CLASSYS

QUADESSY

Clinical Application of Energy Cruise Control-Based Microneedle Radiofrequency for Melasma and Facial Redness



Jewan Hwang(Maylin Clinic, The Hyundai Daegu Branch)



Complex Pathophysiology of Melasoma and Facial Redness

Melasma and facial redness are not merely cosmetic concerns, but rather conditions with complex pathophysiology that are challenging to treat. Conventional approaches have largely focused on “reducing” melanin through treatments such as laser toning, pigment-targeting lasers, and topical agents. However, clinical experience suggests that simply removing melanin is insufficient to prevent recurrence or achieve sustained improvement. Melanin is an essential component of the skin’s defense system, acting as a potent antioxidant and radical scavenger that protects the skin from ultraviolet radiation and external stressors (<Antioxidant and Antimicrobial Activities of Melanin Produced by a Pseudomonas Balearica Strain. Bioproduction>, <Characterization, Anticancer and Antioxidant Activities of Extracellular Melanin Pigment Produced by Newly Isolated Microbial Cell Factories Streptomyces Glaucescens NEAE-H>).

The problem lies not in melanin itself, but in the altered cutaneous environment that promotes its excessive production and persistence. This pathological environment is associated with basement membrane damage, the emergence of pendulous melanocytes, accumulation of melanin and melanophages in the dermis, mast cell hyperactivity, vascular dilation, and a reduction in type III collagen.

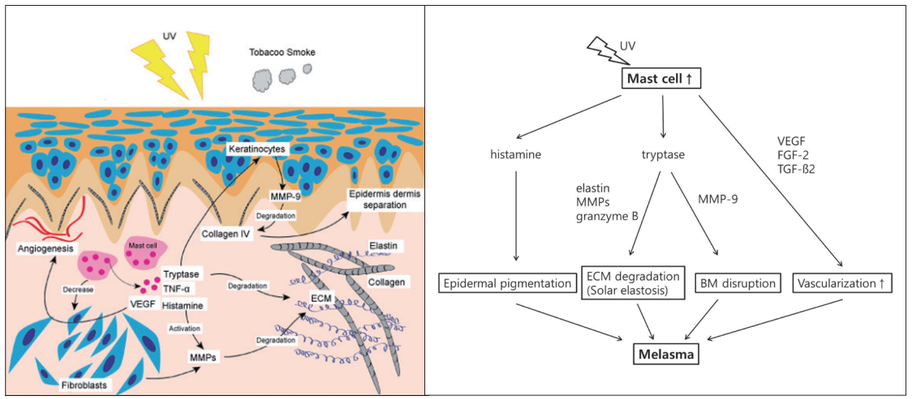
Important of Restoring the Basement Membrane and Dermal Environment

Histologically, melasma and facial redness may present with different clinical appearances, but they share a common feature: disruption of dermal structure and function. When the basement membrane is damaged, the boundary between the epidermis and dermis becomes weakened. This can lead to the presence of pendulous melanocytes extending below the basement membrane, dermal melanocytes located within the dermis, and melanosomes that have dropped into the dermis and are subsequently phagocytosed by macrophages, remaining as melanophages. In addition, mast cell activation can increase inflammatory responses and vascular reactivity, thereby promoting melanin synthesis and worsening facial redness. A reduction in type III collagen may decrease the elasticity of the dermo-epidermal junction (DEJ) and impair the overall regenerative capacity of the skin.

Accordingly, the treatment goal should be the overall restoration of the basement membrane and dermal environment. By doing so, abnormal pathways of melanin accumulation may be interrupted and the risk of recurrence may be minimized.

Energy Cruise Control-Based Microneedle Radiofrequency (MNRF) Technology Resembling Cutaneous Electrophysiology

The skin has a negative electrical charge in the epidermis and a positive charge in the dermis. When tissue injury occurs, the damaged dermal area becomes negatively charged, attracting positively charged leukocytes and fibroblasts through electrical forces and thereby promoting tissue regeneration. The lateral electric current generated during this process serves as an energy source for wound healing. QUADESSY’s energy cruise control system, which enables constant-



(Left) Schematic representation of mast cell activity in skin. (Right) The role of mast cells in melanogenesis and photoaging. Source : (Left) The Role of the Mast Cell in Skin Aging. Yang-lin H, Gao W, Hong-ying L, Tang J, J Dermatol Res Ther 2:035, DOI: 10.23937/2469-5750/1510035. (Right) Heterogeneous Pathology of Melasma and Its Clinical Implications, Soon-Hyo Kwon et al., Int. J. Mol. Sci. 2016, 17(6), 824; DOI : 10.3390/ijms17060824.

power MNRF delivery, stimulates the dermis in a manner that closely resembles the natural electrical signals generated during wound healing. By delivering uniform energy through fine needles into the dermis while minimizing epidermal injury, it promotes fibroblast activation, particularly papillary fibroblast activity, and thereby induces type III collagen production. Activation of type III collagen at the dermo-epidermal junction (DEJ) may help reinforce the basement membrane during the early phase of treatment and plays a key role in limiting the downward migration of melanin (<Figure 1>).

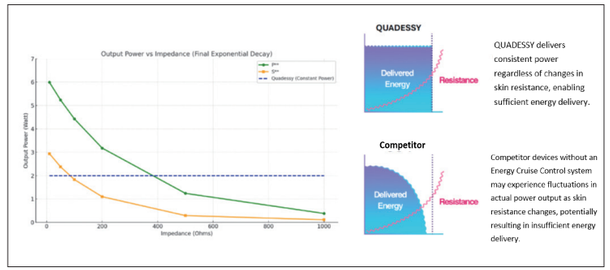


Figure 1. Stable energy delivery enabled by the Energy Cruise Control system. Courtesy of CLASSYS

Treatment Protocol

Treatment parameters are adjusted according to the characteristics of the lesion. For melasma, a non-insulated single tip is used at a depth of 0.3 mm with a total pulse duration of 200 ms. Multi-pulse treatment consisting of six sub-pulses is delivered in two passes. Treatment is performed four times at 2-week intervals, after which a non-insulated multi-tip may be used depending on the degree of clinical improvement. This approach is intended to promote type III collagen synthesis from the DEJ to the papillary dermis, stabilize the dermal environment, and improve conditions that promote melanin production.

For facial redness, a non-insulated multi-tip is used at a depth of 0.5 mm with a total pulse duration of 200 ms. Multi-pulse treatment consisting of eight sub-pulses is delivered in two passes.

The goal of treatment is not vascular destruction. Rather, thermal modulation is used to induce dilation of vessels associated with facial redness, while relatively larger vessels are reinforced through endothelial cell stimulation to support adequate blood supply. This may reduce blood flow to smaller vessels, thereby decreasing shear stress and contributing to the reduction of unnecessary small vessels (<Monocyte Adhesion by Upregulating PECAM-1 Expression>).

Figure 2. Melasma treatment: before and after four sessions with a non-insulated single tip at 2-week intervals, followed by one session with a non-insulated multi-tip. Courtesy of Dr. Jewan Hwang.



Figure 3. Facial redness treatment: before and after one session with a non-insulated multi-tip. Courtesy of Dr. Jewan Hwang.

Stable energy delivery enabled by the energy cruise control system plays an important role in this process.

Clinical Outcomes and Patient Satisfaction

Lesions improve through early changes in the papillary dermis observed from immediately after treatment to approximately 2 weeks, followed by further improvement in the dermal environment (<Figures 2 and 3>). Patients often report that their skin feels “younger and healthier.” Treatment of melasma and facial redness should focus on modulation and restoration rather than simple removal or destruction. In melasma treatment, melanin is essential for protecting the skin, and correcting the dermal environment that drives its excessive production is key to reducing recurrence. In the treatment of facial redness, blood vessels are important structures for maintaining tissue supply. Therefore, the therapeutic goal is to preserve adequate blood supply through appropriate vascular modulation while promoting apoptosis of unnecessary small dilated vessels.

Stable energy delivery is critical for achieving these treatment goals. By maintaining controlled power throughout treatment, the Energy Cruise Control system enables safe and reproducible dermal remodeling and may contribute to the long-term restoration of overall skin health.