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CELL DRY MASS AND SIZE, NUCLEAR DRY MASS AND SIZE, AND MATURATION INDICES FOR HUMAN GINGIVAL CELLS

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ABSTRACT

Methods used to study buccal exfoliative cytology were applied to gingival smears. Buccal and gingival cells were classified using three indices. Cells observed in both types of smears were primarily intermediate with round or oval nuclei. Gingival Cells averages were: cell area, 3046 X $10^{-8}cm^2$; nuclear area, 92 X $10^{-8}cm^2$; cell dry mass 1592 pg; and, nuclear dry mass, 47 pg. Gingival cells were generally smaller and weighed less than buccal cells, but the nuclei in these were similar in size and mass.

Lee et al. (1974) reviewed the data on cell and nuclear size and dry mass for cells from the cheek and upper lip of the oral cavity of humans. The means for parabasal cells from the cheek could be generalized as follows: cell area (CA), 1800 X $10^{-8}cm^2$; cell dry mass (CDM), 1000 pg (1 pg = 1 X $10^{-12}g$); nuclear area (NA), 70 X $10^{-8}cm^2$; and, nuclear dry mass (NDM), 45 pg. Means for intermediate cells with round or oval nuclei were about 250% greater for CA and CDM, 25% greater for NA, and 50% greater for NDM than those for parabasal cells. Means for pycnotic cells were similar to those for intermediate cells for CA and CDM but the nuclei were about one-third the size and one-half the mass. Parabasal cells from the upper lip were slightly smaller in area and weighed less than those from the cheek but their nuclei were about 10% larger and 20% greater in dry mass. The means for CA, NA, and NDM for intermediate and pycnotic cells from the upper lip were similar to those from the cheek but CDM for lip cells was less than that for cheek cells. Binucleate cheek cells were like mononucleate cells except for smaller NA. The sequence for development in cheek and lip cells appeared to be similar. In general, parabasal cells became intermediate cells by increasing in CA, CDM, NA, and NDM. As intermediate cells matured, CA, NA, and NDM decreased but CDM remained relatively unchanged.

The purposes of this study were: to apply methods used in buccal exfoliative cytology to gingival cells; to determine CA, NA, CDM, and NDM for gingival cells; and, to summarize the cell types observed in gingival smears using three maturation indices used successfully in buccal exfoliate cytology.

Buccal and gingival cells were obtained from the senior author (male, age 14) by light rubbing action of the index finger on the outer surface of the right side of the upper gum and the buccal mucosa. Cells were transferred to a slide, covered with a drop of 0.01% acridine orange and a cover glass. The cover glass was sealed to the slide with paraffin oil to prevent evaporation. Fifty randomly selected cells were classified using the system described by Pappelis et al. (1976): parabasal (Pb) cells; intermediate cells with round nuclei (I-R), with oval nuclei (I-O), or, with small, rod-shaped nuclei (I-RP); pycnotic (P) cells; nuclei less than 6 μ diameter; ghost (G) cells, like I-R or I-O using phase-contrast or interference microscopy but having very low optical path differences (low dry mass) when viewed with an interference microscope and little or no fluorescence when viewed in acridine orange using an ultraviolet microscope equipped with epifluorometry accessories because of little or no DNA content; anucleate (A) cells; and binucleate (BN) cells.

When computing Cell Development Index (CDI), the cell types were classified as above and assigned values as follows: Pb, 1; I-R, 4; I-O, 5; I-RP, 6; P, 7; G, 8; and A, 9. BN cells were assigned a mean value based on the morphology of the two nuclei and cell. The CDI was obtained by multiplying the assigned values by the percentages of each type in the smear, and adding the products. Three groups of cells were used to compute Maturation Index (MI): Pb, assigned the value of 0.0; intermediate cells (I-R, I-O, and I-RP) assigned 0.5; and, superficial cells (P, G, and A) assigned 1.0. We assigned G to superficial cells because their nuclei were considered to be more degenerate than those of intermediate cells. The values were multiplied by the percentages of each cell type classified in the smear and the products summed to arrive at MI. Karyopycnotic Index (KI) was computed by dividing the number of P and A cells by the total number of cells.

Photomicrographs of ten randomly selected cells per smear were used to determine CA and NA. NDM and CDM were computed as described by Pappelis et al. (1973). Optical path differences were obtained using a Leitz transmitted light interference microscope and monochromatic light. Three replications were used to obtain means.

The cells observed in both right cheek and gingival smears were primarily of the I-O and I-R type (gingival, I-O = 61%, I-R = 29%; cheek, I-O = 64%, I-R = 20%). In gingival smears, there were about 2% Pb, 4% I-RP, 1% P, 2% G, and 2% A. In buccal smears, there were about 2% Pb, 6% I-RP, 3% P, 5% A, and 1% BN. CDI, MI, and KI were computed for the gum and cheek using the replicate means for cell types. For gingival cells, these were: CDI = 487; MI = 52; and KI = 0.03. For buccal cells, these were: CDI = 502; MI = 53; and KI = 0.08. The percentage of the various types of cells in gingival and buccal smears and the CDI, KI, and MI means were similar. We conclude that the three cell maturation indices used to classify cells in buccal smears are well suited for classifying cells in gingival smears.

The averages for CA and NA in gingival cells were 3046 and 92 X $10^{-8} cm^2$, respectively. For gingival cells, CDM and NDM were 1039 and

45 pg, respectively. In buccal smears, the average of CA and NA were 3978 and 89 X $10^{-8}cm^2$, respectively. The averages for CDM and NDM were 1592 and 47 pg, respectively. The gingival cells were generally smaller and weighed less than buccal cells, but the nuclei in these were similar in size and mass. CA, CDM, NA, and NDM for buccal cells are in close agreement with data for randomly sampled buccal cells reported and reviewed by Lee et al. (1974): CA, 4105 X $10^{-8}cm^2$; NA, 87 X $10^{-8}cm^2$; CDM, 1941 pg; and, NDM, 55.5 pg.

Physical changes that occur with advanced aging are seen in the oral cavity as well as the rest of the body. Gingival recession and loss of gingival attachment are well correlated with chronologic age and estimates of biologic age (Hansen 1973). Very little is known about the relationghip between aging and periodontal disease. If the natural dentition is to be retained throughout life, more must be known about the aging process (Hazen, S. P., 1974). We conclude that gingival exfoliative cytology may be helpful in the study of aging in this tissue. We suggest that cells in smears be classified using the methods described in this study and that the size and mean values for mass of cells and their nuclei also be determined for donors in various age classes, chronologic and biologic.

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