

Research Note

Ultrastructures of *Diplogonoporus grandis* microthrix

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Due to the development of electron microscope, studies on the fine structures of helminthic parasites have advanced remarkably. Regarding cestodes, great attention has been directed especially towards the role and structure of the tegument, because all the nutrients must be taken through the tegument as they lack a mouth and an alimentary tract (Pappas and Read, 1975). There are many electron microscopical studies on the cestode tegument and they revealed that the free surface of the tegument is covered with digitiform projections, for which Rothman (1963) coined the term microtriches. Furthermore, in many cestode species it was shown that the proximal part of a microthrix contained a number of longitudinally oriented microfilaments (Grammeltvedt, 1973; Lumsden *et al.*, 1974; Lumsden and Specian, 1980; Holy and Oaks, 1986).

The pseudophyllidean cestode, *Diplogonoporus grandis*, has been considered to be a parasite of man in Japan (Kamo *et al.*, 1971). Some ultrastructural characters of this parasite have been studied using a transmission and scanning electron microscope (Yamane, 1969; Yamane *et al.*, 1975). However, the fine structure of microtriches has not been thoroughly studied. In the present study, transmission electron microscopical observations were carried out on the fine structures of microtriches of *D. grandis*.

Adult *D. grandis* which was spontaneously expelled from a patient was used. Several proglottids were washed carefully in the physiological saline and cut into small pieces before fixation for 2 hours at 4°C in 2% glutaraldehyde in 0.1 M phosphate buffer (pH 7.4). Following a rinse with the same buffer, the specimens were post-fixed for 2 hours at 4°C in 1% osmium tetroxide, dehydrated through ascending alcohol series, and embedded in Epon 812. Ultrathin sections were stained with uranyl acetate and lead citrate, and observed with a JEOL 100CX transmission electron microscope.

As described by Yamane (1969), the tegument of this species was densely covered by posteriorly directed microtriches consisting of two main parts, proximal and distal (Fig. 1). As revealed at high magnifications, the whole structure was bounded by the plasma membrane being continuous with the limiting membrane of the tegument matrix. The distal part of the microthrix, which was extremely electron-dense, was pointed sharply becoming slenderer toward the apex. The cylindrical proximal region of the microthrix was surrounded by an electron-dense layer with 8–10 nm thickness. In longitudinal sections, this layer extended from the distal part to the base of the proximal part (Fig. 2). In the longitudinal and transverse sections of the proximal part of the microtriches, microfilament-like structures, approximately 6 nm in diameter were shown within the thicker, electron-dense layer (Fig. 3). They did not extend deeply into the underlying cytoplasm, and a filamentous system like a terminal web appeared to be lacking. The

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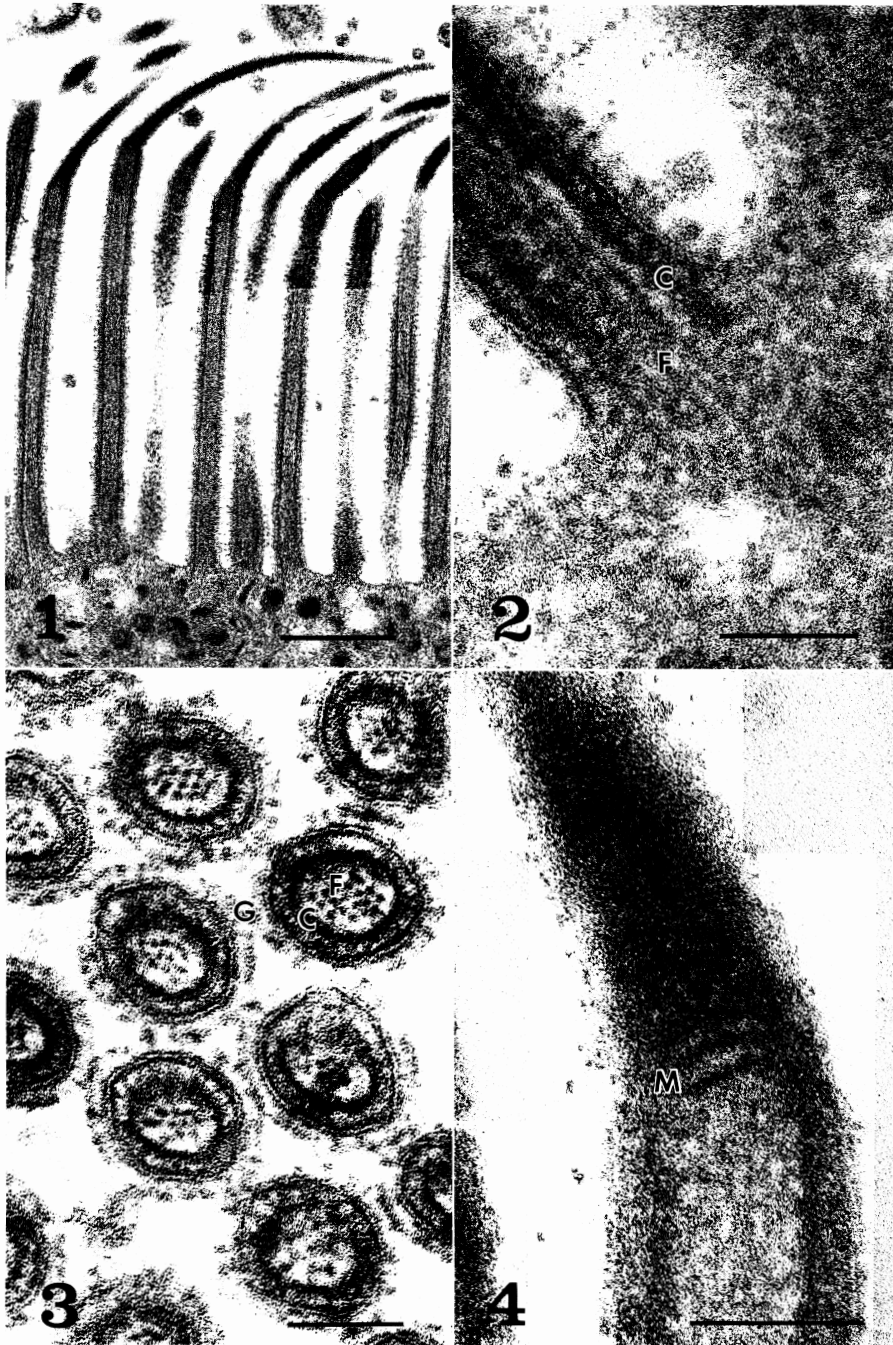


Fig. 1 Longitudinal section of tegument, showing the posteriorly directed microtriches. Bar: 500 nm.

Fig. 2 Longitudinal section of microtrich, showing a bundle of microfilaments (F) and an electron-dense cylinder (C). Bar: 100 nm.

Fig. 3 Transverse section of the proximal part of the microtriches, showing a bundle of microfilaments (F), an electron-dense cylinder (C) and fibrous material coating (G) Bar: 100 nm.

Fig. 4 Longitudinal section of microtrich, showing a multilaminar substructure (M). Bar: 100 nm.

junction of the distal and proximal parts was characterized by a multilaminar substructure (Fig. 4). In cross and longitudinal sections of the microthrix, a discontinuous, radial distribution of fibrous material was observed on the outer membrane of the microthrix.

Microtriches have been analogized with the microvilli, though there are some differences in the fine structure. They have been believed to aid in keeping the position of a worm in the gut (Rothman, 1963), and also in producing migrational movements (Mettrick, 1971). The other obvious function is the uptake of nutrients including the possible increase in the absorptive and secretory area of the tegument. Microtrichial microfilaments have not been previously reported in *D. grandis* (Yamane, 1969), but in the present study they were clearly found in the proximal part of microthrix. Furthermore, the arrangement of the filaments indicated packing in the form of a hexagonal array which is similar to that of microfilaments in the mammalian intestinal microvillus (McNabb and Sandborn, 1964). Microfilaments have been reported in most cestodes examined and are now regarded as a common structure in cestode microtriches.

Within the proximal part of the microthrix, some form of amorphous electron-dense material was observed (Fig. 3). This material has been reported in most tapeworm species examined (Charles and Orr, 1968; Grammeltvedt, 1973; Holy and Oaks, 1986). The multilaminar structure at the junction of the distal and proximal parts has also been described in previous studies and a cushion-like function is speculated (Threadgold, 1984). External to the plasma membrane is an amorphous, fibrous layer strongly resembling a glycocalyx, a feature common to mammalian intestinal microvilli (Ito, 1965). In our study this fibrous layer showed the discontinuous and radial distribution of material, which has not been reported previously. Whether this unique distribution is a characteristic in *D. grandis* or an artifact during preparation process is not yet clear.

Comparing to the enterocyte microvilli, it is apparent that the ultrastructure of the

microtriches is much more complex. This complex architecture may reflect more complex functions for the tegumental specialization of cestodes. Therefore, further ultrastructural observations of cestode tegument will yield more intriguing results in relation to the physiological and biochemical studies.

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