

The Erbium:YAG Laser in the Treatment of Hyperesthesia: An Experience of 2 Patients

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The erbium:YAG (Er:YAG) laser is particularly useful for highly precise ablative skin work, with negligible thermal damage and complications. Two female patients suffered from nerve damage to the neck and shoulder area after undergoing cancer surgery, which left them with severe hyperesthesia and extreme pain. Both patients received Er:YAG treatment for the reduction of postsurgical scars, reporting 60% to 100% improvement in their symptoms. We report a potential novel use of the Er:YAG laser in the treatment of hyperesthesia, and we suggest that this technique be evaluated in the treatment of similar hypersensitive neurologic manifestations.

Cutaneous laser resurfacing has been used for many years in the treatment of various skin conditions, including verrucous hamartoma, wrinkling, scarring, growths, and actinic damage. Specifically, the erbium:YAG (Er:YAG) laser permits tissue abrasion in the treatment of verrucous hamartoma, extensive benign superficial dermoepidermal lesions, and aesthetic treatment of nonmuscular wrinkles.^{1,2} The laser emits light at a wavelength of 2940 nm, and its mode of action is photothermal.³ Erbium:YAG lasers are currently being used for cutaneous laser resurfacing, utilizing a 7-mm spot at 2.0 J/cm². Approximately 3 passes of Er:YAG lasers are necessary to effect total epidermal ablation, dermal contraction, and collagen remodeling, with complete reepithelialization noted at 0.5 to 1.0 week and resolution of erythema noted at 2 to 8 weeks postoperatively.⁴

In addition to these established treatment indications, alternative uses of laser therapy have been under investigation. We report 2 cases in which patients had 60% to 100% resolution of severe hyperesthesia after undergoing treatment with the Er:YAG laser. Although one recent report discusses the use of lasers for treatment of chronic pain, extensive review of the literature does not reveal any cases of patient relief from hyperesthesia. Based on our initial findings, we hope that the Er:YAG laser may continue to prove beneficial in the treatment of hyperesthesia unresponsive to conventional medical treatment and that it may prove to be useful in the treatment of other chronic pain syndromes.

CASE SERIES

Two women with Fitzpatrick skin type I presented to Advanced Dermatology, PC, in Fresh Meadows, New York, for revision of postsurgical scars, as well as for laser resurfacing treatment of facial wrinkles, furrows, and actinic damage. Patient 1, who was 54 years old at the time of presentation, had a 6-cm scar as a result of thyroid cancer surgery that was performed 29 years prior to presentation (Figure 1A). The thyroid cancer surgery resulted in severe hyperesthesia over the skin on the right side of her neck, along with 60% nerve damage to the area (as per the

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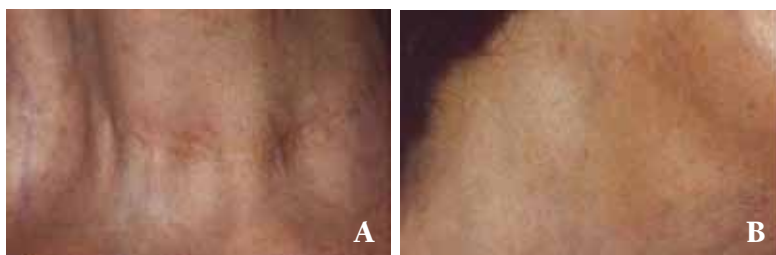


Figure 1. Patient 1 before treatment, with an extensive scar on the right side of the neck from past thyroid cancer surgery (A), and after treatment with the erbium:YAG laser for the scar, wrinkles, furrows, and actinic damage (B).

patient's neurologist), leaving her with extreme pain and sensitivity, even to light touch. The patient reported loss of feeling, tingling, and itching on the right side of the body, extending from above the right breast to the back of her neck and ear, including the shoulder. Patient 2, who was 62 years old at the time of presentation, had an 8-cm scar over the right neck as a result of an excision of a liposarcoma that was performed 1 year prior to presentation (Figure 2A). Patient 2 suffered from extreme sensitivity to light touch in an area that extended from her right shoulder to her right axilla and breast.

Both patients' nerve damage and hyperesthesia greatly affected their quality of life and interfered with their daily activities. Both patients received intravenous anesthesia and regional nerve block from an anesthesiologist, as well as local anesthesia from a dermatologist while being treated with the Er:YAG laser for their postsurgical scars and for wrinkling of the face and neck. The Er:YAG laser was applied over the entire hyperesthetic area using standard laser technique. In treating both patients, the energy used ranged from 2.08 to 3.12 J/cm² over the scar, with a 7-mm spot and 1 to 2 passes. This is in contrast with the standard dosimetry of 5.20 J/cm² with 2 to 4 passes, not including additional resurfacing treatment for areas of wrinkles on the rest of the face. Standard postoperative wound care consisting of moist wound healing using an open, nonocclusive technique was administered to both patients without any postoperative complications.

Within several weeks of the procedure, patient 1 reported 100% resolution of her hyperesthesia, tingling, and itching on the right side of her neck (Figure 1B). On a scale of 1 to 10, with 1 indicating no pain and 10 indicating the worst pain, patient 1 originally ranked her pain a 4 during periods of rest and an 8 when the pain was exacerbated by light touch. After treatment with the Er:YAG laser, patient 1 no longer experienced any of the extreme sensitivity to pain that had plagued her for so many years. Patient 2 had ranked her pain a 5 prior to the procedure

and changed it to a 2 posttreatment, with a reported improvement of more than 60% in her symptoms (Figure 2B). Follow-up of both patients more than 2 years after the laser treatments indicated that their initial symptoms did not return.

DISCUSSION

The Er:YAG laser has been used for cutaneous laser resurfacing to achieve skin rejuvenation.^{1,5-7} At a wavelength of 2940 nm, which closely approximates the absorption peak of water (3000 nm), nearly all of the energy is absorbed into the epidermis and papillary dermis, yielding superficial ablation and less underlying thermal damage.⁸ The mechanism of tissue damage by which the Er:YAG lasers work is mainly by removal through vaporization of the epithelial layer near the surface. In addition, there is minimal thermal coagulation necrosis of cells in the residual layer; minimal thermal denaturation of extracellular matrix proteins in the residual layer; and a small, deeper zone of sublethal residual thermal damage. The laser resurfacing destroys skin to a controlled depth, with a wound-healing process determining clinical outcome.⁹⁻¹¹ This ablation of the superficial layer of skin causes a release of a number of inflammatory mediators and growth factors, which activates fibroblasts responsible for the deposition and remodeling of collagen and proteoglycans, which then activates smooth muscle and endothelial cells, thereby inducing neovascularization.¹²⁻¹⁵ The efficacy of the Er:YAG laser is dependent on several factors, such as wavelength, irradiance of the laser, spot size, and specific skin properties, including thickness, age, and pigmentation.¹⁶

Considering the Er:YAG laser's effect on skin, we postulate that during the initial phase of scar formation and collagen deposition, entrapment of nerves in the bands of collagen in the scar tissue may occur. But after application of the laser and the resultant ablation, it is possible that the reorganization of collagen may lead not only to the removal of scar tissue, but to the release of the entrapped nerves, resulting in the resolution of hyperesthesia.



Figure 2. Patient 2 before treatment, with an extensive scar on the right side of the neck from liposarcoma surgery (A), and after treatment with an erbium:YAG laser to reduce the postsurgical scar (B).

Studies conducted on patients with a history of chronic scar pain lasting more than 3 months who were treated with an Er:YAG laser resulted not only in an improvement in the appearance of the scars, but also a significant decrease in pain and itching.^{17,18} Kotani et al¹⁹ hypothesizes that during the process of scar formation, nerve endings are entrapped in the scar, resulting in scar pain, and that the laser may simply be destroying the collagen, causing it to regrow in an organized manner such that it no longer constricts the nerve endings. An alternative hypothesis is that surgical excision of thyroid cancers alters the regenerating nerves and damages or sensitizes the nociceptors. During and after the process of scar formation, the inflammatory mediators, and later, the scar tissue, act as stimuli and cause sensitization of peripheral nociceptors, lowering their threshold.²⁰ C nociceptors, responsible for the reception and transmission of painful stimuli, are found in the very superficial layer of the skin.⁵ Each time C nociceptors are stimulated, they not only transmit pain signals via afferent pathways to the dorsal root ganglion, but they also transmit antidromic signals via their efferent pathways to surrounding nociceptors and bathe them in substances such as prostaglandins and histamine, which lower their threshold, causing hyperesthesia.²¹ On each provocative stimulus of the laser, more and more nociceptors are bathed in the mediators, which permeate the skin and lower their threshold, thereby lessening the perception of pain at sites away from the scar tissue.^{20,21} We believe that it is possible that the irradiation with the Er:YAG laser caused the resolution of the scar tissue and that it also ended the stimulus responsible for the activation of peripheral C nociceptors.

In these cases, the regaining of sensation in the neck may have been little more than an astonishing coincidence or a psychosomatic reaction to the treatment. We have speculated on the potential mechanisms, including the interference in the nociceptors from the treatment with the Er:YAG laser, which could contribute to an interruption of the peripheral sensitization. The treatment with the Er:YAG laser induces the release of various inflammatory chemokines and growth factors, which cause collagen deposition and resolution of scar tissue, thereby helping patients to regain sensation. Although in our patients, Er:YAG laser treatment has proven efficacious and their initial symptoms have not returned. Additional patients with hyperesthesia, similar manifestations, or both, such as postherpetic neuralgia and posttraumatic pain syndrome, must be evaluated to establish the efficacy of Er:YAG laser treatment.

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