FORM-FITTING PLASTIC CRANIOPLASTY

WILLIAM T. SPENCE*
Georgetown University School of Medicine, Washington, D.C.

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The methods of cranioplasty must progress with the times, the same as all types of neurosurgery, and it is the purpose of this paper to show the advantages of repairing certain cranial defects with a form-fitting plastic implant. The author has used a highly refined methyl methacrylate resin since November, 1947. The first plates are still firmly in place. At least five have been entirely satisfactory for 6 years.

The objections to metal plates run from scientific to personal. The latter is exemplified by the patient who said, "I do not want a lightning rod in my head." There is almost a social stigma to having "a silver plate in the head," and this takes a more serious turn when the individual is refused employment because of such. The scientific objections are as follows: (1) Metal resists X-ray penetration, thus interfering with X-ray therapy, ventriculography, arteriography, and visualization of the position of silver hemostatic clips. (2) Metal transmits heat and cold too readily, often causing headache. (3) Metal is difficult to work and make a suitable fit, especially if it is to be water-tight. (4) Metal bends easily to trauma, causing deformity and/or brain compression. (5) Working sharp edges may cut the operator's finger and even rounded edges may perforate the patient's skin. (6) Highly purified metals such as tantalum are ten times more expensive than plastic. Tantalum costs $1.50 or more per square inch, plastic about 25¢ a square inch. (7) The metal-bone relationship is not as natural as plastic and bone. Certain plastics look like, feel like, and cut like bone. Plastic screws are better tolerated than metal.

A liquid plastic to seal the cranial replacement and make it water-tight is being investigated at the present time. This would provide another advantage of plastic over metal.

Objections to rolled plates per se are: (1) Cranioplasty with a metal or rolled plate does not take into account the third dimension of depth in closing the defect. This results in a dead space into which herniation of the brain may occur (Fig. 1). (2) A plate over a hole, instead of in it, results in a rim of disturbed circulation where the inner tables meet the pulsating resistance of the herniating brain, i.e. the neck of the hernial sac (Fig. 2).

That metal plates have not been entirely successful has been mentioned by others. Grantham and Landis* reported that headache was not relieved in 50 per cent of the patients after cranioplasty with metal plates. Tuffier and

* 1150 Connecticut Avenue, Washington 6, D. C.
Guillain\textsuperscript{12} are cited as having found no improvement except a cosmetic one. Woodhall and Spurling\textsuperscript{14} likewise found that generalized headache was unrelieved by tantalum cranioplasty.

The author’s neurosurgical experience during 4½ years of World War II is contrary to the statement made by some that excellent shaping of metal for cranioplasty may be accomplished with ease.\textsuperscript{15} The complexity of the procedure of metal cranioplasty is well borne out by Reeves\textsuperscript{10} monograph (pp. 1–42). For the most part, metal cranioplasty was a time-consuming process holding up the operating room for such long periods that it was abandoned as a primary procedure in combat. This was especially true when attempts were made to countersink the metal plates in a cutout of the skull around the edge of the defect such as has been recommended by others\textsuperscript{1,3,4,10,12} working with metal or rolled plastic plates.

**PRINCIPLES**

Most everyone agrees now that cranioplasty is desirable. The reasons have been outlined by Grant and Norcross\textsuperscript{5} and others. The author is in agreement with those who believe that the principal reason for improvement after cranioplasty is the better splinting of the brain. Gardner\textsuperscript{4} emphasized this concept and his conclusions bear repeating:

“Since immobilization is important in wounds of baser tissues, it should be doubly important in the case of wounds of the brain. But when the surgeon closes the scalp over a brain