USE OF A PRODUCTION PORTABLE INSTRUMENT FOR ELECTROLYTIC SHARPENING OF SURGICAL INSTRUMENTS IN THE PREPARATION OF METAL MICROELECTRODES

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To study the physiology of subcortical cerebral structures by means of a stereotaxic technique, an absolutely straight and very fine microelectrode is required. To prepare such electrodes we made use of a production instrument for electrolytic sharpening of surgical instruments, and made certain additions to it. When used in the normal way a metal rod is placed vertically in the bath containing the electrolyte, and the instrument to be sharpened (in this case a steel needle-shaped blank) is connected to the positive pole of a rectifier. The need for an addition to the device arose because when a blank, which is the anode, becomes thinned as a result of losing metal into the solution, the effect is most rapid in the surface layer of the electrolyte, so that a "waist" forms in this region, and in addition the blank becomes bent towards the cathode. The formation of a "waist" may be regarded as the result of a concentration polarization [2]. This effect consists in the formation of a dense layer of ions in the solution surrounding the anode brought about through an arrest of the diffusion process in which ions from the anode pass deep into the solution [1]. This ionic layer reduced the current density on which the rate of solution of the metal anode depends. It has a higher density than the surrounding fluid, and therefore falls to the bottom in the form of a sleeve surrounding the anode [2, 3], which causes continuous renewal of the electrolyte in the upper layer of the immersed portion of the blank, enabling the current to be maintained and dissolution to proceed at a higher rate in this region.

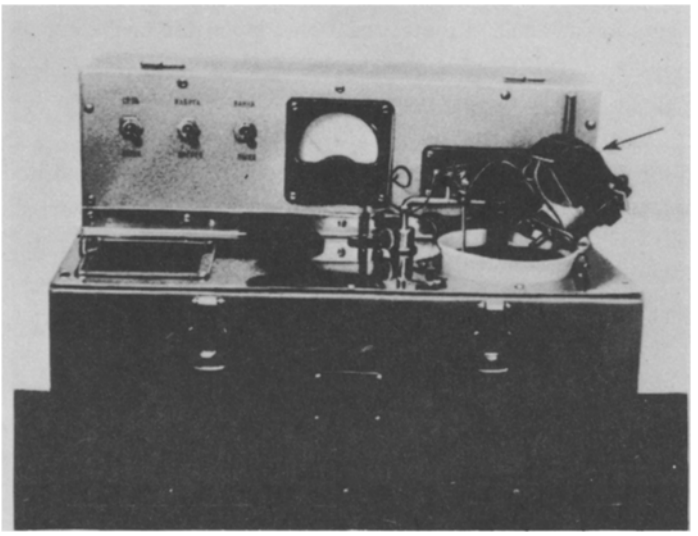

Fig. 1. General appearance of the apparatus for electrical preparation of surgical instruments. The electric motor (shown by arrow) is mounted in the operating position above the bath with electrolyte.

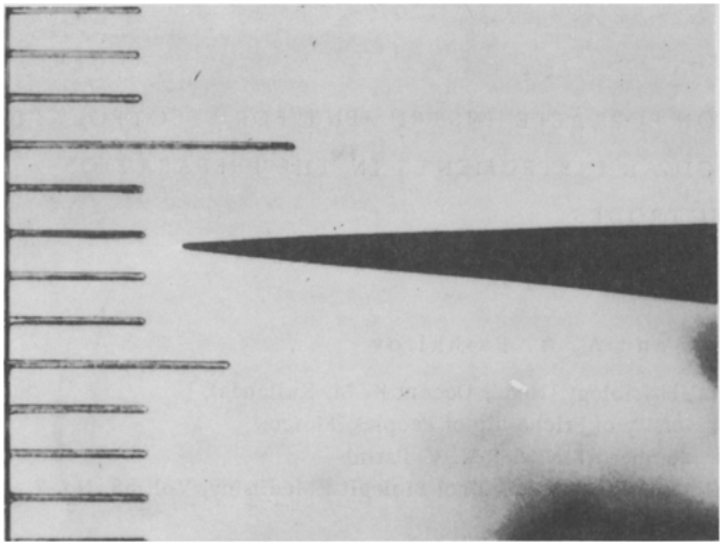

Fig. 2. End of a steel microelectrode. One division equals 10 μ. Magnification 160 (20 x 8)x.

To prevent the formation of a waist, the simplest means is to place the whole of the blank intended for treatment in the surface layer of the electrolyte (up to a depth of 1.5 cm). The blank is fixed to the shaft of an electric motor making a small angle with the surface of the electrolyte, and is held in a position which enables the motor to be moved in three planes (Fig. 1). Because of its position and rotation the blank is prevented from bending towards the cathode, and from forming a waist. For a current strength of 0.8 A, depending upon the required thickness of electrode, the treatment lasts for 15-20 min, and requires no continuous control over the course of the sharpening (Fig. 2). The time of treatment is reduced when the current strength is higher, but then unevenness is developed in the electrode surface, spoiling its shape.

The completed microelectrode is rinsed in distilled water; in order to reduce the noise level caused by the film of oxide which develops during the electrolytic treatment it is next passed through solutions of sodium carbonate, 1% acetic acid, alcohol, and xylol.

The device may be used also for the electrolytic deposition of a layer of copper on the opposite end of the microelectrode; for this purpose the electrode is connected to the negative pole of the current source; as an electrolyte we used copper sulphate, and as anode a metal rod. The deposition of the copper was facilitated by soldering a lead to the steel microelectrode. Electrodes made of other metals were treated in a corresponding manner.

SUMMARY

A method is described for the preparation of metal electrodes. A slightly modified Soviet production portable apparatus for electrolytic sharpening of surgical instruments was used for this purpose.

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