Augmentation of Craniofacial Defects Using Alloplastic Material

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ABSTRACT

Background: Alloplastic materials are increasingly being used in augmentation of craniofacial defects because of its ready availability, good aesthetic outcome and absence of donor site morbidity. This paper highlights experience in the use of heat-cured acrylic in augmentation cranioplasty. **Subjects and Method:** The management of three patients with anterior skull defect who presented at the Dental and Maxillofacial Surgery Clinic of the Aminu Kano Teaching Hospital over a five-year period is presented.

Results: There was good aesthetic outcome in all the patients and no complications were recorded. **Conclusion:** Augmentation of craniofacial defects using customized prefabricated heat-cured acrylic provides patients with a durable, stable and structural repair of craniofacial defects with good aesthetic outcome.

Keywords: Alloplastic material, augmentation, craniofacial defects

Técnica de Aumento para la Reparación de Defectos Craneofaciales Usando Materiales Aloplásticos

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RESUMEN

Antecedentes: Los materiales aloplásticos son usados cada vez más en la técnica de aumento para la reparación de defectos craneofaciales, debido a su disponibilidad inmediata, buen resultado estético y ausencia de morbosidad del sitio donante. Este trabajo destaca nuestra experiencia en el uso de acrílico curado por calor en las técnicas de aumento en la craneoplastia.

Sujetos y métodos: Se describe el tratamiento de tres pacientes con defectos del cráneo anterior, que asistieron a la Clínica de Cirugía Maxilofacial y Dental del Hospital Docente Aminu Kano por un período de más de cinco años.

Resultados: Hubo un buen resultado estético en todos los pacientes y no se reportaron complicaciones. **Conclusión:** La técnica de aumentación para los defectos craneofaciales, utilizando acrílico prefabricado curado con calor, proporciona a los pacientes una reparación duradera, estable y estructural de los defectos craneofaciales con buen resultado estético.

Palabras claves: Aumento, material aloplástico, defectos craneofaciales

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INTRODUCTION

Repair of craniofacial defects has long been a challenge to the reconstructive surgeon. The goal of craniofacial reconstruction is to achieve a lifelong, stable and structural repair of the cranium covered by a healthy skin and scalp. Options for surgical repair include autogenous grafts, allografts, xenografts and alloplastic materials. The factors guiding choice of reconstructive option include skill of the operator, location and size of the defect, availability of materials, timing of the reconstruction and past medical history (1). The most popular alloplastic materials for use in reconstruction of skull defects are methylmethacrylate (acrylic) and titanium mesh (1). Other available materials include synthetic hydroxyappatite ceramics, calcium carbonate, bioactive glass and biocompatible composite polymers and

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several others (2). These latter categories are, however, not readily available in a developing country like Nigeria. The aim of this paper is to present three patients who had reconstruction of anterior skull defects using customized prefabricated heat-cured acrylic, at the Oral and Maxillofacial Surgery Clinic of the Aminu Kano Teaching Hospital, Kano, Nigeria, between 2003 and 2007.

CASE REPORTS

Case 1

A 26-year old Nigerian female presented at our clinic with a two-year history of depression of the forehead. Clinical examination showed three isolated oval defects at the mid portion of the frontal bone each measuring about 6 mm on average, with minimal scar at the margin of the lesion. A diagnosis of a resolved infected fronto-ethmoidal mucocoele was made. Systemic examination and investigations were essentially normal. The patient was scheduled for augmentation cranioplasty using heat-cured acrylic. Preoperatively, a mirror image of the defect was obtained with the aid of alginate impression material and three 'balls' of heat-cured acrylic were fabricated to simulate the shape and size of each of the defect. The patient was positioned supine and under general anaesthesia and endotracheal intubation, the lesion was approached via a bicoronal incision, raising the flap down to the pericranium. The prostheses were placed beneath the pericranium. The flap was repositioned with vertical mattress sutures using 1/0 prolene and a corrugated sheet drain was inserted. The procedure was uneventful and at one week post-surgery, the patient had no further complaint and seemed to be pleased with the improved aesthetic outcome. The patient was discharged home for recall after two weeks. Thereafter, the patient was reviewed at intervals of one month, three months, six months and a year. The initial aesthetic outcome was maintained without any complication.

Case 2

A 28-year old Nigerian male presented at our clinic with a six-year history of a painless swelling in the right frontoparietal region. Clinical examination revealed a bony hard swelling measuring about 8 cm x 6 cm in its greatest diameter. Other clinical findings included bulging of the right supra-orbital ridge with mild proptosis of the involved eye. Vision was, however, intact. A clinical impression of craniofacial fibrous dysplasia was made. Plain radiographic and computed tomographic examinations revealed an intracranial extension with slight displacement of the right frontal lobe. Laboratory investigations showed elevated serum calcium (25 mg/dL), phosphate (15 mg/dL) and alkaline phosphatase (12.8 units). Other blood parameters were within normal limits. A joint surgical management by the neurosurgery team and our unit was planned. Preoperatively, the size and shape of the defect was obtained using alginate impression material and cast in dental stone to produce a replica of the defect. The exuberant part of the cast was cut off to simulate the resulting postoperative defect. A heatcured perforated acrylic plate was prepared slightly larger than the anticipated size of the surgical defect. The patient was taken to theatre about six weeks from the day of first presentation. Under general anaesthesia and endotracheal intubation, a bicoronal flap was raised to expose the lesion which was resected. The frontal sinus was cranialized, and partly filled with pedicled twigs of temporalis muscle. The perforated acrylic was trimmed to approximate the size of the surgical defect. The acrylic plate was placed into the defect and anchorage was achieved by suturing the plate to the bony margin at multiple points. The flap was replaced and drains were inserted. Surgery and postoperative periods in the ward were uneventful and the patient was discharged on the 8th postoperative day with satisfactory aesthetic outcome. The patient was reviewed after discharge at two weeks, one month, three months, six months and one year. There were no complications and initial aesthetic outcome was still maintained. The patient has not presented since.

Case 3

A 35-year old Nigerian male presented at our clinic with a two-year history of a defect in the mid-frontal region resulting from a road traffic accident. Clinical examination revealed a trapezoidal-shaped defect measuring about 8 cm x 5 cm x 2 cm located in the mid-frontal region limited inferiorly by the supra-orbital ridges and the fronto-nasal junction. The superior extent was limited by the hairline (Fig. 1). Plain



Fig. 1: Before surgery (frontal view). Note the depression in the midfrontal region.

radiographic examinations revealed an intact inner layer of the calvarium. Laboratory investigations were essentially normal. The patient was scheduled for augmentation of the defect using heat-cured acrylic under general anaesthesia. A measurement of the defect was obtained with an alginate impression material preoperatively and the approximate dimension of the defect was fabricated with heat-cured acrylic. The acrylic plate was perforated to aid retention. *Via* a bicoronal incision, the flap (Fig. 2) was raised and the



Fig. 2: Bicoronal flap with insertion of acrylic plate.

perforated plate was inserted beneath the pericranium. Anchorage was achieved by suturing the plate to the bony margin at multiple points. The flap was replaced and drains were inserted. Surgical procedure and postoperative recovery were uneventful. Surgical outcome was satisfactory (Fig. 3). The patient was discharged home at one week post-



Fig. 3: Immediate postoperative appearance.

surgery and was thereafter reviewed at two weeks, one month, three months, six months and one year following discharge. The initial aesthetic outcome was still maintained and the patient has not reported any discomfort to date.

DISCUSSION

Anterior skull defects occur as a result of traumatic, inflammatory, neoplastic, congenital and ablative surgical procedures (3). The indications for restoration may be cos-

metic or protective. Cosmetic reconstruction is often necessary in view of the social unacceptability of a defect, particularly in a non-hair-bearing area. The choice of materials for anterior cranial augmentation is between an alloplast and bone, or a combination. Alloplastic materials include metal plates, methylmethacrylic acid (MMA), silicone rubber, hydroxyapatite and proplast (4), while autogenous materials include bone, dermis, fat and cartilage (5). The advantages of alloplast include the availability of the materials, ease of the surgical procedure, non-resorbability and superior cosmetic results. The main disadvantages are possible foreign body reaction and the potential for infection which may produce fistulae, extrusion, granulomas and erosion (6). Autogenous bone grafts have good tissue tolerance and presence of a viable reconstruction matrix. Its limitations include resorption, infection, donor site morbidity and inability to obtain enough bone for large defects (7).

Ideally, alloplastic implant materials should be biocompatible, non-antigenic, non-carcinogenic and non-inflammatory (8). Additionally, they should be sufficiently porous and interconnective for tissues to grow into and around the implant (osteoconduction), able to stimulate bone induction, resorbable and replaceable by bone, radio-opaque, able to withstand sterilization without losing favourable qualities, stable in varying temperatures and humidity, inexpensive and readily available (8). Although no single implant material satisfies the above listed criteria, acrylic has found a place in craniomaxillofacial prosthodontics because of its good physical, mechanical and biological properties.

Methylmethacrylic acid as a cranioplastic material is strong, of similar density to bone and possess a low thermal conductivity similar to that of cortical bone (9, 10). In addition, it has superior aesthetic outcome without donor site morbidity. Acrylic, however, has a low impact strength and toxicity which is related mainly to the level of free monomer that has been reported to range between 2 and 4% in the selfcuring acrylic compared to 1% in the heat-cured acrylic (9). The polymerization of the self-curing acrylic is exothermic. In vivo experiments with self-curing acrylic have found temperatures at the bone-resin interface to range from 45-70 C (10) which may be harmful to the local tissues. For these reasons, we opted for the heat-cure acrylic, even though the self-curing type has the advantage of intraoperative contouring to fit the anatomic defect. The incidence of complications with acrylic has been reported to range from 2 to 12% in two years (11). Reported complications include foreign body reactions which may result in infection, erosion, extrusion and fracture of the acrylic (11). Over the one-year period of follow-up for each of the cases, no complication was reported.

Patients' compliance to postoperative follow-up is poor in this part of the world because of several factors. These include apparent sense of well-being, long distance from the hospital and poverty. Nevertheless, we expect a return if there is any complication. To date, none of the patients has presented with any form of complaints since insertion of the alloplastic material.

CONCLUSION

Augmentation of craniofacial defects using customized heatcured acrylic provides patients with a durable, stable and structural repair of craniofacial defects with good aesthetic outcome. Oral and Maxillofacial Surgeons in less developed countries may find heat-cured acrylic as a viable alternative in craniofacial reconstruction.

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