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An Easily Mass Produced Cannula System for Chemical Stimulation of the Brain[1]

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STATON, D. M. AND P. R. SOLOMON. *An easily mass produced cannula system for chemical stimulation of the brain.* PHARMAC. BIOCHEM. BEHAV. 11(3) 363–365, 1979.—This paper describes a cannula system for chemical stimulation of the brain which can be easily mass produced in a reliable and inexpensive manner.

Cerebral cannula Chemical stimulation

ANY successful intracerebral cannula system must overcome a number of basic technical difficulties: the implant must remain intact despite the animal's attempt to remove it; it must resist clogging due to the coagulation of blood, cerebrospinal fluid or the injected chemical; and it must be simple to accurately implant and use [1, 2, 4]. In addition, because direct chemical stimulation of the brain has become a standard technique in studying the relationship between neurochemical events and behavior [4], it is desirable to have a cannula system that can be mass produced in a reliable and inexpensive manner. The present paper describes a system that we have used for the past year and which appears to meet these criteria.

Design and Construction

The implant consists of three basic parts: (1) a base made from a nylon machine screw (Small Parts, Inc., Miami, Florida); (2) the outer cannula, made from stainless steel hypodermic tubing, and (3) a cap threaded to fit the nylon base. Figure 1-A shows the entire assembly.

Depending upon the lateral coordinates of the implant, we use one of several different size bases. For bilateral implants that are no more than 2 mm apart, we use a single 1/4 in. $\times$20 nylon machine screw in which both cannulae are placed. For implants spaced farther than 2 mm apart, we use separate nylon screws (size 6–32), each containing a single cannula.

We first cut the threaded portion of the screw into 5 mm segments. This is most easily accomplished by placing a utility knife blade between two threads and gently tapping the top of the blade with a hammer. We have found that any attempt to cut the screw using a power tool (e.g., a Dremel tool) melts the nylon. We then place the cut portions in a threaded metal jig (Fig. 1-B) and drill two longitudinal channels. The distance between these holes is determined by the lateral coordinate of the implant. Although it is more expedient to drill out the nylon screws before they are cut into segments, this often produces nonparallel channels. Because we typically use 28 ga hypodermic tubing for outer cannulae, we use a number 70 drill bit to produce the channels. In most instances this produces a snug fit, but to assure that the tubing does not slip after implantation, we apply a drop of instant bonding glue (e.g., Eastman 910) where the tubing protrudes from the base of the nylon screw.

The length of the hypodermic tubing is determined by the depth of the implant plus the length of the base. In addition, we allow the cannula to protrude 1 mm above the nylon screw and we leave a 2 mm space between the bottom of the screw and the skull (see Fig. 1-A).

The time necessary to assemble the implant can be substantially reduced by using a depth gauge to precisely position the tubing in the nylon base (Fig. 1-C). This gauge consists of an aluminum base to which two plates are attached. The thickness of the plates is determined by the depth of the implant plus 2 mm (for the space between the skull and the base of the nylon rod). The precut tubing is placed in the nylon base such that the top of the tubing is flush with the top of the base. In this way the bottom of the tubing protrudes 1–2 mm too far beyond the bottom of the base. The bottom of the tubing is then placed on the base of the depth gauge and the nylon rod is pushed until it touches the top of the plates (Fig. 1-C). This yields a reproducible and accurate method for assuring that both cannulae protrude the proper distance from the nylon screw.

The final portion of the unit consists of a cap constructed from a solid 1/4 in. diameter Plexiglas rod which is cut into 3–4 mm segments. Each segment is then tapped to form a cap which screws onto the threads of the nylon base. This serves the dual purpose of preventing the animal from removing the dummy cannulae and of keeping the implant clean. When the caps are secured to the nylon base, they form an air-tight

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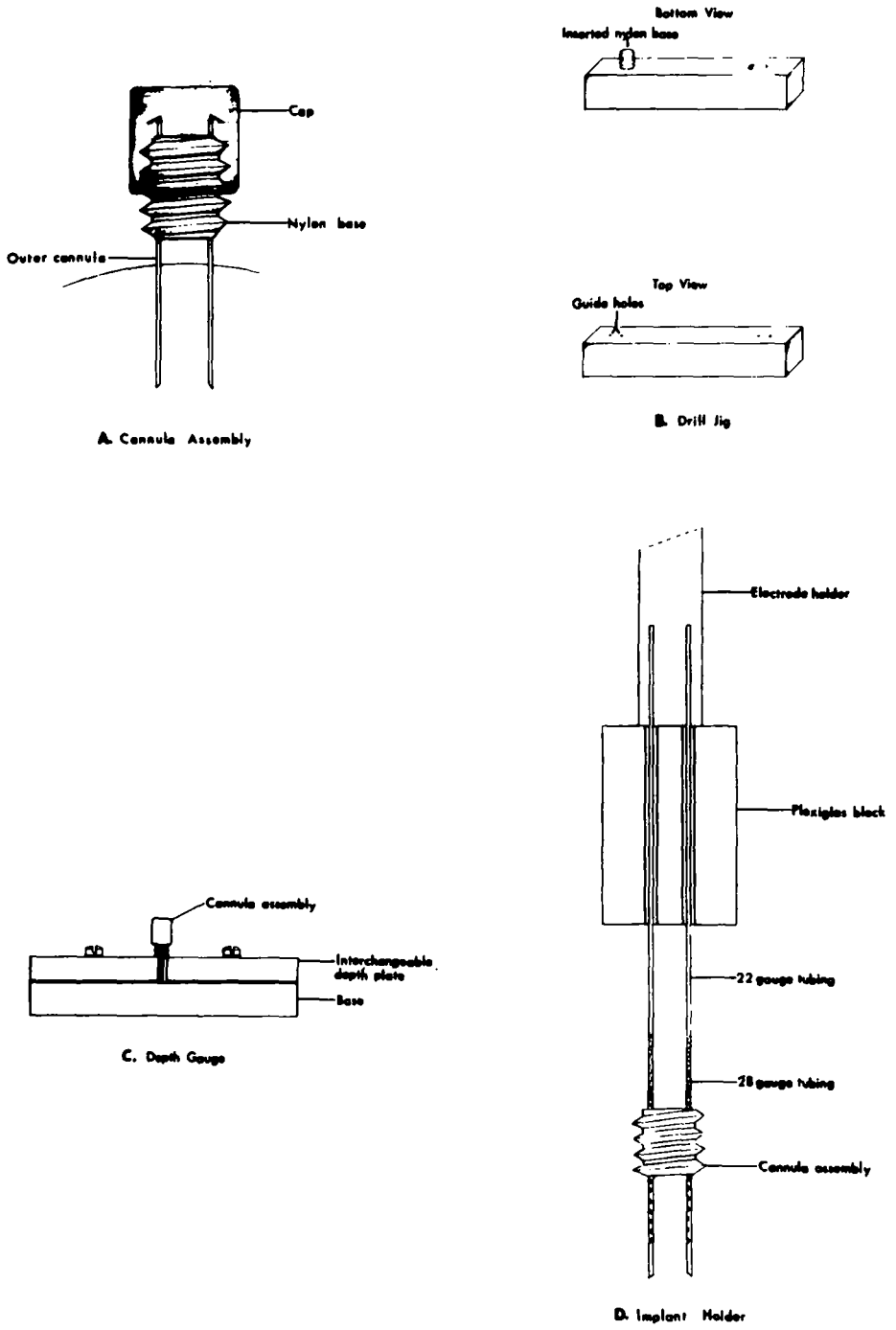

FIG. 1 (A) Fully assembled cannula system. The kinked inner pins, made from nickel chrome gauge J wire, prevent clogging of guide cannulae. (B) Jig used to produce holes in nylon base for guide cannulae. The nylon base is screwed into the bottom of the jig and the drill bit is passed through the guide holes in the top of the jig. This assures a reliable method of producing straight channels. (C) Gauge for determining length of outer cannula. The depth plates can be interchanged in order to vary the length of the implanted outer cannula. This provides a rapid and accurate method of assembling many cannulae with the same dorsal/ventral coordinates, and, in the case of multiple cannulae in a single base, the depth gauge assures that both cannulae protrude the same distance from the base. (D) Holder for implanting cannula assembly. This unit is easily adapted to most stereotaxic instruments.

seal. Thus to reduce the possibility of intercranial pressure via the cannula when securing the caps, we drill a small hole (1 mm in diameter) in the top of each cap. Although producing the caps is the most time consuming part of the construction, the advantage of not losing inner cannulae and thus subjecting the animal to the possibility of foreign matter in the implant seems to justify the time expenditure. In addition, the caps can be recycled so only a small supply is necessary. In fact, we have found that the implant itself can be recycled by soaking it overnight in chloroform. This removes the dental cement, but does not affect the nylon screw or hypodermic tubing.

Implantation

The assembled units can be implanted in the usual manner using stereotaxic surgery on the anesthetized animal. The cannula system can be attached to a Kopf stereotaxic instrument (and with minor adjustments to other units) using the holder shown in Fig. 1-D. The holder consists of a 1.5 cm square Plexiglas block which is threaded so it can be attached to the electrode holder. Two grooves, spaced to correspond to the distance between the cannulae, are cut in the Plexiglas block. A 4 cm length of 22 gauge hypodermic tubing is placed in each groove and secured with masking tape. A 3–4 cm length of 28 ga tubing is then fitted into each of the larger tubes. The smaller tube is secured in the larger tube by placing a small kink in the inserted end. The remaining portion of the 28 ga tube extends from the bottom of the 22 ga tube and it is this portion that holds the cannula assembly during implantation. In addition to holding the cannula assembly firmly during implantation, the system allows ample working space to apply the cranioplastic cement. The 28 gauge tubing also helps keep the cannula from clogging during implantation.

We have used this implantation procedure in both rats and rabbits. The nylon screw base provides an excellent bonding surface for the cranioplastic cement and in only a few cases out of several hundred implanted animals has an animal dislodged the assembly. In addition, the Plexiglas cap virtually eliminates dislodged dummy cannulae thereby cutting down on infections and clogged guide cannulae. Finally, the unit is inexpensive (about 25 cents in each in materials) and, once the necessary jigs have been made, easily mass produced.

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