2025 ASLS Fall Conference Review

Microneedle RF with Constant-Power Control for Uniform Subpulse Energy Delivery

Lecture/Dr. Jewan Hwang (Maylin Clinic, The Hyundai Daegu)

The 2025 Fall Conference of the Korean Society for Aesthetic Plastic Surgery and Laser Medicine (ASLS; President Minho Lee) was held on October 12 at COEX Hall C and the conference rooms. Organized as an international academic meeting under the name “ASLS Korea,” the conference brought together aesthetic medicine professionals and industry representatives from Korea as well as the United States, Europe, Japan, China, Thailand, Indonesia, and other countries. Under the slogan, “ASLS, Where Innovation Meets Inspiration,” ASLS also expressed its vision of shaping the future paradigm of aesthetic medicine. In this issue, we introduce a lecture titled “Mechanisms of Melasma and Erythema Treatment Using Microneedle RF with Constant-Power Control for Uniform Subpulse Energy Delivery,” presented by Dr. Jewan Hwang of Maylin Clinic in Daegu.



Dr. Jewan Hwang described QUADESSY as “a microneedle RF system that uniformly controls subpulse energy through constant-power delivery, enabling stable low-temperature heating at 42–45°C and simultaneously promoting dermal remodeling, pigmentation improvement, and vascular stabilization in the treatment of melasma and erythema.”

This session focuses primarily on the concept of constant power. Constant-power control is a novel microneedle RF (MNRF) technology that maintains a consistent level of power -the product of voltage and current- while monitoring tissue impedance in real time. QUADESSY is a device that incorporates this constant-power technology.

Having served as a clinical advisor since the early stages of its development, I would like to explain the mechanisms through which QUADESSY may contribute to the treatment of melasma and erythema.

Key Features and Advantages of QUADESSY

One of the key differentiating features of QUADESSY is that it combines noninvasive bipolar RF with MNRF. Bipolar RF first provides bulk heating, after which the needles are inserted to create coagulation zones. In other words, the bipolar RF electrodes heat the epidermal and dermal tissue in bulk, and in the second step, needle penetration induces focal coagulation, thereby enhancing the overall treatment effect.

Although the effects of the bipolar RF and MNRF can be delivered according to preset settings, the operator can also adjust the treatment sequence, allowing for a variety of treatment approaches and outcomes.

Conventional MNRF devices have generally been limited to effects such as channel formation and coagulation. QUADESSY, however, enables both rejuvenation through bulk heating and the effects of microneedling within a single treatment platform.

I would particularly like to emphasize the concept of “power.” In laser systems, power can be understood in terms of the amount of light energy delivered, whereas in electrical energy systems, it refers to electrical power. Electrical power is the product of voltage (V) and current (I), expressed as $P = V \times I$. According to Ohm’s law, $V = I \times R$, meaning that changes in tissue resistance, or impedance, cause corresponding changes in voltage and current.

Many RF devices monitor impedance in real time and limit the maximum power output to reduce the risk of excessive heating and thermal injury. In such systems, the output voltage is automatically reduced as impedance increases. While this may help reduce adverse effects in areas with high impedance, power delivery may conversely become insufficient in low-output ranges, potentially reducing treatment efficacy. In the treatment of melasma and erythema, however, uniform energy delivery within a relatively low-energy range is particularly important.

QUADESSY dynamically controls voltage and current to maintain constant power output. This constant-power approach enables uniform energy delivery to the skin across varying impedance conditions. After impedance is measured, the system maintains the same power level regardless of changes in resistance. In our own experiments, conventional RF devices showed irregular temperature-rise curves depending on impedance, whereas QUADESSY demonstrated a more uniform increase in temperature. Relatively few devices are capable of this type of real-time impedance matching.

QUADESSY monitors impedance during both electrode-based RF delivery and microneedle RF treatment.

QUADESSY also delivers energy by dividing each pulse into multiple subpulses. If the total energy of multiple pulses were delivered as a single pulse, overheating could result in tissue damage. By fractionating the energy into multiple pulses, however, a more uniform and gradual coagulation zone can be formed, which may enhance the rejuvenation effect.

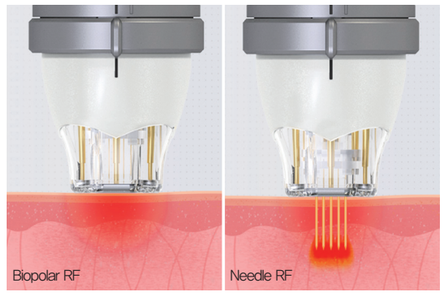
Drug delivery has also become increasingly incorporated into aesthetic treatments. QUADESSY can facilitate effective drug delivery through its double-depth mode, which essentially involves two sequential needling steps. Normally, a channel is created at the site of needle penetration, and negative pressure generated within the channel helps draw the topically applied agent into the skin. When a second needling step is

added, the agent can penetrate into deeper layers. Interestingly, the degree of absorption varies depending on the sequence of needle depths. Drug absorption is greater when the first needling is performed at a shallower depth followed by a deeper second needling, rather than beginning with deep needling. In other words, the first needling creates superficial channels and facilitates penetration of the applied agent through negative pressure, while the second, deeper needling produces a “push-in” effect that drives the agent further into the deeper tissue layers.

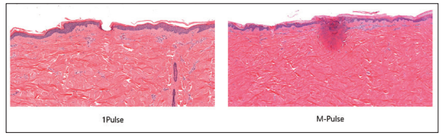
From "Removing" Pigmentation to “Restoring” the Skin

I previously treated a male patient with prominent melasma that would ordinarily have required multiple laser sessions. Over an eight-week period, he received 0.3 mm MNRF at appropriate energy settings, comparable to those used in a Genesis-type technique, at intervals of one to two weeks. Only two laser treatments were additionally performed during this period. After two months, the patient showed a remarkably dramatic improvement. Histologic evaluation was performed to further investigate these changes. Before treatment, Fontana-Masson staining demonstrated increased melanin deposition in the basal layer, together with pendulous melanocytes and dermal melanophages. After treatment, these findings were markedly reduced, accompanied by an overall improvement in pigmentation. H&E staining and immunohistochemical analysis also demonstrated an increase in the extracellular matrix (ECM).

Changes in collagen type I and collagen type III were also evaluated by ILC. Collagen type I showed an overall increase, whereas collagen type III increased more prominently at a depth of approximately 300 μm, immediately beneath the basement membrane. The increase in collagen contributes not only to structural regeneration but also to physical buffering and



QUADESSY utilizes MCSD (Multi-Channeling Selective Delivery), a method that sequentially alternates RF energy delivery through invasive and noninvasive modes. This approach enables efficient RF energy delivery while potentially reducing procedural discomfort. Courtesy of CLASSYS.



Comparison of tissue responses under single-pulse and multipulse conditions. In the single-pulse condition shown on the left (20%, 70 ms, 1.5 mm; noninvasive RF: 60%, 80 ms), ablation is observed in the epidermis and upper dermis. In the multipulse condition shown on the right (6%, 20 ms × 5 pulses, 0.8 mm; noninvasive RF: 60%, 80 ms), a uniform coagulation zone is formed in the surrounding tissue without overt thermal damage, demonstrating a stable dermal remodeling response. Courtesy of CLASSYS.

antioxidant effects. By reducing the extent to which melanin itself must serve as a compensatory antioxidant defense, this remodeling may help prevent excessive activation of melanogenesis. As a result, a more resilient dermal environment may be established, allowing faster recovery and fewer adverse reactions even after relatively intense laser exposure.

In addition, pendulous melanocytes extending below the basement membrane appeared to be buffered and supported by collagen remodeling, with a tendency to return toward a more normal position.

Fundamentally, melanin is part of the skin’s defense mechanism for protecting keratinocyte nuclei from ultraviolet radiation. When the skin is exposed to ultraviolet-induced injury, an antioxidant response is initiated. If sufficient antioxidant capacity is available, inflammation can resolve rapidly. If antioxidant capacity is inadequate, however, inflammation may persist. During acute inflammation, insufficient antioxidant capacity may signal that the inflammatory process has not been adequately resolved. In response, the skin may produce additional melanin to compensate for this deficit in antioxidant defense. This process can manifest clinically as post-inflammatory hyperpigmentation (PIH).

For this reason, treatment should focus on reducing inflammatory stress rather than simply attempting to eliminate pigmentation with aggressive laser treatment. Excessive laser energy may further aggravate inflammation and, in some cases, worsen pigmentation.

The situation is somewhat different in chronic inflammation. Persistent inflammatory stress caused by factors such as hormonal imbalance or ongoing cutaneous stress may lead to melanin deposition as part of the skin’s protective response. This process is one of the mechanisms associated with melasma. If this melanin is regarded simply as a target that must be removed and is treated aggressively with laser energy, pigmentation may appear temporarily lighter, but recurrence or worsening may ultimately occur. This is why treatment should aim not only to remove melanin, but also to restore the skin’s intrinsic antioxidant and regenerative systems.

Melasma treatment case by Dr. Jewan Hwang. Courtesy of Dr. Jewan Hwang.

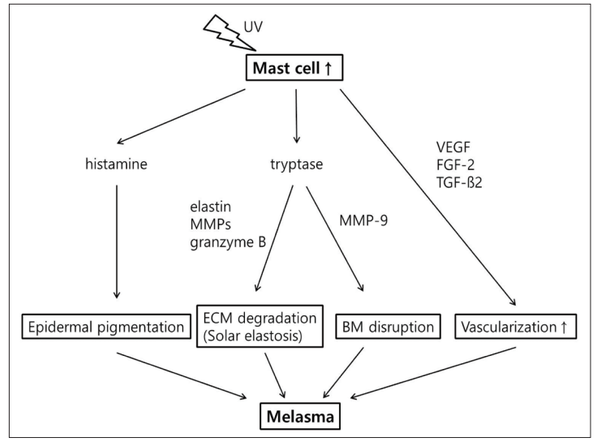
Infant and young children's skin contains relatively abundant collagen type III, which is considered to contribute to antioxidant defense. This may partly explain the relative absence of melasma in younger skin. Therefore, sufficient regeneration of collagen type III within the papillary dermis may be an important component in suppressing excessive melanogenesis and minimizing rebound pigmentation and PIH after laser treatment.

Dermal Pigmentation and Its Improvement

Antioxidants are substances that donate electrons. In other words, they reduce other substances by transferring electrons while becoming oxidized themselves. In this sense, antioxidant activity can also be understood as a form of energy transfer. At a fundamental level, energy transfer is closely related to the movement of electrons and electromagnetic forces. In the skin, the surface is relatively negatively charged, while the deeper tissue maintains a relatively positive charge. Under normal conditions, there is no significant current flow. However, when the skin is injured, this charge distribution is disrupted, initiating an endogenous electrical current. The energy generated by this current contributes to the wound-healing process. If the internal electrical potential returns to a positive state before the wound has fully healed, however, a chronic imbalance in electrical potential may persist. Procedures such as skin boosters and needling can therefore be viewed, in part, as interventions that reactivate electrical signaling and restore the endogenous currents involved in tissue repair. Thus far, this concept has been discussed at the tissue level. At the cellular level, electrical potential differences also exist across the cell membrane. Fibroblasts, for example, normally maintain a membrane potential of approximately 60 mV. When activated, this potential decreases to approximately 30 mV, reflecting the utilization of electrical potential during cellular activation. However, fibroblasts cannot remain in this activated state indefinitely. Fibroblasts subsequently obtain electrons from the extracellular matrix (ECM) through the degradation of the acidic proteoglycan matrix, generating a negative electrical current. During this process, collagen synthesis and antioxidant activity also occur.

In patients with melasma, however, the dermal environment may be compromised by photoaging, including solar elastosis, which may interfere with the efficient supply of electrons. Therefore, treatments such as the Genesis technique or RF-based rejuvenation may help improve the electrical and biochemical environment of the dermis. From this perspective, the fundamental goal of melasma treatment is not simply pigment removal, but dermal rejuvenation. If treatment focuses only on eliminating pigment, the underlying cycle may continue.

Another factor contributing to the difficulty of treating melasma is mast-cell activity. Matrix metalloproteinase-9 (MMP-9), released by mast cells, can degrade collagen type IV and weaken the basement membrane. As a result, melanocytes may extend downward as pendulous melanocytes. Melanosomes released from these melanocytes may subsequently be phagocytosed by melanophages within the dermis. Pigmentary disorders associated with these structural changes—particularly melasma and pigmentation around the periorbital area—may therefore require restoration across three levels: the epidermal basal layer, pendulous melanocytes, and dermal melanophages. With laser toning, energy that is too low may produce insufficient clinical improvement, whereas excessive energy may exacerbate pigmentation. The therapeutic goal should therefore extend beyond pigment removal to include improvement of the dermal environment while simultaneously controlling pigmentation. Cutaneous pigment may be present in several types of cells, including keratinocytes, melanocytes, andmacrophages.



The role of mast cells in melanogenesis and photoaging. UV= ultraviolet; MMPs = matrix metalloproteases; VEGF = vascular endothelial growth factor; FGF-2 = fibroblast growth factor-2; TGF-β = transforming growth factor-β; ECM = extracellular matrix; BM = basement membrane. 출처 : Heterogeneous Pathology of Melasma and Its Clinical Implications, Soon-Hyo Kwon, Young-Ji Hwang, Soo-Keun Lee, Kyoung-Chan Park, Int. J. Mol. Sci. 2016, 17(6), 824; https://doi.org/10.3390/ijms17060824.

Dermal pigmentation can broadly be divided into two types. One is represented by nevus of Ota, in which melanocytes are located within the dermis. The other is associated with melasma, in which melanophages are present within the dermis. Because melanocytes normally reside in the epidermis, melanocytes located within the dermis may be recognized as abnormal in the local immunologic environment. These cells may become surrounded by a dense tissue barrier that separates them from adjacent structures. When high levels of energy are used in an attempt to eliminate such pigment-containing cells, surrounding blood vessels may also be damaged, increasing the risk of PIH.

Papillary Dermis and the Optimal Therapeutic Temperature

In nevus of Ota, the surrounding tissue contains abundant collagen. For this reason, even relatively high-energy treatment with a ruby laser does not readily cause bleeding, as the collagen-rich tissue provides a physical buffering effect. When collagen is degraded, it is converted into collagen peptides, which themselves possess antioxidant activity. This reduces the need for melanin to compensate as part of the antioxidant defense system. In contrast, acquired bilateral nevus of Ota-like macules (ABNOM) are associated with a richer

vascular environment. When excessive laser energy is delivered, vascular injury and subcutaneous bleeding may occur, potentially triggering a cycle of inflammation, PIH, and repigmentation. The antioxidant effects of collagen peptides are particularly noteworthy. For example, collagen peptides derived from jellyfish have been reported to suppress melanogenesis, reduce tyrosinase activity, and increase glutathione production, thereby supporting a more physiologic pathway of melanin regulation.

The Kaiser Method that I use clinically, based on Q-switched Nd:YAG Laser and Long-pulsed Nd:YAG lasers, follows a similar principle. In patients presenting with aggravated melasma, approximately five treatment sessions at two-week intervals not only improved pigmentation but also produced a marked improvement in skin texture. This was associated with a substantial increase in collagen type III within the papillary dermis. Ultimately, the papillary dermis should be heated uniformly to approximately 42–45°C. This temperature range promotes collagen reorganization and regeneration while helping restore the skin's antioxidant environment. Such controlled heating can be achieved with either laser or RF-based treatment. When tissue temperature is maintained at approximately 42–45°C, collagen type III can be effectively induced beneath the basement membrane. Regardless of whether laser or RF is used, the goal should not be to create excessive coagulation and irreversible tissue damage, but rather to induce a reversible thermal response, or thermoreversible reaction. Within this temperature range, cellular turnover may proceed through apoptosis rather than necrosis, allowing dermal rejuvenation to be induced more safely and effectively in patients with melasma or erythema.

The same principle applies to erythema. If RF treatment is delivered too aggressively in patients with erythema, symptoms may worsen over time even if the immediate sensation of heat is cooled. Worsening erythema reflects persistent vascular dilation. With repeated treatment at approximately 42–45°C, these dilated vessels may gradually become more stable. Even chronic erythema persisting for more than 10 years may improve. As with melanin, blood vessels should not simply be regarded as undesirable structures. They are formed as part of the skin's protective response. When inflammation occurs, vascular networks develop to deliver oxygen and immune mediators to the affected area. The problem arises when inflammation does not resolve and excessive vasculature persists. Fine vessels then branch and accumulate, clinically manifesting as erythema. With appropriately controlled heating at 42–45°C, the endothelial cells of larger primary vessels may first become more stable, strengthening the vessel wall and improving blood flow. As a result, shear stress within smaller branching vessels may decrease, leading to reduced blood flow through these microvessels. When blood flow becomes insufficient, the cells receive less physiologic stimulation and may eventually undergo apoptosis. In this way, selective vascular stabilization together with the gradual regression of unnecessary microvessels may represent an important mechanism underlying the improvement of erythema through uniform, low-temperature thermal stimulation. Vascular shear stress plays an important role in maintaining vessel survival. When shear stress is lost, endothelial cells may naturally progress toward apoptosis, allowing physiologically unnecessary microvessels to regress. Once the main vessels are sufficiently stable and capable of maintaining blood flow, the smaller branch-like vessels may no longer be required. This may contribute to restoration of a more normalized vascular pattern in the treatment of erythema.

For these mechanisms to occur effectively, uniform energy delivery is essential. This is where the constant-power approach described earlier becomes particularly important. Maintaining consistent power helps produce uniform thermal stress, supporting an optimal rejuvenation response while minimizing unnecessary tissue damage.

Consistent Energy Delivery for Consistent Clinical Outcomes

One of the most challenging aspects of my involvement in the development of this technology was the concept of energy cruise control, which lies at the core of constant-power delivery. Conventional devices often show substantial fluctuations in voltage or current, making it difficult to maintain consistent power output and resulting in variable treatment responses.

In our clinical investigations, we therefore took the approach that treatment of melasma and erythema should not rely on high energy, but rather on achieving the most uniform energy delivery possible. In the process of identifying the optimal output range, we found that settings of approximately 30–50% provided the greatest stability and also produced the most favorable clinical outcomes. The best results were observed with approximately six subpulses for melasma and eight subpulses for erythema. Tissue temperature remained consistently within approximately 42–45°C, while uniform coagulation zones were formed without overt thermal damage to the dermis.

For patients with melasma, treatment was performed at a depth of 0.3 mm and an output level of approximately 30%, using a non-insulated tip. Four treatment sessions were performed at two-week intervals, followed by one final treatment using a tip equipped with bipolar RF electrodes. Despite the absence of concomitant laser treatment, both melasma and erythema showed improvement.

For patients with erythema, a depth setting of 0.5 mm was used. Taking into account the approximately 0.2 mm thickness of the electrode, this setting was selected to accurately target the papillary dermis. Improvement in both erythema and pigmentation was observed after a single treatment in A-pulse mode. The rationale for using a tip equipped with electrodes is to incorporate the bulk-heating effect of noninvasive bipolar RF. By uniformly increasing temperature throughout the dermis, this approach may further enhance the rejuvenation effect.

Conventional devices can, of course, also produce favorable clinical outcomes. However, the QUADESSY system, which uniformly controls subpulse energy through constant-power delivery, may provide greater treatment efficiency within a shorter procedure time. In other words, precise and consistent energy control may allow dermal remodeling, pigmentation regulation, and vascular stabilization to occur simultaneously.

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