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How to

A simple and economical method of electrode fabrication for brain self-stimulation in rats

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ABSTRACT

Introduction: Intracranial self-stimulation (ICSS) is an operant paradigm in which rodents self-administer rewarding electrical stimulation through electrodes implanted into the brain. We describe a simple, inexpensive and reliable method to fabricate monopolar and bipolar electrodes, along with the swivel system, for delivery of electric pulses at the targeted sites in the brain of rat. **Methods:** The system consists of an insulated stainless steel wire(s) (diameter: 0.25 mm), plastic base, pedestal and connector attached to a swivel via a stimulating cable, which is connected to the stimulator. We provide the specifications, source of each component, and the method of fabrication in details. **Results:** In-house fabricated monopolar or bipolar electrodes were subjected to rigorous tests. We implanted the electrode into the medial forebrain bundle (MFB) and rat was trained to press the lever for electrical self-stimulation in operant chamber for 60 min each day. In about 3–4 days, the animal gave a consistent response (~40 presses/min) and was considered as conditioned. For evaluation of reinforcement behavior, the number of lever pressings of conditioned rat with or without electrical stimulation was assessed for a period of 30 min each day for 10 weeks. The rewarding frequency sustained for the entire duration. In addition, we compared the lever pressing data of the groups of rats implanted with in-house fabricated versus with those with commercial electrodes; no significant differences were encountered. **Discussion:** The required components for the electrode fabrication are easily available. With some practice, the system can be easily assembled in the laboratory and costs less than a dollar. We suggest that the electrodes, fabricated using this method, may serve as an economical and reliable tool in neuropharmacological and neurobehavioral studies.

1. Introduction

The intracranial self-stimulation (ICSS) paradigm involves brief electrical self-stimulation of specific brain sites through the electrodes implanted in the brain (Olds & Milner, 1954). This is very reinforcing as indicated by the fact that animal (rodent) will repeatedly work for it. The ICSS paradigm provides a reliable measure for reward which is altered in psychiatric conditions (Carlezon & Chartoff, 2007). Implantation of electrode (monopolar or bipolar) in the rodent brain is a critical component of this system. While the commercially available electrodes are quite expensive, earlier in-house fabrication methods employed cumbersome procedures and costly metals like gold or platinum (Chiaia & Teyler, 1983). A good electrode system is expected to fulfill the following criteria. It should be (1) non-toxic to the brain tissues, (2) sturdy to bear physical stress during the period it is mounted on the skull, and (3) economical. Here we present a stepwise procedure to fabricate monopolar or bipolar electrodes using inexpensive and readily available material in local market. The system can be used on conscious, freely moving rats and behavior can be assessed in an operant chamber. We tested the fabricated system in rats in ICSS paradigm and found it to be at par with commercial electrodes. We obtained consistent and reproducible result over the 10 weeks testing period in our laboratory.

2. Materials and methods

The list of components required, their sources and a thumb-nail photo of each is provided in the Table 1.

2.1. Design of electrodes

Each component number (first column of the Table 1) is indicated by the hash sign (#). For easy understanding, a diagram of the entire

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Table 1
List of material required with their sources.

#	Components with specification	Source	Comments
1.	Polyimide insulated stainless steel wire (diameter: 0.25 mm, length: 50 mm, insulated diameter: 0.28 mm)	Plastics One, USA	Cut into 25 mm long pieces- to be used as electrodes
2.	Injection needle (22 gauge) 	Becton Dickinson India (P) Ltd.	Cut into 8 and 9 mm long pieces. Each goes through the pedestal (# 5). Electrode (# 1) will be inserted from the ventral end.
3.	Insulator disc (2 mm thick). (To be used as a base for monopolar electrode only)	Foam sheets from stationary shop	A disc was punched from the foam sheet and used as base which sits on the skull of animal and provides support to electrode assembly. A hole is made (0.25 mm) at the center to allow the monopolar electrode to pass.
4.	Plastic sleeve (inner diameter −0.5 mm and outer diameter −1 mm)— to be used as a base 	Electrical goods shop	The inner metal wire should be removed and the hollow sleeve (2 mm in length) should be used.
5.	Berg strips. Pins should be removed and the holder should be broken in smaller units (pedestal holder) as shown 	Electrical goods shop	Pins should be removed and the holder broken into smaller units. Each holder with two opening will be used in the fabrication of pedestal. This will be used for monopolar/bipolar electrodes.