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An Easily Constructed Durable Chronic Intracerebral Cannula System[1,2]

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GRAY, D. S. AND B. B. GORZALKA. *An easily constructed durable chronic intracerebral cannula system.* PHARMAC. BIOCHEM. BEHAV. 11(4) 463–466, 1979.—A simple, inexpensive, and rugged intracerebral cannula system is described and construction details are provided for both guide and injection cannula assemblies. The guide cannula assembly is easily and quickly molded from dental acrylic cement and has a protective acrylic collar surrounding the end of the actual guide cannula. This system is believed to offer some advantage over current methodologies in terms of expense, durability and ease of construction and is well suited to use in rodents.

Intracerebral cannula Chemical stimulation Micro injection Intraventricular Infusion Intracranial Rodents Cannula techniques

IT WOULD seem that there is a demand for a chronic intracerebral cannula system that may be manufactured quickly and inexpensively in the laboratory. Commercially manufactured systems are available (e.g., Plastic Products Co., Roanoke, Virginia), but appear to suffer from relatively high cost and lack of suitability for certain applications. Although a complete review of the many cannula systems in existence is not possible here, a number of ingenious designs have been proposed by various authors (e.g., 1–10) to circumvent these problems. Most of these, however, suffer from complexity of construction, special tools or materials required for construction, or inordinate amounts of time required for construction. Simpler solutions have been proposed (e.g. [1,6]), but these devices appear to suffer from a lack of durability in that they can easily be made unservicable by loss of obdurators or similar problems.

Recently in our laboratory it became necessary to design a chronic intracerebral guide cannula and delivery system for rats that could be constructed quickly and inexpensively and yet survive exposure to the manipulations of other animals in a sexual behavior test or group housing situation. Without some form of protection in these types of situations, soft plastic guide cannula mounts such as those described by Myers *et al.* [7,8] may be destroyed or obdurators pulled out and lost with attendant plugging and loss of the guide cannula assembly.

Our solution to this problem was to embed the upper portion of the guide cannula in dental acrylic cement for support and to continue the acrylic upwards to form a cylindrical collar around the exposed end of the cannula. Dill [3] has described the use of a protective collar made from a section of plastic syringe barrel but the soft plastic may be easily destroyed and the difficulty involved in affixing this barrel section securely limits its usefulness. The injection cannula and delivery system described here is equally as simple and effective as the outer guide cannula assembly.

The present design also has the advantage of being well suited to the use of various sizes of guide and injection cannulae with little or no modification of the basic design.

METHOD

Guide Cannula Construction

Steps in the construction of the outer guide cannula and a completed and cross-sectional view are illustrated in Figs. 1B and 2. The stainless steel cannula is obtained by pulling the needle portion of a disposable hypodermic needle (e.g., Yale 23 g, 1 in. disposable needles) straight out from the plastic hub. The white cement adhering to the stainless tubing remains and the tubing is cut to a uniform length appropriate to the target depth, measuring from the blunt end of the tubing. Stainless steel tubing of this size may be satisfactorily cut by nicking the tubing with an ampule file or similar instrument and grasping the tubing in plier jaws such that the nick is just at the edge of the jaws. Pressure is then exerted opposite the nick such that the tubing snaps over the edge of the jaw across the nick. Any rough edges may be later removed with a file or rotary grinder although this is seldom necessary.

The small 'ribs' on the plastic hub are shaved off with a knife. The hub is inverted on a flat surface and the cement-covered end of the cannula is then placed back into the hub just far enough to hold the cannula upright. A short (approximately 1.5 cm) section of a plastic tuberculin syringe (e.g., Yale 1 cc disposable tuberculin syringe) barrel is then slipped over the cannula and hub such that it rests on the wider portion of the inverted plastic hub. This assembly then forms a mold which is filled with dental acrylic (e.g., Flash Dental

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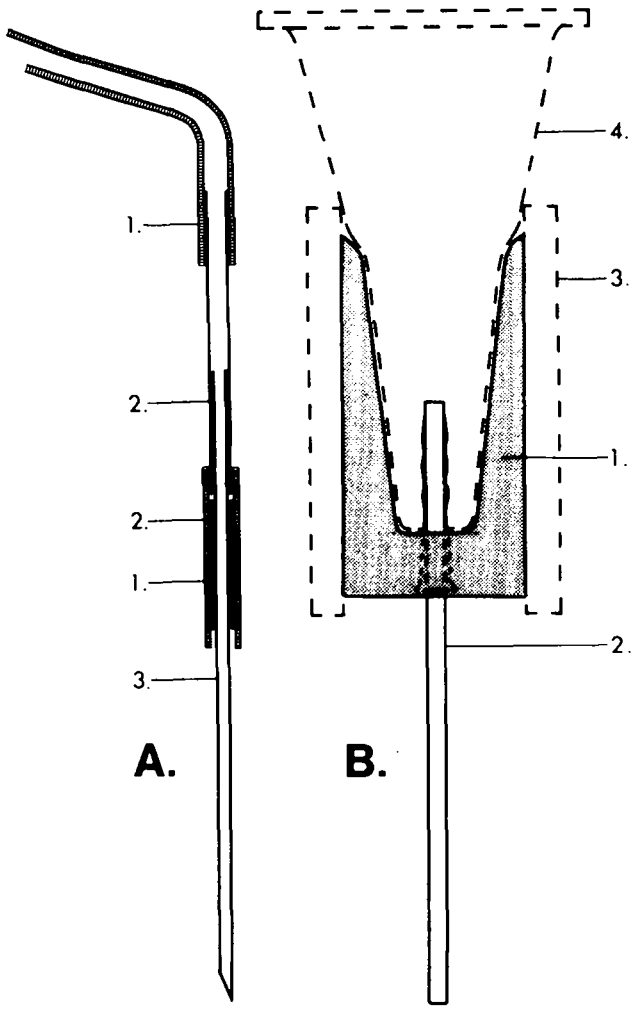

FIG. 1. A. Cross-sectional view of injection cannula assembly: (1) polyethylene tubing, (2) 23 ga stainless steel tubing, (3) 30 ga injection needle. The length of stainless steel tubing shown here connecting the PE tubing from the syringe and the injection needle could be eliminated from the design and the PE tubing connected directly to the injection needle. B. Cross-sectional view of guide cannula assembly: (1) acrylic cement collars, (2) 23 ga guide cannula. Dashed lines indicate positions of syringe barrel section (3) and plastic hub (4) which form the mold and are discarded following the molding operation.

Acrylic Compound) all the way down to the barrel-hub junction and up to a point just above the cement covered portion of the cannula. Once the acrylic has hardened, the plastic hub and barrel section are easily removed and any mold flash may be trimmed, completing the guide cannula assembly. The entire operation requires approximately five minutes to complete.

The Injection Delivery System

The injection delivery system shown in Figs. 1A and 2G is comprised of a 30 ga injection needle of a length appropriate to the guide cannula in which it will be used, carefully cemented inside a 3 mm length of 23 ga tubing with a fast-setting non-viscous glue (e.g., Eastman 910 adhesive or Krazy Glue) and is similar to the injection system described by Marley and Stephenson [6]. This 3 mm collar of 23 ga tubing is fixed in such a way that it forms a stop for insertion of the injection cannula into the guide cannula. The injection cannula-stop assembly is pushed into a short length of 0.023 in. (ID) polyethylene (PE) tubing (e.g., Intramedic PE 50) such that a short section of the PE tubing extends past the stop collar on both ends. This permits the extended PE tubing portion to fit over the projecting end of the implanted guide cannula and hence allows a fluid seal and mechanical support of the injection cannula in the guide cannula. The projecting portion of PE tubing on the opposite end is then fixed onto a length (approximately 2 cm) of 23 ga stainless steel tubing. The tubing from the injection pump or syringe is then attached to this 2 cm length of tubing. Although this intervening length of stainless steel tubing is not necessary and could easily be eliminated from the design, it does increase the ease of handling and insertion of the injection cannula into the guide cannula. It also allows quick and easy replacement of bent or otherwise damaged injection cannulae. If additional support is required, such as in a long-term injection situation, the tubing may be affixed to a small alligator clip shaped to attach firmly onto the side of the acrylic collar.

When the injection system is not in use, the guide cannula is plugged by a length of stainless steel pin (e.g., insect pin, size 00) kinked slightly so that it is held in the guide cannula by friction. The top end of the pin is bent in a small loop (approximately 2 mm dia.) and the loop enclosed in a small ball of acrylic. The obdurator is placed in the guide and cut to length before implantation. This obdurator is easily removed and replaced with the use of fine-point forceps.

For stereotaxic manipulation of the guide cannula, a slight kinked length of either 30 ga tubing or insect pin (00) is partially inserted into a length of 23 ga tubing and fixed with solder or cement. This 23 ga portion is fixed into a conventional electrode carrier on the micromanipulator and the guide cannula held by inserting it over the smaller gauge portion of the holder. The guide cannula assembly is affixed to the skull in conventional fashion using skull screws and dental acrylic [7].

DISCUSSION

It is felt that this chronic implanted cannula-injection system offers some significant advantages over either commercial or custom made variations. It is inexpensive, extremely rugged, and easy to assemble. The use of dental acrylic in construction makes the implantation procedure more efficient as there is little need for extensive build-up of acrylic cement when anchoring the device to the skull. This system is suitable to a variety of applications as varying sizes of guide and injection cannulae may also be easily constructed using exactly the same technique.

For bilateral applications, one side of the acrylic collar may be easily ground or filed away allowing two parallel guide cannulae to be placed a very short distance apart (see Fig. 2F). This eliminates the necessity of angular placements and the remaining individual collars will again form a large collar around the ends of the two guide cannulae. The two collars could easily be permanently joined with the application of small amounts of acrylic cement.

This system has been utilized in our laboratory in approximately 70 animals and to date, no problems have developed. The guide cannula assembly has easily survived exposure to

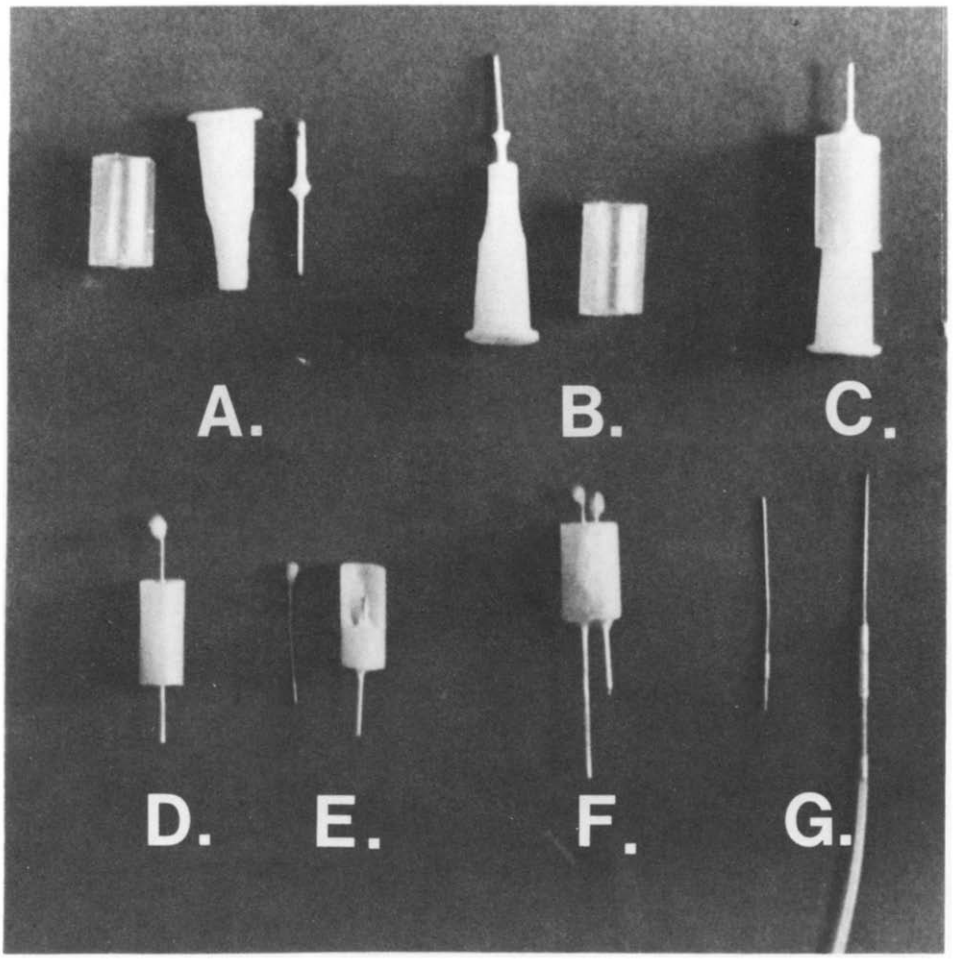

FIG. 2. Photograph illustrating various stages and components of cannula system construction. A. Individual components of guide cannula assembly: syringe barrel section, needle hub and cannula. B. Cannula inserted in hub prior to molding. C. Filled mold ready to disassemble. D. Completed cannula with obdurator in place. E. Cut-away view of cannula assembly with obdurator. F. Parallel cannulae application created by grinding away a portion of and cementing together two individual cannula assemblies. G. Injection needle and assembled injection system.

a group-housing, food-deprivation situation and has also been recently utilized in our laboratory in a study of the effects of intraventricular adrenocorticotrophic hormone (ACTH) on lordosis behavior in female rats with no apparent problems.

Collection of debris in the funnel-shaped acrylic collars does not appear to occur to any great extent. However, if the animals are housed on some form of loose bedding material, debris collection may create some contamination problems and care should be taken to remove any amounts of debris collected. The acrylic collars do not become jammed in the wire mesh of typical hanging cages when the animals curl up while sleeping, a possible problem discussed by Myers [7].

Although certainly not the ultimate solution, it would seem that this system does provide some advantages over already existing methodology in terms of expense, durability, and ease and speed of assembly.

REFERENCES

1. Altaffer, F. B., F. de Balbian Verster, S. Hall, C. J. Long and P. D'Encarnacao. A simple and inexpensive cannula technique for chemical stimulation of the brain. *Physiol. Behav.* **5**: 119–121, 1970.
2. Chisholm, B. and G. Singer. A new type of cannula for central administration of drugs in rats. *Physiol. Behav.* **5**: 1069–1070, 1970.
3. Dill, R. E. Induction and measurement of tremor and other dyskinesias. In: *Methods in Psychobiology*, Vol. 3, edited by R. D. Myers. New York: Academic Press, 1977, pp. 245–246.
4. Hayden, J. F., L. R. Johnson and R. P. Maickel. Construction and implantation of a permanent cannula for making injections into the lateral ventricle of the rat brain. *Life Sci.* **5**: 1509–1515, 1966.
5. Lavenhar, S. R. and A. L. Palanker. Cannula system for local stimulation of the rat brain. *Pharmac. Biochem. Behav.* **4**: 351–352, 1976.
6. Marley, E. and J. D. Stephenson. Intracerebral micro-infusions of drugs under controlled conditions in young chickens. *J. Physiol.* **196**: 97P–99P, 1968.
7. Myers, R. D. Methods for chemical stimulation of the brain. In: *Methods in Psychobiology*, Vol. 1, edited by R. D. Myers. New York: Academic Press, 1971, pp. 247–257.
8. Myers, R. D., G. Casaday and R. B. Holman. A simplified intracranial cannula for chemical stimulation or long-term infusion into the brain. *Physiol. Behav.* **2**: 87–88, 1967.
9. Potts, W. J. and P. F. East. A simple intracranial cannula for the rat. *Physiol. Behav.* **7**: 281–282, 1971.
10. Rezek, M. and V. Havlicek. Cannula for intracerebral administration of experimental substances. *Pharmac. Biochem. Behav.* **3**: 1125–1128, 1975.