Infected Apical Papillae of Immature Permanent Teeth Retain the Regenerative Capacity

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Statement of Purpose: The therapeutic feasibility of endodontic regenerative treatment for immature permanent teeth with pulp necrosis and apical periodontitis is unclear. In this study, it was examined whether infected apical papillae of immature permanent teeth retain the regenerative capacity.

Methods: The immature permanent premolars of beagles (5~6 months old) were used in this study. The premolars were randomly divided by two. The pulp was exposed to induce the periapical lesions and left access open (AO) for one group. For the other, suspension of the plaque around teeth was inserted into the exposed pulp, and the access cavity was sealed (PS). After 2 and 4 weeks for each group, the teeth were extracted. The apical papilla tissues were subject to transplantation, primary culture, and histology. We transplanted the immature roots into subcutaneous tissue of nude mice. After 4weeks of transplantation, the roots were collected and examined histologically. Apical papilla-derived cells (DAPDCs) were primary cultured. The DAPDCs were tested for their stemness, proliferation, and odontogenic differentiation at passage 2 (Fig. 1)

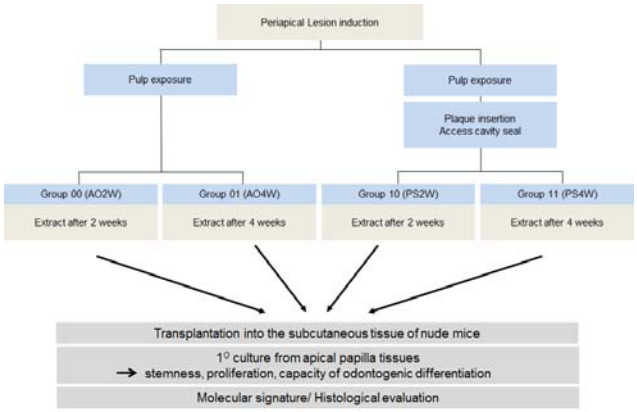

Fig 1. Flow chart of experiment

Results: Induction of periapical lesion was confirmed by taking X-ray (Fig. 2). PS groups produced larger lesion than others. The roots transplanted into nude mice were further developed. Regardless of the presence and the size of apical lesions, growth of the root was not limited (Fig. 3). The primary cultured DAPDCs form AO4W or PS4W groups proliferated at much higher rates, especially when they were seeded at a high cell density (Fig. 4). The stemness marker genes (Oct-4, Sox2, and nestin) expressed in all groups, and the levels were not significantly different. The capacity of odontogenic differentiation was also retained in the cells from inflamed tissues. The transcripts of dentin sialophosphoprotein (Dspp) and Osteocalcin (Ocn) were expressed in the culture with a differentiation medium. The Dspp and Ocn expressed at greater levels in the groups of AO4W and PS4W (Fig. 5).

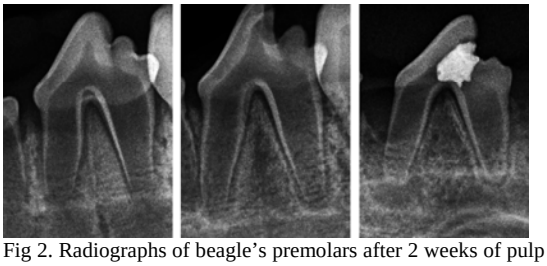

Fig 2. Radiographs of beagle's premolars after 2 weeks of pulp exposure. Left: control (no treatment), center: AO group, right: PS group.

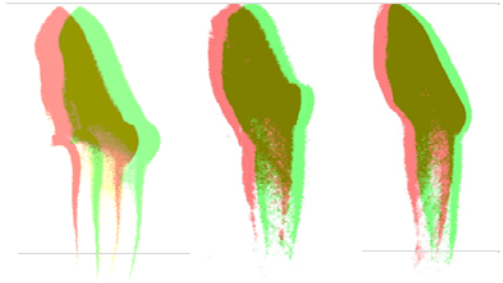

Fig 3. Radiographs of transplanted roots into the subcutaneous tissues of nude mice. Images of before (red) and after 4 weeks (green) of transplantation were overlaid. Left: control (no treatment), center: AO group, right: PS group.

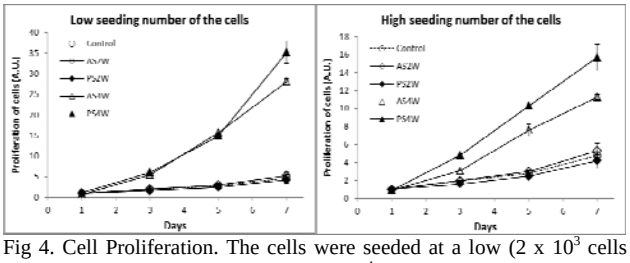

Fig 4. Cell Proliferation. The cells were seeded at a low (2 x 10^3 cells per well of 48-well plate) or a high (2 x 10^4 cells per well) density.

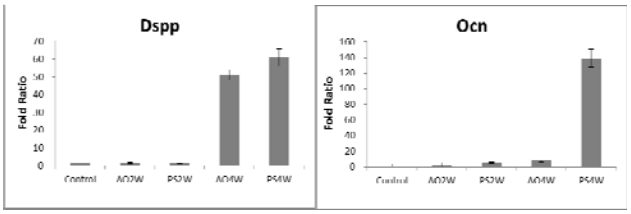

Fig 5. RT-qPCR for the marker molecules of odontogenic differentiation.

Conclusions: In this study, we developed an ex vivo model to confirm the regenerative capacity of inflamed apical papillae. The results in this study provide evidence that inflamed (infected) apical papillae of immature permanent teeth retain the regenerative potentials.