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Implanting Radio Transmitters in Plains Pocket Gophers

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ABSTRACT — Implantation and removal of transmitters in pocket gopher peritoneal cavities under field conditions proved successful in 25 of 27 experimental surgeries. Weight loss in the first days following surgery never exceeded 11% of total body weight. Females tended to show greater losses than males, but recovery times were equivalent. Gophers were mobile within two hours after surgery, and healing was completed in two to three days. Gophers in captivity were capable of constructing one mound per hour within 12 hours after surgery. Gophers survived multiple surgeries, and some showed long-term weight gain while carrying transmitters. Overall, peritoneal implantation is a satisfactory method of attaching transmitters to pocket gophers.

Plains pocket gophers (*Geomys bursarius*) dig extensive underground burrow systems for shelter and access to food. These three-dimensional tunnel systems allow gophers to forage on both above- and below-ground vegetation. Conventional observation techniques have produced few data on behavior of pocket gophers; however, radio telemetry has potential for non-intrusive monitoring of subterranean movements.

Gophers have short necks without constriction (Chase et al. 1982), which precludes attachment of transmitter collars. Andersen and MacMahon (1981) used transmitter collars on gophers for 2-8 days and felt that the collars may have affected normal use of the cheek pouches. A harness-mounted transmitter would probably inhibit digging and might interfere with travel through burrows.

Artmann (1967) found that gophers expelled transmitters sewn into cheek pouches within 48 hours and our preliminary experiments confirmed these results. Even if gophers left the transmitters in place, this technique could possibly reduce gopher foraging efficiency.

Successful transmitter implantations with mink (*Mustela vision*) and Franklin's ground squirrels (*Citellus franklini*) (Eagle et al. 1984) suggested that implantation might have fewer adverse effects on pocket gophers than other methods. This study was conducted to determine a suitable size and shape of transmitters and method of attachment for pocket gophers. We initiated trials to evaluate transmitter implantation and replacement techniques for use in the field, to determine acceptable transmitter dimensions, and to determine if implanted transmitters inhibited freedom of movement required for digging or gathering food.

METHODS

Between 9 December 1982 and 10 July 1983, 27 surgeries were performed on 11 gophers (five females, six males) trapped on the Cedar Creek Natural History Area in east central Minnesota. Body mass was determined at time of implantation and at time of removal of transmitters. Since gophers were supplied with food and did not have to maintain burrow systems, mass loss was assumed to be related to surgical trauma.

Gophers were placed in a plexiglass chamber, anesthetized with methoxyflurane (Metofane), and then weighed and sexed.. A 15x25 mm patch parallel to the last rib was shaved with dog clippers halfway between the diaphragm and the forward arch of the pelvis. Fur removal kept the incision clean and allowed easier viewing of the sutures while closing. A layer of subcutaneous fat extending from around the base of the tail into the sacral region was found to extend into the incision area in some gophers. Because sutures in this type of tissue sometimes tore loose, subsequent incisions on "fat" gophers were situated more anteriorly and ventrally. Betadine antiseptic solution was used to swab the incision area before and after surgery.

Scissors were used to cut each of the three tissue layers: skin, muscle, and peritoneum. Forceps with locking teeth were used to lift fragile tissues away from the body cavity so that scissor cuts could be made safely and precisely. Incisions were enlarged to the diameter of the transmitter, usually about 12 mm. Three to five interrupted sutures were used to close the muscle and peritoneum as a single layer. Next the skin was closed in a similar manner. Of four suture types tested, 4-0 chromic gut was superior to both 3-0 or 5-0 monofilament nylon and 5-0 polypropylene. Although reverse cutting suture needles worked better for suturing skin, tapered point suture needles were satisfactory for both muscle and skin. One 68-cm filament with a tapered needle was sufficient for all the suturing required for two surgeries. Implantation required about 20 minutes.

Transmitter removal and/or replacement took about 25 minutes and required an incision about 15 mm long. Because of the cylindrical shape of the transmitter and the usual lack of encapsulation by tissue, the abdomen of the gopher was manipulated to slide one end of the transmitter under the incision. By squeezing the gopher's abdomen gently with one hand, we caused the transmitter to protrude from the opening enough to be grasped by the thumb and forefinger of the other hand and gently drawn from the body cavity. On the one occasion when encapsulation occurred, retractors were used to spread the incision and hold back the intestine so a scalpel could be used to scrape away the tissue holding the transmitter in place. Replacements were inserted into the same position as the previous transmitters. After repositioning the intestine that had been shifted during removal of the old transmitter, the incision was sutured.

Two transmitter styles, constructed by the Cedar Creek BioElectronics Laboratory, were used in the implantation trials. Both were cylindrical with smooth rounded ends, weighed approximately 12 g, and measured 12x57 mm and 14x40 mm. Slight variations in transmitter size and weight were due to the coating of inert electrical resin (Scotchcast, 3M Co., St. Paul, MN). To create a smooth impermeable surface, the final stage of transmitter preparation involved repeated dipping of transmitters into hot resin and curing the surface in a drying oven. Before surgery, transmitters were disinfected in methyl alcohol for at least 15 minutes. Transmitters were then placed in 38°C salt water while the gopher was anesthetized and the incision made. To ensure that each transmitter would be functional after surgery, the transmitter pitch, pulse interval, and duration were checked while the transmitter was immersed in salt water.

Usually two surgeries, implantation and removal, were performed on each gopher with subsequent incisions placed parallel to the first. Reported mass changes reflect results of the initial surgery only. Exceptions were one male gopher who was operated on five times and another male who experienced four surgeries.

The ability of each gopher to dig was evaluated to determine how this behavior was affected by surgical trauma and by carrying an internal transmitter package. Each gopher was tested three times by placing it in a 92x38x20 cm aquarium filled with 40 liters of sand obtained from the Cedar Creek Natural History Area. Each trial lasted 1 hr; trials were conducted approximately 12, 24, and 48 hr after surgery. All loads of sand pushed up into a mound were counted as well as other behaviors such as grooming or exploratory bulldozing. The sand was moistened and packed down before each trial; no burrows existed at the time each gopher was placed in the test arena.

RESULTS AND DISCUSSIONS

Average body mass (with standard deviation) at the time of implantation surgery was 271 ± 55 g for six males and 186 ± 25 g for five females. Average mass change from time of implantation to time of removal of transmitters, which ranged from 3 to 13 days, was -1.5 ± 2.1% of original weight for six males and -2.6 ± 3.2% of original weight for five females (Fig. 1).

The most striking demonstration of the acceptability of this method of transmitter attachment was the long-term observation of a male gopher (not included in Fig. 1) who carried a transmitter internally for a total of 159 days. This gopher weighed 202 g when the transmitter was first implanted and 258 g after 159 days, a 21% gain. Based on observation of mound building activity, this gopher also survived after being returned to its original burrow system following transmitter removal.

Two of 27 surgeries resulted in death. We believe the first fatality occurred because the 57-mm transmitter was too long to easily fit inside the small (155 g) female. The transmitter had lodged against the sternum

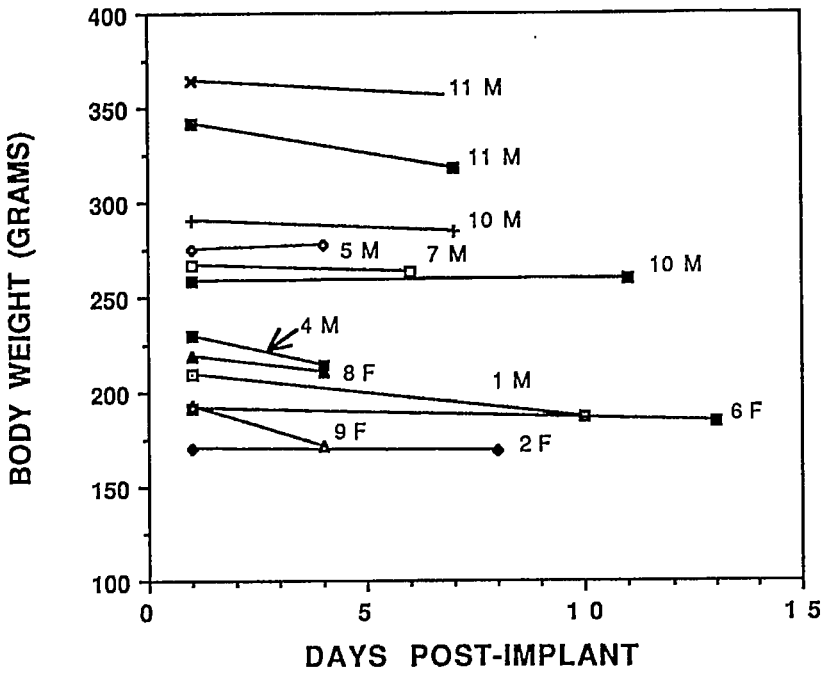

Figure 1. Mass change of pocket gophers following surgery to implant radio transmitters. Gopher identification number and sex are shown for each surgery.

and appeared to have bruised the heart and lungs, causing death in 12 hours. The other mortality was not due to the transmitter per se, but occurred after the fourth surgery in 45 days for a very large (364 g) male. This gopher opened the incision with its claws. A second large male also tore out its stitches with its claws immediately following surgery, but was re-anesthetized and resutured.

Since gophers double up their bodies to reverse direction while pushing a load of dirt, the style determined to be optimal was a short, fat cylinder 30-35 mm long and 10-14 mm in diameter. Minimum size (30x10 mm) was determined by the linear alignment of a 1/2 amp, 3.6 v, lithium battery with a 53 mhz crystal oscillator and copper antenna coil.

Gophers dug as readily during the initial trial at 12 hr post-surgery as during the third trial after 48 hr. Tunnels long enough to fit the body of the gopher were constructed in 4-6 minutes (n=30). After choosing a site to begin excavation, the first mound was completed (burrow opening plugged) within 6-34 minutes (n=30). At least one mound was constructed per hour; multiple mounds were constructed in 40% of the trials.

Observed digging activity demonstrated that gophers can function normally 12 hr after surgery. Observed mound building activity was at

least 1.66 mounds per day long term, and often greater than 1 mound per hour, short term. Mohr and Mohr (1936) reported *Geomys bursarius* in Minnesota produced 1.88 mounds per day. In Sherburne County, Minnesota, Bailey (1929) observed three pocket gophers for 14 days and found a daily average of 2.86 mounds per gopher per day. Kennerly (1964) reported the production of five mounds in 2.75 hr following the release of a subadult *Geomys bursarius*; this constitutes 1.88 mounds per hour which is comparable to what we observed.

CONCLUSION

No animals died from post-operative infections, and incisions were closed and healing within 2-3 days. Mass loss in the first week following surgery never exceeded 11% of total body mass (Fig. 1). Females tended to show greater short-term weight losses than males, but recovery times were equivalent. Because transmitters were free-floating in the body cavity, they did not appear to impair digging behavior or foraging efficiency. Similar implantations in marmots (*Marmota flaviventris*) did not appear to affect survival or reproduction (Van Vuren 1989). Gophers were mobile within 2 hours after surgery, and were capable of constructing mounds 12 hours after surgery.

Implantation appears to be a viable technique for field studies of movements and behavior of pocket gophers, and has also been shown to be appropriate for much smaller species (Koehler et al. 1987).

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