

## Three-dimensional Characteristics of the Interface Epithelium-Connective Tissue Surface of Finger's Lamina Propria of *Cebus apella* Monkey: Scanning Electron Microscopy Study

Características Tri-dimensionales Superficiales de la Interfase del Tejido Epitelial-Conectivo de la Lámina Propria de los Dedos de Monos *Cebus apella*: Estudio con Microscopía Electrónica de Barrido

\*<sup>\*\*</sup>Ii-sci Watanabe; \*Juliana Plácido Guimarães; \*\*\*Mamie Misuzaki Iyomasa; <sup>\*</sup>Maria Angélica Miglino; <sup>\*\*\*\*</sup>Marília Gabriela de Oliveira Lopes; Márcia Consentino <sup>\*\*\*\*\*</sup>Kronka Sosthines & <sup>\*\*\*\*\*</sup>Marcelo Cavenaghi Pereira da Silva

---

**WATANABE, I.; GUIMARÃES, J. P.; IYOMASA, M. M.; MIGLINO, M. A.; LOPES, M. G. O.; SOSTHINES, K. & DA SILVA, M. C. P.** Three-dimensional characteristics of the interface epithelium-connective tissue surface of finger's lamina propria of *Cebus apella* monkey: scanning electron microscopy study. *Int. J. Morphol.*, 26(2):325-330, 2008.

**SUMMARY:** In the present paper were analysed the three-dimensional characteristics of the interface epithelium-connective tissue surface of finger prints of *Cebus apella* monkey employing the scanning electron microscopic methods. The connective tissue core (CTC) and epithelial papillae were examined verifying the three-dimensional configuration of the tissue projections. The samples were fixed in Bouin solution for histologic preparations and in modified Karnovsky for examine to observe in scanning electron microscopy. After treatment in the 10% NaOH solution during 3 to 5 days, the surface of finger prints revealed a distribution of CTC of lamina propria in situ showing original three-dimensional SEM images. The linear and circular dispositions CTC, and the furrows were clearly identified. Each pointed papilla presented a large base and longitudinal disposition of thick collagen fiber bundles and in some areas with a complex reticular formations. The longitudinal furrows between the pointed papillae exhibited a dense layer of connective tissue and showed only low CTC or laminar in shape. The presence of numerous foramina of sweat gland were noted in three-dimensional SEM images.

---

**KEY WORDS:** Skin; Finger; Collagen fibers; *Cebus apella*; Scanning electron microscopy.

---

### INTRODUCTION

The histological and ultrastructural observations of connective tissue core (CTC) of lamina propria of mucosae have been reported by several authors. The CTC structure of human tongue was studied by Horstmann (1954) using light microscopy. Kobayashi *et al.* (1987) reported the three-dimensional aspects of the CTC of the neonatal dogs, after treatment in HCl solution in order to explore the CTC, concluding that the CTC of filiform papillae present a elliptical protrusion and in the fungiform papilla a round in shape. Also, Kobayashi (1990) revealed that the lingual mucosa of guinea pig present numerous projections of CTC formed by three or more stick's protrusions in shape. The large and small conical papillae and ducts of salivary gland

were noted in the posterior region of tongue. The three-dimensional architecture of CTC in lamina propria of rat soft palate were demonstrated by Nakano (1992). Kobayashi (1992) reported the architecture of CTC lingual papillae of *Tupai glis* observing that the CTC of filiform papillae showed a human hand and of the fungiform in columnar form. Iwasaki *et al.* (1992) demonstrated the structures of interface epithelium-connective tissue of turtle's tongue (*Clemmys japonica*). Watanabe *et al.* (1992) showed the structures of lingual mucosa *Dasyurus novemcinctus* mentioning that the CTC presented in form finger tips. Misumi & Akiyoshi (1984) evidenciated the CTC of human finger prints detecting the papillae in rows and of different sizes.

\* Department of Surgery, Domestic Animal Anatomy Section, Faculty of Veterinary Medicine, University of São Paulo

\*\* Department of Anatomy, Institute of Biomedical Sciences, University of São Paulo.

\*\*\* Department of Morphology, Physiology and Estomatology, Faculty of Dentistry, campus of Ribeirão Preto, University of São Paulo

\*\*\*\* Faculty of Sciences and Health, University of Vale do Paraíba, São José dos Campos, São Paulo.

\*\*\*\*\* Department of Morphology, Biological Sciences Center, Federal University of Belém, campus of Guamá, Belém, PA, Brazil.

\*\*\*\*\*"Departmenmt of Morphology, Federal University of São Paulo, UNIFESP, São Paulo.

The aim of present paper is to demonstrate the characteristics of interface epithelium-connective tissue of finger prints of monkey *Cebus apella*, using scanning electron microscopic method.

## MATERIAL AND METHOD

In the present study were used the palmar skin of five monkeys *Cebus apella*. The animals were anesthetized by intraperitoneal injection of pentobarbital sodic and perfused with the modified Karnovsky solution containing 2.5% of glutaraldehyde, 2% paraformaldehyde in sodium phosphate buffer at 0.1M (pH 7.4). For light microscopy sections, the specimens were fixed in Bouin solution during 8hs and embedded in Paraplast resin. Thick sections of 6 micrometers were mounted and stained by Hematoxilyn-eosin, Azo-Carmin and Picosirius. For scanning electron microscopy, after fixation by perfusion, the samples were dissected and fixed in same solution during 12 h at 4°C. The samples were treated in 10% sodium hydroxide solution for 3 to 5 days, at room temperature, according to the technique reported by Ohtani (1987). Then, the samples were rinsed in distilled water for several days and postfixed in 1% aqueous osmium tetroxide solution during 2 hs at 4°C. The samples were immersed in 1% aqueous solution of tannic acid during 90 minutes at room temperature (Murakami, 1974).

Then, the samples were dehydrated in increasing series of ethanol, dehydrated by critical point dryer utilizing Balzers, CPD-030 device with liquid carbon dioxide and coated with gold in "Ions Sputter" Balzers SCD-040 apparatus. The observations were made in a scanning electron microscopy Jeol, JSM-840.

## RESULTS

Light microscopy observations revealed that the epithelial layer measures  $171.58\mu\text{m} \pm 37.01\mu\text{m}$ , containing a dense connective tissue with dermal and epidermal portions. The thick connective tissue layer containing the CTC are evidenced in stained sections of Hematoxilyn-eosin and Azo-Carmin (Figs. 1A and 1B). The sections stained with Picosirius and examined by polarized light microscopy may detect the presence of thick collagen fibers of type I and III (Fig. 2).

The scanning electron microscopic observations in the samples treated with sodium hydroxide solution revealed that the surface of interface epithelium-connective tissue of finger prints were constituted by CTC having the bundles of collagen fibers *in situ* (Fig. 3). The CTC formations were encountered in all extensions of lamina propria revealing the circular and longitudinal dispositions in three-dimensional SEM images (Fig. 4). Bifurcated and trifurcated papillae were noted in some areas. At base of papilla showed usually thick connective tissue. In the surface of furrow of each papilla, the connective tissue projections were generally small and few. The connective tissue projections present a pointed in shape revealing clearly a disposition of collagen fiber bundles (Fig. 5). The elongated and conical CTC possessed at their base numerous collagen fiber bundles in linear and irregular disposition (Fig. 6). Each papilla present a longitudinal disposition of collagen fiber bundles (Fig. 7). The pointed CTC delimited a longitudinal furrows (Fig. 8). The surface of furrow present a flat area and contain several foramina of ducts. At high magnification of figures, may observe a distribution of the bundles of longitudinal fibers (Fig. 9). Also, the circular disposition of collagen fibers and

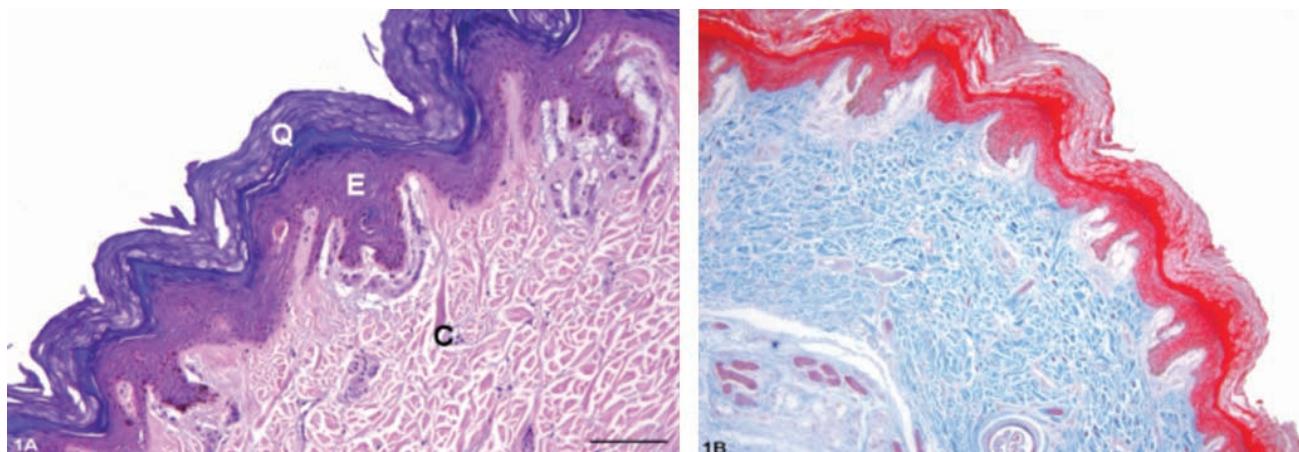


Fig.1. Photomicrography of finger print skin of *Cebus paella* monkey. A: General aspect, showing the epithelium (E), queratinized layer (Q) and connective tissue (C). Hematoxilyn-eosin stained section. X100. Bar: 100µm. B: The surface of interface epithelium-connective tissue, with CTC projections may be seen. Azo-Carmin stained section. X100. Bar: 100µm.

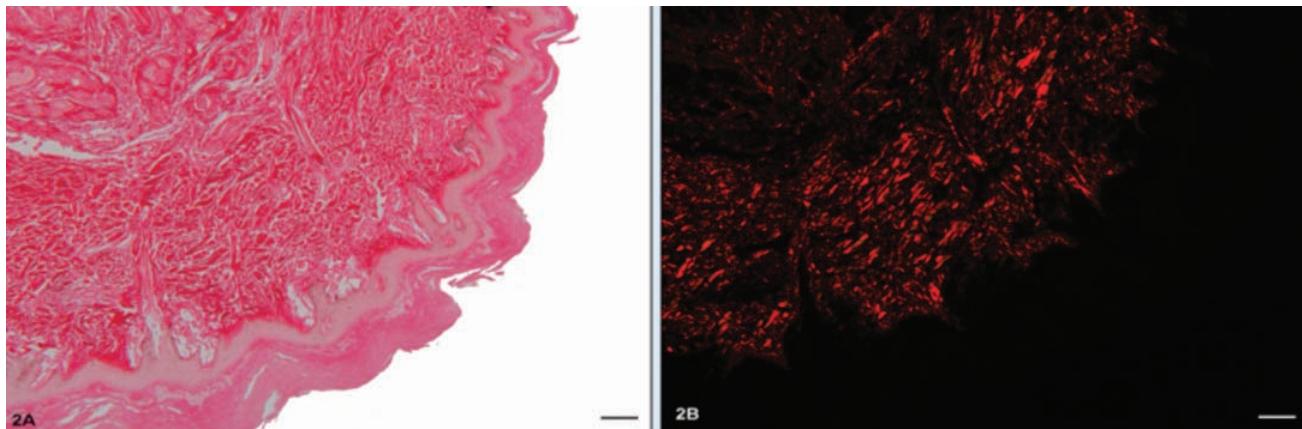


Fig. 2 A: Photomicrography of Picosirius stained section showing a distribution of connective tissue in red. X100. Bar: 100µm. B: Polarized light microscopy image revealing the collagen fibers type I and III. X100. Bar: 100µm.

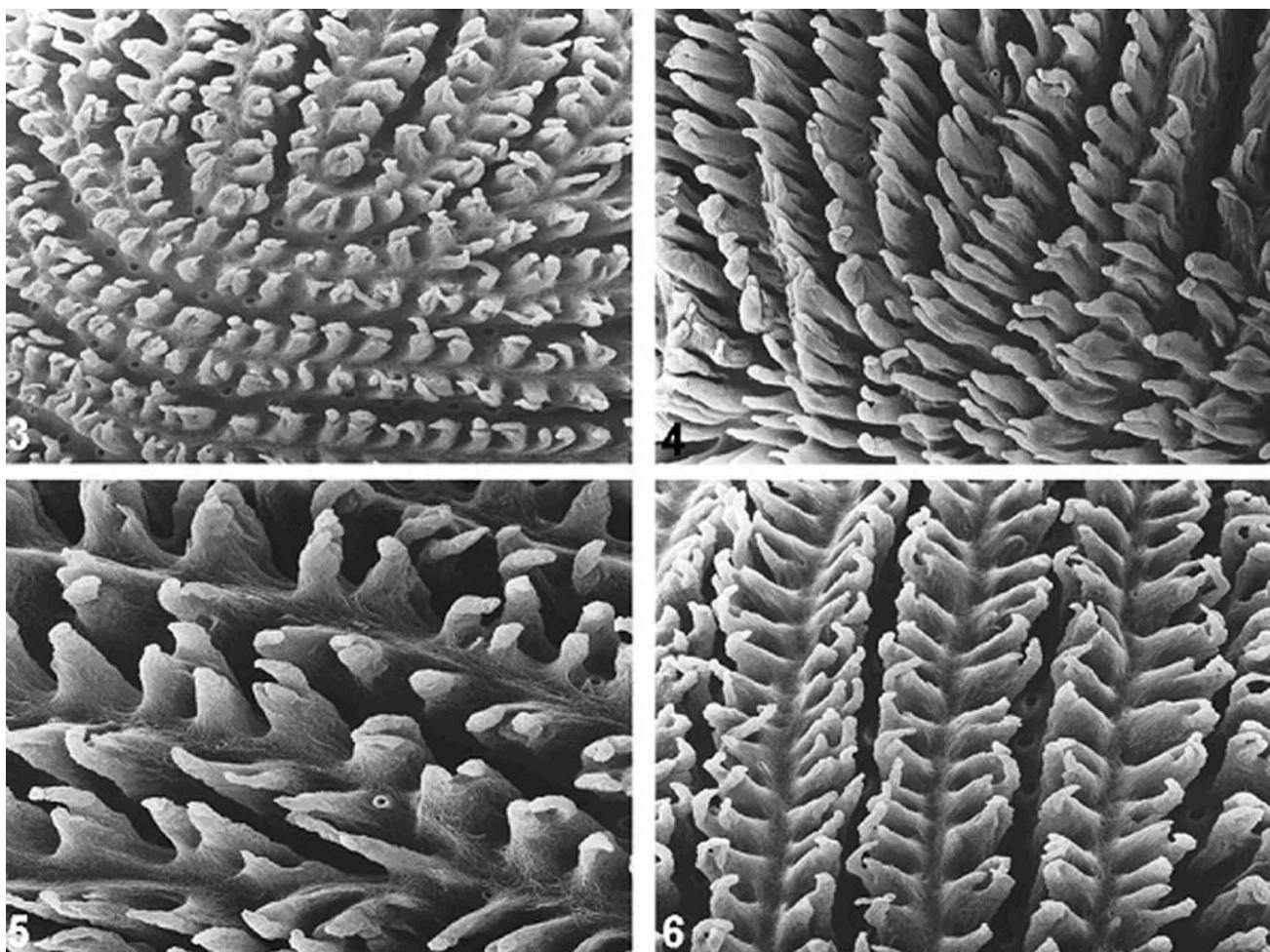


Fig. 3. Sample treated with NaOH solution. Surface of interface epithelium-connective tissue of circular disposition. 50X.

Fig. 4. Shows the elongate CTC longitudinally disposed having some bifurcate or trifurcated tips. 50X.

Fig. 5. The space between CTC projections revealing the dense collagen fibers surface. 100X.

Fig. 6. Sample treated with NaOH solution. The interface epithelium-connective surface revealed the space between the CTC containing a dense collagen bundles. 70X.

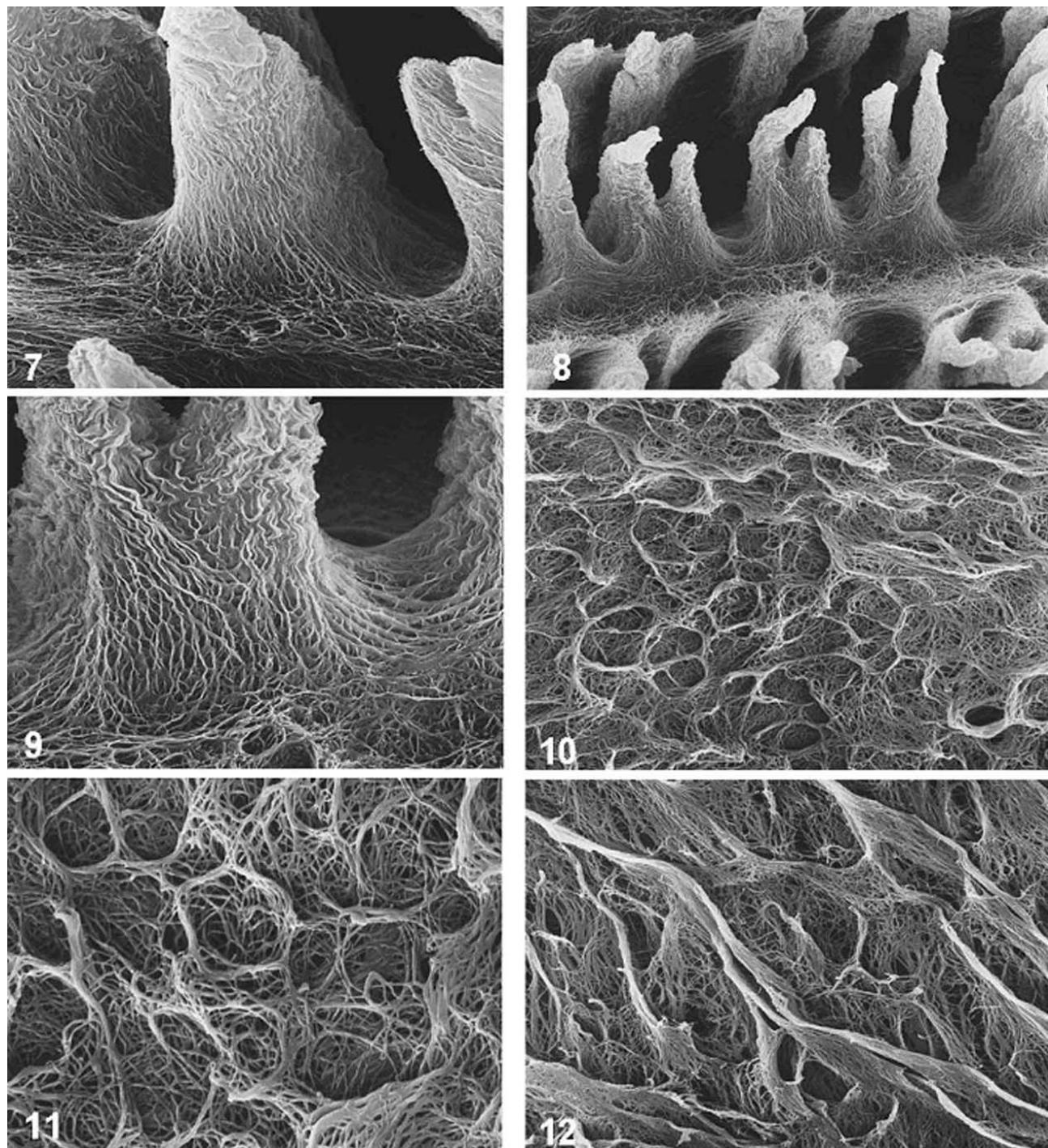


Fig. 7. Samples treated with NaOH solution. The interface epithelium-connective tissue revealed CTC and the adjacent spaces. A longitudinal disposition of collagen fibers is clearly seen. 500X.

Fig. 8. The surface of interface epithelium-connective tissue and the spaces are shown. The details of the base are clearly noted. 200X.

Fig. 9. At high magnification, a vertical disposition of collagen fibers are identified. 700X.

Fig. 10. The reticular fibers are clearly shown. 5.000X.

Fig. 11. At high magnification the circular formations are seen. 10.000X.

Fig. 12. The longitudinal disposition of collagen fiber bundles are noted. 5.000X.

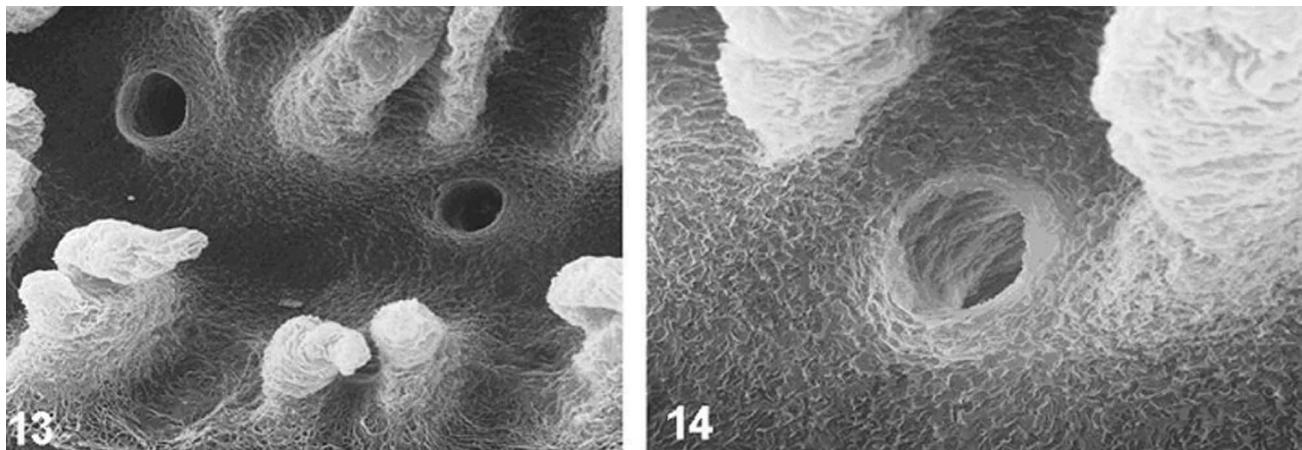


Fig. 13. The presence of foramina of sweat gland duct are shown. 300X. Fig. 14. At high magnification may observe a disposition of collagen fiber bundles surrounding the forame of sweat gland duct. 700 X.

the spaces which permit the passage of small capillaries and bundles of nerve fibers can be seen (Fig. 10). The circular aspect of the collagen fibers revealed a network on the surface and the trabeculations (Fig.11). The figure 12 shows at high magnification a longitudinal distribution of collagen fibers

in each CTC. The duct of sweat gland were observed on the surface between the longitudinal disposed papillae (Fig.13). The duct of sweat gland was surrounded by circular bundles of collagen fibers noted in three-dimensional SEM images (Fig.14).

## DISCUSSION

Our results revealed clearly the presence of CTC of lamina propria identifying the surface of interface epithelium-connective tissue, after treatment with NaOH solution. Then samples analysed by scanning electron microscope demonstrated the morphology of the papillae, which are usually pointed in shape. Our data showed that the exposition of structures of lamina propria evidenced CTC in original localization and in three-dimensional SEM images. These similar characteristics of CTC in other animals have been reported by Kobayashi (1990, 1992), Kobayashi *et al.*, Ohtani *et al.* (1988) and Watanabe *et al.* (1992, 1994). Considering the functional aspect, it may confirm that the structures of CTC located between epithelial layer and connective tissue may act to increase the contact surface in both sides and promote the junction and facilitate the blood supplement (Kobayashi *et al.*; Kobayashi, 1990, 1992; Nakano).

Although, our results examining the finger prints of monkeys can be noted that the characteristics of CTC, and the details of disposition of collagen fiber bundles in the lamina propria revealing in three-dimensional SEM images. Other aspects that our results may identify the surface of interface epithelium-connective tissue where different regions of fingers of *Cebus apella* monkey revealed a disposition of the collagen fibers in each papilla. Nakano suggested that the architecture of interface epithelium-

connective tissue must to be determine genetically. Recently, several researchers demonstrated that CTC of tongue mucosa in various species of animals using SEM (Kobayashi *et al.*; Nagato *et al.*, 1989; Kobayashi, 1990; Watanabe *et al.*, 1992; Silva *et al.*, 2002). According to the authors, the architecture of CTC is variable due to the type of lingual papillae. Although, it was related that the filiform papillae of tongue presented morphological variations not only between the species, but also between different localizations on the tongue surface. The CTC in the present study represent the general external conformation of fingers and of each type of papilla having a framework formed by bundles of collagen fibers disposed in different directions. Our results obtained in the fingers of monkeys presented CTC relatively uniform in size following the external conformation and size and shape of papillae presenting small variations comparing to those observed in the oral mucosa of mammals.

## ACKNOWLEDGMENTS

The authors express many thanks to Mr. Sebastião Aparecido Bioleta, Mrs. Sonia Regina Yokomizo de Almeida and Mrs. Marta Maria da Silva Righetti for their technical assistance.

**WATANABE, I.; GUIMARÃES, J. P.; IYOMASA, M. M.; MIGLINO, M. A.; LOPES, M. G. O.; SOSTHINES, K. & DA SILVA, M. C. P.** Características tri-dimensionales superficiales de la interfase del tejido epitelial-conectivo de la lámina propria de los dedos de monos *Cebus apella*: Estudio con microscopía electrónica de barrido. *Int. J. Morphol.*, 26(2):325-330, 2008.

**RESUMEN:** Se analizaron tridimensionalmente las características de la interfase del tejido epitelio-conectivo en la superficie de huellas dactilares de mono *Cebus apella*, empleando el microscopio electrónico de barrido. El núcleo del tejido conectivo (NTC) y las papilas epiteliales se examinaron en las tres dimensiones. Las muestras fueron fijadas en solución histológica Bouin para los preparativos y en Karnovsky modificada para examinar y observar en el microscopio electrónico de barrido. Después del tratamiento en solución de NaOH al 10%, durante 3 a 5 días, la superficie de las huellas dactilares revelaron una distribución de NTC de lámina propia *in situ* mostrando imágenes en tres dimensiones originales con microscopio electrónico de barrido. Las disposiciones lineal y circular del NTC están claramente identificadas. Cada papila señalada presenta una gran base y la disposición longitudinal de gruesos haces de fibras de colágeno y, en algunas zonas con formaciones de un complejo reticular. Los surcos longitudinales entre las papilas señaladas mostraron una densa capa de tejido conectivo con NTC bajos o de forma laminar. La presencia de numerosos forámenes de las glándulas sudoríparas se observaron en tres dimensiones.

**PALABRAS CLAVE:** Piel; Dedo; Fibras de colágeno; *Cebus apella*; Microscopía electrónica de barrido.

## REFERENCES

Horstmann, E. Morphology and morphogenesis of the papillary body of the oral mucosa in man. *Z. Zellforsch. Mikrosk. Anat.*, 39(5):479-514, 1954.

Iwasaki, S.; Asami, T.; Asami, Y. & Kobayashi, K. Fine structure of the dorsal epithelium of the tongue of the Japanese terrapin, *Clemmys japonica* (Chelonia, Emydinae). *Arch. Histol. Cytol.*, 55(3):295-305, 1992.

Kobayashi, K. Three-dimensional architecture of the connective tissue core of the lingual papillae in the guinea pig. *Anat. Embryol. (Berl)*, 182(3):205-13, 1990.

Kobayashi, K. Stereo architecture of the interface of the epithelial cell layer and connective tissue core of the foliate papilla in the rabbit tongue. *Acta Anat. (Basel)*, 143(2):109-17, 1992.

Kobayashi, K.; Miyata, K. & Iino, T. Three-dimensional structures of the connective tissue papillae of the tongue of Newborn dogs. *Arch. Histol. Jap.*, 50(3):347-57, 1987.

Misumi, Y. & Akiyoshi, T. Scanning electron microscopic structure of the finger print as related to the dermal surface. *Anat. Rec.*, 208(1):49-55, 1984.

Murakami, T. A revised tannin-osmium method for non-coated scanning electron microscope specimens. *Arch. Histol. Jpn.*, 36(3):189-93, 1974.

Nagato, T.; Nagaki, M.; Murakami, T. & Tanioka, H. Three dimensional architecture of rat lingual filiform papillae with special reference to the epithelium-connective interface. *J. Anat.*, 165:177-89, 1989.

Nakano, T. NaOH cell maceration scanning electron microscopic studies on the architecture of the lamina propria of the mouse palate. *Auris Nasus Larynx*, 19(2):133-42, 1992.

Ohtani, O. Three-dimensional organization of the connective tissue fibers of the human pancreas: a scanning electron microscopic study of NaOH treated-tissues. *Arch. Histol. Jpn.*, 50(5):557-66, 1987.

Ohtani, O.; Ushiki, T.; Taguchi, T. & Kikuta, A. Collagen fibrillar networks as skeletal frameworks: a demonstration by cell-maceration/scanning electron microscope method. *Arch. Histol. Cytol.*, 51(3):249-61, 1988.

Silva, M. C. P.; Watanabe, I. & Kronka, M. C. Three-dimensional architecture of the connective tissue core and surface structures of the lingual papillae in the rabbit. *Histol. Histopathol.*, 17(2):455-61, 2002.

Watanabe, I.; Morais, J.O.R.; Iyomasa, M.M. & Konig Jr., B. Stereo architecture of the connective tissue cores of the gingiva in the *Cebus apella* monkey. *Rev. Bras. Ciênc. Morfol.*, 116:45-50, 1994.

Watanabe, I.; Morais, J.Q.R.; Yokoyama, R.; Inokuchi, T. & Hamasaki, M. Three-dimensional structures of the subepithelial connective tissue papillae of the armadillo, *Dasypus novemcinctus* tongue. *Rev. Chil. Anat.*, 10:97-103, 1992.

Correspondence to:

Prof. Dr. Ii-sei Watanabe, Professor Titular

Departamento de Anatomia Humana

Instituto de Ciências Biomédicas

Universidade de São Paulo

Avenida Lineu Prestes, 2415

CEP 05508-900

Cidade Universitária

São Paulo, BRASIL

Received: 03-12-2007

Accepted: 22-02-2008

E mail: watanabe@icb.usp.br; watanabe@usp.br