A powerful new way of healing"

It has been suspected for some time that small electrical currents applied to bone might promote growth and healing, and a number of investigators have evaluated its effects in animals. Now a group of orthopedic surgeons at the University of Pennsylvania have announced what they believe may be the first clinical case of fracture healing with electricity.

They chose the case—a 51-year-old woman—because of an ununited fracture of her ankle that had persisted for more than a year. A 7.5-volt battery with resistors and field effect transistors designed to produce a constant current of 10 microamperes was attached to her cast—the cathode placed directly in the fracture site, and the anode placed on the skin surface. Current was delivered for nine weeks. At the end of that time x-rays showed that the nonunion was healed, with bony trabeculae crossing the defect.

Because periosteal reflection and bone grafting were not performed, Dr. Carl T. Brighton, head of the team, believes that "controlled electrical energy within a physiologic range healed the fracture."

Dr. Brighton and his associates, Drs. Z. B. Friedenberg and M. C. Harlow, had earlier found in their animal studies that optimum bone formation occurred with a constant current of 5 μamps to 20 μamps at the cathode, or negative electrode, site; while bone destruction was seen at the anode, or positive electrode, site.

Next they performed a number of experiments designed to accelerate fracture healing in the rabbit fibula, using 10 μamps of direct current with the cathode implanted in various positions in relation to the fracture site. "All parameters studied indicated that an increased rate of fracture healing occurred with electrical stimulation when the cathode was placed directly into the fracture site," Dr. Brighton observes, writing in the *Journal of Trauma* (11:883-885).

The patient they chose had had a bimalleolar fracture of her right ankle in December 1969. After closed reduction, the fracture was immobilized for 13 weeks in a long leg cast. Weight-bearing was begun at 15 weeks. The patient did not return for follow-up, but walked without assistance for a year, suffering intermittent pain and swelling. Because these symptoms worsened, she returned to the hospital in February 1971, 14 months later.

At that time, moderate swelling was confined to the medial aspect of the ankle joint; a palpable fracture defect tender to palpation was noted 2 cm above the tip of the right medial malleolus. The malleolar defect was definitely movable. X-rays showed a healed fibular fracture with a nonunion of the medial malleolar fracture and slight displacement.

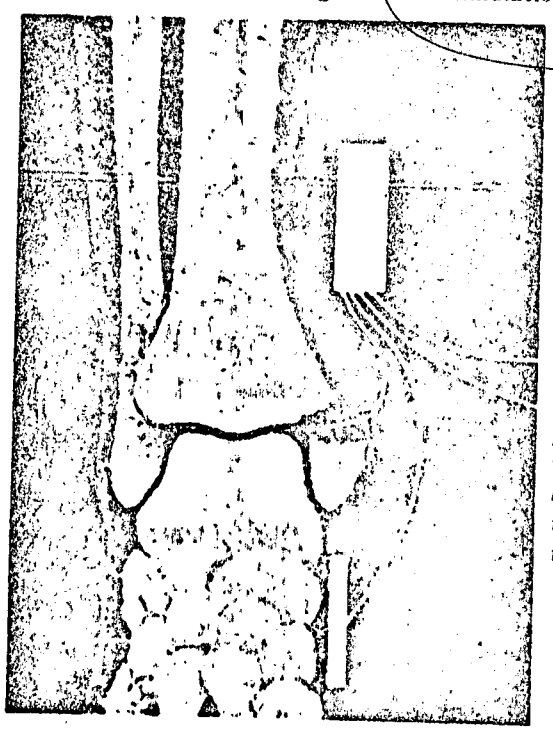
Under local anesthesia, an incision was made over the nonunion site, and a straight needle was used to bore a small hole in the nonunion defect. The cathode, a 26-gauge stainless steel wire, was inserted in the hole, fastened to the surrounding soft tissue with a suture, and brought out through a separate stab wound. The anode, an aluminum grid, was placed over the medial aspect of the foot and held to the skin with adhesive. A short nonweight-bearing leg cast was applied and the wires brought out through a window to the power pack, which was taped to the cast.

At nine weeks, when the nonunion was healed, the cast was removed and the cathode wire pulled out. The patient started partial weight-bearing, walking with the aid of crutches. Full weight-bearing was started two weeks later.

Dr. Brighton says he does not think the operation itself contributed to the healing "because the tissue intervening between the fragments was thick, fibrous, and avascular, and every effort was made to leave this tissue undisturbed." Further, he says, no periosteum was reflected in this case, and no bone graft was used.

"It is unlikely that the nine-week period of immobilization in a nonweight-bearing cast contributed to union of the fracture when one considers that the fracture was over a year old, displaced, and separated by thick, fibrous tissue. It is our opinion that controlled electrical energy in a physiologic dose healed the fracture."

Part of the studies of this group were supported by the Navy; Dr. Brighton is now developing a protocol for a Navy-sponsored, double-blind study to test the efficacy of electrical stimulation in "normal" fractures. ■



Drawing shows cathode inserted in nonunion site of medial malleolus, with anode taped to skin surface. Patient remains asymptomatic and has developed no problems from wire insertion. Dr. Brighton hopes to do further work with such nonunion fractures.