A COMPARATIVE SEM STUDY OF KERATINIZED AND NON-KERATINIZED ORAL MUCOSA OF THE VERVET MONKEY

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Scanning electron microscopy has revealed that the surfaces of keratinized and non-keratinized oral epithelial cells have characteristic features which enable these tissue types to be readily distinguished. These features include pits, villus-like projections and ridge-like folds called microplications. The origin and functional significance of these structures is not known, although several hypotheses have been proposed. Microplications have been interpreted as a reserve area for cell stretching[1] but further studies[2,3] have yielded conflicting results. Cleaton-Jones[4] has suggested that the cellular interdigitation resulting from the microplications may aid adhesion between the stratified epithelial cells. This view has been supported by subsequent investigations of superficial epithelial cells[5]. The situation in the deeper cell layers is not entirely clear.

The purpose of this study was threefold. Normal keratinized attached gingiva and non-keratinized alveolar mucosa were examined under the SEM to:

(a) characterise the surface appearance of normal cells throughout the full thickness of the epithelium;
(b) establish whether complementary structures which could assist cellular adhesion existed on upper and lower surfaces of the cells;
(c) determine whether or not epithelial cells showed any characteristic surface features which could be related to their position in the epithelial stratum.

Samples of clinically healthy alveolar mucosa and attached gingiva were dissected from seven adult vervet monkeys (*Cercopithecus pygerythrus* F. Cuvier) and processed for SEM. After the surface features of both epithelial types had been examined and photographed, cells were sequentially stripped from the epithelial surface with a specially made 3.1 mm diameter viewing stub and double sided adhesive tape. A piece of tape was attached to the stub surface after which the other adhesive side was applied to the surface of the epithelium, in order to remove cells from the surface. After every five applications of adhesive tape the epithelium surface was coated and viewed again, together with undersurfaces of the epithelial cells removed by the tape. In this way the epithelial cells were examined at successive levels from the oral surface to the lamina propria. A Digiplan® electronic image analysing system was used to obtain histometric data on the two tissue types. Twenty cells were measured at the outermost and deepest levels reached for (a) individual cell area, (b) diameter of the pits and villi on the upper and lower surface of attached gingiva epithelial cells (c) widths of the plications on the lower surface and grooves on the upper surface of the cells of the alveolar mucosa, (d) lengths of the plications on the upper and lower surfaces of the alveolar mucosa cells. The mean value and standard deviation were calculated in each case and the results subjected to the Student's t test for independent samples.

The results are summarised in Table I. The number of cell strippings necessary to reach the lamina propria of each epithelium differed. The attached gingiva required 310 instances compared to some 104 for alveolar mucosa, which suggests greater intercellular adhesion between cells from the attached gingiva. The results indicate that the conformation of the lower surface of an attached gingival cell is complementary to the upper surface of an underlying cell. No statistically significant difference was found between the diameters of the pits and villi of these cells, evidence which supports the "press-stud" interdigitation mechanism suggested by Cleaton-Jones[4]. Similarly the upper and lower surfaces of the cells of the alveolar mucosa can be considered complementary. Statistical analysis also showed that the widths of the microplications on the lower cell surfaces were not significantly different to the widths of the grooves on the upper cell surface, an observation which indicates a possible interlocking slot and groove formation. Therefore the surface arrangements of these cells could aid intercellular adhesion. The difference in microplication length between the upper and lower cell surfaces was statistically significant ($t = 8,64$; $p < 0,001$) but this cannot be explained at present.

Although the cells of the attached gingiva and alveolar mucosa differed from each other, within each epithelium cells had a uniform appearance throughout the full thickness of the epithelium. No surface features were found which could characterise the cell to any epithelial cell layer. A significant decrease ($t = 3,86$ $p < 0,01$) in mean cell area was present between the upper and lower layers of the attached gingiva. Stripping caused cells of the alveolar mucosa to fragment and it was not possible to determine deep cell areas for this epithelium.

TABLE I: COMPARISON OF SURFACES OF EPITHELIAL CELLS OF ATTACHED GINGIVA AND ALVEOLAR MUCOSA

(measurements are given as means ± standard deviations)

Attached gingiva	
Number of strippings to lamina propria	310
Area of individual superficial cells	950,4 ± 201,9µm^2
Area of individual deepest cells	755,1 ± 96,6µm^2
Upper cell surface - pit diameter	0,33 ± 0,07µm
Lower cell surface - villus-like projection diameter	0,36 ± 0,05µm
Alveolar mucosa	
Number of strippings to lamina propria	> 104
Upper cell surface - length of microplications	12,00 ± 2,77µm
- width of groove	0,28 ± 0,06µm
Lower cell surface - length of microplications	5,8 ± 1,98µm
- width of microplications	0,27 ± 0,03µm

References

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