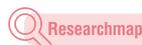




Novel vital pulp treatment to overcome pulpitis

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Abstract

Pulpitis caused by dental caries can induce severe spontaneous pain. Current clinical treatment of pulpitis still involves the removal of pulp tissue and there is no option for conservative treatment of the pulp. One of the reasons for this is the lack of experimental models for pulpitis. This study successfully established a rat caries-derived pulpitis model dependent on caries progression through pulp capping experiments. We also found a functional peptide that could facilitate pulpal wound healing ability and this peptide showed anti-inflammatory function. These results suggested the possibility of applying vital pulp treatment against inflammatory pulp tissue.

Background & Results

Removal of pulp tissue is the only treatment option in current clinical dentistry when a patient suffers from irreversible pulpitis. The clinical diagnosis of pulpitis is based on the patient's perception of pain, which is subjective and varies from individual to individual, so it is still difficult to make an objective and accurate diagnosis of pulpitis. Since one of the reasons for the difficulty of pulpal diagnosis is the lack of a standard experimental model of pulpitis, this research attempted to establish a rat caries-derived pulpitis model.

M2 macrophages were predominantly distributed in the pulp of the moderate caries group, whereas M1 macrophages predominated in the severe caries group. Pulp capping experiment was performed against moderate caries group and hard tissue formation was observed at the exposed site of the pulp and pulpal inflammation disappeared, indicating moderate caries induced reversible pulpitis. On the other hand, pulp capping against severe caries also showed hard tissue formation, but inflammatory tissue remained in the pulp, indicating severe caries induced irreversible pulpitis.

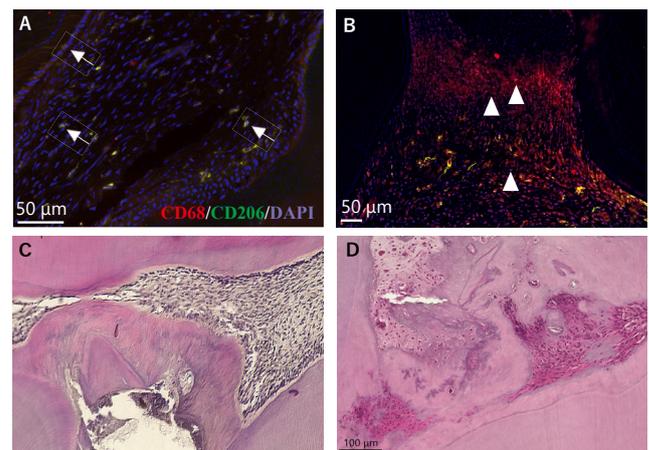
Pulp tissue is known to have a self-healing ability, and we reported that this ability could be induced by the organic components of the dentin matrix, and we attempted to develop a next-generation pulp capping agent based on this mechanism. Then, a functional peptide derived from protein S100A8 present in the dentin matrix (amino acid sequence: KLLTECPQ) showed hard tissue formation and this peptide was found to have an anti-inflammatory function.

We are now developing an objective and accurate pulpal diagnostic method using the rat caries-derived pulpitis model and investigating the effect of the functional peptide on the pulpitis model.

Significance of the research and Future perspective

This research has shown a way of overcoming irreversible pulpitis that can't be achieved in current clinical dentistry. Objective and accurate pulpal diagnostic methods will be developed using the rat caries-derived pulpitis model, which is not dependent on a subjective feeling of "pain". In addition, a specific biomarker for pulpitis will be sought and the deeper pathological state of pulpitis will be investigated. Future perspective of this project is to estab-

lish a next-generation strategy for pulp preservation, including both diagnosis and treatment, and to further extend tooth longevity.



Pulp tissue affected by moderate caries **Pulp tissue affected by severe caries**

Fig. 1 Fluorescent immunohistochemical observation of M1/M2 macrophages (A, B) and HE staining after pulp capping (C, D) in reversible/irreversible pulpitis. A. M2 macrophages were predominantly distributed in the pulp (arrows) in the moderate caries specimen (reversible pulpitis). B. M1 macrophages predominated in the pulp (arrowheads) in the severe caries (irreversible pulpitis). C. Hard tissue formation was observed after pulp capping in the moderate caries specimen without severe inflammation in the pulp. D. Inflammatory reactions were remained in the pulp with hard tissue formation in the severe caries specimen.

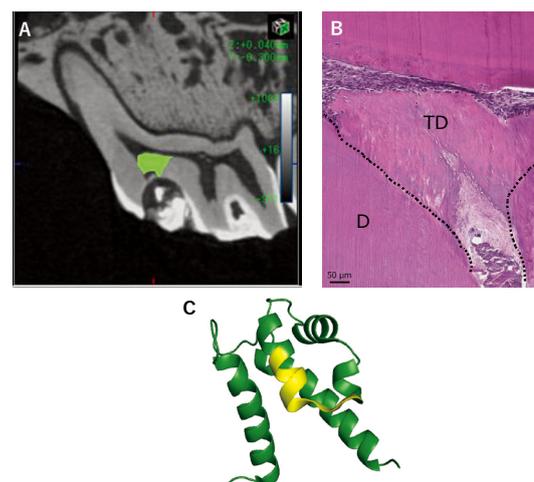


Fig. 2 Hard tissue formation after pulp capping with a functional peptide that promotes wound healing of pulp tissue. A. Micro-CT image showed thick hard tissue formation observed at the exposed site (green area). B. HE staining image of pulp and hard tissue after pulp capping. Formed hard tissue (TD) showed compact structure without defect. D: Primary dentin C. The position of the functional peptide in the protein conformation (yellow part).

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Keyword reversible pulpitis, irreversible pulpitis, caries derived animal pulpitis model, vital pulp treatment, functional peptide