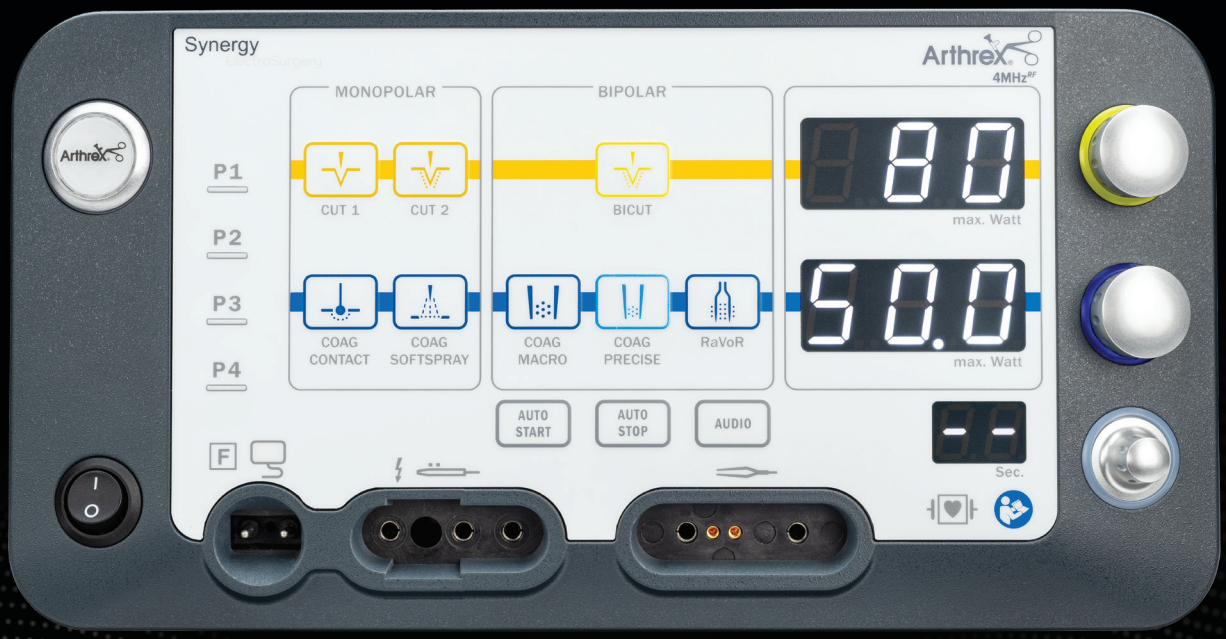
Advantages of Impedance-Controlled 4 MHz Radiofrequency Technology



Arthrex®

Advantages of Impedance-Controlled 4 MHz Radiofrequency Technology

Radiofrequency has found its place as a precision tool in ENT, neurosurgery, and microsurgery. Numerous studies have evaluated the use of 4 MHz radiofrequency technology in comparison with other technologies.[1-7] With the impedance-controlled Synergy ElectroSurgery generator, Sutter offers the benefits of an advanced 4 MHz radiofrequency technology for a variety of applications.

- Minimal lateral thermal damage[4,5]
- Better wound healing[6]
- Precise and focused coagulation

The advantages of impedance-controlled 4 MHz radiofrequency technology lie in its physics
With the Synergy ElectroSurgery generator, energy is distributed uniformly inside the cells, reducing heat buildup on the outer layer seen with standard high-frequency systems. This even flow of energy inside the cells makes the generator an optimal tool for both cutting and coagulation in precision electrosurgery.

Conventional Electrosurgical Units

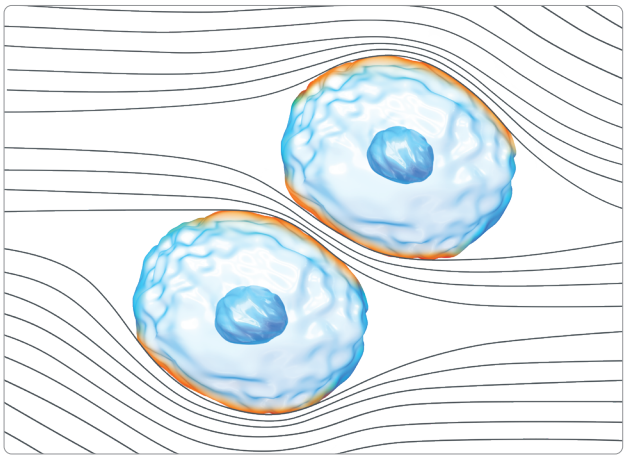


Figure 1a. With conventional electrosurgical units, the electromagnetic field concentrates between the cells and heats up only the outer layer.

Synergy ElectroSurgery Generator

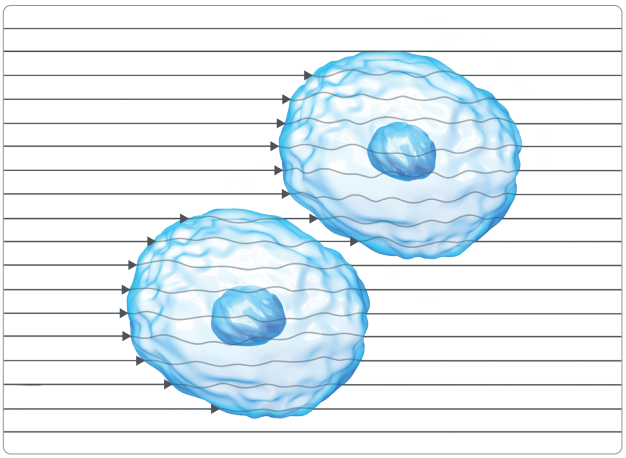


Figure 1b. With the Synergy ElectroSurgery generator, cell membranes are conductive and the energy is absorbed evenly inside the cells. The results are highly focused tissue effects.

Source: Electrical Impedance Tomography–Methods, History and Applications. IOP Publishing Ltd 2005

> *Using radiofrequency for dissection compared to other instruments is clearly superior. It shows better hemostasis, better handling, better cutting and it is an inexpensive treatment compared to laser."*

Clemens Heiser, MD
Munich, Germany

Minimal Lateral Thermal Damage: CUT

Studies support the conclusion that the impedance-controlled 4 MHz radiofrequency technology produces **less lateral thermal damage** than other technologies.

The Synergy ElectroSurgery generator demonstrated the **greatest cutting width** (Fig. 2), the **smallest coagulation defects**, and the **narrowest lesions** across all energy levels compared with the CO_2 laser, YAG laser, and high-frequency technology. In addition, it produced the **smallest coagulation zone** across different tissue types and energy levels compared with the other technologies (Fig. 3a and 3b). As a result, impedance-controlled 4-MHz radiofrequency technology best **preserves tumor-adjacent structures** and **improves pathologic assessment**.[4]

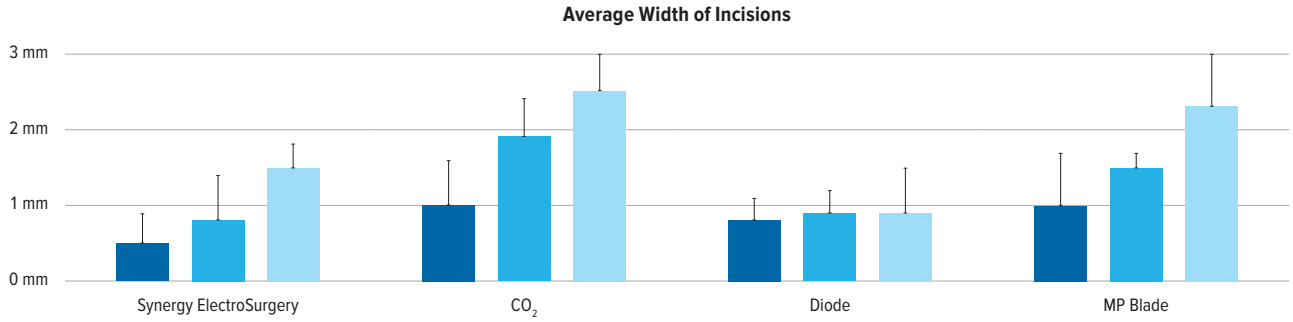


Figure 2. Comparing the average width of incisions produced by different instruments at different energy levels

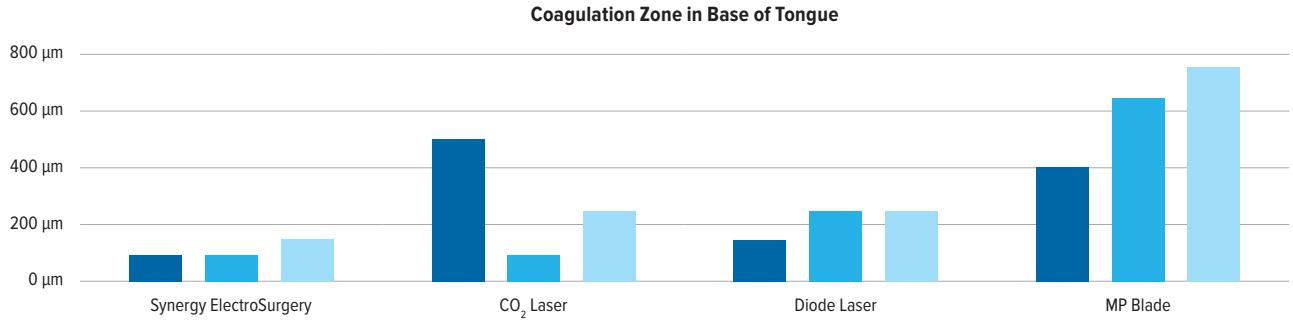


Figure 3a. Comparing the coagulation zone of the instrument in the base of tongue at different energy levels

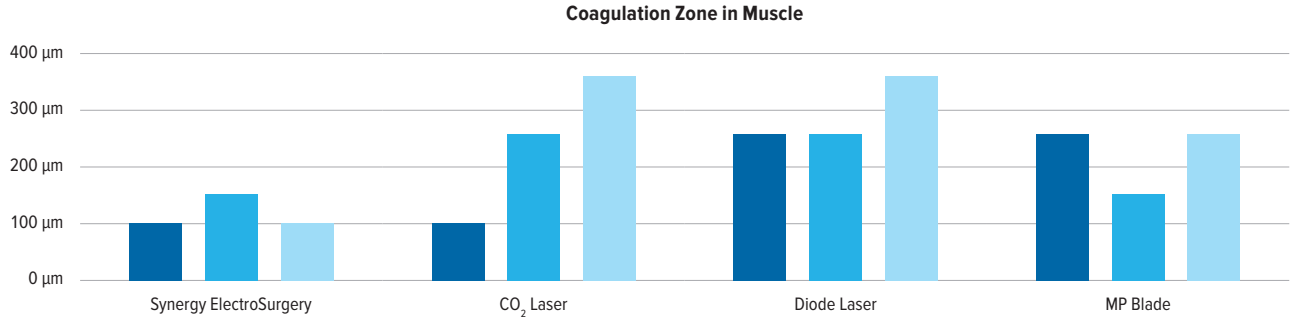


Figure 3b. Comparing the coagulation zone of the instrument in muscle tissue at different energy levels

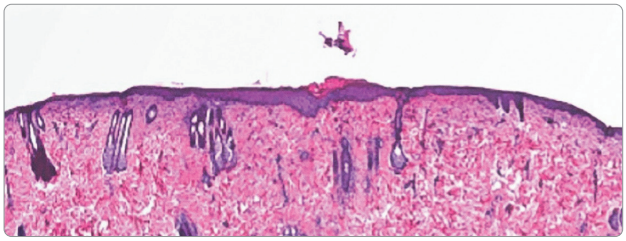
Energy levels: Low Medium High

In a study of 25 patients with oral or oropharyngeal tumors, specimens resected using radiofrequency-assisted technology with the Synergy ElectroSurgery generator were **more assessable than those resected** with laser assistance. Impedance-controlled 4-MHz radiofrequency technology produced smoother resection margins, reduced tissue resistance, and resulted in the **narrowest lesions** and **coagulation zones** compared with CO_2 laser and high-frequency technologies.[5]

Better Wound Healing: CUT

A comparison of the healing process of lesions in albino rats created by different technologies showed proven benefits of the 4 MHz radiofrequency technology in terms of wound healing. Using the impedance-controlled Synergy ElectroSurgery generator proved to be **more targeted and precise than conventional high frequency**, preserving the basal membrane as well as the deeper layers of the epithelium and resulting in less profound wounds.[6] The histological assessment also showed that **wound healing using the Synergy ElectroSurgery generator is faster compared to conventional high frequency**. Radiofrequency-induced wounds show complete epithelialization after 7 days, in contrast to the lesions produced by high frequency, which show abundant inflammation associated with focal suppurations (Fig. 4).

Radiofrequency



High frequency / electrocauterization

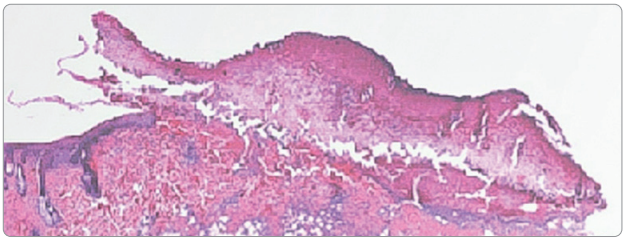


Figure 4. Histological aspects on day 7, comparing radiofrequency and conventional high frequency

Precise Coagulation and Gentle Tissue Effects: COAG

The precision and quality of coagulation results can be observed in the effects on the tissue. A study comparing bipolar coagulations on egg yolk showed that the impedance-controlled Synergy ElectroSurgery generator achieves **gentler effects as well as more reproducible results compared to conventional high frequency**. With each of the two generators, 100 coagulations were performed for durations of 1, 2, and 3 seconds. Results were evaluated by three blinded analysts on a visual analog scale across three criteria: edge sharpness, homogeneity, and coagulation shape (Fig. 5 and Fig. 6).[9]

Synergy ElectroSurgery Generator

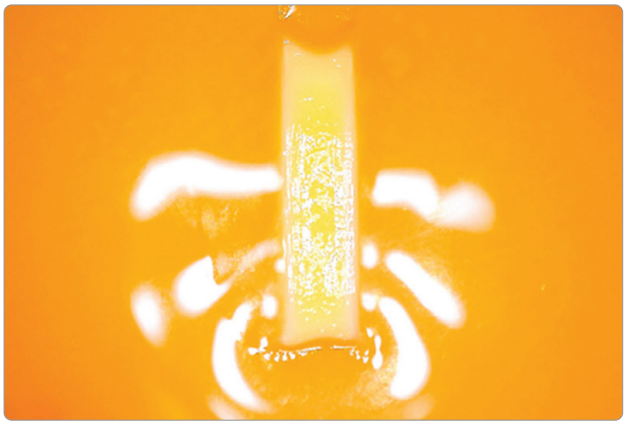


Figure 5. An example of good edge sharpness, homogeneity, and coagulation shape

Conventional High-Frequency Generator



Figure 6. An example of poor edge sharpness, homogeneity, and coagulation shape

The evaluations revealed a clear difference between the two generators. Overall, the impedance-controlled Synergy ElectroSurgery generator produced **better results in terms of edge sharpness, homogeneity, and coagulation shape** than conventional high frequency. The coagulations produced by the Synergy ElectroSurgery generator were rated in the excellent range, whereas those produced by the conventional high-frequency generator were less favorable (Fig. 7, Fig. 8, and Fig. 9). Because all three criteria showed better results with 4 MHz radiofrequency technology, the findings suggest that the impedance-controlled Synergy ElectroSurgery generator produces gentler tissue effects.[9]

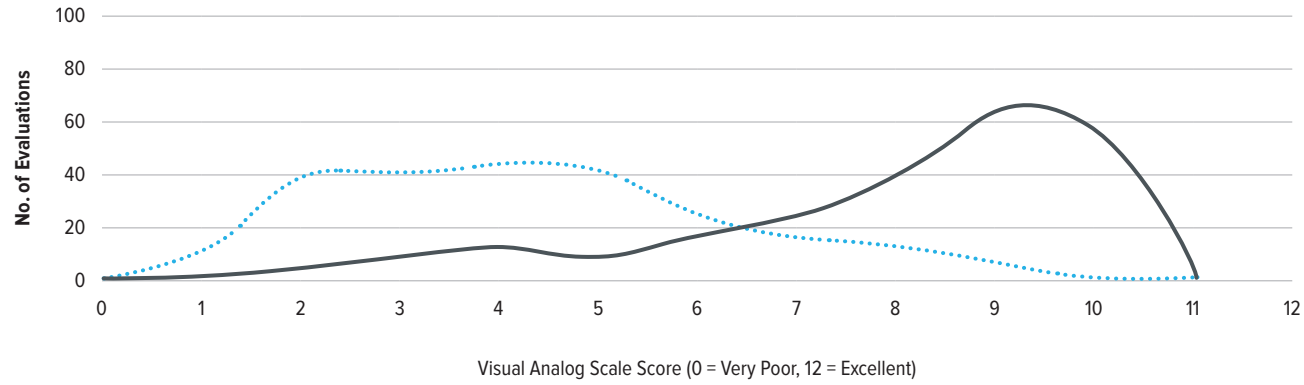


Figure 7. Edge sharpness of coagulations at 2 seconds activation time

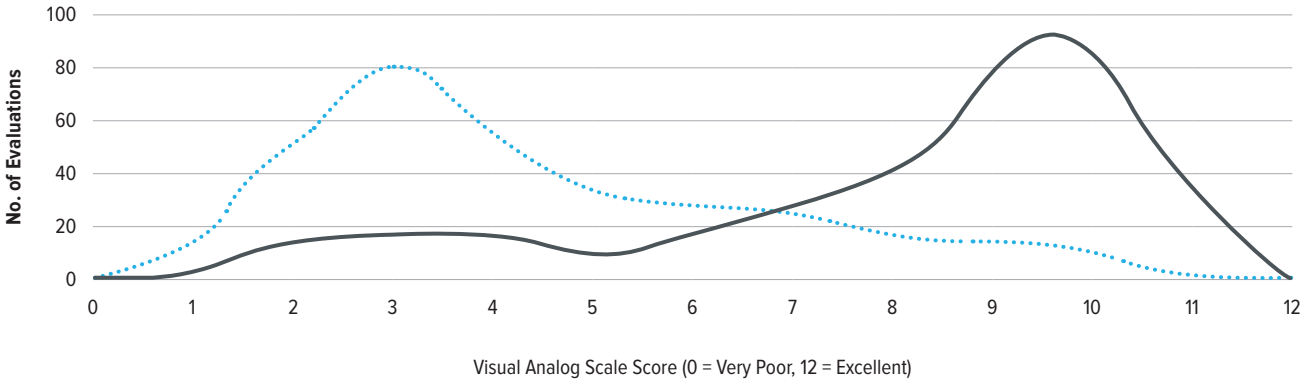


Figure 8. Homogeneity of coagulations at 2 seconds activation time

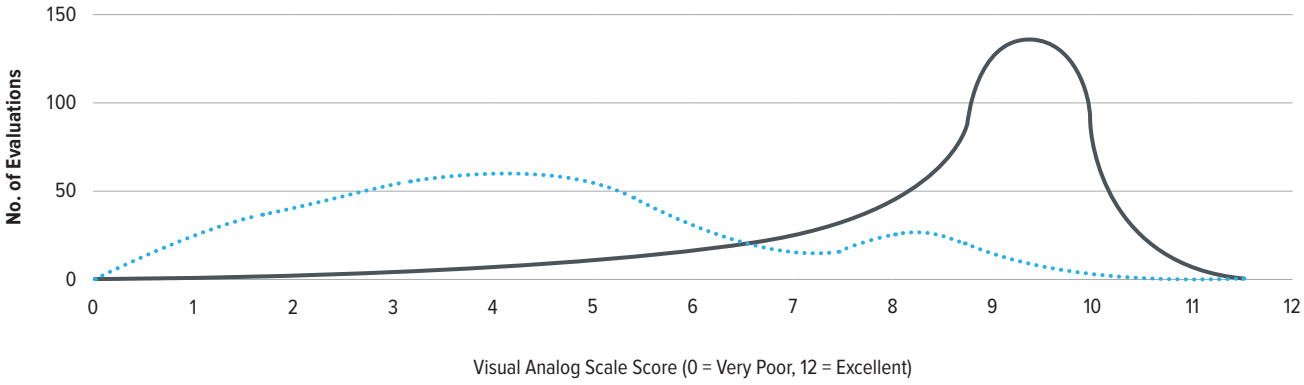


Figure 9. Shape of coagulation at 2 seconds activation time

Synergy ElectroSurgery Generator High-Frequency Generator

“The Synergy ElectroSurgery generator provides unparalleled precision to the neurosurgeon seeking optimal control in neurosurgical cases. I found the ability to perform pinpoint coagulation with minimal thermal and electrical spread increasing the safety and efficacy of my operations.”

Ali Zomorodi, MD
Durham, NC, United States

Focused Coagulation at Low Temperatures

Interstitial Application of Bipolar Energy: COAG

A comparison between impedance-controlled 4 MHz radiofrequency technology and Coblation technology (operating at 100.1 kHz, approximately 40 times lower than the Synergy ElectroSurgery generator) demonstrates the thermal advantages of 4 MHz radiofrequency during coagulation. While Coblation technology reached elevated temperatures following saline injection,[a] mean temperatures with the impedance-controlled Synergy ElectroSurgery generator remained below 100 °C (Fig. 10). These thermal characteristics support the use of impedance-controlled 4 MHz radiofrequency as a more suitable option for the treatment of hypertrophic turbinates.[7]

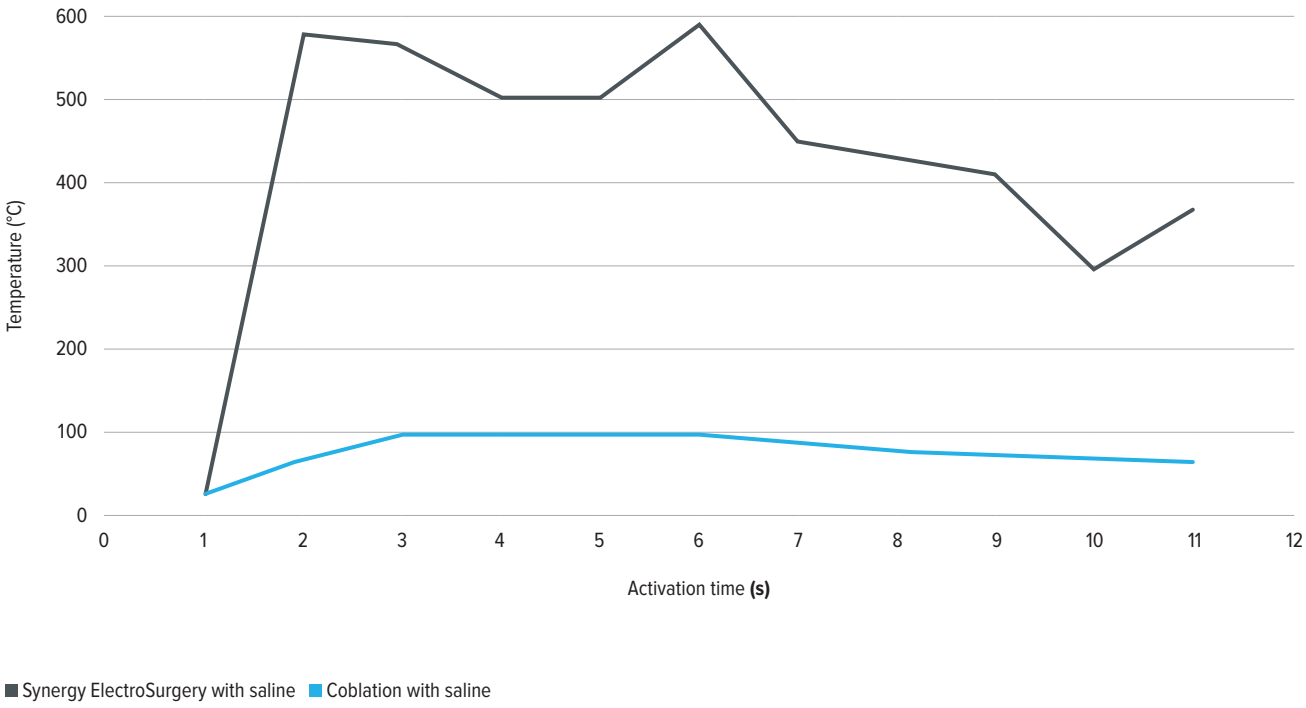


Fig. 10: Mean temperatures (°C) from a series of measurements using Synergy ElectroSurgery with RaVoR™ bipolar electrode and Coblation[b]

[a] According to manufacturer's guidelines, saline gel must be used during the procedure
[b] Illustration adapted for clarity

Additional Advantages of the Impedance-Controlled Synergy ElectroSurgery Generator

› Easy handling[5,10]

› Time-saving[10,11]

› Cost-efficient[10]



Auto*RF*™
Auto*RF* is a smart impedance control function that adapts the power output of the Synergy ElectroSurgery generator to the tissue condition. Whether it is cutting through different types of tissue (such as mucosa, muscle, fat, or connective tissue) or altering tissue conditions during coagulation, the Auto*RF* feature delivers adapted power output as required by the different tissue impedance.

p3™ technology
p3, which stands for pulsed power performance, is active in all coagulation modes of the Synergy ElectroSurgery generator. Radiofrequency energy is delivered in about 50 small packages per second. Due to the pulsed power output, there are short breaks between the individual packages, giving the tissue enough time to absorb the energy. Highly focused, yet gentle coagulation with minimal thermal damage is possible.

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This description of technique is provided as an educational tool and clinical aid to assist properly licensed medical professionals in the usage of specific Arthrex products. As part of this professional usage, the medical professional must use their professional judgment in making any final determinations in product usage and technique. In doing so, the medical professional should rely on their own training and experience and should conduct a thorough review of pertinent medical literature and the product's directions for use. Postoperative management is patient-specific and dependent on the treating professional's assessment. Individual results will vary and not all patients will experience the same postoperative activity level or outcomes.

US patent information

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