Madreporic Coral for Cranial Base Reconstruction
8 Years Experience

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Summary
The authors, since 1985, have used 587 Madreporic Coral grafts as bone substitute in a total of 183 patients, among them in 80 cases for repair of cranial base bone defects. They report their long-term results.

Partial resorption to about 40% of the initial volume occurred in almost all cases within 8 to 10 months, with complete resorption after about one year. 20% of the coral blocks moved spontaneously or split into pieces, but could easily be withdrawn rhinoscopically through the nostrils. No CSF leakage was noticed afterwards.

The local infection rate was only 4%, always close to the basal coral graft. This is lower than the infection rate after using autologous bone harvested from the inner table of the bone flap (20%). Infections were cured by removal of the coral graft.

Despite the mentioned drawbacks, Madreporic Coral graft implants can be recommended as bone substitute in cranial base surgery: 1. The material simplifies the surgical procedure; 2. Harvesting of autologous bone is no longer necessary; 3. Transmission of infections like AIDS, Hepatitis C or Creutzfeld-Jacob-disease can be avoided with certainty.

Keywords: Cranial base repair; bone substitute; Madreporic Coral; transmission of infections; Creutzfeld-Jacob-disease; AIDS; hepatitis C.

Introduction
During skull base reconstruction, the harvest of autologous bone grafts usually requires a second incision and therefore prolongs the surgical procedure. Heterologous or artificial grafts do not seem to be as efficient⁹. Allografts raise the problem of their perfect sterilization which seems to be almost impossible⁸; particularly concerning the risk of transmission of Creutzfeld-Jacob-disease. That is why we searched for an efficient bone graft substitute. Since 1985, we have been using madreporic corals¹⁷,¹⁸. The aim of this paper is to present our results and to discuss the advantages and drawbacks of such a material.

Material
Coral implants used in our department belong to the Madrepora group, genera porites. Once the organic part of the corals (the polyp) has been destroyed by drying in the sun, the corals are prepared by chemical and physical treatment which preserves their structural integrity. Their skeleton is composed of about 99% calcium carbonate and 0.07% amino-acids. Their structure is made of microtubules (average diameter: 230 μ) which intercommunicate longitudinally as well as laterally.

They can be shaped and adapted easily to different dimensions and forms, and several coral sizes are available: - precut cone-shaped corals adapted to burr holes (larger diameter: 11 mm; smaller diameter: 9 mm), - precut rectangular blocks which have the following dimensions: 10 mm x 15 mm x 20 mm, 10 mm x 20 mm x 30, 40, 50, or 60 mm (Fig. 1). From 1985 to 1988, these implants had to be sterilized before operation in an autoclave (130° for 60 minutes). Since 1989, they are radio-sterilized before being distributed by INOTEB Company*.

Surgical Applications
From January 1985 to March 1986, as a preliminary step and in order to evaluate the possibilities of coral implants in the craniofacial field, we placed 100 “corks” into burr holes after the cranial bone flap had been replaced; this initial experience concerned 42 neurosurgical patients.

From April 1986 to January 1993, an additional 141 patients were grafted with porites coral fragments:
- 400 burr holes were filled in with “corks”
- 7 coral implants (length: 20 to 40 mm; width: 5 to 11 mm) were used to repair traumatic or surgical defects of the skull. These implants were easily reshaped with a grinding wheel or bone forceps during the operation so as to fit the defect; they were secured in place with trans-osseous – trans-coral sutures.
- 80 large madreporic grafts were used to repair the floor of the anterior cranial fossa (Fig. 2): 62 times after the removal – through a double trans-facial and subfrontal approach – of a tu-

* Biocoral, INOTEB Company, Saint Gonnery, F-56290 Noyal Pontivy, France.
mour of the ethmoidal sinuses extending to the cribiform plates, ×18 times to treat post-traumatic rhinorrhea.

The lengths of the blocks were: 20 mm (6 cases), 30 mm (30 cases), 40 mm (25 cases), 50 mm (13 cases), 60 mm (6 cases).

A coral block was used twice to reconstruct simultaneously the cranial base and the nasal pyramid.

We always chose the size of the precut coral fragment slightly larger than the defect to be repaired. The coral was recontoured until it could be pressed firmly into place. Two to four trans-osseous – trans-coral sutures ensured graft immobilization.

Results

183 patients were implanted with a total of 587 madreporic coral grafts.
The average follow-up was 44 months, varying from two months to eight years.