Stereotactic implantation for small animals: A "wire-bridge" technique¹

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The technique and advantages of a new implantation method is described.

Of the various implantation techniques in use for rats and other animals, that first used by Albino in 1954 (Albino & Spearman, 1957), has the advantage of allowing the placement of a number of electrodes independently of each other within a relatively large area of the skull. Three or more screws are fixed into the skull and dental cement is used to anchor each electrode in place. The jeweller's screws are, however, usually driven through the skull, and the 1 mm or more that protrudes deforms the underlying tissue, soon rusts, enlarges, and effectively prevents the plant from coming away from the skull. It probably also causes both primary and secondary brain damage.

The use of screws in our laboratory has not met with the success claimed for it by others. In many cases, removing a stilette and fitting a micro-injection cannula, or fitting an electrode attachment to an assembly, resulted in its coming away from the skull. The use of small wood screws and of tantalum orthopedic screws met with as little success. This was perhaps due to our wishing to avoid damage consequent upon screws protruding through the skull. What was required was some technique using stainless steel which would not involve brain damage.

After attempting a number of techniques, one was developed which proved so effective that since July 1964 it has been used routinely for all implants, none of which have been lost.

Method

Using a dental drill with thyristor control to allow high torque at low speed, two pairs of holes are drilled, bilaterally (size 2/0 inverted cone drill reduced in diameter on a grindstone), on the dorsal surface of the frontal and parietal bones. The rostral pair are about 2 mm in front of the lambda and the caudal just rostral to the bregma. Each hole is drilled at about 45° to the horizontal plane, outwards, and about 2 mm from the dorso-lateral flexure of the skull. Rocky-Mountain arch wire of .015 in diameter is then cut to a length

one quarter longer than the separation of the holes, bent with two artery forceps, and the ends fitted into the holes. The same procedure is repeated to form the second bridge. Holes are then drilled for the electrodes or cannulae and these are held by flowing dental cement (cold-cure acrylic) around them and the bridges. Many electrodes can be placed by allowing the cement to set for each before placing the next, one bridge being sufficient to hold electrodes during implantation. Since the area between the bridges is relatively large, and since placements can be anywhere in this area as well as on both sides of either bridge, the only limitation on the number and placement of electrodes is due to their physical size or through the type of electrode attachment used. The bridges do not have to be placed transversely but can be angled to accommodate electrodes in a particular area. Their separation can also be varied. If required, the arch wire can be insulated by using one of the solutions mentioned in Scheer (1961).

Advantages.

This technique has the advantage of being firmer than others, but it is, in addition, extremely rapid to perform, the materials used are less expensive and the resultant plant is smaller since the bridge has its highest point at the center and is even here only a couple of millimeters above the skull surface. Perhaps the chief gain is, however, the negligible damage to the brain. Since the arch-wire penetrates at the flexure of the skull where there is a ridge with thicker bone, and where the brain surface is curved laterally, the chance of damaging cortex is slight. Post mortem confirms that there is no damage to cortex. And since stainless steel wire is used, little long-term deterioration can result.

References

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Note

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