Biophys. Struct. Mechanism 5, 107–109 (1979)

Biophysics of Structure and Mechanism

Short Communication

Suction Capillaries with U-Shaped Opening for Holding Moving Cells During Intracellular Electrical Recording

M. Peters

Institut für Zoologie, Rheinisch-Westfälische Technische Hochschule Aachen, Kopernikusstraße 16, D-5100 Aachen, Federal Republic of Germany

Abstract. The production of suction capillaries with an U-shaped cross-section is described. The capillary may be used for holding contractile cells during intracellular recording to diminish movement artifacts. In addition microelectrode penetration is facilitated by stretching the surface of the cell.

Key words: Moving cells – Intracellular recording – Suction capillary.

During intracellular recording from muscle cells contractile activity often results in great mechanical artifacts or the electrode may even be dislodged from the cell. Various attempts have been made to overcome this problem (Coraboeuf, 1969), the most commonly used solution being the use of floating microelectrodes (Woodbury and Brady, 1956). However, it is difficult to position these electrodes exactly and thus the applicability of this method for recording from very small preparations is restricted.

In a study on the ventral diaphragm of the locust I successfully used a suction capillary with an U-shaped mouth for holding single muscle fibres for intracellular recording (Peters, 1977). As this electrode may be useful for similar preparations, the method for fabrication which I used will be described here.

A glass capillary tube (borosilicate; 1.5 mm outer diameter; 0.15 mm wall thickness) is drawn by hand to a diameter of 50–200 μm in the pilot flame of a gas burner. The capillary thus obtained is broken at about 30 mm from the shaft. After sealing the tip in the pilot flame the capillary is then inserted into a holder which allows suction to be applied to it. The holder is fastened to a micromanipulator. A second one is arranged in such a manner that a tool can be moved at right angles to the longitudinal axis of the capillary. Now suction from a water-jet pump is applied and a glowing platinum sheet (squashed loop of platinum wire, heated by passage of current) is positioned near the drawn-out part of the capillary as shown in Figure 1 under visual control in a stereo microscope. The glass in the vicinity of the hot platinum sheet softens and because of the negative pressure inside the glass-tube the wall folds in. Infolding is allowed to proceed until the inner surfaces come in contact

0340-1057/79/0005/0107/$ 01.00

with each other (last stage in Fig. 1). The capillary (mounted infolding up) is then scraped from above with a small diamond fastened to the second micromanipulator perpendicular to the long axis at the middle of the infolding. During this procedure the capillary is supported at this site from below by a piece of razor blade, mounted on a third micromanipulator. For breaking then the capillary the best method consists in slightly pressing it between thumb and forefinger. The U-shaped opening thus obtained is fire-polished with a glowing platinum wire. The capillary may finally be bent to an angle of ca. 135° by asymmetric heating (El-Badry, 1963).

The relative positions of such a holding capillary and a recording microelectrode on a locust muscle fibre are shown schematically in Figure 2. The muscle cell is held

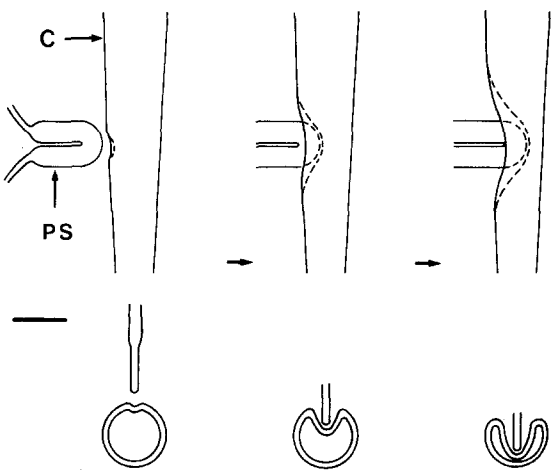

Fig. 1. Production of U-shaped holding capillaries: The capillary (*C*) is shown in longitudinal (upper; only outer surface, for clarity) and cross-sectional (lower) view. As a glowing platinum sheet (*PS*) is advanced towards the capillary, the glass wall folds in because of reduced pressure inside. Three successive stages of this process are shown. (bar: ca. 0.2 mm)

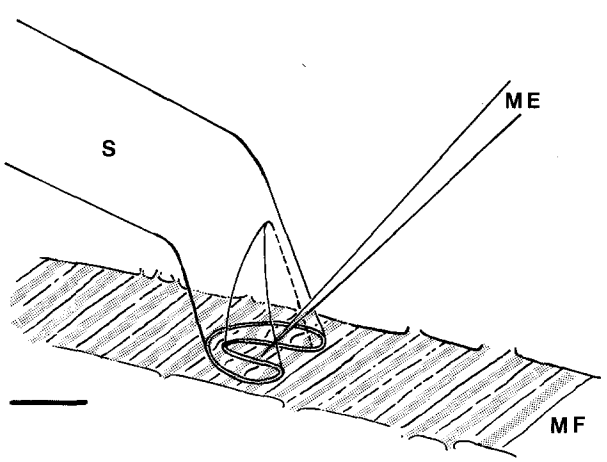

Fig. 2. Electrode arrangement for intracellular recording: A striated muscle fibre (*MF*) is held by an U-shaped suction capillary (*S*). The muscle fibre is impaled by a glass microelectrode (*ME*). (bar: ca. 0.1 mm)

in position at the recording site by the suction capillary. Suction was applied from a water-jet pump but had to be reduced by opening of a blow-by valve because too low a pressure damaged the cell membrane as indicated by a fall in resting potential. An additional advantage of this arrangement lies in the fact that the membrane at the recording site is stretched, which greatly facilitates impalement of the cell with a microelectrode. Successful penetrations holding for up to 1 h have been regularly made by the use of these suction capillaries. Visual control was possible both in an ordinary microscope with long working distance objectives or an inverted microscope.

Acknowledgements. I wish to thank Miss I. Holtkamp for technical assistance.

References

Coraboeuf, E.: Resistance measurements by means of microelectrodes in cardiac tissues. In: Glass microelectrodes. Lavallée, M., Schanne, O. F., Hébert, N. C. (eds.) New York: Wiley & Sons 1969

El-Badry, H. M.: Micromanipulators and micromanipulation. Wien: Springer 1963

Peters, M.: Innervation of the ventral diaphragm of the locust (Locusta migratoria). J. Exp. Biol. **69,** 23–32 (1977)

Woodbury, J. W., Brady, A. J.: Intracellular recording from moving tissues with a flexible mounted ultra microelectrode. Science **123,** 100–101 (1956)

Received December 7, 1978/Accepted December 14, 1978