THE USE OF PURE POLYETHYLENE PLATE FOR CRANIOPLASTY

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Skull defects have been satisfactorily covered for many years with celluloid, tantalum, methyl methacrylate (Lucite, Plexiglass, Perspex), bone from other parts of the body, and various other substances, but each of these materials has one or more properties which make it disadvantageous for this procedure. Pure Polyethylene plate seems to have the desirable properties of all of the substances previously used without their disadvantages. It has undergone adequate experimental trial and has received limited clinical use. This synthetic plastic approaches the ideal so far as material for cranioplasty in human patients is concerned.

Pure Polyethylene causes no immediate or delayed tissue reaction, and its physical properties are not apparently changed by contact with body fluid. It maintains contour and does not change its physical properties under the extremes of temperature variations to which the body is normally subjected; it is neither epileptogenic nor carcinogenic; it does not cast an opaque shadow in roentgenograms; and it is easily malleable when heated in boiling water to make it convenient for use at the operating table (Fig. 1).

Of the substances now in common use for cranioplasty, tantalum is the most popular among neurosurgeons. It causes negligible tissue reaction and is easily molded at the operating table, but it is opaque to roentgen rays and, therefore, the air studies, angiograms, and other roentgenographic studies postoperatively are not usually satisfactory when tantalum has been used.

Methyl methacrylate is not opaque to roentgen rays, but it is extremely hard at room temperature and requires a special technique for use at the operating table, which makes it cumbersome and inconvenient. It causes little if any tissue reaction.

Bone from other parts of the body has proved satisfactory in many hands.
over the years. It is difficult to obtain contour in complicated bone defects with this substance, and its use requires two surgical incisions.

Celluloid\textsuperscript{5,13} is easily molded to contour at the operating table and is not opaque to roentgen rays. It has received wide clinical use, but it is not a pure plastic substance and its physical properties change when it is buried in tissues. It becomes brittle in some cases and, like cellophane, causes an intense tissue response in both experimental animals and human subjects.

Other materials used for cranioplasty such as gold, silver, stainless steel, vitallium, ticonium and stainless steel wire mesh have one or more of the disadvantages mentioned above.

EXPERIMENTAL DATA

Pure Polyethylene in the form of tubing and film has been uniformly innocuous to tissue.\textsuperscript{1,3,7,8,10} Certain forms of this material apparently containing impurities have been found by Poppe and de Oliveira\textsuperscript{15} and by Yeager and Cowley\textsuperscript{20} and others to cause intense tissue reaction and fibrosis, but in such instances the response is caused by impurities, not by the Polyethylene. Specifically, contact of Polyethylene with brain,\textsuperscript{10} dura,\textsuperscript{3} and bone\textsuperscript{12} has been adequately studied and found to cause no significant tissue reaction. Since these experimental studies were made, Polyethylene in the form of plates varying from 2 mm. to 25 mm. in thickness has become available. In view of the rigidity of this material in plate form, it seemed to present itself as entirely suitable for cranioplasty. Laboratory investigation was, therefore, undertaken to determine the response of tissues in contact with Polyethylene plate and the ease with which it could be used in the operating room.

A total of 10 adult mongrel dogs was used to test this substance. The animals were operated upon under intravenous nembutal anesthesia, aseptic technique was used throughout, and skull defects measuring 2 to 4 cm. in size were created. These were then filled with pieces of Polyethylene plate,\textsuperscript{*} 3.25 mm. in thickness cut to appropriate size, held in place with sutures of fine silk.

The animals were sacrificed at scheduled intervals from the 3rd to the 180th

\begin{figure}[h]
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\caption{(Dog. No. 73) Section of dura directly underlying Polyethylene plate 180 days after cranioplasty; there is no appreciable thickening.}
\end{figure}