The Existence and Distribution of Melanocytes in the Periodontal Ligament of the Mongrel Dog*

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Summary. The existence and distribution of melanocytes in the periodontal ligament of the mongrel dog were investigated. Melanocytes were found in the periodontal ligament of the maxillary incisor and premolar segments. Melanocytes in the periodontal ligament varied in number, and generally appeared as dendritic or elongated cells with several, long cytoplasmic processes. These melanocytes were always distributed closer to the tooth root side of the periodontal ligament than the alveolar bone side, but did not contact the cementum. Melanocytes were longitudinally distributed in the apical half of the periodontal ligament. There were no findings suggestive of a relationship between melanocytes and epithelial rests of Malassez or other cellular elements of the periodontal ligament. Although some parts of the gingival mucosa of all dogs in this study showed pigmentation, no relationship was seen between melanocytes in the periodontal ligament and those in the gingival mucosa.

This is the first report of melanocytes in the periodontal ligament under normal conditions.

MATERIALS AND METHODS

Mandibles and maxillae obtained from 10 young mongrel dogs, weighing 10–12 kg, with complete dentition of permanent teeth and healthy gingiva, were fixed in 10 % neutral-buffered formalin for 3 weeks, then divided into smaller incisor, canine, premolar, and molar segments. They were demineralized in Plank-Rychlo's solution at 4°C for 2 weeks, dehydrated and embedded in celloidin. Longitudinal serial sections 15 μm thick were made along buccolingual or mesio-distal direction through the apical area of all teeth. The sections were stained routinely with hematoxylin and eosin. The sections were further treated with 10% hydrogen peroxide solution when cells with brown to black pigmentation were found in hematoxylin and eosin-stained sections. The brown to black pigmentation in cells with elongated branches disappeared after treatment with 10%

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hydrogen peroxide solution, these pigmented cells being regarded as melanocytes (Lillie and Fullmer, 1976).

In addition, the upper and lower jaws of two dog fetuses (mongrel dogs), 12 to 13 weeks of gestation, were examined histologically by the methods mentioned above.

RESULTS

Melanocytes were found in the periodontal ligament of the maxillae of 4 dogs, and not in the mandibles. The segmental locations of the periodontal ligaments containing melanocytes in each dog were as follows: right premolar, left incisor and left premolar regions in Case 1; right incisor region in Case 2; right and left incisor regions in Case 3; and right incisor region in Case 4. Excepting the periodontal ligament, no melanocytes were found in any other areas of the jaw bone.

Melanocytes in the periodontal ligament varied in number, e.g., a solitary cell, groups of a few cells, or groups of numerous cells; these cells generally appeared as dendritic or elongated cells with several long cytoplasmic processes (Figs. 1, 2). Neither melanophages nor pigmentation in cellular elements of the periodontal ligament were seen. Melanocytes were arranged parallel to the long axis of the tooth root (Fig. 2), and their elongated cytoplasmic processes also ran parallel to this axis (Fig. 2b). Melanocytes were longitudinally distributed in the apical half of the periodontal ligament, and varied numbers of melanocytes were also scattered in the loose fibrous connective tissue of the periapical area (Fig. 3). There were no findings suggestive of a morphological intercellular relationship between melanocytes and cells of epithelial rests of Malassez or other cellular elements of the periodontal ligament. Although some parts of the gingival mucosa of all the dogs examined showed pigmentation, serial sections failed to reveal any relationships between melanocytes in the periodontal ligament and those in the gingival mucosa.

In the fetuses, melanocytes were found in mesenchymal tissue around the dental anlage of the upper and lower jaws (Fig. 4), and melanocytes appeared neither in the oral squamous epithelium nor in the epithelial element of the dental anlage at this fetal stage.

DISCUSSION

The periodontal ligament is a fibrous connective tissue attaching the tooth to the alveolar bone. Its primary function is to support the tooth in the alveolus and to maintain the physiological relation
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between the cementum and the bone. It also has nutritive, sensory and homeostatic properties. The periodontal ligament is composed of cells and an extracellular component of fibers and ground substances. The cells of the healthy, functioning periodontal ligament are as follows: synthetic cells such as fibroblasts, osteoblasts, cementoblasts; resorptive cells such as osteoclasts, cementoclasts, fibroclasts; undifferentiated mesenchymal cells; epithelial rests of Malassez; other types of connective tissue cells such as mast cells and macrophages; cells of blood vessels, lymphatics and nerves. However, there have been no descriptions of the existence of melanocytes in the periodontal ligament of mammals.

Melanocytes are widely distributed in the skin, the nervous system, certain types of mucosa and other sites, but are not normally present within the bones of mammals. Pathologically, there are very few descriptions of intraosseous melanocyte-containing lesions other than metastases of malignant melanoma, and all reported examples have occurred within the jaw bone (Takeda et al., 1985a, b, 1987, 1988, 1989, 1990; Takeda, 1989; Takeda and Yamamoto, 1989). Since the presence of melanocytes in the oral mucosa is not uncommon in mammals, and since the dental anlage originates from the primitive oral lining, the occasional presence of melanocytes in intraosseous lesions of the jaw must be expected. Lawson et al. (1976) have studied the distribution of melanocytes in the dental primordium of human fetuses, and found melanocytes within both the dental lamina and tooth bud, and in the squamous epithelium that lines the

Fig. 2 a and b. Melanocytes (arrow heads), arranged parallel to the long axis of the tooth root in the periodontal ligament. Their elongated cytoplasmic processes are also run parallel to the long axis of the tooth root. Melanocytes are distributed closer to the tooth side of the periodontal ligament than the alveolar bone side, but do not contact the cementum. B alveolar bone, AC acellular cementum, D dentin, CC cellular cementum. ×100
oral cavity of fetuses, which had melanocytes in the
dental anlage. Such evidence of melanocytes in dental
anlage may also explain the histogenesis of melano-
cytes in intraosseous lesions of the jaw. However, the
fate of melanocytes presented in the dental anlage of
fetus has not been studied.

Another possible origin of intraosseous melanocytes
of the jaw is that melanocytes migrate through the
mesenchyme, not within the ectoderm. It has been
indicated that the cells composing the sheath of the
peripheral nerve bundles are derived from the neural
crest (SHANThA and BOURNE, 1968), and that the per-
ipheral nerve ending is often of neural crest origin and
very close to melanocytic differentiation (ACKERMAN,
1978; CRAMER, 1984). In addition, it has been establish-
ed that not only melanocytes but also maxillofacial
skeletal cells are derived from the neural crest in
mammals (LeDouARIN, 1982). From such evidence,
the postulation is made that the melanocytes migrate
through the mesenchyme and reach the intraosseous
region of the jaw. In fact, the present study showed
that melanocytes exist in mesenchymal tissue around
the dental anlage of the upper and lower jaws in dog
fetuses, and that melanocytes appear neither in the
oral squamous epithelium nor in the epithelial ele-
ment of the dental anlage at this fetal stage. Such
melanocytes found in the mesenchyme around the
dental anlage during the fetal stage may be related to
the melanocytes in the periodontal ligament of the
jaw, since the periodontal ligament originates from
mesenchyme around the dental anlage.

The present study employed light microscopy with
conventional staining procedures, and no conclusion
can be drawn as to the physiological and pathological
significances of melanocytes in the periodontal liga-
ment of the dog. However, further histochemical
studies to detect melanocytes in the periodontal liga-
ment will clarify such points as their detailed distri-
bution, frequency of occurrence, or behavior under
both normal and pathological conditions.
REFERENCES


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