ABSTRACT

In vivo organogenesis is based on the temporal-spatial developmental processes that depend on cell behaviour, for example on their growth, migration, differentiation and intercellular interactions. Such behaviour is regulated by appropriate transient expression of various signalling molecules. Despite the significant advances in therapeutic strategies, the secret of the development of the biological replacement of a damaged or missing tooth has not yet been revealed. In this context, animal models provide a powerful tool for studying tooth normogenesis and pathogenesis in both basic and applied research.

Early development of the tooth shares similar morphological and molecular features with other ectodermal organs. At the same time, these features are largely preserved also between species, which is advantageous for the use of model organisms. The dental formula of both: the human and the mouse are reduced against a common ancestor, but both groups of organisms evince simple as well as multicusped teeth. In both, structures called rudimentary were found. These structures are suppressed during ontogenetic development and generally they are not attributed to essential functions. That is why we aimed to study dental rudiments in detail and reveal their function in odontogenesis.

This work presents new interpretations in the field of early dental normogenesis, which should be taken into account in studies on dental pathologies. We have shown that during the physiological development of the primary enamel knot (pEK), cells of tooth rudiment (R2) are involved in its formation, and only after the inclusion of these cells the pEK is formed as a signalling centre of the first molar (M1). Thus, signalling events in a certain area of jaws do not only correspond to the primordium of future functional teeth, what the generally accepted concept contradicts. Besides the direct contribution of cells to the development of the functional tooth, the dental rudiments and their signalling may also possess an initiating function. It means that they trigger the development of the primordium of future functional tooth, as has been shown here in the incisor region of mice. The tooth rudiments maintain their odontogenic potential, which can be reactivated under pathological conditions, resulting in the persistence of the rudimentary tooth primordium, which would disappear normally, with the consequent formation of a supernumerary tooth. These results can help with understanding the mechanisms of dental regulation or with developing new therapeutic approaches to the treatment of dental pathologies.