FINE STRUCTURE OF THE MERKEL CELL AND ITS ASSOCIATED TERMINAL AXON IN THE HARD PALATE MUCOUS MEMBRANE

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II-SEI WATANABE — Fine structure of the Merkel cell and its associated terminal axon in the hard palate mucous membrane. **Rev. Odont. UNESP**, 8/9, 9-17, 1979/1980.

SUMMARY: Electron microscopic observations of Merkel cells and their intra-epithelial nerve endings are studied in the palatine mucous membrane of the mouse. The Merkel cells may be identified by the following characteristics such as situation on the basal layer of the palatine mucous membrane, dense core granules which are located in the cytoplasmic side towards to the terminal axon and several finger-like cytoplasmic protrusions. In the terminal axon numerous mitochondria and small clear vesicles are noted. Desmosome type junctions are evident between terminal axon and Merkel cells and adjacent epithelial cells.

KEY WORDS: Merkel Cells, Nerve Endings, Sensory Innervation, Palatine Mucous Membrane.

The Merkel cells and its associated nerve endings, considered as being mechanoreceptors have been reported by several authors (MUNGER, 1965, KUROSUMI et al., 1969; ROBINS, 1970; SMITH, 1970; ANDRES & DURING, 1973; and BREATHNACH & WINKELMANN, 1973).

In the oral cavity, NIKAI *et al.* (1971) and HASHIMOTO (1972) reported the presence of these cells in the human gingiva.

Recently, ANDERSEN & NAFSTAD (1968), and SAXOD (1978) reported the presence of Merkel cells in some species of birds.

However, no mention has so far been made of occurrence of this cell in the palatine mucous membrane. So, the present paper describes ultrastructural characteristics of Merkel cells and their associated nerve endings.

Material and Method

Palatine mucous membrane from adult male and female mice were used.

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The animals were anesthetized with intraperitonial injection of Nembutal and perfused with a fixative containing 2% formaldehyde and 2.5% glutaraldehyde in 0.1M phosphate buffer, pH = 7.4 for 3-4hr afterwards the tissues were rinsed in distilled water for 15 min, and postfixed in 1% 0s04 in the same buffer for 1.5hr in bloc stainning were made in 5% uranyl acetate for 2hr and dehydrated through graded concentrations of ethanol and propylene oxide and embedded in Epox 812 resin.

The sections were cut in a Porter-Blum MT-2 and a LKB ultramicrotome, placed on grids, stained with 4% uranyl acetate and 0,4% of lead citrate.

Stained sections were observed in a Hitachi HU-11DS and a HU-12a electron microscopes.

Results

Merkel cells were found in the basal layer of the epithelium and usually they do not contact with the basal lamina. An unmyelinated terminal axon is associated to the Merkel cell as an intra-epithelial sensory nerve ending (fig. 1). Also the nerve ending is originated by myelinated terminal fibers and the Schwann sheath is lost before entering the intra-epithelial portion. The nucleus of the Merkel cell is usually lobulated. The cell and nucleus are oriented horizontally. Some colateral finger-like protusions of cytoplasm from Merkel cells are often situated in the intercellular space of adjacent epithelial cells (fig. 2).

They are attached to adjacent epithelial cells by desmosomes, and filaments and many mitochondria may also be seen on the cytoplasmic side.

The rough endoplasmic reticulum is usually poorly developed, but free ribosomes are numerous. The mitochondria may be large or small in some areas. Golgi membranes and vesicles are showed. The especific electron-dense granules of Merkel cells are present in the cytoplasmic side but their size in diameter commonly range from 60 to 100nm. The granules possess a dense core surrounded by a clear space (fig. 3).

It is generally observed that the specific granules are accumulated in the cytoplasm near and opposite to the terminal axon (fig. 1). The axon is closely associated with the Merkel cell, as a flat discus and contains many mitochondria, microtubules, neurofilaments and small clear vesicles (figs. 1 and 3). Rare Merkel cells, without associated nerve terminals are observed in the palatine mucous membrane.

Desmosome-type junctions are present between the axon and the Merkel cell (fig. 3). Also, they are noted between the Merkel cell and the adjacent epithelial cells.

Several unmyelinated nerve fibers are also evident in the adjacent connective tissue near the basement membrane (fig. 4). The fibers are surrounded by a thin sheet of the cytoplasm of a Schwann cell. They contain mitochondria and microfilaments. The axons characterize by the presence of many mitochondria, neurotubules, neurofilaments and small vesicles.

Discussion

According to our data there are few Merkel cells in the palatine mucous membrane. The observations on the transmission electron microscope revelead that these cells are

constituted by a cytoplasm rich in organelles such as Golgi apparatus, mitochondria, filaments and specific electron-dense granules.

On the other hand, the Merkel cell presents finger-like cytoplasmic protrusions, which may be considered as a essencial component for the sensory mechanism. They are situated in the intercellular spaces. ANDRES & DURING (1973) reported that similar protrusions in birds are localized in the envelope of Schwann cell cytoplasm.

In the physiological sense, some authors have mentioned that the specific electron-dense granules in the Merkel cell cytoplasm act as an identical function to the noradrenalin containing granules of the adrenal medulla and other chromaffin cells. But, the content and functional significance about these granules are still unknown. However, we also think that the electron-dense granules are essencial to the mechanism of transmission because they are accumulated in the cytoplasm towards the "discus" and take part in a special contact between sensory cells and terminal axons. MUNGER (1965) also suggests that the electron-dense granules are probably correlated to the function of nerve impulse.

Information demonstrating the presence of the cells in the skin of man and other mammals are noticed. But, at present, there is no sufficient data about these cells in the palatine mucous membrane. Our results may be compared to those found by NIKAI *et al.* (1971) and HASHIMOTO (1972) on Merkel cell in the gingiva however, they did not describe the desmosome type junctions between the Merkel cell and terminal axon.

Summary and Conclusions

Electron microscopic observations of Merkel cells and their associated nerve endings are described in the palatine mucous membrane of the mouse. These cells can be identified by the following characteristics: 1) situation on the basal layer of the palatine mucous membrane, 2) presence of the specific electron-dense granules, which are commonly located in the cytoplasmic side near to the terminal axon, 3) the finger-like cytoplasmic protrusions extend from the Merkel cell to the intercellular space of adjacent epithelial cells, 4) the associated terminal axon is characteriezd by the presence of mitochondria, microtubules and small clear vesicles, 5) junctions of desmosome-type are encountered either between the terminal axon and the cytoplasmic membrane of Merkel cell or between the Merkel cell and adjacent cells.

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II-SEI WATANABE — Ultraestrutura da célula de Merkel e axônio terminal associado na mucosa do palato duro de camundongo. **Rev. Odont. UNESP**, 8/9: 9-17, 1979/1980.

RESUMO: Com a utilização de microscópio eletrônico de transmissão foram observadas as células de Merkel e a terminação nervosa associada em mucosa de palato duro de camundongos.

Estas células podem ser identificadas pelas seguintes características: 1) localização na camada basal do epitélio; 2) presença de grânulos específicos electrondensos os quais são comumente localizados no citoplasma junto a terminação nervosa; 3) protrusões citoplasmáticas em forma de dedo são estendidas no espaço intecelular contactando com as células adjacentes; 4) o axônio terminal associado apresenta mitochondrias, microtúbulos e pequenas vesículas claras; e 5) zonas de contato do tipo desmosomos são formadas entre o axônio terminal e a membrana citoplasmática da célula de Merkel e entre a célula de Merkel e as células epitelias adjacentes.

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ILLUSTRATIONS

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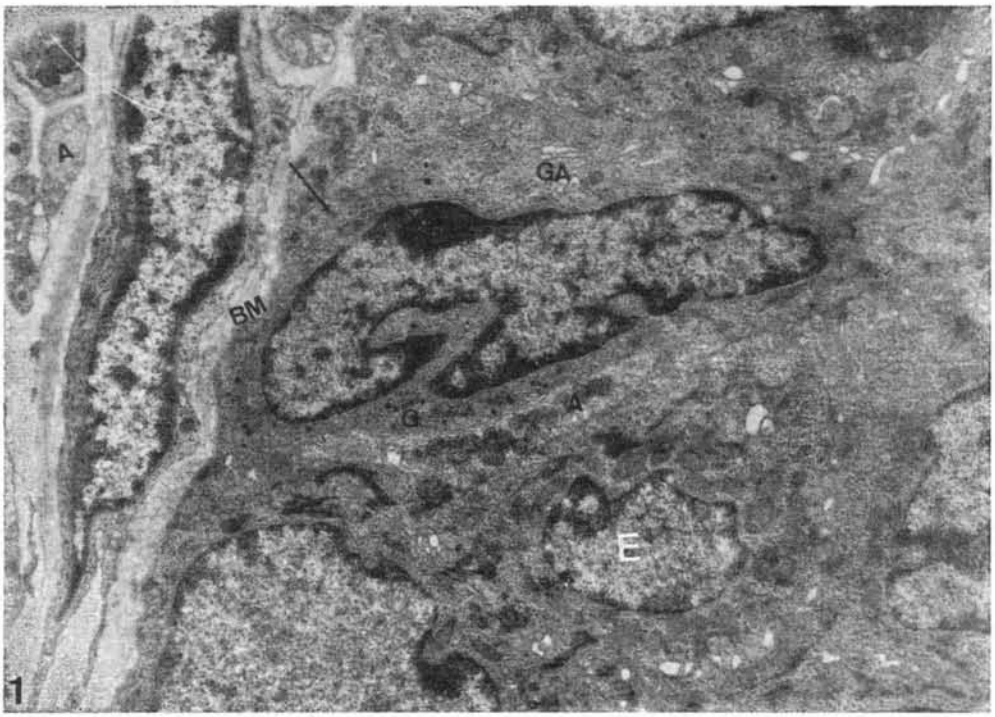
LEGENDS

Fig. 1. Photomicrography of a Merkel cell. The epithelial cells (E), associated terminal axon (A), specific electron-dense granules (G) and Golgi apparatus (GA) are well evident. Junction is noted between Merkel cell and adjacent epithelial cell (arrow), basement membrane (BM).
Magnification: 10.500 X

Fig. 2. A high magnification illustrating the finger-like protrusions (P), mitochondria (MI), filaments (F) and free ribosomes (R). The specific electron-dense granules have dense core separated from the limiting membrane. The desmosome type junction between the Merkel cell is also identified. (arrow).
Magnification: 42.000 X



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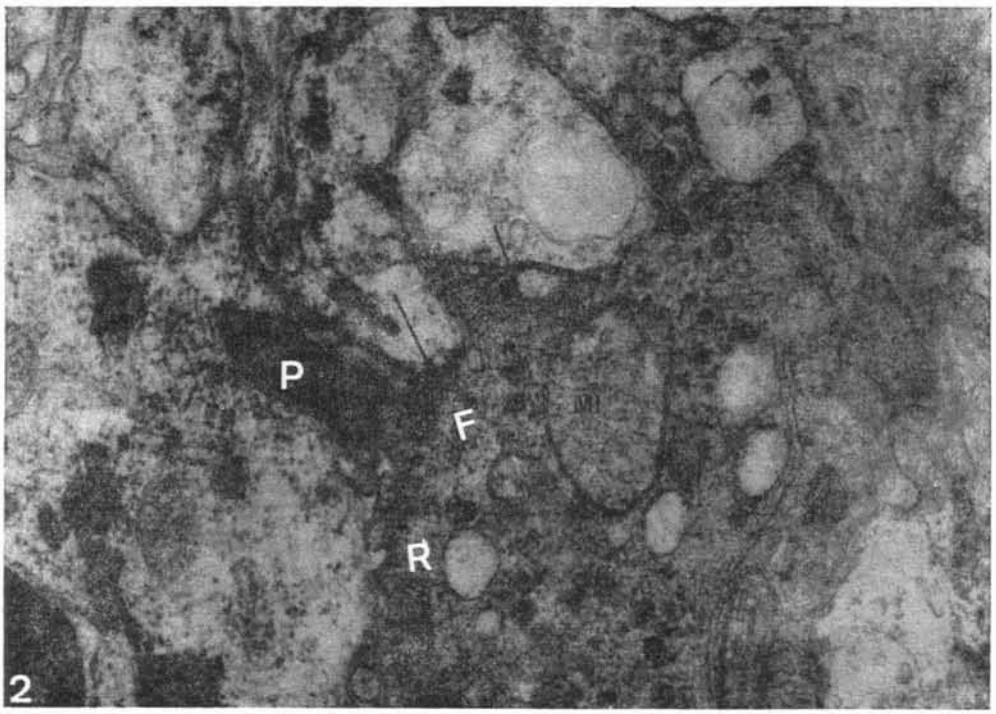

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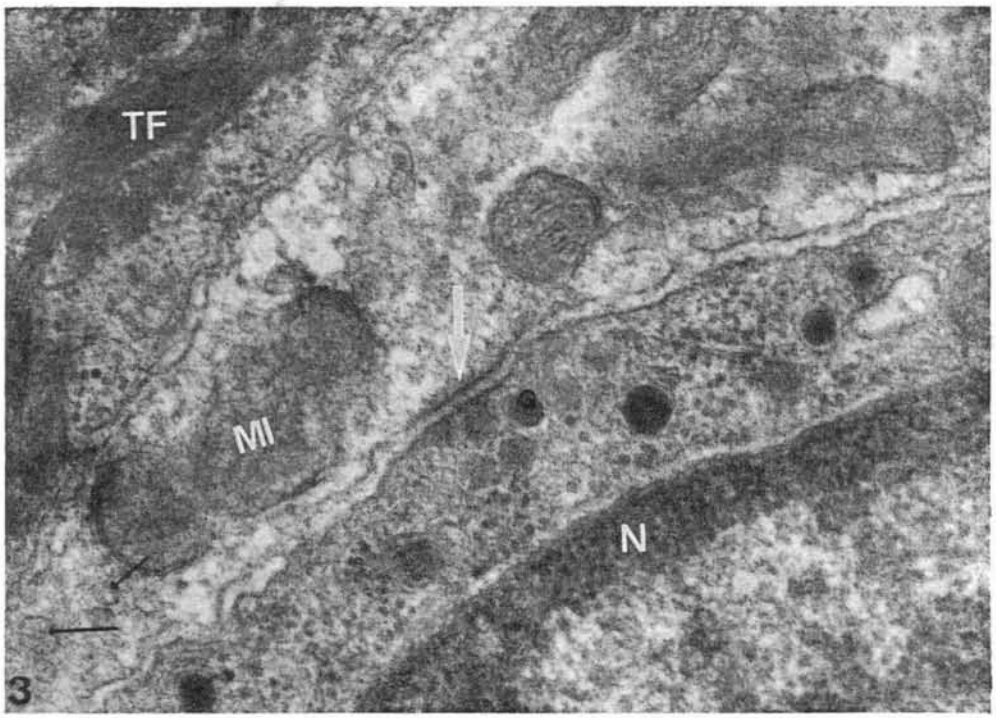
LEGENDS

Fig. 3. The large arrow indicates the desmosome-type junction between axon and the Merkel cell. Nucleus (N), tonofilaments (TF), mitochondria (MI) and small vesicles (small arrow). Specific electron-dense granules (G) are accumulated in the cytoplasm of Merkel cell toward the axon.
Magnification: 68.400 X

Fig. 4. Photomicrography showing an unmyelinated axon (A) surrounded by a thin sheet of the cytoplasm of a Schwann cell (SC), and collagen fibres (C). The axon contains many mitochondria (MI), neurotubules, neurofilaments and vesicles (arrow).
Magnification: 41.000 X



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