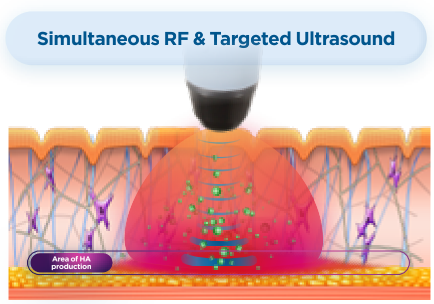
EXION™ Face & Body Applicators

MECHANISM OF ACTION PAPER

Not many know that the first signs of aging are often due to a shortage of hyaluronic acid rather than changes in collagen or elastin. Hyaluronic Acid creates volume and provides structural support, intense hydration, and plumping effects to the skin.[1] Unfortunately, its concentration decreases as we age. At age 60, our skin has 50% less hyaluronic acid than when we were in our 40s.[2] Thus, aestheticians counter the hyaluronic acid depletion by delivering manufactured HA into the skin through topical solutions, injectable dermal fillers, and oral remedies, which may substitute the natural function of skin cells but do not encourage the body to produce more HA on its own.[1]

Specialized cells called fibroblasts produce HA, as well as collagen and elastin. However, with age, their activity decreases which leads to the continuous depletion of all three components. Yet, it has been shown that the fibroblast activity can be rebooted by exposure to external stress, such as mechanical or heat stress. Studies documented that heat or mechanical stimulation is able to enhance collagen and elastin levels. However, the hyaluronic acid levels remained intact.[3] The studies also found slight variations in the responses to different types of stress. Therefore it has been proposed that inducing the two types of responses simultaneously could be the key to restarting the production of hyaluronic acid as well. For this purpose, a new technology has been developed. It combines monopolar radiofrequency and targeted ultrasound to provide the two required stress factors and it has indeed been shown to effectively boost the production of all skin components, including hyaluronic acid. [4-8]

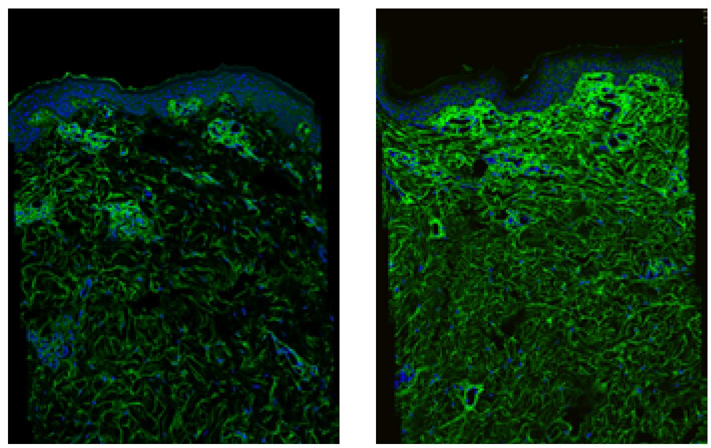
The monopolar radiofrequency homogeneously heats the entire dermis to 40-42°C which induces therma stress on fibroblasts and targets aged and rigid collagen and elastin fibers in the dermis.[10] The thermal energy triggers collagen coagulation and rapid skin tightening, evoking the restorative process, which promotes the production of new collagen and elastin. This allows for improvement in the dermal structure resulting in skin improvement through neocollagenesis and neoelastinogenesis.[9]



Targeted ultrasound directs high-frequency mechanical waves to the reticular dermis, where the most active fibroblasts reside. The mechanical stimulation caused by the ultrasound waves induces vibrations in the tissues, including the fibroblasts, resulting in an energy buildup within the reticular dermis that leads to the heating of the tissue up to 42°C. Ultrasound waves activate cell receptors, causing changes in gene expression and protein synthesis within fibroblasts. This enhances their responsiveness to radiofrequency waves, which can disrupt the cellular environment and increase the production of hyaluronic acid, collagen, and elastin fibers.[3]

Multiple clinical studies showed that directing the ultrasound to the reticular dermis is absolutely crucial for increasing the concentration of HA in the skin, as demonstrated by Duncan et al., who found that only targeted ultrasound and RF resulted in increased HA production, while the RF with general non-targeted ultrasound did not yield any significant changes. The group treated by RF + targeted ultrasound showed up to a 224% increase in HA concentration.[4] Similarly, Fritz et al. showed that RF+TUS led to a significant increase in hyaluronic acid levels in porcine skin samples, while radiofrequency alone did not have the same effect, highlighting the importance of targeted ultrasound in altering tissue composition.[6] Findings from the animal studies were confirmed by Goldberg et al.´s study on human subjects.[7] Kent et al.'s porcine study then documented that this technology can significantly increase collagen (by 47%) and elastin (by 50%).[8] The improvement in skin structures translated into an overall improvement in skin appearance, as evidenced by Chilukuri&Boyd's study showing increased skin hydration (by 23%) and improved skin texture (by 41 %).

BEFORE AFTER



Confocal microscopy images show that at the 2-month follow-up, the network in the dermis of the RF+TUS group appears denser with more green fibers compared to the baseline on the left

1. Vasvani S, Kulkarni P, Rawtani D. Hyaluronic acid: A review on its biology, aspects of drug delivery, route of administrations and a special emphasis on its approved marketed products and recent clinical studies. Int J Biol Macromol. 2020;151:1012-1029. doi:10.1016/j.ijbiomac.2019.11.066
2. Göllner I, Voss W, von Hehn U, Kammerer S. Ingestion of an Oral Hyaluronan Solution Improves Skin Hydration, Wrinkle Reduction, Elasticity, and Skin Roughness: Results of a Clinical Study. J Evid-Based Complement Altern Med. 2017;22(4):816-823. doi:10.1177/2156587217743640
3. Bohari SP, Grover LM, Hukins DW. Pulsed low-intensity ultrasound increases proliferation and extracelluar matrix production by human dermal fibroblasts in three-dimensional culture. J Tissue Eng. 2015;6:204173141561577. doi:10.1177/2041731415615777
4. Duncan D, Bernardy J, Hodkovicova N, Masek J. Increased levels of hyaluronic acid in skin after monopolar radiofrequency and TUS treatment: porcine animal study. In: 41st Annual Conference of the American Society for Laser Medicine and Surgery, San Diego, California, April 27-30; 2022.
5. Chilukuri S, Boyd C. The simultaneous application of monopolar radiofrequency and targeted ultrasound for improvement of skin laxity and skin texture. In: Annual Meeting of the Vegas Cosmetic Surgery & Aesthetic Dermatology, Las Vegas, Nevada, June 10-12 ; 2021.
6. Fritz K, Bernardy J, Jarosova R, Kralova N. The simultaneous application of monopolar radiofrequency and targeted ultrasound for stimulation of hyaluronic acid production: porcine animal study. In: 41st Annual Conference of the American Society for Laser Medicine and Surgery, San Diego, California, April 27-30 ; 2022.
7. Goldberg D. Facial rejuvenation by enhanced production of hyaluronic acid after monopolar radiofrequency and targeted ultrasound: human histology study. In: 41st Annual Conference of the American Society for Laser Medicine and Surgery, San Diego, California, April 27-30 ; 2022.
8. Kent D. Monopolar radiofrequency and TUS induces remodeling of fibrillar collagen and elastin fibres: histological and polarized microscopy porcine model study. In: 41st Annual Conference of the American Society for Laser Medicine and Surgery, San Diego, California, April 27-30 ; 2022.
9. Shin JW, Kwon SH, Choi JY, et al. Molecular Mechanisms of Dermal Aging and Antiaging Approaches. Int J Mol Sci. 2019;20(9):2126. doi:10.3390/ijms20092126
10. El-Domyati M, El-Ammawi TS, Medhat W, et al. Radiofrequency facial rejuvenation: Evidence-based effect. J Am Acad Dermatol. 2011;64(3):524-535. doi:10.1016/j.jaad.2010.06.045