

Cranioplasty with a Patient-specific Implant Using a Low-Cost 3d Printer: Outcome Comparison with the Free-hand Technique

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Introduction

The use of additive manufacturing in cranioplasties has provided better aesthetic results and low rates of complications. In countries with limited resources, "free-hand" techniques are used to mould polymethylmethacrylate implants in the surgical procedure, due to lower economic costs, but with worst outcomes. New accessible and affordable techniques are needed to improve the outcome of cranioplasties.

Methods

We conducted a prospective cohort study, to analyze a new cranioplasty technique, using custom-made intraoperative moulds fabricated by additive manufacturing with a low-cost 3d printer. Primary outcome variables included aesthetic results and surgical time, and secondary outcome variables were defined as surgical complications and number of reinterventions. Patients were included from February 1, 2017, to October 1, 2017. Aesthetic results were assessed using a numeric scale, and surgical time was recorded by the anesthesiologist. In order to compare the new patient-specific technique with the usual free-hand moulding technique, the same variables were analyzed in a retrospective series of patients, from March 1, 2016 to February 1, 2017.



Bifrontal Cranioplasty using Pacient-specific Implant

Fig. 1: a) DIgital Modelling - Fig. 2: a) & b) Molds; c) Perspective - Fig. 3: a) PMMA Implant b) fixation c) & d) Postop Results.

Statistical analysis was performed using (SPSS Software, IBM, Armonk, NY)

Results

12 patients underwent cranioplasties with 3d printed patient-specific moulds, and 14 patients operated with the free-hand technique were analyzed as a control group. Average surgical time was significantly shorter in the prospective group (151 min vs 190 min, p<0,011) than in the control group.

The aesthetic results were scored higher in the patient-specific mould group, with an average of 8,8/10, compared with 7,3/10 in the control group, with statistical significance (p<0,013). The overall complication rate was low in both groups, with only 1 wound infection in the free-hand technique group.

Conclusions

In our study, we found that cranioplasties performed using additive manufacturing to produce low-cost patient-specific moulds had better aesthetic results, and shorter surgical times than the free-hand moulding technique, with very low rates of complications.

Key Words: Cranioplasty, PMMA, 3D Printing.