

Responses of dental pulp stem cells against exogenous stimuli

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INTRODUCTION: The dentin-pulp complex is capable of repair after tooth injuries such as dental caries, attrition, abrasion, and restorative procedures. This study focuses on the responses of dental pulp stem cells (DPSCs) against tooth injuries to clarify the pulpal healing mechanisms against exogenous stimuli.

MATERIALS & METHODS: Five to seven peritoneal injections of 5-bromo-2'-deoxyuridine (BrdU) into the pregnant Wistar rats labeled the adult stem cells in the matured tissues of born animals, 4 weeks and 100 days old, who were used in this study for cavity preparation and tooth replantation, respectively.

RESULTS & DISCUSSION: Four week-old animals contained numerous DPSCs in the center of the dental pulp except for the periphery of the pulp tissue including the odontoblast and subodontoblastic layer. Intense heat-shock protein (HSP)-25- and nestin-immunoreactivity (IR) was found in the cell bodies of coronal odontoblasts. Cavity preparation caused degeneration of the odontoblast layer resulting in the loss of HSP-25- and nestin-IR in the injured dental pulp at the early stages after tooth injury. Newly differentiated odontoblast-like cells with HSP-25- and nestin-IR were arranged at the pulp-dentin border during postoperative Days 2-3 after tooth injury. Interestingly, proliferative cells appeared in the dental pulp on Day 2 when the newly differentiating cells had already arranged along the pulp-dentin border, and increased in number in the wide range of the dental pulp during Days 2-5. The DPSCs were not committed into the newly differentiated odontoblast-like cells along the pulp-dentin border. These results indicate that progenitor cells equipped in the subodontoblastic layer firstly migrate and differentiate into new odontoblast-like cells to compensate for the loss

of the odontoblast layer, and subsequently the reorganization of the dental pulp was completed by active proliferation of the DPSCs occurring in the wide range of the pulp tissue (Fig. 1). Tooth replantation also induced active cell dynamics in the dental pulp, although firstly the DPSCs proliferate during Days 3-5 after operation, and subsequently the transit amplifying cells were committed into the newly differentiated odontoblast-like cells to arrange along the pulp-dentin border during Days 5-7. These findings indicate that the DPSCs orchestrate the pulpal responses to the exogenous stimuli in cooperation with the progenitor cells by use of the different cell dynamics depending on the modes of tooth injuries.

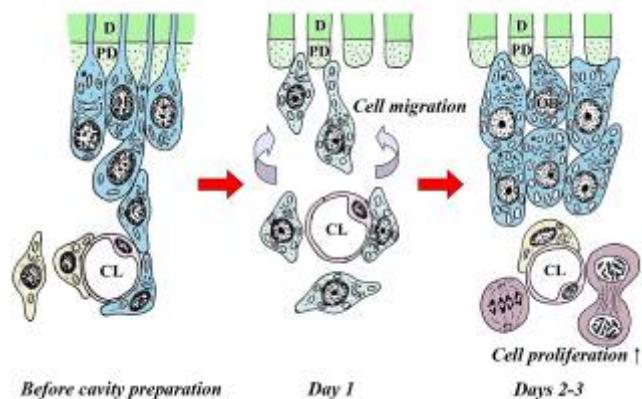


Figure 1. A schematic diagram summarizing cell migration and proliferation in the periphery of dental pulp following cavity preparation. Blue: HSP-25; CL: capillary lumen; D: dentin; OB: odontoblasts; PD: predentin.

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