REPLACEMENT OF SPINAL INTERVERTEBRAL DISCS WITH LOCALLY POLYMERIZING METHYL METHACRYLATE

EXPERIMENTAL STUDY OF EFFECTS UPON TISSUES AND REPORT OF A SMALL CLINICAL SERIES*

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After rather complete curettage of intervertebral disc spaces became the common treatment of disc protrusions, various methods have been used in attempting to "fix" the joint or to prevent loss of the vertical dimension of the disc. This seems desirable to maintain the normal relations of the facets. Van Wagenen packed the disc space with bone chips; Cloward\textsuperscript{2,3} wedged in plugs of solid bone; Gardner implanted plastic blocks of appropriate thickness, and Wiltberger\textsuperscript{7} imbedded plastic cylinders into channels drilled through the disc and the adjacent vertebrae. Although these proponents all considered their methods desirable, they have not been accepted generally as superior to the simpler disc operations.\textsuperscript{4} Cleveland\textsuperscript{1} proposed filling the disc space with the fluid mixture of monomers of methyl methacrylate and allowing it to polymerize in situ. The sterilization of the powdered fraction of methacrylate by ultraviolet light has made it feasible to so prepare prostheses in situ. Methods for preparing prostheses of the skull with this material were introduced by Woringer\textsuperscript{8} and by Spence\textsuperscript{6} and result in closer approximation than is possible with other materials. The acrylic is generally well tolerated by body tissues. In the disc cavity this type of prosthesis would seem mechanically superior to those proposed earlier, since it conforms perfectly to the lens-shaped disc cavity so should not be displaceable, and presents broad surfaces for bearing of weight.

When mixed into a fluid mass, methacrylate polymerizes; molecules of the plastic combine to form long chains, causing the liquid monomer to produce a solid, hard, polymeric form of methyl methacrylate. The time of polymerization varies from 8 to 15 minutes, depending on the proportions of the two fractions. Woringer stated that the pH value of the liquid fraction is low enough to cauterize living tissue. Polymerization liberates a great deal of heat, reaching 175\degree–180\degree F.

It seemed desirable to determine the effects upon host tissues of these physicochemical reactions. Since the intervertebral disc spaces of experi-

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mental animals are too small for easy manipulation, the reaction was studied in the knee joints of the hind-legs of a series of dogs. It is realized that these joints, being lined with synovia, are not entirely comparable with disc spaces, but the effects upon articular cartilage and bone could be determined. The joint space was opened aseptically and 3–3.5 cc. of the acrylic mixture was introduced and allowed to "cure" in situ. The joint was closed surgically. For a control, the contralateral joint was opened similarly, moderately scarified mechanically and closed. After wound healing, motion of the joints containing acrylic was relatively limited, but in all cases, after subsidence of the surgical discomfort, weight was borne on the limb with minimal limping.

The results of the study have been reported by Glaser. In brief, definite changes were demonstrated, consisting, in addition to nonspecific synovial arthritis, of chondritis and of focal osteomyelitic reaction, with subchondral, osteoclastic bone resorption and definite new bone formation. The changes reached their peak at about the fifth month and showed evidence of subsiding by the eighth month.

CLINICAL MATERIAL

Encouraged by Cleveland's favorable experiences, between November 9, 1955 and October 24, 1956 we employed his method in 14 patients having uncomplicated protrusion of low lumbar intervertebral disc. The series then was terminated and a year was allowed to lapse, after which the patients were questioned. All responded and most of them were re-examined. Responses were obtained from a random selection of an equal number of patients operated upon during the same time period without implantation of acrylic.

Analysis of returns was disappointing, perhaps because of the small size of the series. No significant difference was found in the length of hospital stay, in return to outdoor activity, return to light or to heavy work, or to sports. Return to usual pre-injury work appeared to be a factor of the heaviness of the work rather than of the type of operation. The present status of pain in back and/or leg is essentially the same in both groups.

In postoperative films and laminagrams made at least a year after operation, we have been unable to see any evidence of essential difference between the spines of the two series. Ratios were calculated of the maximal thickness of the disc to the height of adjacent vertebral bodies, in order to compensate for differences in tube-film distance in exposures made under varying technical conditions. In this time period, no essential difference was found between pre- and postoperative films made in the two series of cases.

One complication occurred during the 14 acrylic implantations. A loose protrusion was removed from the fourth lumbar disc which then was evacuated through a window cut in the thinned annulus. After the acrylic was injected and the tube and its packing were removed, loose acrylic paste was found in the epidural space. This was removed and its egress from the disc was found to have occurred via a previously unrecognized midline rent in the annulus. Other loose fragments of acrylic were recognized and removed