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Facial Skin Rejuvenation with High Frequency Ultrasound: Multicentre Study of Dual-Frequency Ultrasound*

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ABSTRACT

According to modern theories, the process of skin ageing may be connected with local up-regulation of matrix metalloproteinases (MMP) and down-regulation of heat shock proteins (HSP) in the skin. In this pragmatic, non-randomised, multicentre study we investigated the skin rejuvenation effect of dual-frequency ultrasound, with frequencies of 3 and 10 MHz, which has the ability to modulate both MMPs and HSPs. It was shown that such waves can significantly improve different visual appearances of ageing skin. This safe, non-invasive method yields results that are not as marked as those shown by injecting of fillers, but can be successfully used by subjects with a broad spectrum of visual skin ageing problems, which have to be treated simultaneously.

Keywords: Skin Rejuvenation; Dual-Frequency Ultrasound; Matrix Metalloproteinases; Heat Shock Proteins

1. Introduction

Skin ageing is a continuous process, which occurs on a cellular as well as on a molecular level. It is traditionally divided into intrinsic (chronological) and extrinsic ageing. The former is considered to be genetically pre-determined; the latter is mainly caused by different environmental factors. These two ageing processes have different pathophysiological mechanisms and lead to different visual changes of the skin. It is strongly believed that intrinsic ageing is mainly responsible for skin appearances such as fine wrinkles, a reduction in firmness, enlarged pores, sagging and dryness as well as for thin and fragile skin. Extrinsic ageing is connected with the production of fine and coarse wrinkles, skin hyperpigmentation, loss of skin turgor, freckles and roughness as well as with dilatation of blood vessels.

The reasons for intrinsic skin ageing are largely unknown. One classic pathophysiological mechanism is the excessive oxidative phosphorylation with an accumulation of superoxides. Another is a continuous reduction in the number of synthetically active fibroblasts, which are mainly responsible for the dynamic balance in the active connective tissue and the progressive accumulation of senescent fibrocytes presented in inactive connective tissue. This process leads to the subsequent reduction in collagen content in the ageing skin [1] and may be also responsible for the reduction of glycosaminoglycanes, which, consequently, can modify the skin micro-relief and reduce its turgor. These mechanisms can be also involved in extrinsic ageing.

Two other pathophysiological mechanisms of skin ageing have recently been proposed. The first is based on the overproduction of matrix metalloproteinases (MMPs) as a result of chronic, intrinsic inflammation or external exposure to UV- or IR-radiation. Connective tissue normally stands in dynamic balance between the processes of its production and destruction. A temporary increase in MMPs activity makes this system unbalanced, increasing the rate of its destruction. Depending on the duration and strength of this process, the connective tissue structure and its mechanical properties can afterwards fully or partly restore. MMPs activation occurs in both chronological and photo-induced skin ageing [2-5]. The increase in MMPs activity can be dramatic, even with sub-erythemal doses of UV radiation, which could be enough for significant degradation of dermal connective tissues [2]. Such pathophysiology of skin ageing led to the formulation of new prevention and treatment strategies for anti-ageing therapy that are based on the inhibition of production and/or activity of some specific MMPs in the skin [4].

The second new pathophysiology of skin ageing is connected with the phenomenon of continuously reduced

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