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Craniotomy, and Second and Third Phase Implantation to Complete Two-Part Chamber System

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Jiwon Choi^{1,2}, Usamma Amjad^{1,2}, Helen Schwerdt^{1,2}

¹University of Pittsburgh;

²Aligning Science Across Parkinson's (ASAP) Collaborative Research Network, Chevy Chase, MD



Helen N Schwerdt

University of Pittsburgh

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We use this protocol and it's working

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Abstract

This protocol describes how to install the second or third phase of the two-part chamber system, as well as the craniotomy. The first baseplate installation is described in a separate protocol entitled, "Baseplate Implantation for Two-Part Chamber System in Rhesus Monkeys".



Materials

Third phase part (machined PEEK) (Gray Matter Research)
Second phase part (3D printed plastic) (Gray Matter Research)
Window and port covers (3D printed plastic) (Gray Matter Research)
Rubber gasket for baseplate and for port covers (Gray Matter Research)
Third phase cap (3D printed plastic) (Gray Matter Research)
Electric drill
Kwik-sil (World Precision Instruments)
High-vacuum grease (Dow Corning)
Ground screw wires (Gray Matter Research)
Screws for mounting third or second phase to baseplate
Stereotax
Vicryl 3-0 suture (Johnson and Johnson)
Nylon 3-0 suture (Ethilon)
Screwdrivers

Note: All implanted materials and surgical supplies were sterilized on-site with ethylene oxide gas sterilization and/or hydrogen peroxide plasma from the vendor (Gray Matter Research).

Craniotomy, and Second and Third Phase Implantation to Complete Two-Part Chamber System

- 1 Procedures were performed on Rhesus monkeys ($n = 2$) and were approved by the Institute's Animal Care and Use Committee (IACUC) at the University of Pittsburgh and were performed following the Guide for the Care and Use of Laboratory Animals (Department of Health and Human Services), the provisions of the Animals Welfare Act (USDA) and all applicable federal and state laws.
- 2 Monkeys were first given ketamine and atropine in their home-cage and then maintained on anesthesia with 1.5–2.0% isoflurane and 1 L/min oxygen. Analgesics, anti-inflammatory agents, and prophylactic antibiotics were administered pre- and/or post-op (i.e., meloxicam, dexamethasone, ceftriaxone, and buprenorphine).
- 3 Monkeys were placed in stereotactic frames to fix their head for surgical operation.
- 4 A sterile field was created on the skin above the implanted baseplate and the surface was disinfected with several rounds of applying betadine and 70% isopropanol, in a serial manner, with gauze.
- 5 The skin was incised down the center of the baseplate and retracted to expose the baseplate surface.
- 6 At this point, either the second phase was installed, as described in the following steps, or a craniotomy was performed, followed by the third phase, as described in the next section.
- 7 In monkey T, a second phase was installed as an intermediate step because the animal had developed an open wound at the anterior and posterior edge of the baseplate about 1.5 months after the baseplate had been implanted. This would allow us to clean and treat the wound. The baseplate surface was also fully exposed to screw on a protective cover (i.e., second phase) onto the baseplate to keep the baseplate's craniotomy window covers sealed and ensure that the underlying bone surface did not become exposed. In this case, the skin was sutured back around the now two-part chamber system so that the chamber was fully exposed and a skin margin surrounded its perimeter. The craniotomy and third phase installation would be done in a separate procedure for monkey T. Monkey J proceeded directly to craniotomy and third phase installation described below.

Craniotomy

- 8 One of the baseplate window covers was removed to expose the bone surface.

- 9 A foot-pedal-operated electric drill with a stainless steel or diamond-coated burr was used to thin down the bone surface and create a hole to expose the brain tissue. A rongeur was used to clip away the remaining bone inside the window. Throughout the process, 0.9% saline was applied on the bone and exposed brain tissue to prevent over-heating from the drill as well as to keep the surface moist.

Third Phase Installation

- 10 The second baseplate window cover was removed first to allow the third phase to fit onto the baseplate. Ground wires were also plugged into the two ground screws in the baseplate and threaded individually into channels through the third phase. The third phase was then screwed onto the baseplate with an interleaving rubber gasket used to seal the interface between the two pieces and prevent communication of liquid between the two ports or from the external environment. The rubber gasket was lightly covered with high-vacuum grease (Dow Corning) to help reinforce the seal. The top surface of the third phase also incorporated a number of threaded screw holes to install custom-designed electrode-interface-boards (EIBs) that would be used to connect subsequently implanted intracranial electrodes.
- 11 Both ports were then filled with Kwik-sil (WPI) to seal the bone surface. The ports were then closed with a plug, also containing a rubber gasket, to further seal the surfaces and create a robust aseptic enclosure.
- 12 A protective cap was screwed onto the third phase to cover and protect the top surface of the third phase.
- 13 The skin was sutured to create a tight margin covering the bone and minimally exposing any underlying tissue around the perimeter of the chamber.