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ENERGY-BASED PROCEDURES

SCIENCE CAN DO MORE

A critical guide for plastic surgery

Surgery · Tissue quality · Continuity

A treatment pathway beyond surgery.

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Science can reveal connections.

Contents

Biology · Technology · Evidence · Clinical practice

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Four ruled notes pages follow page 22, without page numbers.

Plastic surgery combines anatomical correction, tissue quality and long-term care. Adjunctive procedures are selected according to clinical findings, treatment goals and evidence.

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Science can broaden the scope of surgical care.

Tissue remains a treatment priority.

BIOLOGY GUIDE 3

1. **Biological stability**
   Assess the barrier, irritation and previous treatments.
2. **Tissue modulation**
   Identify the target: dermis, matrix or subcutis.
3. **Biostimulation**
   Assess tissue condition and regenerative capacity.
4. **Anatomical limits**
   Assess skin excess, ptosis and supporting structures.
5. **Plastic surgery**
   Perform the anatomical corrections required.
6. **Postoperative regeneration**
   Support healing, scar maturation and tissue remodelling.
7. **Long-term tissue maintenance**
   Monitor changes and reassess indications.

Energy-based procedures complement the care pathway according to tissue findings and evidence. They do not replace necessary surgery.

Biological framework by Beate Scheffler, specialist article Part 3. [A]

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Science can connect stages of treatment.

Surgery is one step.
The care plan goes further.

Surgery changes the anatomy. Skin ageing, matrix remodelling and individual tissue responses continue and need to be addressed in long-term follow-up.

Before surgery: The skin barrier, signs of inflammation, blood circulation and previous treatments define the baseline. Non-invasive RF can induce collagen and matrix responses [14]. However, an improved surgical outcome has not yet been demonstrated.

After surgery: Healing and scar maturation set the framework. A network meta-analysis found benefits for low-level laser and pulsed dye laser treatment of surgical scars [10]. This does not demonstrate a benefit for all energy-based procedures. Coordinate selection and timing with the surgical plan.

Throughout treatment: Adjunctive procedures need a defined goal, controlled energy delivery and verifiable benefit. Collagen stimulation does not require an invasive approach.

Treatment planning must also consider the appropriate timing of surgery. A useful adjunct fits into the care pathway; it does not delay necessary surgery.

Framework: [A]. [14]: tissue response in n=4; no proven benefit for surgical outcomes. Scar treatment: [10].

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Science can distinguish mechanisms of action.

What acts on tissue?

High-frequency electrical energy / radiofrequency
Alternating currents can produce thermal effects through tissue resistance. Electrodes, access, dose and control determine the energy distribution. Non-invasive, needle-based and subdermal RF differ substantially.

Ultrasound, including HIFU
Mechanical vibrational or acoustic energy enters tissue. Absorption can produce thermal effects; pressure fluctuations can produce mechanical effects. Distinguish the energy type from its tissue effects: focus and dose shape the response. [16]

Plasma energy
In medical nitrogen plasma systems, RF generates the plasma within the handpiece. The activated gas transfers energy to the skin, unlike direct delivery of RF current into the tissue. [15]

Use optical energy for a defined purpose
Laser and IPL effects depend on wavelength, target structure, pulse and dose. Check the intended purpose and treatment goal: ablative resurfacing removes tissue and does not necessarily result in skin tightening.

Microwaves, electrical and magnetic stimulation, shock waves and cold have distinct mechanisms of action.

Context: [15] nitrogen plasma; [16] focused ultrasound. Check each product's intended purpose. Further background: [C].

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Science can assess technical quality.

Control shapes clinical application.

Energy and conditions at the target tissue are decisive. Wattage and frequency alone do not define a treatment approach.

Application: Electrode geometry, contact, focus, route of delivery and treated area determine energy distribution.

Dose: Power, pulse sequence, exposure time, movement and interval between treatments must be adapted to the tissue findings.

Feedback: What does the system actually measure and control: temperature, impedance or contact quality?

Safety measures: Cooling, automatic shut-off mechanisms, and error alerts must effectively mitigate risks. Their presence alone does not demonstrate that the system offers superior clinical outcomes.

Safe use: Indication, device control and expertise are essential. Frequency alone does not determine treatment depth; high power does not necessarily indicate quality.

Questions on energy delivery: [A, C]. Technical safety requirements: [9], Annex I, Section 21.

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Science can extend our perspective beyond surgery.

The skin remains. Its needs change.

You correct anatomical changes. Skin ageing and matrix remodelling continue. Successful surgery therefore does not address every subsequent issue of tissue quality.

Where a gap in care can arise
After surgical correction, treatment needs may persist or develop without requiring further surgery. Appropriate energy-based procedures can complement the pathway before or after surgery, according to indication, tissue findings and evidence.

Assess technologies beyond familiar names
Colleagues' recommendations cannot substitute your own assessment. Which tissue structure is being targeted? How is the energy controlled? What benefits are supported by evidence, and what adverse effects have been reported? Not all radiofrequency technologies are the same.

Why the following studies are critically evaluated
They investigate specific applications, not an entire technology class. Critical evaluation supports considered choices for your patients' long-term care. Adjunctive procedures do not replace necessary surgery.

The author's perspective on care [A, D], not a general treatment recommendation.
Application-specific evidence and limitations: see the following study appraisals.

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Science can inform technology selection.

The treatment goal first. Then the technology.

What should change in the tissue?
Contour, excess skin, skin quality and scarring each require a different approach. The technique should be selected according to the clinical findings and treatment goals; no single system is suitable for every indication.

Radiofrequency is not a single, uniform technology.
External electrodes, needles and subdermal probes deliver energy differently. The method of delivery, dosage, and energy control are key factors. Results cannot simply be generalized to other applications.

Assess the studies. Keep your options open.
The number of published studies, price and reputation cannot replace comparison. Less well-known technologies should also be evaluated in terms of clinical benefit, safety, controlled energy delivery, and the quality of the available evidence.

Build long-term patient care.
Well-founded complementary approaches can expand your options for supporting existing patients over time. Criticism of specific applications neither discredits all energy-based procedures nor establishes the superiority of other systems.

Conceptual framework [A, C, D]. Energy delivery and safety requirements: [9].
The following appraisals distinguish reported findings from the limits of the evidence.

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Science can support informed decisions.

Evidence: Why look more closely?

EVIDENCE [D]
READ MORE

Surgery does not stop tissue ageing. Appropriate energy-based procedures can complement long-term management of tissue quality and address a gap in patient care. Critical evaluation of the evidence should guide treatment selection.

Evidence base: New patients or re-analysed cohorts? A controlled study, case series or basic biological research?

Clinical significance: How large is the absolute change, how long does it last, and is it independently measured? An increase from 2 to 3 mm is +50%, but only a 1 mm difference.

Applicability: Which system, generation and protocol were studied? Findings from older technologies do not automatically apply to current-generation systems.

Independence and adverse events: Consider funding sources, authors' conflicts of interest, study dropouts, and whether adverse events were actively monitored and recorded. Close ties to manufacturers do not automatically invalidate data. The same standards should be applied to the systems you use yourself.

The author's perspective on care and evidence [A, D]. Example of critical study appraisal: [1].

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Science can question publication volume.

Much published. How strong is the evidence?

RF REVIEW [1]
SUBDERMAL

Dr Eric Swanson (MD, FRCS(C), FACS), plastic surgeon, reviewed 30 publications on subdermal RF; 23 involved systems from one manufacturer. At the time, the review found no prospective randomised controlled trials. Authors with known conflicts of interest were involved in 77% of the papers. [1]

More publications, the same patients

According to the review, two papers published in 2019 and 2020 reported the same results from a cohort of 247 patients. A second publication is therefore not independent confirmation.

The key limitation

Concomitant liposuction, inconsistent photographs and subjective endpoints leave the added benefit of RF unclear. A greater publication volume is not a substitute for evidence of efficacy. Critical reviews also require methodological assessment; absence of evidence does not prove lack of efficacy.

[1] Swanson 2022, PMID 35081544. Comparative data: page 12.

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Science can assess benefits alongside harms.

What do clinical series show?



ARM & NECK STUDIES [2,3]

RF-assisted upper-arm liposuction: 120 patients [2]
Tettamanzi et al. (2023): At six months, arm circumference was reduced by an average of 3.75 cm. Hyperesthesia occurred in 8.3%. Patient satisfaction improved; no brachioplasty was reported. The 27.5% figure also includes residual laxity.

RF-assisted neck contouring: 66 patients [3]
Yen et al. (2023): 62 of 66 patients (93.9%) were satisfied at six months. Burns occurred in 5/66 (7.6%), transient neuropraxia in 3/66 (4.5%), and nodules in 5/66 (7.6%). No permanent motor nerve damage was reported.

Critical appraisal: Both series combined subdermal bipolar RF with liposuction, without a control group. Circumference reduction does not establish RF-induced skin tightening, and patient satisfaction does not substitute objective comparative measurements. The independent added benefit of RF and its associated additional risks remain unclear.

[2] PMID 37314467. [3] PMID 37205298. Do not simply add complication percentages.

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Science can identify added benefit.

Combined procedures. Which effects are proven?

RF COMBINED PAPERS [4,11]

Combined neck procedures [4]
Gomez: 391 patients underwent suture suspension, usually with additional procedures; 300 received subdermal bipolar RF. Benefits and risks of the overall treatment cannot be clearly attributed to RF.

Comparison in gynaecomastia [11]
Ravindran/Suresh: 118 patients, with 59 in each group, underwent liposuction either with or without additional subdermal RF and RF microneedling. More favorable skin-tightening measurements were reported in the RF treatment group at six and twelve months.

What the comparison does not distinguish
A retrospective, non-randomised comparison of different treatment periods. Additional RF microneedling prevents clear attribution of the findings to subdermal RF alone.

Combination treatments require evidence of added benefit. These data support the combination studied, but do not demonstrate the isolated effect of individual RF components.

[4] PMID 36342786. [11] PMID 40336303, DOI 10.1093/asj/sjaf074.

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Science can put conflicting assessments into context.

Positive findings. Open questions.

LASER DATA
REVIEWS/CASE

2024 review: 23 papers [5]
Nilforoushzadeh et al. provide a largely positive assessment of subdermal 1470-nm diode lasers: adverse effects were generally mild, while larger controlled studies were recommended.

2025 review: seven papers [6]
Modena et al. examined subdermal 1470-nm diode lasers and found a high risk of bias, inconsistent treatment parameters, and potentially incomplete reporting of adverse events. They concluded that robust conclusions regarding efficacy and safety are difficult to draw.

More recent publications [12, 13]
2026 narrative review: positive assessment of subdermal 1470-nm diode lasers combined with other procedures; no original cohort. Case report: thermal skin necrosis following subdermal laser treatment; no complication rate.

Critical appraisal: The number of publications does not demonstrate quality. Positive reviews do not overcome the limitations of the individual studies. Systems and protocols must be evaluated separately, and incomplete reporting of adverse events does not support broad claims of safety.

[5] PMID 38886198. [6] PMID 39827299. [12] PMID 42153325. [13] PMID 41552195.

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Science can put safety data into context.

HIFU: What do adverse event reports tell us?

HIFU RISKS STUDY [7]

Japanese HIFU survey [7]
A total of 1,792 medical facilities were surveyed: 139 cases involving 165 adverse events were reported, including 61 burns, 49 cases of neuropathy, 10 cases of hyperpigmentation, two cases of scarring or hypertrophic scarring, and two cases of cataracts. Deep dermal burns accounted for 10% of burn cases, not 10% of all patients treated.

Microfocused ultrasound with visualisation [17]
19 studies involving 506 patients: mostly transient adverse events with one case of subcutaneous atrophy. Separately, 106 MAUDE reports involving an MFU-V system included fat atrophy, neurological injury and scarring. These were predominantly unconfirmed safety signals and do not represent a rate of "106 out of 506".

Interpretation and implications
Total treatment numbers are unavailable for both the survey and the MAUDE reports. Therefore adverse event rates or direct safety comparisons cannot be determined. Anatomy, tissue thickness, focal depth, and proximity to nerves, bone, or the eye remain critical factors; medical use does not eliminate the risk of adverse events.

[7] Kono et al. 2026. DOI 10.53045/jprs.2025-0105.
[17] Humphrey et al. 2025. Dermatol Surg. PMID 39625163; access via references.

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Science can clarify the limits of use.

Technical possibility is not an indication.

The patient's needs determine the value of treatment. Integration into plastic surgery starts with a clearly defined, evidence-based indication.

Product and application: The device model, handpiece, operating mode, combination treatment, body region and target tissue must be appropriately aligned.

Intended purpose: What indications, patient groups, and users is the product intended for? Which contraindications and warnings apply?

Evidence: Has the intended application actually been studied, using comparable technology and relevant endpoints?

Informed consent: Address expected added benefit, risks, limitations and suitable alternatives within the overall surgical treatment plan.

Compliance with the EU Medical Device Regulation (MDR) applies to the defined intended purpose. Studies do not automatically extend this purpose; uses outside its scope require separate assessment. [9]

[9] Regulation (EU) 2017/745: Article 2(12), Article 7; Annex I, Section 23.4.

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Science can take safety signals seriously.

RF microneedling: the FDA warning.

FDA WARNING
RF NEEDLING

On **15 October 2025**, the FDA reported serious complications associated with certain uses of RF microneedling: burns, scarring, fat loss, disfigurement and nerve damage, sometimes requiring medical or surgical intervention. [8]

Distinguishing between procedures: RF microneedling uses needles, subdermal RF uses a probe beneath the skin, and non-invasive RF uses external electrodes. The warning does not apply to all RF procedures.

Read data critically: Spontaneous reports without the total number of treatments do not provide a reliable complication rate.

For clinical practice: Device selection, indication, and safety measures should be assessed together. Adverse events should not automatically be attributed to operator error.

Successful integration also requires recognizing limitations, informing patients about risks, and ensuring competent management of complications.

[8] FDA Safety Communication, 15 October 2025. Original via the QR code above.

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Science can put clinical experience into perspective.

Energy-based and thermal procedures: What harm can occur?

Choosing the right technology is crucial: not every procedure is suitable for every indication.

An unsuitable choice of system or incorrect application can cause superficial, deep and, in some cases, permanent damage.

01 **Burns and necrosis.** Blistering and tissue loss with RF/laser; burns also occur with HIFU/MFU. [S1-S3]

02 **Scarring and tissue distortion.** Scars and tissue traction; outward turning of the lower eyelid (ectropion) can also occur after laser resurfacing. [S1, S3]

03 **Changes in pigmentation and skin appearance.** Discolouration and skin irregularities after laser, RF microneedling or nitrogen plasma. [S3, S8, S9]

04 **Unintended fat loss.** Depressions and asymmetry due to loss of subcutaneous fat have been reported with RF microneedling. [S1]

05 **Nerve damage.** Numbness or functional impairment with RF microneedling and HIFU/MFU; sometimes permanent. [S1, S2]

06 **Impaired healing and infections.** Delayed healing, infections and scarring, for example after ablative laser treatment. [S3]

07 **Eye damage.** Laser/light can cause permanent visual impairment when protection is inadequate. [S2, S4]

Supplementary references [S1-S9]: page 18.

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Science can reveal differences.

Other procedures, distinct risks

08 **Microwaves.** Burns, blisters, nodules and temporary sensory disturbances; depending on the system. [S7]

09 **Electrical stimulation.** Skin irritation, burns, interference with active implants; observe contraindications. [S5]

10 **Magnetic stimulation.** Muscle soreness, cramps; observe contraindications involving active implants and metal. [S2]

11 **Shock and pressure waves.** Pain, bruising; depending on wave type, dose and target area. [S2, S6]

12 **Cryolipolysis.** Cold injuries, persistent numbness; paradoxical adipose tissue growth rather than fat reduction. [S2]

Research enables progress. Research and insights from clinical practice contribute to the continuous improvement of technologies. New and refined procedures must be assessed for benefit and safety. Not every procedure carries every risk. A complication alone does not establish operator error. This selection provides no frequency data and is not exhaustive.

Before purchasing, consider not only demonstrated efficacy and suitability for your indications, but also safety and control functions with documented testing, as well as precisely dosed and monitored energy delivery. Ask me! I will help you choose the right technology.

[S1] FDA: RF-Microneedling, 15 October 2025. [S2] FDA: Non-Invasive Body Contouring Technologies. [S3] Laser: PMID 19291745; 9537005; 41063540. [S4] Eye: PMID 26418330. [S5] FDA: Powered Muscle Stimulator 510(k)s, 1999. [S6] ESWT: PMID 36226364. [S7] Microwaves: PMCID PMC11672876 (expert recommendations). [S8] Nitrogen plasma: PMID 30146783; 19451453. [S9] RF-Microneedling: PMID 38282120.

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Science can strengthen a specialty.

Surgical expertise goes beyond the operating table.

Plastic surgery assesses anatomy, tissue characteristics, and the limits of treatment. Energy-based procedures can broaden the range of treatment options when integrated into a comprehensive, physician-led treatment plan.

Before treatment: Assess clinical findings, previous treatments and target tissue. Make a reasoned choice between surgery, an adjunctive procedure or no intervention at this stage.

During treatment: Document treatment parameters, tissue responses, and outcomes. Proper training and procedure-specific experience cannot be replaced by specialist qualifications alone.

Within the team: Clearly assess which procedures can be delegated, staff qualifications, medical responsibility and supervision arrangements.

If problems arise: Establish clear arrangements for availability, follow-up care and complication management.

Individual procedures cannot replace comprehensive patient care. Professional expertise is defined by well-founded treatment choices and responsibility throughout the entire course of care.

Conceptual framework [A, C]; safety and user requirements: [8, 9].

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Science can look beyond the procedure.

Surgery corrects. Ageing continues.

Skin quality, elasticity and tissue organisation continue to change after surgery. Plastic surgery therefore has a role in long-term patient care.

An integrated treatment pathway
Surgery, follow-up, scar treatment and appropriate energy-based adjunctive treatments require coordination in timing and tissue biology. They do not replace necessary surgery.

Long-term care for established patients
Regular follow-up assessments can identify emerging new needs at an early stage. Clinically justified treatments for improving tissue quality support continuity of care and can strengthen long-term patient relationships.

Develop the specialty
A gap in care may arise between surgery and the need for further corrective treatment. Integrated approaches strengthen the role of plastic surgery in a market of stand-alone treatments.

Energy-based procedures can thus become part of long-term care. Their use follows an indication, not a predetermined repeat-treatment schedule.

Perspective on care: specialist article Part 3 and Practice Concepts & Returns. [A, B]

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Science can guide a clear-eyed investment appraisal.

What does the treatment plan cost?

Good technology need not be expensive. Manufacturers place different levels of emphasis on research, development and marketing. Suppliers relatively unknown in Germany may have been well established internationally for decades.

Brand recognition, price, colleagues' recommendations or a limited marketing presence are not indicators of quality. Verifiable quality, safety, evidence, service and total costs are decisive.

Acquisition: Device, handpieces, accessories, installation and financing.

Operating costs: Consumables, handpiece lifespan, maintenance, software and downtime. Assess **delegation to practice staff**, including qualifications, medical responsibility and supervision requirements.

Staffing and utilisation: Allow realistic time for treatment, preparation, documentation, training and follow-up care. Consider the initial implementation phase, patient suitability, and actual demand.

Sustainable services are those that meet a need within the treatment pathway and are delivered competently. Unused additional features create no clinical value.

Selection and economics: Practice Concepts & Returns and specialist article Part 3. [A, B]

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Science can inform decisions.

Seven questions before you sign.

01 Patient need: What need does it address within the surgical care pathway?

02 Evidence: What added benefit is established, and what uncertainty remains?

03 Intended purpose: Does it match the indication, target tissue and application?

04 Control: Is energy delivery precise, reproducible and documentable? Which risks does the system detect?

05 Expertise: Have training, delegation, treatment termination criteria, follow-up care, and complication management been clearly defined?

06 Total costs: Is the treatment concept financially viable based on realistic demand and staffing requirements?

07 Continuity: How are treatment outcomes, progress, and the need for further treatment assessed?

Looking ahead, expertise in energy-based procedures belongs within a plastic surgical treatment concept. Well-founded complementary treatments and long-term responsibility strengthen the specialty.

Energy delivery and safety: [9], Annex I, Section 21; use: [8]. Context: [A-D].

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Notes

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Science can remain open to scrutiny.

References and further reading

[1] Swanson. Subdermal RF, review. 2022. PMID 35081544. Access: page 10.
[2] Tettamanzi et al. RF-assisted upper-arm liposuction. 2023. PMID 37314467.
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The author's background articles on intercosmed.de (German):

[A] Specialist articles: Part 1 · Part 2 · Part 3 (access: page 3)
[B] Practice Concepts & Returns · [C] Technology Expertise
[D] Science & Clinical Evidence (access: page 9)

Disclosure: Owner and Managing Director of Intercosmed GmbH (technology distribution and manufacturer of selected products); potential financial conflicts of interest.

Selected literature for further reading. Original sources are accessible via links and page references. This is a topic-based selection, not a systematic literature search.

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Beate Scheffler



Biologist (Diplom)

Specialization:
Medical microbiology

Technology expertise.
Beyond blind faith.

DIGITAL
EDITION (DE)

Her career led her into the medical and scientific sector early on. As the former managing director of a company with around 200 employees, she worked with clients including the Thieme Publishing Group (now Thieme Group).

Since 1999, Beate Scheffler has specialized in medical aesthetic technologies. She trains doctors and professional aesthetic practitioners and engages in international professional exchange. Tissue is her benchmark: which mechanism of action is biologically plausible, clinically established and appropriate for the treatment goal?

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