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Effects of continuous and intermittent forces on human fibroblasts in vitro

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ABSTRACT

Orthodontics is based upon the cellular response to biomechanical forces. However, little is known about the way cells respond to such forces. An experimental model has been designed to study the morphological and metabolic behaviour of human cells, subjected to cyclical or static mechanical loads. The model involves attaching human fibroblasts to silicone collagen-coated membranes, which are subjected to either continuous of cyclical stretching by a motor coupled with a movable supporting frame. The effect of continuous or cyclical stretching on the secretion of collagenase, an enzyme thought to play an important role in the process of tooth movement, was measured. Cyclical stretching of fibroblasts over a 4-day period, approximately doubled collagenase production as compared with the control. Continuous stretching, on the other hand, was only 50 per cent as effective in enhancing enzyme release. In contrast, the secretion of the collagenase inhibitor was unaffected by either form of mechanical deformation. To understand the effect of cyclical forces further, a morphological study using humane fibroblasts was performed. It was found that stretching or compression delivered an immediate and proportional deformation of the cells. After 10-15 minutes the morphology of cells readapted to the new mechanical environment, causing a loss of the biological activation. This suggest that a new mechanical stimulus is necessary to induce a new biological reaction.

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