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The Effect of Cellular Shape on Differentiation of Dental Pulp Stem Cells

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Abstract: Many studies have shown that cell shape effects cell chromatin aggregation, gene expression, protein synthesis, cell growth, apoptosis, and cytoskeletal rearrangement [1, 2]. Dental pulp stem cells (DPSCs) are capable of osteogenic, dentinogenic, chondrogenic, and neurogenic differentiation. They are regarded as a promising candidate for tissue regeneration. How the cell shape regulates their cell behavior is still unknown. We used micropatterning technology to design single cell patterns in a 1:1, 1:2, 1:4, 1:8, 1:16 length-width ratio of rectangles with the same area. The results indicated that cell shape rearranged the cytoskeleton of DPSCs. The nuclear shape also affected by different cell shape. The nuclear area and value of 1:16 pattern were increased. The nuclear height of 1:1 and 1:4 were increased obviously. The osteogenesis of DPSCs were highly inhibited in 1:2 and 1:4 groups. The gene expression of RUNX2 and ALP decreased significantly, accompanied by a decrease of ALP protein expression. Stemness marker of SOX2 and NANOG were significantly increased in 1:2 and 1:4 group. To further investigate the underlying mechanism, we studied some cell signal pathways. p-ERK in 1:2 and 1:4 groups shape were significantly increased. So did p-STAT3 in 1:2 and 1:4 groups. Nuclear YAP protein expression and the downstream genes of ANKRD1 and CTGF were also affected by different patterns. Our study demonstrated that cell shape will regulate cell differentiation of DPSCs. ERK, STAT or YAP might play a role in this process. It will be good fundament for future oral or bone regenerative medicine.

Keywords: Dental pulp stem cells; micropattern; differentiation

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