

Esthetic Removal of Head and Neck Nevus and Lesions With 4.0-MHz Radio-Wave Surgery: A 30-Year Experience

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Purpose: The cosmetic removal of facial nevi and related lesions is a frequent patient request of cosmetic surgeons. Many patients live with esthetically bothersome lesions, unaware that scar-free or minimal scar treatment modalities are available.

Materials and Methods: The author has used a protocol of treating thousands of nevi and related benign lesions with 4.0-MHz radio-wave ablation during the past 30 years. A review of this technique is presented with substantiation by before and after images. Indications, diagnosis, and complications also are reviewed.

Results: Conservative ablation of nevi and benign lesions of the face and neck can be predictably removed with minimal and frequently imperceptible scarring.

Conclusion: Facial surgeons see multiple patients on a daily basis requesting the removal of nevi and other benign lesions of the face and neck. Many patients are misinformed by experienced practitioners that the resulting scar will be worse than the lesion. This unfortunate dictum has been disproved hundreds of times by the author's treatment using 4.0-MHz radio-wave surgery to ablate benign lesions of the face and neck, with excellent cosmetic results. Even if practitioners do not offer this treatment, they should be aware that it exists and offer patients exposure to this modality.

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Nevi are pigmented and nonpigmented tumors of the skin that contain nevus cells and present on virtually all adults. They can be elevated, flat or pedunculated, smooth or papillomatous, hair bearing or nonhair bearing. Common nevi are classified as junctional or intradermal. A combination of these characteristics is referred to as *compound nevi*. The main challenge with any potential lesion removal is to rule out malignancy. Histologic submission is necessary for suspicious lesions, although some clinicians recommend biopsy for any pigmented lesion.¹

It is very common for patients to present to a cosmetic surgery practice for the esthetic removal of nevi and various other benign lesions, including keratosis, dermatosis papulosa nigra (DPN), sebaceous hyperplasia, syringoma, and verruca. Although there are numerous ways and means of treating benign lesions, liquid nitrogen, electrosurgery, and surgical excision

remain the most common.² The main drawbacks of cryotherapy include hypopigmentation and scar depression owing to excessive lateral cryodamage or lateral thermal damage in the case of electrosurgery (Fig 1). Unesthetic surgical scars remain the main downside of surgical excision. It is not common for a patient to say, "my plastic surgeon or dermatologist told me never to have this removed because the scar will be worse than the lesion." Invariably, the author can perform extremely esthetic lesion removal with 4.0-MHz radio-wave surgery, much to the relief of the patient who has unnecessarily lived with the mole or wart for years.

Radio-Wave Surgery Principles

"Electric surgery" was used soon after man harnessed electricity³⁻⁸ and has been used by numerous specialties for surgical procedures.⁹⁻²³

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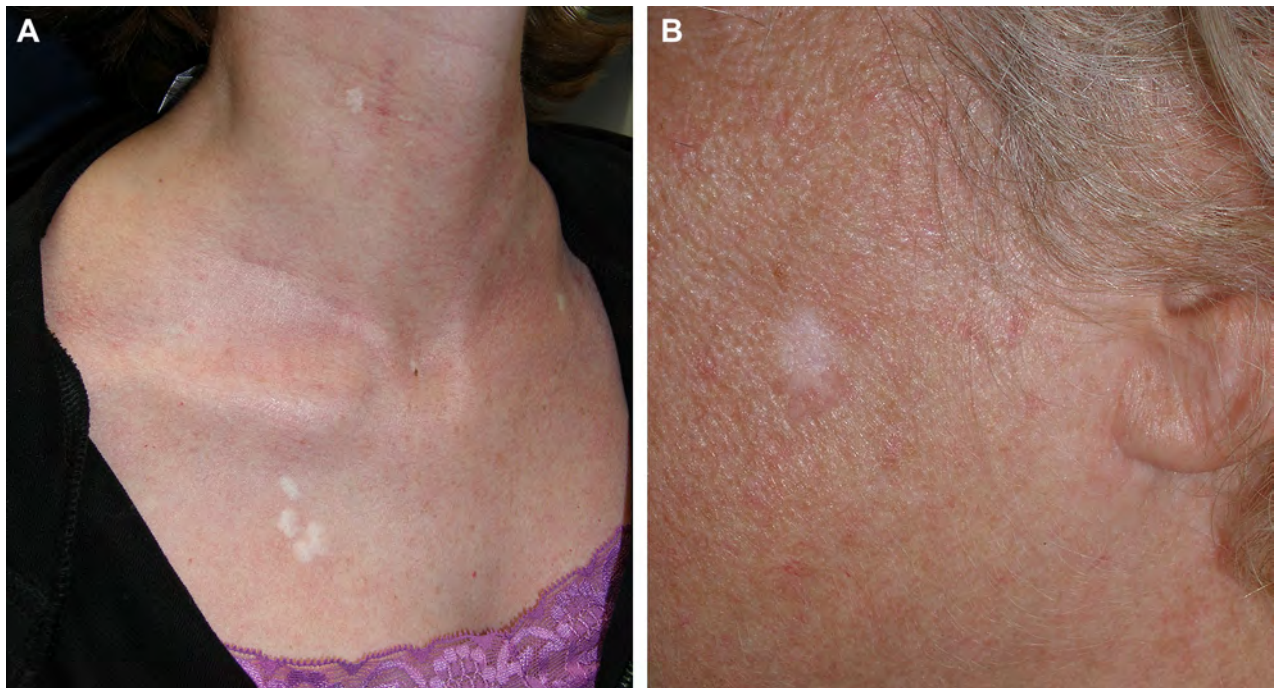


FIGURE 1. A, B, These patients show typical hypopigmentation and scarring from overtreatment of benign nevi.

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Radio-wave surgery is a modality that is often mistakenly referred to as *electrosurgery*, *cautery*, or *diathermy* (as it is referred to in the UK). Although radio-wave surgery and electrosurgery use household current to energize their respective systems, there are vast differences in the technology. The optimum radiosurgery wave is a frequency of 4.0 MHz, which is similar to the frequency of marine band radios^{24,25} (Fig 2). Radiofrequency machines operate by using a 60-cycle (ordinary household) alternating current,

which is converted to a direct current by a rectifier. Then, the direct current passes through a coil, which actually generates the radio waves. The radio waves pass through a high-frequency waveform adaptor, which can modify the shape and magnitude of the radio waves. The Ellman Surgitron (Ellman International, Oceanside, NY) emits a choice of 4 waveforms, but the pure cutting setting (90% cutting and 10% coagulation) produces less lateral thermal damage.²⁶ The radio waves are transferred from the electrode tip to the

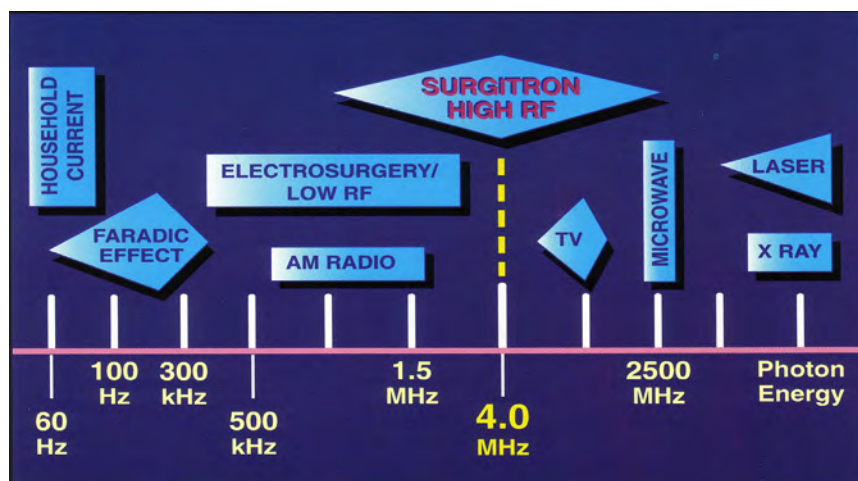


FIGURE 2. The 4.0-MHz radio wave is close to marine band radios on the electromagnetic spectrum. RF, radiofrequency.

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FIGURE 3. A, Malignant melanoma in a 42-year-old man. B, Basal carcinoma in a 66-year-old man. C, Squamous cell carcinoma in a 70-year-old man.

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patient and are returned to the machine by a neutral antenna plate. The neutral electrode plate does not need to contact bare skin and is coated with Teflon. This is a significant advancement over traditional electrosurgical ("bovie") cautery units, which require a true grounding plate with skin contact. Numerous and

serious burn injuries have occurred from grounding plate failure. This is not possible with radio-wave surgery because the neutral antenna does not need to contact the patient and it can be placed under clothes or chair cushions. Neither the patient nor surgeon can be shocked or burned with 4.0-MHz radio-wave surgery.



FIGURE 4. The finger rest involves stabilizing the handpiece in the operating hand with a stable base using the fingers of the nonoperating hand. This technique, used by dentists, microsurgeons, and watchmakers, allows better stabilization and control of the electrode tip to make "paintbrush strokes" with the handpiece and electrode. The active electrode is bent to best facilitate ergonomics.

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Heat and Resistance

Standard electrosurgery or cautery units operate at a lower frequency (<3 MHz) and it is their active electrode (needle) that provides the electrical resistance

to cut or ablate tissue. Any surgeon with experience with standard hospital electrosurgical units can testify that with continued high-power treatment, it is not uncommon to see the needle electrode become red hot and possibly melt. In effect, these units are similar to a soldering iron. This type of heat generation does not occur with the 4.0-MHz radio-wave unit and is a significant advantage for less lateral thermal damage. With radio-wave surgery, the needle (active electrode) does not become hot; it is the tissue that provides the resistance and not the electrode tip. With 4.0-MHz radio-wave surgery, the impedance to the passage of the radio waves through the tissue generates heat within the cells, which boils intracellular tissue water, creating steam.²⁷ The steam generated causes the inner pressure of the cell to increase from the inside out (explosion) and this phenomenon is referred to as *intracellular volatilization*.²⁸

Radio-wave surgery mechanics produce less heat and lateral thermal damage compared with laser or common lower-frequency electrosurgery units.²⁹⁻⁴⁰ Scalpel incision produces approximately 15 to 20 μ of lateral thermal damage. The 4.0-MHz radio-wave surgery has been shown to produce a similar depth of lateral tissue damage,^{29,30} whereas lasers or lower-frequency electrosurgery units can produce upward of 500 μ of lateral tissue damage. Hence, the higher the frequency, the less lateral tissue damage and char.^{31,32}

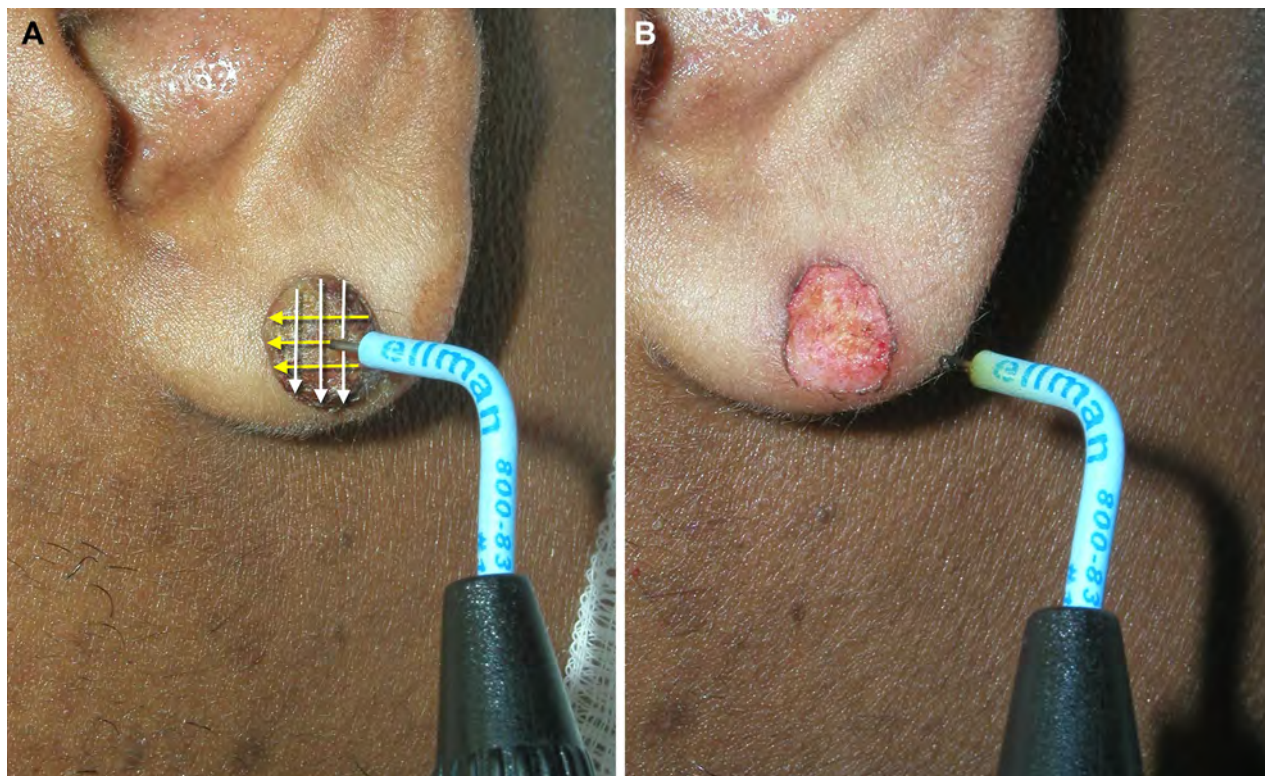


FIGURE 5. A, Preoperative lesion with a cross-hatch treatment pattern. The first pass is made with vertical strokes and the second pass is made with horizontal strokes. This enables a more controlled and homogenous reduction. B, Ablated lesion.

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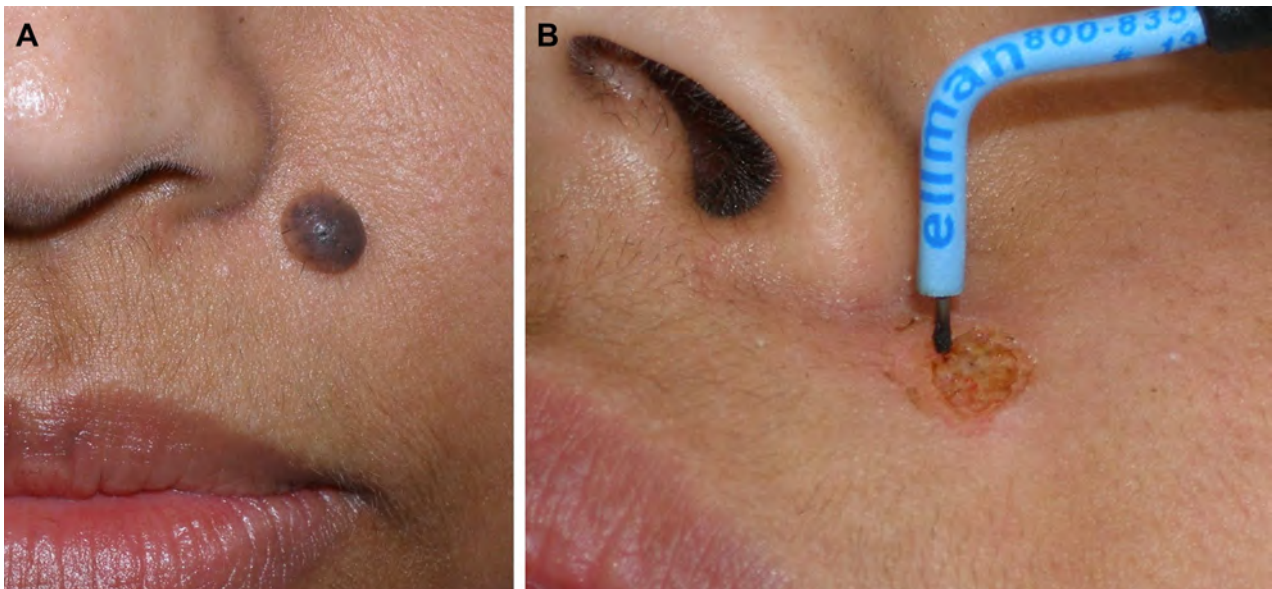


FIGURE 6. A, Preablation lesion treated to its base. B, Remnant chamois-colored tissue.

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Technique

DIAGNOSIS OF MALIGNANT LESIONS

All practitioners who treat lesions must be proficient at identifying an ominous or malignant presentation. The most basic diagnostic aid is the ABCDE of a lesion. This is especially true for malignant melanoma. This is not a fool-proof method and any lesion that is “different” should be submitted for pathology.

A = Asymmetry. Although most benign lesions are symmetric, melanoma or other malignancies often present with asymmetry. A line drawn through the

lesion will show that the lesion does not match from side to side.

B = Border. Most benign lesions have a smooth border, whereas melanoma can have a scalloped or irregular border.

C = Color. Most benign lesions are monochromatic. Melanoma can present as variants of brown, black, red, and blue.

D = Diameter. Many benign lesions are smaller than 6 mm in diameter. Early melanomas also may be small, but advancing or mature melanomas generally exceed 6 mm in diameter.

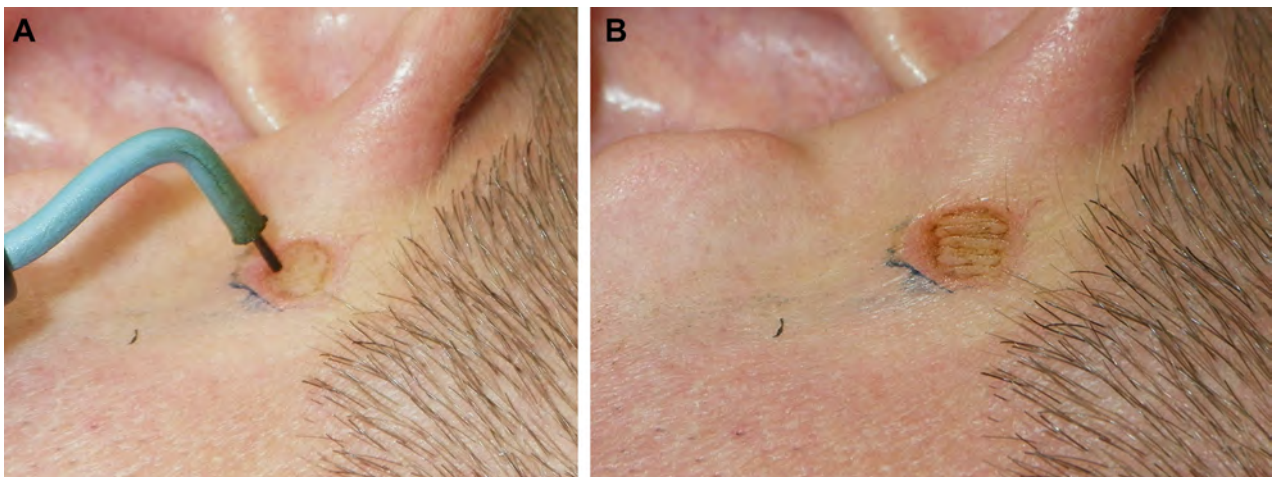


FIGURE 7. A, Remnant lesion generally appears as a chamois-colored raised area. The endpoint of treatment requires leveling this base of remnant tissue to or slightly below the dermal surface. B, Raised lesion base leveled as the endpoint in treatment.

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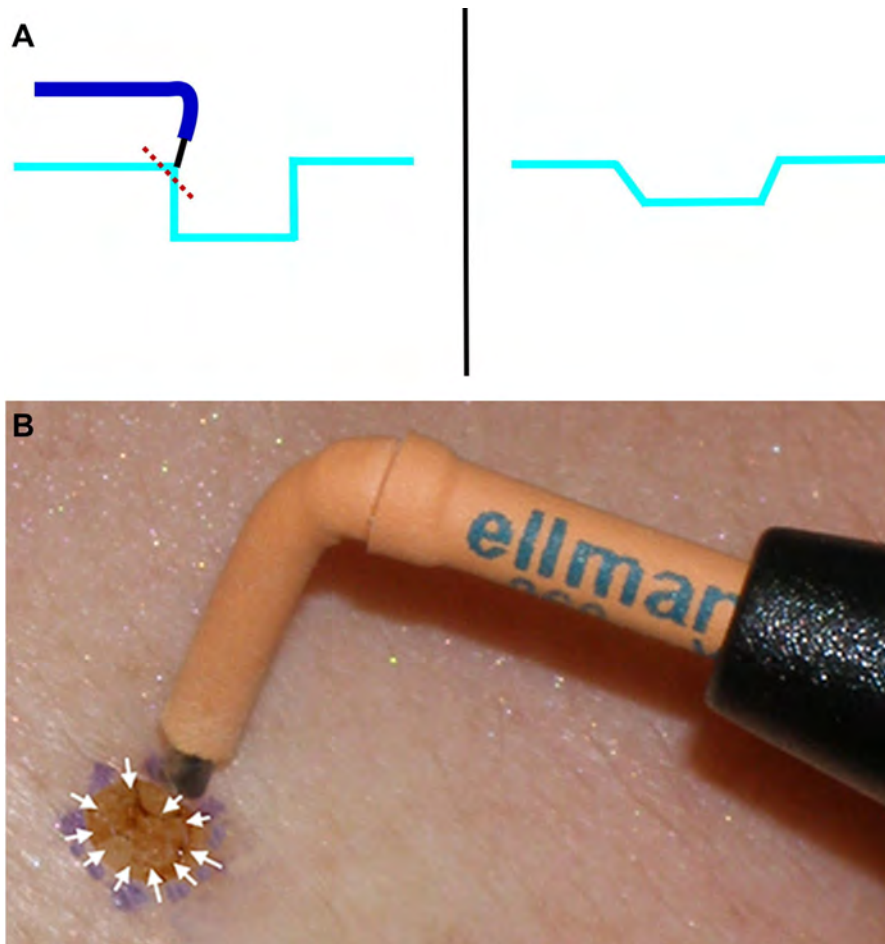


FIGURE 8. A, Diagram of the precipitous lesion rim during and after beveling with the electrode tip. B, Clinical image of final treatment with the edges beveled and blended.

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E = Evolving. Any lesion that changes over time in terms of the ABCDE list should be considered suspicious and submitted for biopsy. Changes also include enlargement crusting, itching, bleeding, and ulceration. Basal cell carcinomas are often “pearly” and contain telangiectasias and may ulcerate.

The best general rule is, when in doubt, perform a biopsy. All patients (and surgeons) should see a dermatologist for a yearly full-body mole check. This is documented in the chart when treating lesions. Figure 3 shows actual malignant lesions from the author's practice.

Before treatment, patients are informed that a small percentage (1 to 2%) may require retreatment and that this conservative approach prevents overtreatment, which is the single most common reason for scarring. All lesions are photographed and then anesthetized with 2% lidocaine with 1:100,000 epinephrine.

Lesions requiring pathologic diagnosis are shave-biopsied just before ablation by using a scalpel (or radio-wave loop electrode) to remove a representative

portion of the lesion. For actual ablation, the author prefers a #133 malleable electrode (Ellman International), although ball electrodes, loop electrodes, or blade electrodes can be used. The radio-wave generator is set at 7 to 20 W (average, 12 W) and the “pure cutting” mode (90% cut and 10% coagulation) is used. This setting produces the least amount of lateral thermal damage. The electrode is bent to facilitate the most ergonomic angle and stabilized with a finger rest (Fig 4) for the most precise control.

The correct ablation technique is a light, almost pressureless, paintbrush stroke over the lesion (which experienced laser surgeons can relate to). With optimum power settings, the tip should move through the lesion with little or no resistance or drag. If electrode drag is present, the power is too low; and if sparking is present, the power is too high. Optimum power (7 to 20 W) will produce smooth travel through tissue without excessive sparking. Approximately 5- to 10-second bursts of treatment are made

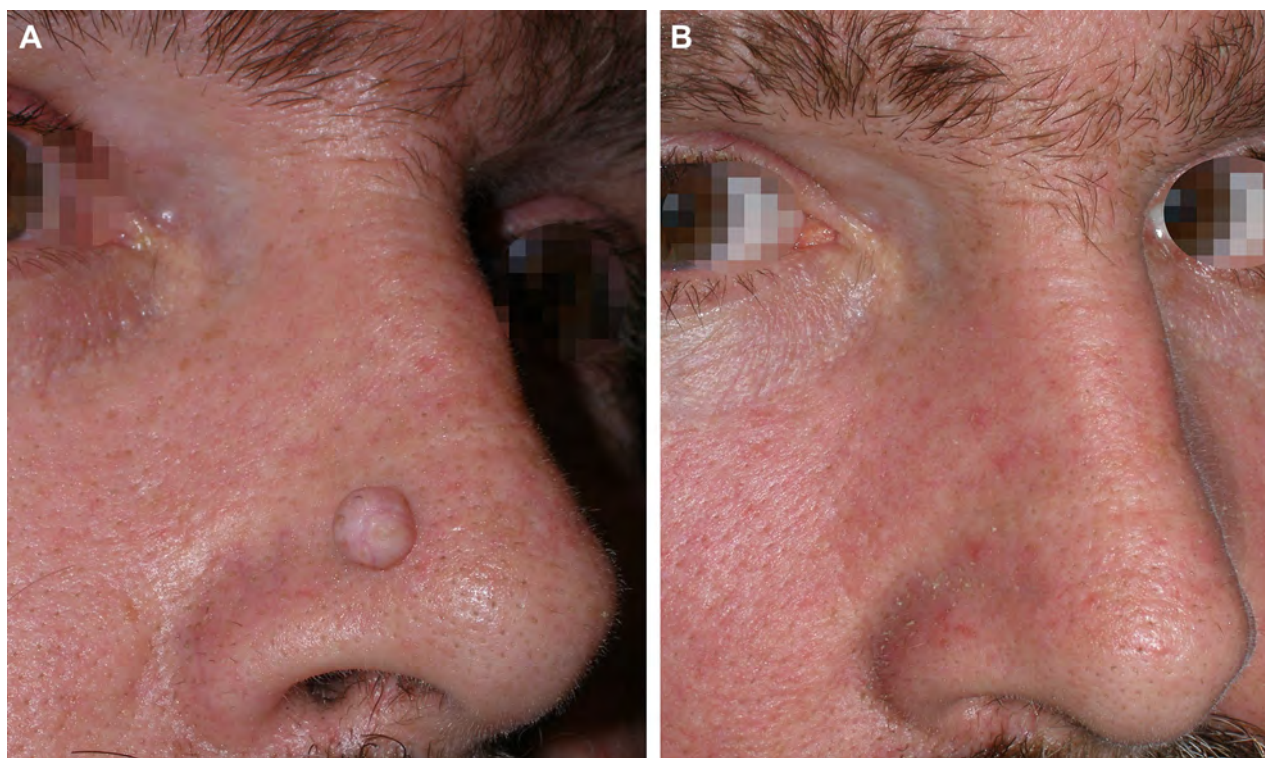


FIGURE 9. Patient A, before and B, 8 weeks after a single treatment with 4.0-MHz radio-wave surgery.

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at a time, and the lesion is “painted” with longitudinal lines from one side to the other (Fig 5). After 1 pass, the lesion is firmly wiped with dry gauze to remove the char. Burn and wipe sequences are repeated until the lesion is treated to its base. The remnant lesion is usually chamois colored compared with the surrounding dermis (Fig 6). The lesion is treated just below the flush skin surface with minimal saucerization, and wearing loupes and a headlight greatly facilitates the differentiation between lesion and normal dermis. The endpoint of treatment is leveling the chamois remnant base of the lesion flush or slightly below the dermal surface (Fig 7). The lesion margins are beveled with the #133 radio-wave tip to prevent a precipitous edge, which is more prone to heal as a depressed scar than those lesions with thinned and blended edges (Fig 8). As the base of the lesion is reached, the electrode is used in an up-and-down “pecking motion” circumferentially around the lesion base with very light finger pressure. This maneuver will allow the surgeon to accurately treat the last vestiges of the lesion and level the base. Lesions with a homogenous base will heal better than those with hills and valleys. Although a small visible remnant of lesion may be visible, it must be kept in mind that there is some (albeit minor) thermal damage that extends beyond the visible lesion base. Undertreatment is preferable to overtreatment.

After the ablation, petrolatum or triple antibiotic ointment is applied on the lesion continuously until it is re-epithelialized (smooth, dry, and pink), which generally takes approximately 7 days. There is no need to cover the lesion, although occlusion does not affect healing. The patient is instructed that the lesion will remain pink with gradual fading to normal color over the ensuing weeks. Patients are reappointed for 8-week follow-up and it is not uncommon to have to resort to the preoperative picture because neither the surgeon nor the patient can see the scar. This is a positive marketing point that the author has experienced time and time again. If the lesion is still visible at the 8-week follow-up, it is retreated. Very light-skinned patients may develop extended erythema and should be instructed that the scar can stay pink, in some cases, for months.

Clinical Cases

Clinical cases are shown in Figures 9 to 15. These patients underwent radiowave surgery for various benign lesions.

Complications

Radio-wave surgery necessitates the same precautions to protect the surgeon, staff, and patient, including

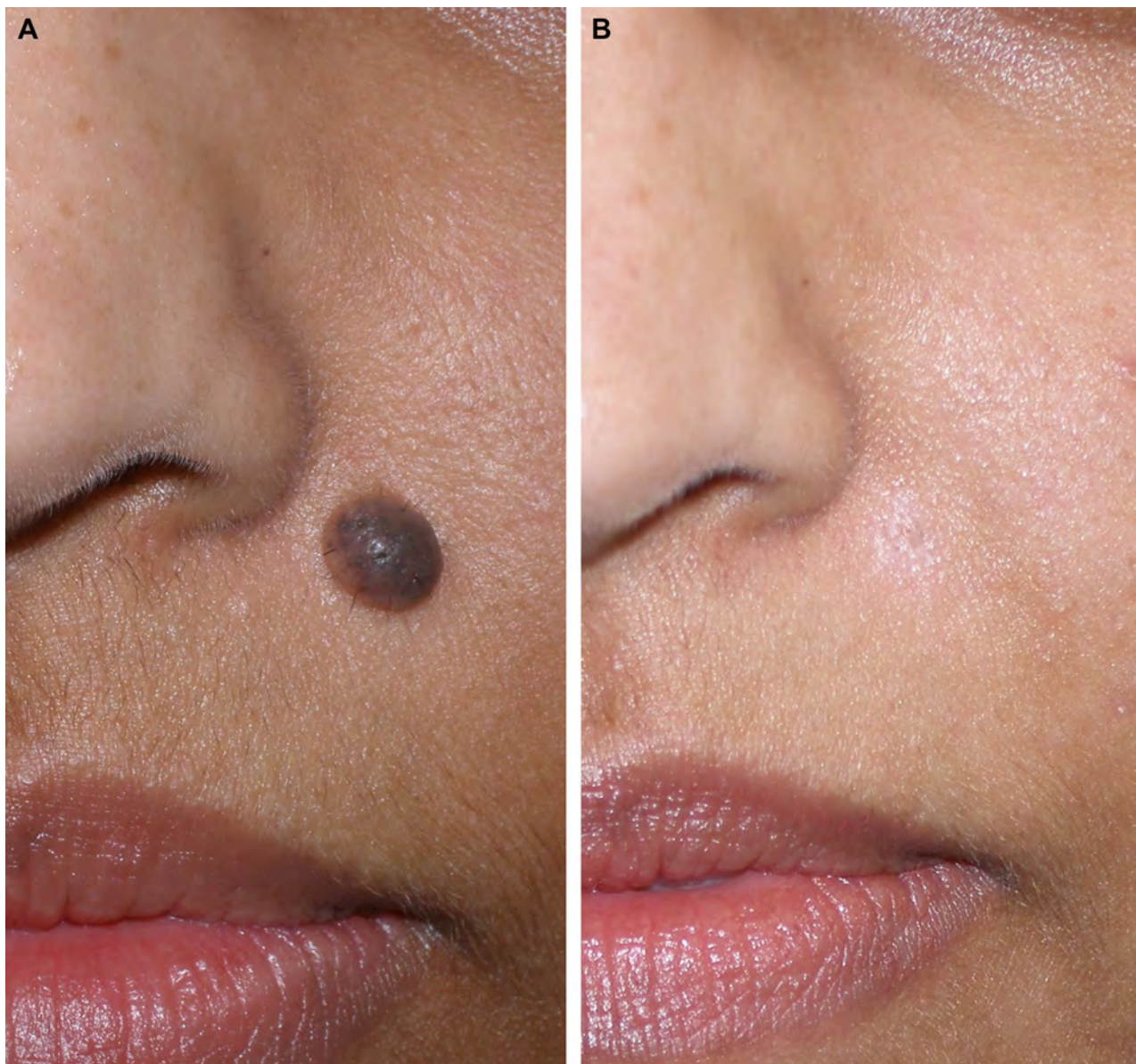


FIGURE 10. Patient A, before and B, 8 weeks after a single session of 4.0-MHz radio-wave ablation. The lesion was shave-biopsied before treatment. There is a very slight area of hypopigmentation that normalized over several months.

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vacuuming of the smoke plume and fire precautions with oxygen use. Patients with unshielded pacemakers (which are currently rare) and implantable defibrillators should have cardiac consultation before treatment with any electrical modality, including radio-wave surgery.⁴¹⁻⁴³

Complications with radio-wave ablation are similar to other ablative treatment modalities, but this treatment has provided a largely “scarless” and predictable patient experience. The most common relative complication is lesion recurrence, which has been estimated at 1%, and conservative retreatment suffices in most cases, although an occasional lesion may require several treatment sessions.

Treating darker Fitzpatrick skin types can result in a degree of hyperpigmentation, especially when treating DPNs; however, the final esthetic result has always been acceptable to the patient who is happy to trade hundreds of black spots for less visible light brown spots (Fig 9).

A possible drawback to the “shave and ablate” technique may be that in the rare incidence of melanoma, this mode may make staging difficult; however, experience with thousands of lesions has never produced this consequence. Because all lesions are photographed, the original lesion footprint is documented.



FIGURE 11. Patient A, before and B, after numerous treatment sessions of 4.0-MHz radio-wave surgery for dermatosis papulosa nigra.
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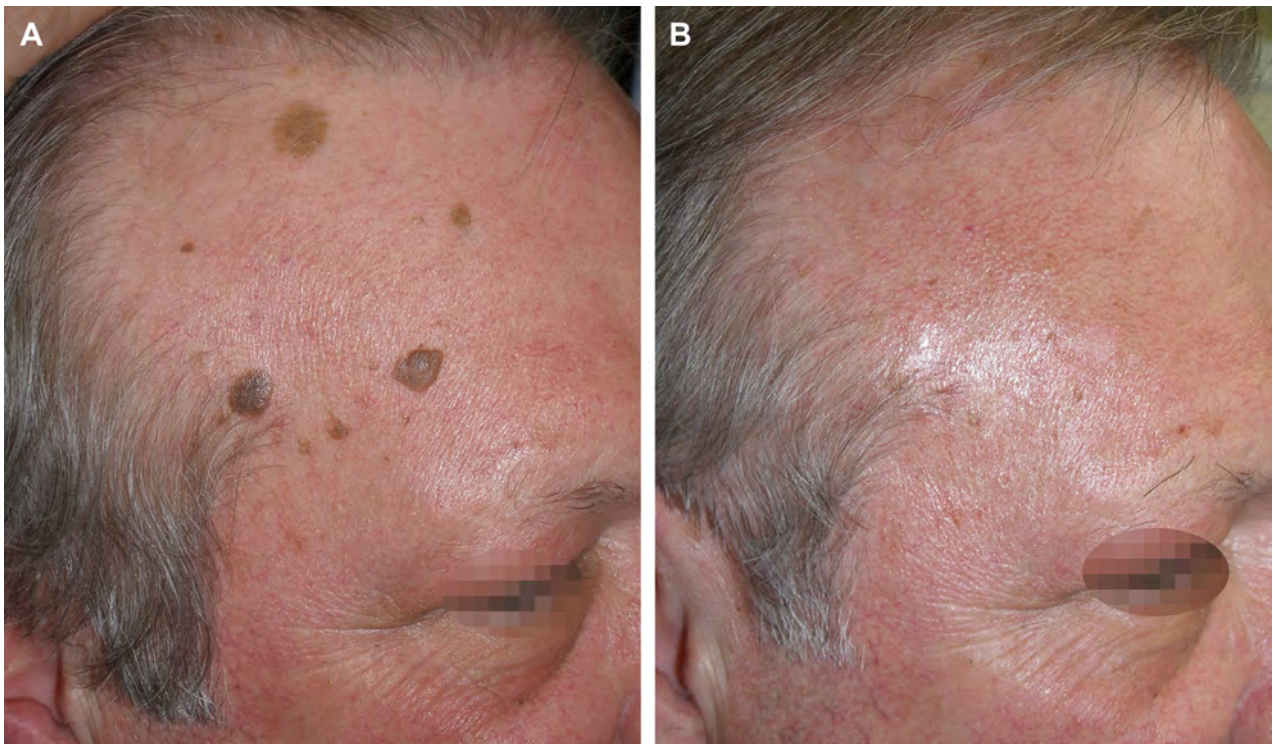


FIGURE 12. Patient A, before and B, 8 weeks after 4.0-MHz radio-wave ablation of nevi and keratosis.
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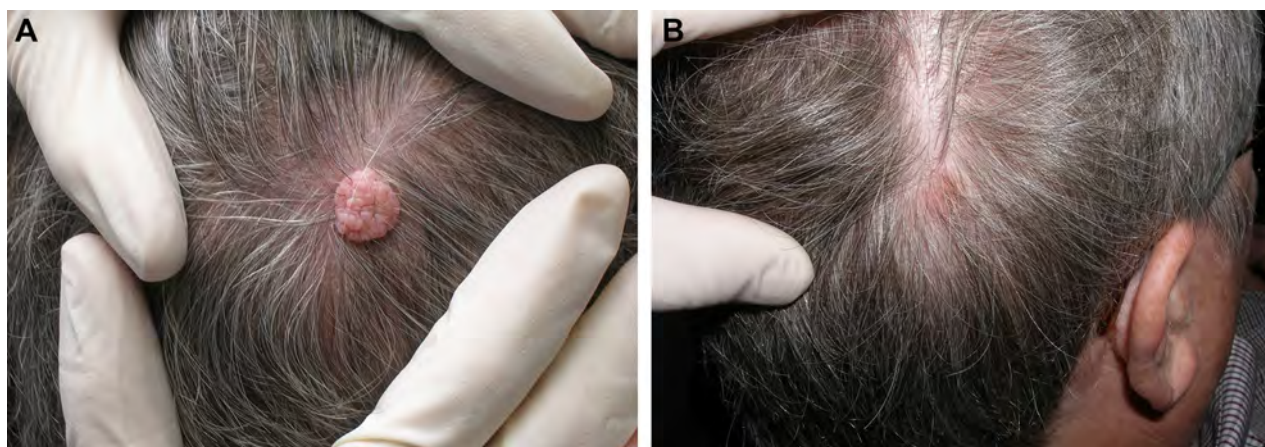


FIGURE 13. Patient A, before and B, 8 weeks after 4.0-MHz radio-wave ablation of a benign scalp lesion.

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Overtreatment obviously can cause scarring, wound depression, and hypopigmentation. A personal 30-year experience with this technique has shown that hypopigmentation and scarring are extremely rare when proper technique and settings are used.

To use the optimum characteristics of radio-wave surgery, adjacent tissue damage must be limited. Time of tissue contact, power intensity, waveform, and frequency of application are the variables that contribute to lateral thermal tissue destruction, as illustrated in the following formula:

$$LH = \frac{T \times I \times W \times S}{F}$$

In this equation, LH is lateral heat, T is time, I is power intensity, W is waveform, S is surface area, and F is frequency.

The amount of time that the electrode contacts the tissue is obviously paramount to prevent excessive lateral tissue damage. The faster the electrode passage, the less tissue damage is produced. A rate of 7 mm/second was proposed by Kalwarf et al.³⁸ Similar to ironing a white

shirt, the correct power setting and movement are required. Moving the iron too slowly or having the heat setting too high will produce scorching.

The waveform contributes to lateral heat and treatment destruction. The fully filtered current (90% cutting and 10% coagulation) produces the least heat, whereas the fulguration waveform generates the greatest amount of heat. Electrode size is another significant variable in the formula of heat generation. A large electrode tip requires more power and therefore produces more lateral heat compared with a thinner electrode.

The main advantages of radio-wave lesion removal are improved scar, less instrumentation, and faster treatment.

Over the past 3 decades, the author has used various modalities in his practice to ablate benign lesions of the head and neck, including common electrosurgery, CO₂ laser, cryotherapy, and direct excision. The evaluation of hundreds of before and after results led to the exclusive use of 4.0-MHz radio-wave treatment based on clinical healing. Although no method of lesion removal can guarantee a “scarless” result without

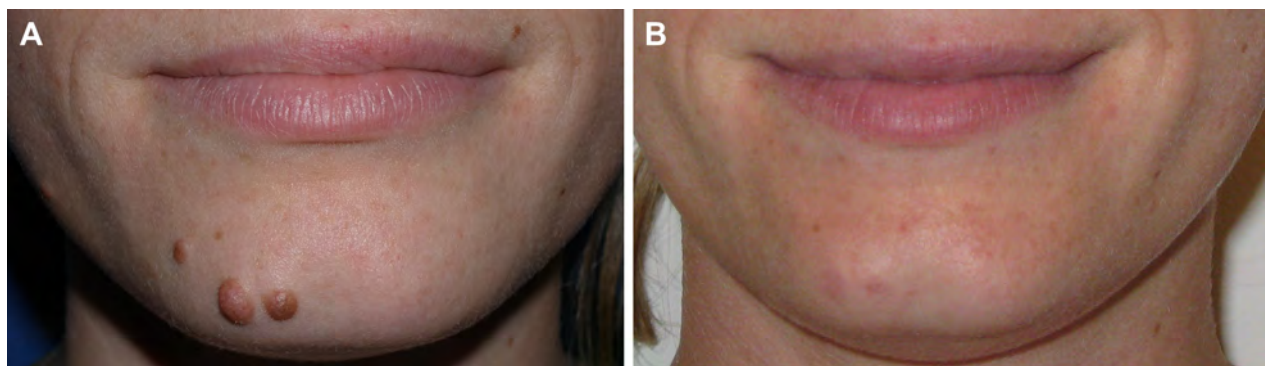


FIGURE 14. Patient A, before and B, 6 weeks after radio-wave ablation of multiple nevi of the chin region.

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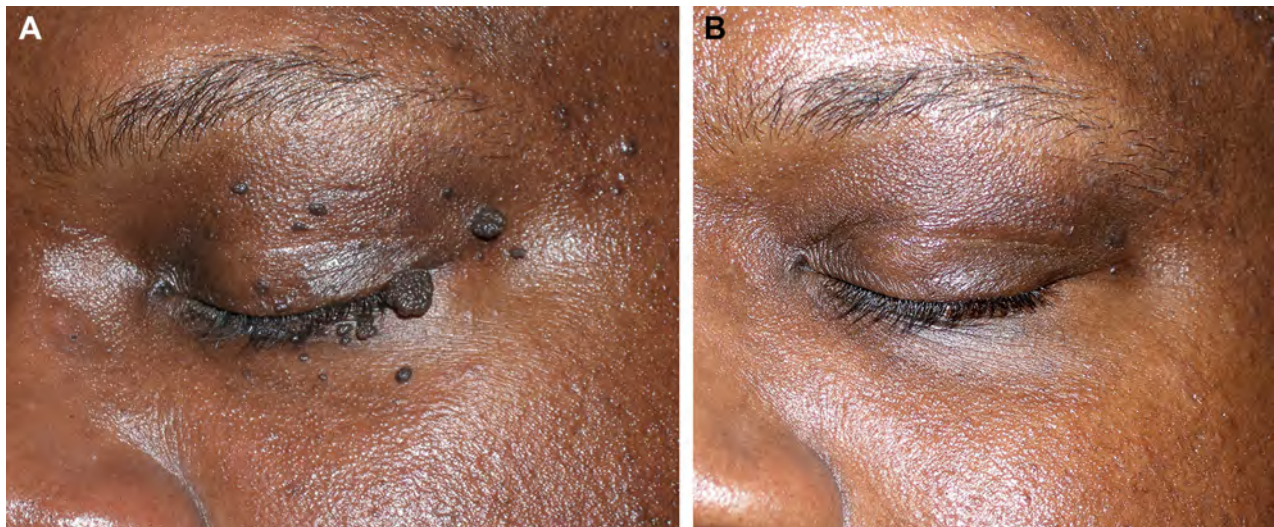


FIGURE 15. Patient A, before and B, 8 weeks after 4.0-MHz radio-wave ablation of periorbital lesions.

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recurrence, the described technique has come as close as possible in the author's 30-year experience with this and other methods. After hundreds of lesion removals, not a single patient has ever regretted the treatment (or wished they still had their mole). Hundreds were told by other surgeons never to have the lesion removed because the scar would be worse than the lesion and are now relieved after treatment.

A continual flow of out-of-town patients (and some international) underlines the fact that there is a great demand for lesion removal with esthetic results and that patients (especially younger patients) will travel great distances to avoid scarring. This study conformed with the ethical guidelines of the 1976 Doctrine of Helsinki.

Press Release

This article's Press Release can be found, in the online version, at <http://dx.doi.org/10.1016/j.joms.2013.10.015>.

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