Contour irregularities following pediatric craniofacial surgery are common. Correction of these irregularities is not only important for cosmetic reasons, but also for the psychological impact of the irregularities on the patient. There are many different surgical options for addressing these contour irregularities, including fat grafts, bone grafts, titanium mesh, custom-made alloplastic implants, and indeed bone substitutes (including hydroxyapatite).

Hydroxyapatite cement (HAC) is an alloplastic material made up of calcium phosphate, a naturally occurring component of the bone. As a result, it induces minimal tissue reaction and has good osseointegration. The hydroxyapatite is absorbed and replaced by normal bone through the process of creeping substitution. HAC cranioplasty is a well-established technique for reconstruction of congenital, traumatic, and oncologic craniofacial defects. It can be difficult, however, to accurately assess the volume of HAC required intraoperatively. It is therefore fundamental that an accurate volume is known preoperatively to improve patient outcome, reduce any wastage, and therefore reduce the cost.

Many techniques are available for estimating volumes in craniofacial patients, including laser surface scanning, stereophotogrammetry, and cross-sectional imaging (computed tomography/magnetic resonance imaging). These rely on expensive specific equipment and are time consuming. We propose a simple bedside technique that can be carried out preoperatively on the same day in any surgical environment. (See Video [online], which displays the water displacement.)

A 16-year-old boy presented for hydroxyapatite cranioplasty following fronto-orbital remodeling for craniosynostosis as an infant. He was concerned about the contour of his forehead, in particular, the fronto-temporal recessions on either side of the midline (Fig. 1). We have chosen hydroxyapatite cranioplasty because this will allow us to accurately and permanently correct the skeletal defect in one sitting as opposed to other techniques (including lipofilling) that are less predictable and may require several operations. The effect of the hydroxyapatite cranioplasty was simulated using Blu-Tack (a freely available putty adhesive) (Fig. 2). Once the desired forehead contour had been created, the Blu-Tack was removed and the volume was calculated using water displacement based on the Archimedes principle: a container was filled completely with water and placed inside a second, larger container to collect the displaced water. The Blu-Tack was submerged in the

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initial container, and the displaced fluid was collected in a syringe, enabling the volume of displaced water to be easily calculated. (See Video [online], which displays the water displacement.) This volume of displaced water correlates to the volume of the Blu-Tack used; therefore, the amount of hydroxyapatite needed, in our case, was 27 mL on the right and 24 mL on the left. Intraoperatively, the required volumes were prepared using the preoperative volumes, and the desired forehead contour was achieved without waste and without requiring additional hydroxyapatite (Fig. 2). The final result is shown in Figure 3.

This technique is a simple, reproducible, cost-effective way of establishing the volume of hydroxyapatite required for cranioplasty.

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PATIENT CONSENT
The patient provided written consent for the use of his image.

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