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Effect of Stretching Stress on Gene Transcription Related to Early-phase Differentiation in Rat Periodontal Ligament Cells

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Abstract: Mechanical stress such as occlusal and orthodontic loading has been suggested to induce a homeostatic and regenerative response in periodontal ligament (PDL), but the underlying mechanism remains to be clarified. The purpose of this study was to investigate expression of mRNAs encoding proteins involved in osteogenesis and homeostasis by PDL cells following application of tensile stress and characterize the relationship between such expression and the regenerative and homeostatic functions of the PDL. PDL cells were obtained from rats and stretched by 9% or 18% at a frequency of 6 cycles/min for 12 hr to 5 days in a FX-4000T™ culture system. After stretching, expression of mRNAs encoding collagen type I (Col-I), alkaline phosphatase (ALP), bone morphogenetic protein-2 (BMP-2), bone morphogenetic protein-4 (BMP-4), heat shock protein 70 (HSP70) and basic fibroblast growth factor (bFGF) was investigated. The highest levels of Col-I, ALP and BMP-2 mRNA expression occurred at 12 hr, while those of BMP-4 and HSP70 occurred at 1 day and 5 days, respectively. Expression levels of Col-I, ALP, BMP-2,

BMP-4 and HSP70 increased magnitude-dependently with stretching force in the stretching groups. In contrast, expression of bFGF mRNA showed statistically significant reduction in both stretching groups, with the largest reduction seen in the 9% stretching group ($p<0.01$). These results suggest that stretching of PDL cells provokes significant increases in expression of factors promoting osteogenic differentiation and HSP70, which protects PDL cells undergoing mechanical stress and contributes to maintenance of PDL homeostasis. However, expression of bFGF was restrained. Reduced expression of bFGF mRNA suggested that there was an optimum magnitude of stretching force for increasing expression.

Key words: Periodontal ligament, Mechanical stress, Homeostasis, Regeneration

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