides a safe, durable and aesthetically satisfactory solution for the patient.

Introduction

In some diseases of the frontal sinuses and frontobasal injuries, a radical surgery of frontal sinuses is required. The most effective surgery is the one by which both the sinuses are cured and the correction of the emerged cosmetic defect of the

forehead is performed¹⁻³. Sometimes, it is necessary to perform a radical surgery of the frontal sinus in order to cure it as proposed by Riedel⁴. Unfortunately, a visible postoperative cosmetic defect of the forehead occurs, which should be corrected for aesthetic reasons. The general opinion is that this ought to be done by the same

surgical intervention with autogenous materials^{5,6} even if they are not always the most adequate^{7–9}.

Synthetic materials proved to be a better choice in many cases. The reasons to use alloplastic implants should be: a lack of adequate material, diseased donor site, prolonged time in obtaining material, a tendency of the autoimplant to bend, twist or to resorb^{9,10}. Finally, it is one more cut and surgical intervention on the same patient. Previous problems with synthetic implants¹¹, imply a necessity of utmost caution when deciding on when and where to use the synthetic implant. On the other hand, synthetic material has been efficiently applied in correction of exterior head deformities^{12,13}. We solved the problem of cosmetic defect of the forehead with polymethyl methacrylate during the second step of surgery, following surgery of frontal sinuses according to Ridel, in 19 patients. The majority of them have been followed up, some up to 25 years after the implant had been inserted into the forehead. Experience, results and technique of polymethyl methacrylate use in cosmetic corrections of the forehead are reported in this paper.

Patients and Methods

From 1975. to 1988. 19 patients – 18 male and 1 female aged 21 to 69 years, mean age 32 years, underwent plastic correction of the exterior forehead deformity with polymethyl methacrylate. Polymethyl methacrylate implants were applied in three groups of patients: the first group – 1 patient (5%) following surgery of pyocele; the second group – 5 patients (26%) following surgery of chronic and acute inflammation of frontal sinuses with complications and the third group – 13 patients (69%) operated on after frontobasal injuries. Osteoplastic surgery was taken into consideration, but as it was not possible, all patients underwent

radical surgery of the frontal sinuses sec. Ridel. One year after the first surgical step patients underwent an aesthetic reconstruction in a second surgical step with polymethyl methacrylate implant.

In the 1st surgical step we healed the sinuses and prepared the bed for the future implant. Osseous sinusal borders were rounded, smoothed and thinned to avoid an abrupt transition, a step to the exterior forehead surface. We took the measurements of the future implant by cutting out thin tin models as templates of osseous depression and later followed them when making acrylate implants on measure. The impression of cosmetic defect of the forehead, root of the nose and supraorbital arches^{14,15} was taken in dental laboratory before the second surgical step, and then cast in plaster of Paris. The prototype of the future implant was shaped in wax pattern on this plaster cast of the forehead. This wax pattern was replaced by polymethyl methacrylate, a final material for the implantation, treated and joined to the plaster cast of the forehead. In the second surgical step, we formed the pocket and placed the implant in the bed made during the first surgical step. Special care was taken not to form the *žpocketž* greater than the tin plate. The implant was adjusted according to sterile surgical principles. The implant was embedded, smoothed and tested in place, and the appearance of the forehead evaluated. It was fixed with chromic catgut 3–0 through small holes already made on various places on the implant sizing from 1–2 mm. The implant was fixed in three to four places of the substrat and the pocket borders. A light fixed dressing was placed on the forehead and removed after 5–7 days.

Results

Nineteen operated patients who underwent polymethyl methacrylate implantation because of reconstruction of

TABLE 1
DISEASES THAT LEAD TO RADICAL
SURGERY OF FRONTAL SINUSES

Kind fo disease	No of patients	%
Forehead trauma	13	68,2
Inflamations	5	26,5
Pyocele	1	5,3
Total	19	100

the outer appearance of the forehead are reported on according to the pathology (Table 1). Supraorbital arches were matched and the exterior appearance and contours of the forehead were found to be aesthetically successfully done and therefore satisfying for the patients (Fig. 1–4). Patients had a follow – up for 25 years after the implantation. No intraoperative

TABLE 2
POSTOPERATIVE CLINICAL COMPLICATIONS

Early postoperative complations	No of cases	%
Accumulation of serous fluid	3	15,9
Inflammation	1	5,3
Haematoma	1	5,3
Total	5	26,5

complications were observed, except for an intensive haemorrhage in one patient with coagulopathy, who postoperatively developed a mild haematoma at the site of the graft. Three patients (16%) had postoperative serious fluid accumulation between the graft and the skin flap (Table 2). Four of them developed transient redness of the forehead skin and the upper



Fig. 2. Lateral view. Expressed depression of the forehead contour following radical sinus surgery.



Fig. 1. Frontal view. Visible cosmetic defect, depression of the forehead as consequence of radical sinus surgery following forehead trauma.

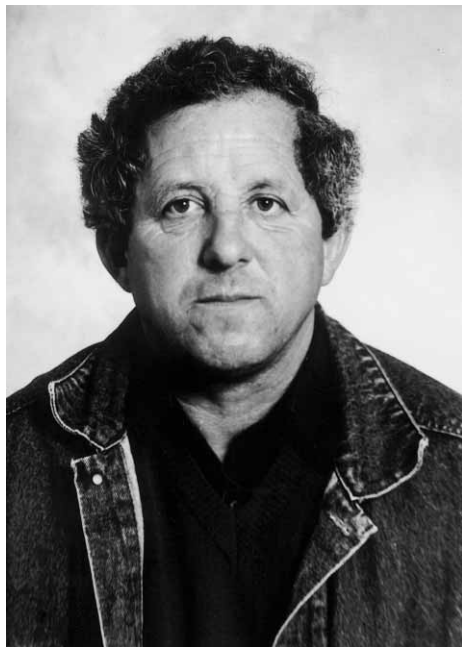


Fig. 3. The same patient as in fig. 1, 25 years later following corrective forehead surgery with polymethyl methacrylate. Frontal view.



Fig. 4. The same patient as in fig. 2, 25 years later following corrective forehead surgery with polymethyl methacrylate. Lateral view.

periorbital part. It disappeared without any treatment. Skin redness continued in one patient with inflammation. It was resolved with intensive antibiotic therapy. Another patient developed pyocele of the ethmoidal sinus at the same side of the graft ten years postoperatively. It extended along the forehead under the implant. Through exterior ethmoidectomy according to Grunwald, the case was successfully cured. The polymethyl methacrylate implant remained unchanged. One case (5%) had slightly sagging implant borders on the right side only. No dehiscence of the wound or implant rejections were observed (Table 3).

Discussion

Polymethyl methacrylate is one of the numerous inert polymeric masses that

can be mixed in the dental laboratory and moulded to desired size and form.

Our primary task was to achieve adequate reconstruction and replacement of

TABLE 3
STATE OF IMPLANTS UP TO 25 YEARS
POSTOPERATIVELY

State of implant	No	%
Displaced	0	0
Resorpted	0	0
Rejected	0	0
Twisted	0	0
Lifted according to the environment	0	0
Sagged according to the environment	1	5
Total	1	5

the osseous defect of the forehead using polymethyl methacrylate in order to even the forehead and correct as much as possible the cosmetic defect, following the normal forehead contours, nasal root and supraorbital arches. Previous autogenous materials were used for the reconstruction of the exterior appearance of the forehead^{5,7}. Artificial materials have been increasingly used in corrective surgery during the last decades^{16–21}. We chose polymethyl methacrylate grafts in 1975.

Our cases developed very noticeable forehead deformities and we properly corrected them, applying polymethyl methacrylate. That would be difficult to achieve with autogenous materials because of the quantity and thickness of the osseous tissue needed for reconstruction. We had 5 complications immediately following surgery, accumulation of serous fluid in three cases, one inflammation and one mild haematoma at the site of the implant. Using needle puncture and syringe through the skin we aspirated the serous content and blood. Protection with antibiotics improved the condition quickly without further complications. No influences or effects to the implant were observed. We had a 50-year old male who underwent surgery according to Ridel, because of mucocele of the right frontal sinus, and who was implanted with polymethyl methacrylate graft in the same year (1979). Ten years later (1989), he was hospitalized because of pyocele now in the right ethmoid penetrating towards the forehead, partly situated under the acrylic implant. Thus we had the opportunity to see *in vivo*, how the polymethyl methacrylate implant behaved and how the organism reacted to it. The implant was found to be stable and unchanged with very thin fibrous capsule formed around it. Microscopic investigation revealed a strong connection between polymethyl methacrylate and the tissue.

All previously made perforations were grown through with the connective fibrous tissue through the whole depth of the implant, connecting and fixing it at the inserted site. That prevented its displacement and enabled its easy removal at the same time, if required. It is of great importance to make a model pocket, according to the tin model during the embedment of the implant. It has to be precise so that the implant fits into the pocket, better tightly than loose.

Except for the periost, a thin tissue layer has to be left between the implant and the osseous basis (the cerebral lamella of the sinus), to prevent rubbing on the periost. Implant thickness varied, depending on the size of operated sinuses, and the depth of the osseous defect. The implant borders must fit tightly into the depression border, completely merging with the surrounding environment.

The implant has never been placed in cases where it would make contact with other sinuses or capsules of the brain, *i.e.* in situations where the inflammation could extend from the sinus around the implant or the endocranium.

Conclusion

Nineteen patients were grafted with polymethyl methacrylate implants in order to correct the forehead depression. The procedure was accompanied by mild postoperative disturbance. This easy and simple surgical technique for relatively major cosmetic defects of the forehead and the supraorbital arches, with minimal trauma on healthy organism and tissue, accompanied by short surgical intervention, mild postoperative course and small number of hospitalization days has been considered as a welcome method in cases when curability and cosmetic correction can not be performed in the same surgical act.

We found polymethyl methacrylate to be a pliable and stable material for the correction of forehead depression. It does not cause any inflammation, fits tightly into the surrounding tissue without irritation. It is acceptable for the organism and easy to remove. Polymethyl methacrylate has remained unchained 25

years following tissue embedment, showing no tendency of twisting or resorption. Further scientific progress will surely give better methods²²⁻²⁴ and materials for implants^{11,17,21,25}. Polymethyl methacrylate has proved to be a good substitution in cases when the autogenous tissue is not available, possible or desirable.

REFERENCES

1. TATO, J. M., D. W. SIBBALD, O. E. BERGAGLIO: Surgical Treatment of the Frontal Sinus by the External Route. *Laryngoscope*, 64 (1954) 504. — 2. MONTGOMERY, W. W.: Osteoplastic Frontal Sinus Operation: Coronal Incision. *Ann. Otol.*, 74 (1965) 821. — 3. WEBER, R., W. DRAG, R. KEERL, J. CONSTANTINIDIS: Aspekte zur Stirnhohlenchirurgie. Teil III, Indikation und Ergebnisse der Osteoplastischen Stirnhohlenoperation. *HNO*, 43/7 (1995 Jul) 414. — 4. RIEDEL, 1898. CIT. H. J. DENEKE: Die Oto-rhino-laryngologische Operationen. Göttingen, Heidelberg, Springer-Verlag, (1953) p. 123. — 5. KRAJINA, Z., F. KOSOKOVIĆ, S. SIMOVIĆ: Povrede frontoetmoidalne regije. *Symp. Otorhinol. Iug.*, 80 (1975) 70. — 6. PADOVAN, I.: Čuvanje i uspostavljanje funkcije u kirurgiji gornjih dišnih puteva. *Symp. Otorhinol. Iug; Supplementum I*, (1973) 77. — 7. MICKEL, L. T. J., R. J. ROHRICH, J. B. ROBINSON Jr.: Frontal sinus obliteration: a comparison of fat, muscle, bone and spontaneous osteoneogenesis in the cat model. *Plast. Reconstr. Surg.*, 95 (3) (1995) 586. — 8. ROHRICH, R. J., T. J. MICKEL: Frontal sinus obliteration: in search of the ideal autogenous material. *Plast. Reconstr. Surg.*, 95 (3) (1995) 580. — 9. WEBER, R., G. KAHLER, J. CONSTANTINIDIS, W. DRAG, R. KEERL: Zum Verhalten des Fertgewebes in der Obliterierten Stirnhöhle. *Laryngorhinootologie*, 74 (1995 Jul) 423. — 10. STUCKER, F. J., L. GAGE-WHITE: Surgery of surgical implants. *Facial. Plast. Surg.*, 3 (1986) 141. — 11. FDA Safety Alert: Serious Problems with Poroplast-coated TMJ Implant. Washington, DS:US Dept of Health and Human Services, December 28, (1990). — 12. DOUGLAS, K., D. K. OUSTERHOUT, S. BAKER, I. ZLOTOLOV: Methylmethacrylate Onlay Implants in the Treatment of Forehead Deformities Secondary to Craniosynostosis. *J. max.-fac. Surg.*, 8 (1980) 228. — 13. EDGERTON, M. T., J. A. JANE: Vertical Orbital Dystopia-Surgical Correction. *Plast. Reconstr. Surg.*, 67 (1981) 121. — 14. SUVIN, M., Z. KOSOVEL, D. NIKŠIĆ: Materijal za stomatološku protetiku. Sveučilište u Zagrebu, Zagreb, (1968). — 15. O'BRIEN, F.: Guida all uso e alla scelta dei materiali dentari. Bologna, Grasso, (1986) p. 63. — 16. PODVINEC, M., D. STULA: Alloplastic materials in frontobasal bone defects. *ORL J. Otorhinolaryngol Relat. Spec.*, 4 (1980) 91. — 17. NEEL, H. B.: Implants of Gore-tex. *Arch. Otolaryngol. Head Neck Surg.*, 109 (1983) 427. — 18. MOLE, B.: The Use of Gore-Tex Implants in Aesthetic Surgery of Face. *Plast. Reconstr. Surg.*, 90 (1992) 2000. — 19. OWSLEY, T. G., C. O. TAYLOR: The Use of Gore-Tex for Nasal Augmentation: a retrospective analysis of 106 patients. *Plast. Reconstr. Surg.*, 94 (1994) 241. — 20. OESTREICHER, J. H., E. LIU, M. BERKOVITZ: Complications of hydroxyapatite orbital implants: A review of 100 consecutive cases and a comparison of Dexon mesh (polyglycolic acid) with scleral wrapping. *Ophthalmolog.*, (1997) 104. — 21. XIOGZHENG, Mu. D.: Jiasheng Dong MD.: Tisheng Chang MD. Surgical Reconstruction of the Contracted Eye Socket and Orbitozygomatic Hypoplasia in a One-Stage Operation. *Plast. Reconstr. Surg.*, 103 (1999) 487. — 22. CUTTING, C., F. BOOKSTEIN, B. GRAYSON, L. FELLINGHAM, J. G. MCCARTHY: Three Dimensional Computer-Aided Designing of Craniofacial Surgical Procedures In D. Marchac (Ed.) *Craniofacial Surgery*. Berlin: Springer-Verlag, p. 17 (1987). — 23. CUTTING, C., B. GRAYSON, H. KIM: Precision multisegment bone positioning using computer aided methods in craniofacial surgical applications. *Proc. IEEE Eng. Med. Biol. Soc.*, 12 (1990) 1926. — 24. CUTTING, C., B. GRAYSON, J. G. MCCARTHY, C. THORNE, D. KHORRAMABADI, B. HODDAD, R. TAYLOR: A Virtual Reality System for Bone Fragment Positioning in Multisegment Craniofacial Surgical Procedures. *Plast. Reconstr. Surg.*, 102 (1998) 2437. — 25. RAVEH, J., H. STICH, P. SCHAWALDER: Biocement-a new material: Result of its experimental use for osseous repair of skull cap defects with lesions of the dura mater and liquorrhea, reconstruction of the anterior wall of the frontal sinuses and fixation of alloimplants. *Acta Otolaryngol.*, 94 (1982) 371.

I. Luštica

D. Cesarića 18, 51000 Rijeka, Croatia

POLIMETIL-METAKRILAT IMPLANT U REKONSTRUKCIJI ČELA I SUPRAORBITALNIH LUKOVA: RETROSPEKTIVNA STUDIJA

S A Ž E T A K

Frontobazalne ozljede i neke druge bolesti frontalnih sinusa ponekad zahtijevaju radikalnu operaciju sa obliteracijom sinusa. Nakon takvih operacija potrebna je estetska korekcija čela i supraorbitalnih lukova. U novije vrijeme imamo veliki broj aloplastičnih materijala. Pokušali smo sa polimetil-metakrilat implantatomu estetskoj korekciji vanjskog izgleda čela i supraorbitalnih lukova i pratili ponašanje implantata do 25 godina nakon implantacije. Rezultat je 18 (94,7%) uspješnih implantacija i jedan slučaj (5,3%) neuspješan, sa blagim izdignućem rubova implantata. Polimetil-metakrilat se je pokazao podatan za rad i modeliranje, neinvazivan za organizam i postojan. Mišljenja smo da je rješavanje nekih frontobazalnih ozljeda (1. akt operacije) zatim estetska korekcija čela i supraorbitalnih lukova (2. akt operacije) sa ovim aloplastičnim materijalom za pacijenta sigurno, trajno, estetsko i funkcionalno rješenje.