

Neocollagenesis in Non-Invasive Aesthetic Treatments

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ABSTRACT

Dermal neocollagenesis is often assumed to be the main reason of visible skin improvement after different non-invasive and minimal invasive aesthetic treatments. However, the very slow dynamics of the mature collagen remodelling in the extra cellular matrix (ECM) of dermis, with a half-life time of 15 years, renders every observable upregulation of collagen production insufficient to replace a significant part of the matrix during the short time in which it is claimed skin improvement takes place.

Keywords: Neocollagenesis; Aesthetic Treatments; Procollagen; Mature Collagen; Turnover

1. Introduction

Skin rejuvenation using ablative and non-ablative procedures based on different light sources (laser, IPL, LED), radio-frequency (monopolar, bi-polar, fractional, etc.), ultrasound as well as combinations of these have become popular in aesthetic medicine. Almost all treatment modalities based on these physical methods claim the main effect of their application to be the thermic or athermic stimulation of neocollagenesis. This inspires the feeling that neocollagenesis is a non-specific process, which can be stimulated through the application of almost every physical force, even at very low intensities. Modulation of the dermal ECM as the main goal of non-invasive or minimally-invasive aesthetic treatment, especially the stimulation of the collagen production *de novo*, is not an accidental choice. The ECM, with its insoluble scaffold—consisting mainly of stiff, mature fibrillar collagen—provides the structural support of the tissue and significantly determines its characteristic shape and dimensions. It is known that collagen content in the dermis continuously diminishes with progressing age [1], and that it can be additionally reduced as a result of photodamage or of the repeated initiation of remodelling processes [2,3].

The hypothesis that the application of modalities such as radio-frequency current, ultrasound, light sources and so on can locally improve collagen content in the dermis, consequently demonstrating some effects of skin tightening and skin rejuvenation, appears to be reasonable. Indeed, the effect of neocollagenesis is generally considered to be long-term compared to other possible effects

such as, for example, hyaluronan and, consequently, water accumulation in a treated area. Such a long-term effect is needed to give the theoretical background to the treatment methods that claim an improvement in skin condition weeks and months after their application. This natural assumption contradicts, however, modern knowledge about the connective tissue structure and especially insight into its turnover, thus making the proclaimed results sometimes controversial and even theoretically impossible.

2. Some Theoretical Problems in Dermal Aesthetic Treatments

Every treatment modality that claims that the modification of dermal collagen content is the main effect of its application comes up against at least three problems.

The first one is that the upregulation of multiple stages of collagen production is not necessarily an indication of increased content of mature collagen in the skin. While procollagen can be easily overexpressed after the application of different physical modalities, it can also be easily degraded, which results in a very slow net remodelling of mature collagen.

The second problem is connected with the type of induced collagenesis-physiological (with a normal structure of collagen network) or pathological (scar-like, with typical hyalinised collagen regions). Strengthening of the natural structure of the collagen network in ECM would be the ideal solution, guaranteeing that physiological processes are retained, but this structure is not necessarily in equilibrium and can be reduced relatively rapidly. Pathological neocollagenesis (fibrosis) is connected to the application of higher intensities and results in the

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