学位論文内容の要約

学位論文題目

Biological evaluation of novel phosphorylated pullulan-based calcium hydroxide formulations as direct pulp capping materials **(リン酸化プルラン含有新規水酸化カルシウム直接覆髄材の生物学的評価)**

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Direct pulp capping (DPC) is the most conservative approach for treating dental caries. As a material of choice for DPC, Calcium hydroxide (CH) has been considered for the last few decades despite having some limitations. Phosphorylate Pullulan (PPL) incorporated with CH; CHPPL, a novel biomaterial has been introduced as a promising candidate for DPC, with the potential to improve the limitations of CH. Therefore, the aim of the study was to evaluate the inflammatory response and mineralized tissue formation (MTF) ability of an PPL-based CH formulations on rat molars after DPC.

This study consisted of six groups; CH with 1% PPL (CHPPL-1); 3% PPL (CHPPL-3); 5% PPL (CHPPL-5); Dycal and commercially available mineral trioxide aggregate (N-MTA) as the positive control; and no capping materials (NC). Sixty male Wister rats with one hundred twenty maxillary first molar cavities were prepared. After capping with the materials, all the cavities were restored with 4-META/MMA-TBB resin and pulpal responses were evaluated at day 1, 7, and 28. Kruskal-Wallis followed by Mann-Whitney U-test was performed with a significance level of 0.05. Expression of IL-6, Nestin, and DMP-1 was used to confirm pulpal inflammation, differentiated odontoblast cells, and dentin matrix formation respectively. At day 1, CHPPL-1, N-MTA, and Dycal exhibited no to mild inflammation, while CHPPL-3, CHPPL-5, and NC showed mild to moderate inflammation. CHPPL-1 and N-MTA significantly different from CHPPL-3, CHPPL-5, and Dycal ($p < 0.05$). At day 7, mild to moderate inflammation was observed in CHPPL-1, N-MTA, and Dycal, whereas CHPPL-3, CHPPL-5, and NC exhibited moderate to severe inflammation. Significant differences were observed between CHPPL-1, N-MTA with NC ($p < 0.05$), CHPPL-1, CHPPL-3 with CHPPL-5, Dycal ($p < 0.05$), and CHPPL-3 with N-MTA ($p < 0.05$). A thin layer of MTF was observed in all groups. At day 28, CHPPL-1, Dycal and N-MTA showed no to mild inflammation, while CHPPL-3, CHPPL-5, and NC exhibited mild to severe inflammation. Significant differences

were observed between CHPPL-1, N-MTA with CHPPL-3, CHPPL-5, and NC ($p < 0.05$). CHPPL-1, Dycal, and N-MTA exhibited continuous MTF, while CHPPL-3, CHPPL-5, and NC had thicker and interrupted MTF. Significant differences were observed between CHPPL-1, CHPPL-3, and N-MTA with NC group ($p < 0.05$). Immunohistochemical analysis revealed variable expressions of IL-6, Nestin, and DMP-1 which indicated differences in the materials' impact on odontoblast-like cell formation and tissue mineralization.

These findings suggest that the PPL-based CH formulation, particularly CHPPL-1, has the potential to minimize pulpal inflammation during DPC, and promote MTF.