AESTHETIC AND COSMETIC DERMATOLOGY (LASERS SEPARATE CATEGORY)

EFFECTS OF LOW-FREQUENCY MECHANICAL STIMULATION OF DERMAL FIBROBLASTS IN 3D MODELS IN-VITRO AND EX-VIVO

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INTRODUCTION: Mechanical stimulation of skin and underlying tissues by means of massage, vibration, suction and other modalities has long been used in beauty procedures. A number of devices and treatment routines use such stimulation for skin and body rejuvenation. However, these empirical practices rarely have rigorous scientific foundation or objective demonstration of efficacy.

OBJECTIVE: To demonstrate mechanobiological effects of low-frequency traction and compression at the skin tissue level and to provide insight on possible mechanisms and pathways involved in transduction of mechanical stimuli into biological responses of skin.

MATERIALS AND METHODS: Test platforms for mechanical stimulation of skin models have been developed in-house. Collagen lattices or sponges seeded with human fibroblasts were stimulated using different frequencies (0-2 Hz range), time patterns and amplitudes, followed by ELISA analysis of soluble biomarkers in culture medium. Sections of stimulated 3D models or ex-vivo skin were analyzed by immunofluorescence microscopy to quantify relevant cellular and extracellular markers.

RESULTS: In the simplest 3D models (lattices and sponges), the effects are rather variable and sensitive to experimental conditions. However, at least two intra-cellular markers appear to have a coherent response to stimulation: alpha-smooth muscle actin and the globular-to-fibrillar actin ratio. In a more complex model, the ex-vivo skin, we observed similar effects on the G/F actin ratio and a tendency of modulation of markers related to the extracellular matrix (fibrillin, fibronectin).

CONCLUSIONS: Low-frequency mechanical stimulation may trigger a mechanobiological response in the dermal tissue. Using 3D dermis models with varying degrees of complexity, we demonstrate that this response can be partially mediated by the rearrangement of the fibroblast cytoskeleton.