Bull Group Int Rech Sci Stomatol Odontol. 49: 116-119 (2010)

P51-52 PRENATAL FORMATION OF THE MAXILLARY AND MANDIBULAR ALVEOLAR BONE IN MICE

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Keywords: alveolar bone, mice, prenatal morphogenesis

Introduction

There is a mutual relation between teeth and bone, not only in postnatal life, but also during stages of initial and early formation of teeth and alveolar bone [2]. It is unknown how the interdental ridges and the bony crypts form, in which the dental primordia develop. The crypts may either form due to bone resorption underneath the expanding dental primordia, and the interdental bony ridges may be remnants of adjacent bone resorption. On the other hand, the ridges may be active outgrows of the maxillary and mandibular bone. It might as well be a mixture of both. The mouse is a widely used animal model for craniofacial research and depicted in several atlases [3, 8], the morphology of the peridental bony structures during the stages of dental morphogenesis is not known in detail. Therefore, the development of the human maxillary and mandibular bone, together with the developing tooth primordia was examined for the prenatal stages with special reference to the regions of bone resorption and apposition
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Materials and Methods

Murine specimens (C57-Bl/6J), ranging from the prenatal stages E13 to postnatal stages P20 were prepared as serial histological sections, stained H.E. and TRAP. Regions of bone remodelling were identified referring to the cell morphology, and marked. 3D-reconstructions were made using the software analySIS (Olympus, Berlin).

Results

3D reconstructions from serial sections showing regions of bone remodelling revealed that the formation of the dental crypts, the interdental and the interradicular bone is a result of a mixture of resorptive and appositional processes. The peridental bone arises by apposition between the dental primordia, while underneath the growing dental primordia, there is bone resorption.

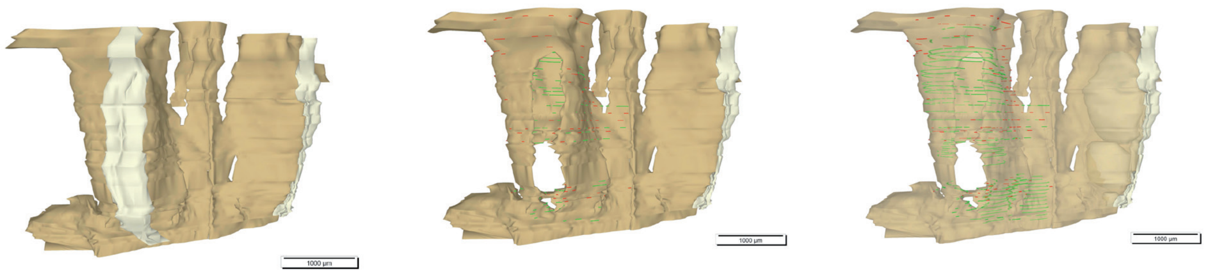

Fig. 1a-c: Murine maxilla, stage P6, in an oral and 30° right oblique view. The upper margin directs into anterior direction, the right half of the maxilla points to the left margin of the images.
a: survey with dental primordia m_1, m_2, m_3 included.
b: dental primordia removed (on the right side only), regions of apposition (red) and resorption (green).
c: bone made transparent to view the remodelling regions within the crypt.

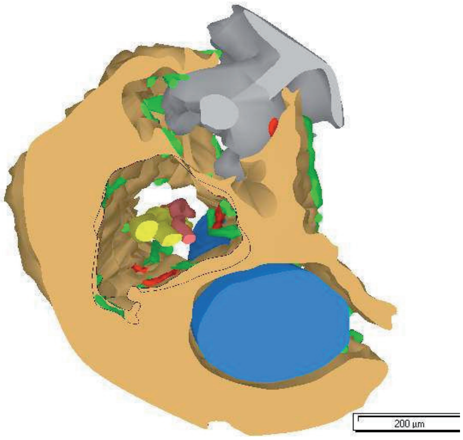

Fig. 2a: Dental primordium M1 (gray), bone (ocre), Meckel's cartilage (blue), N. alv. inf. (yellow), embryo E15, anterior view.

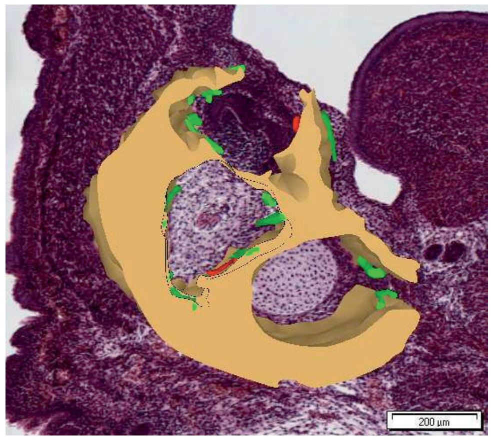

Fig. 2b: mandibular bone superimposed on a histological section through M1. Regions of bone resorption (green), bone apposition (red).

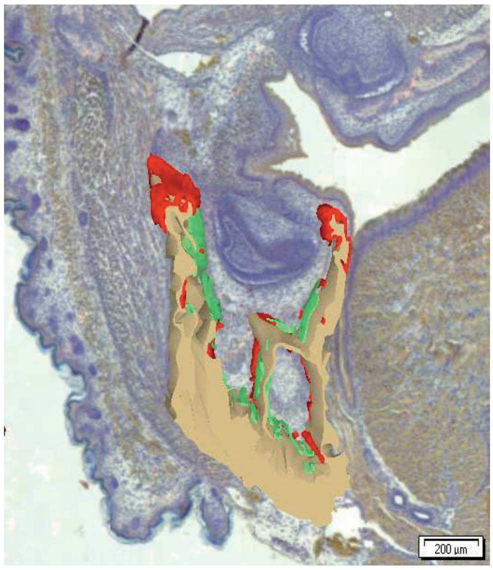

Fig. 3a: Dental primordium M1, bone (ocre), bone resorption (green), bone apposition (red), superimposed on the histological section (TRAP-stained), anterior view. Stage P0.

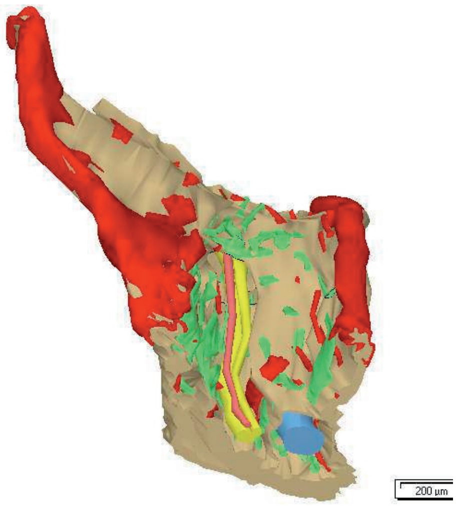

Fig. 3b. Partial reconstruction of the mandibular bone surrounding the dental primordium M1 (removed), bone (ocre), bone resorption (green), bone bone apposition (red), Meckel's cartilage (blue), alveolar inferior nerve (yellow). anterior, and 45°cranial view.

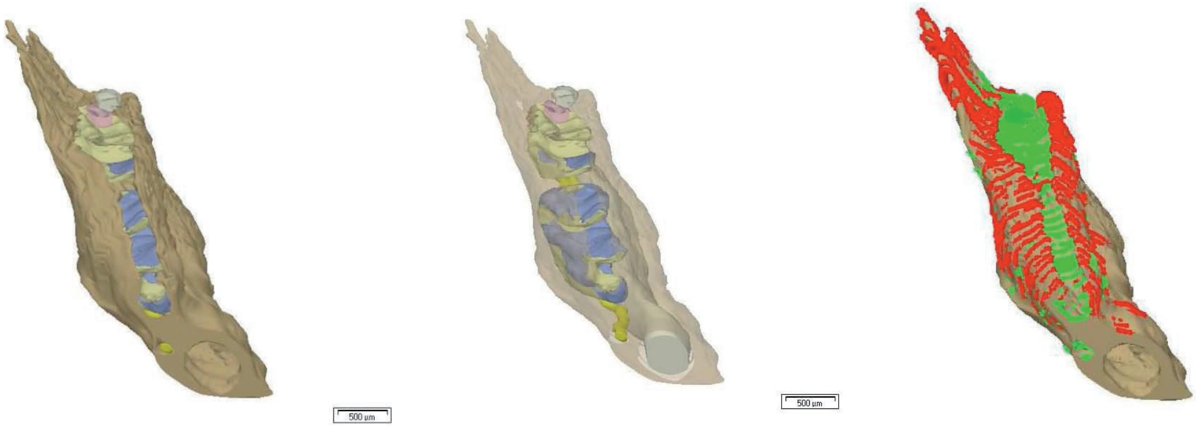

Fig. 4: Partial reconstruction of the right half of the mandible, stage P4, molar region, anterior and 45°cranial view.
a: Dental primordia M1, M2, M3 within their bony crypts. Enamel (blue), dentin (yellow), dental papilla (pink).
b:Same as fig. a, bone made transparent. (dark yellow: alveolar inferior nerve).
c: Same reconstruction, bone (ocre), bone resorption (green), bone apposition (red).

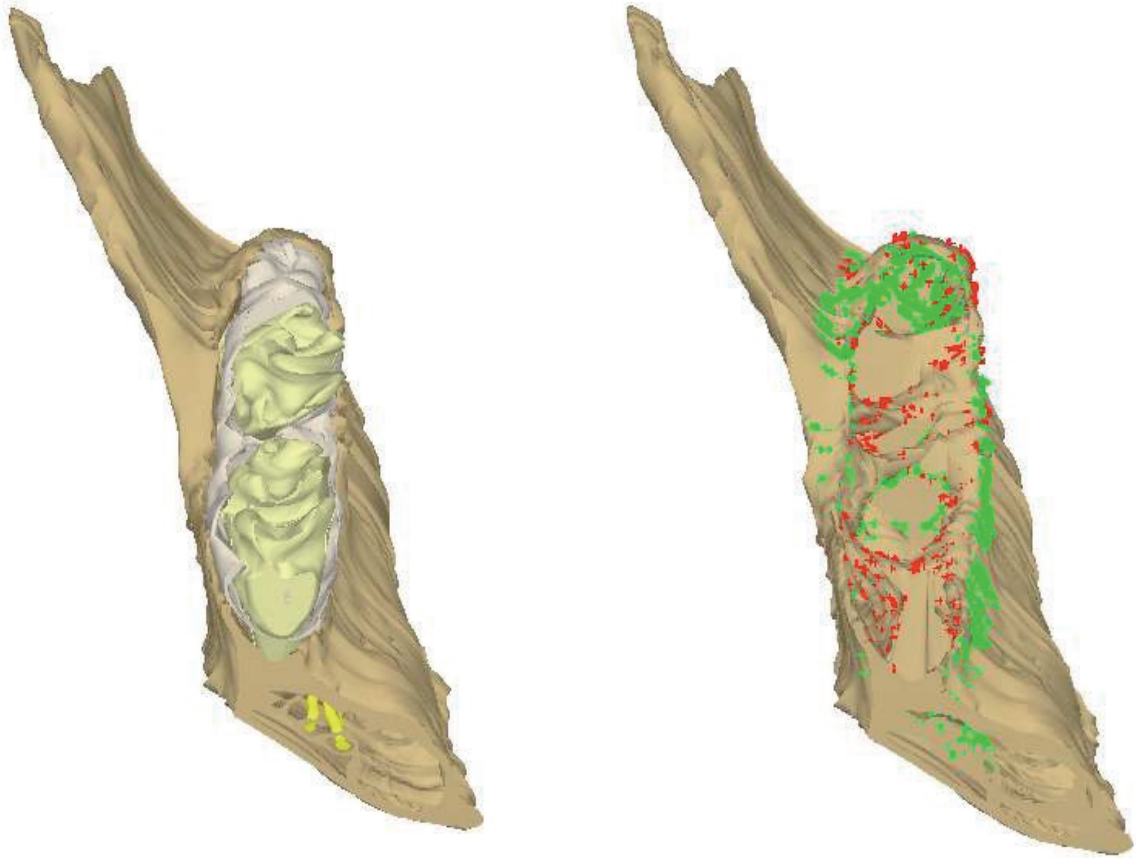

Fig. 5: Partial reconstruction of the right half of the mandible, stage P20, molar region, anterior and 45°cranial view.
a: Dental primordia M1, M2, M3 within their bony crypts. Enamel removed, dental follicle (gray), dentin (yellow).

b: Same reconstruction, bone (ocre), bone resorption (green), bone apposition (red). Active resorption in the crypt and active apposition at the interdental ridges is visible

Discussion

The tooth-bone-interface is an interesting region, where general interactions between different tissues can be studied [2]. As soon as the dental primordia have reached their bud stage, they are surrounded by bone [7]. When the dental primordia increase in size, they necessarily interact with their surrounding bone. According to our results, there is bone resorption underneath and around the dental primordia. The underlying processes may be similar to those that can be found during tooth eruption, where bone is also being resorbed [4-6, 9]. The peridental and interdental bone brims, and the interradicular septa, however, arise due to active outgrows of bone. During desmal ossification, bone, in general, forms in regions of tissue interaction, where distraction forces are assumed [1] and under the influence of a signalling cascade, with Runx-2 as the master regulator [10].

One may assume shearing forces as a primary trigger, as the dental primordia do not only increase in size, but they also elongate in mesiodistal direction and thus change their position along the arch. These results serve as a basis for further research focused on the mechanical and molecular control mechanisms leading to formation of bone form.

Acknowledgement

Supported by grants Ra 428/1-9 Deutsche Forschungsgemeinschaft and by the Czech Academy of Sciences GACR 524/08/J032. We thank Mrs. B. Danielowski, Mrs. I. Schwarz for their most valuable and skilful assistance.

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