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Author(s)	Islam, Rafiqul
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学位論文内容の要旨

博士の専攻分野の名称　　博士（歯学）　氏　名　Islam Rafiqul

学　位　論　文　題　名

Histological evaluation of a novel phosphorylated pullulan-based pulp capping material: An in-vivo study

新規リン酸化プルランベース覆髄材料の組織学的評価：in-vivo 研究

キーワード　calcium hydroxide, direct pulp capping, mineral trioxide aggregate, phosphorylated pullulan, pulp capping material

The properties of a pulp capping material play a major role in the prognosis of pulp capping treatment. A pulp capping material is considered ideal when it exhibits favorable pulpal response, good sealing ability, excellent biocompatibility, effective antibacterial property, and ease of manipulation. In these regards, performance of several materials has already been evaluated. A new biomaterial, Phosphorylated Pullulan (PPL) has recently gained attention in this field because of its bioadhesive behavior, high biocompatibility, and dentin regeneration ability. Based on PPL's above-mentioned advantageous properties, an innovative Mineral Trioxide Aggregate based material was introduced by adding phosphorylated pullulan (MTAPPL).

This study aimed to evaluate the dental pulp responses to novel mineral trioxide aggregate containing Phosphorylated Pullulan (MTAPPL) pulp capping material after direct pulp capping.

Ninety-six cavities were prepared from fifty-six male Wister rat's maxillary first molar teeth. The pulps were intentionally exposed and randomly divided into four groups according to pulp capping materials: an experimental pulp capping material containing Mineral Trioxide Aggregate with Phosphorylated Pullulan (MTAPPL, GC, Tokyo, Japan), an another experimental material containing Phosphorylated Pullulan (PPL, GC, Tokyo, Japan), conventional Nex-Cem MTA (NCMTA, GC, Tokyo, Japan) and Super Bond (SB, Sun Medical, Shiga, Japan). The rats were observed postoperatively after direct pulp capping at four observational time intervals of 1, 3, 7, and 28 days. Six teeth were allocated for each time interval. The maxillary sections, together with molar teeth were dissected and fixed in 4% paraformaldehyde solution for 24 hours at 4ºC. The tissues were demineralized in 10% EDTA solution and embedded in paraffin. The 5 μm-thick serial sections were cut in the mesiodistal direction and prepared according to routine histological techniques to observe pulpal reactions with a scoring system. DMP1 and CD34 antigen were used to check odontoblast differentiation and pulpal vascularization, respectively. Statistical analysis was performed using the Kruskal-Wallis test and the Bonferroni corrected Mann–Whitney U test, for evaluating differences between the groups during each observation period. The level of significance was set at .05.

On day 1, mild inflammatory cells were present in MTAPPL and NCMTA groups, few inflammatory cells were present in PPL group, whereas SB showed mild to a moderate inflammatory response. Significant difference was observed between PPL and SB groups ($p < 0.05$). On day 3, moderate to severe inflammatory cells were present in PPL and SB group, whereas MTAPPL and NCMTA groups showed a mild inflammatory response. No significant difference was observed between all the groups ($p > 0.05$). On day 7, a thin layer of mineralized tissue formation was observed in all tested groups with no or mild inflammatory response. No significant difference was observed between the groups ($p > 0.05$). On day 28, no inflammatory responses were observed in the group MTAPPL and NCMTA, whereas PPL and SB groups showed a mild inflammatory response. significant difference was observed between MTAPPL and SB groups ($p < 0.05$). Complete mineralized tissue barrier formation was observed in the group MTAPPL, NCMTA and PPL with no significant difference ($p > 0.05$). the SB group exhibited incomplete mineralized tissue barrier formation, which was significantly different from NCMTA, MTAPPL, and PPL ($p < 0.05$). Positive staining of CD34 and DMP1 was observed in all the group.

This study demonstrated that MTAPPL material showed similar favorable cellular and inflammatory pulp responses and mineralized tissue formation as pulp capping material. Therefore, MTAPPL can be considered as promising direct pulp capping material.