Radiofrequency

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The following potential conflict of interest relationships are germane to my presentation.

Speaker's Bureau and Investigator: Candela/Syneron

Radiofrequency

• Form of electromagnetic energy ranging from 300 MHz- 3 KHz
• Similar to laser and light in that tissue interaction induces thermal changes
• RF devices generate heat as a result of tissue resistance to movement of electrons within the RF field
Science of Radiofrequency

- Current is formed when charged particles flow through a closed circuit.
- Electric current, rather than a light source
- Electrical field shifts polarity of charged particles, changing their orientation

Science of Radiofrequency

- Tissue resistance to particle movement generates heat
- Electricity follows a path of least resistance ... known as impedance
- Impedance is directionally proportional to heat
  - The warmer a structure is, the more it attracts current
  - Cold repels current

Radiofrequency Energy

Operates on principle of Ohm’s Law

\[
\text{Energy} = \text{current}^2 \times \text{impedance} \times \text{time}
\]

\( \text{energy} \) (joules) \times \text{current} \) (amps) \times \text{impedance} \) (ohms) \times \text{time} \) (sec)
Radiofrequency Depth

• Dependent on number of factors:
  – Configuration of RF electrodes (monopolar vs. bipolar)
  – Conduction medium
    • Fat
    • Blood
    • Skin
  – Temperature
  – Frequency

Radiofrequency

• Flow of radiofrequency through skin related to water content of skin
• Water content of skin dependent upon:
  – Area of body
  – Time of day
  – Humidity
  – Internal hydration
  – Topical agents

Conductivity

• Electric conductivity varies among tissue
  – Blood and wet skin increase conductivity
  – Fat, bone, and dry skin decrease conductivity
• Tissue conductivity influenced by temperature
  – Every 1°C increase in temperature lowers skin impedance by 2%
Radiofrequency Energy

- Radiofrequency can deliver high energy fluences to greater tissue area than nonablative
- Penetrates deeper into dermis, subcutaneous tissue or hair follicle without impacting the epidermis
- Can be used on all skin types (Fitzpatrick I – VI)

Radiofrequency Energy

- Laser energy depends on chromophore of skin to achieve thermal destruction of target
- Radiofrequency depends on electrical properties of tissue
- Heat arises from a current of ions rather than by absorption of photons
- Not scattered by tissue or absorbed by melanin


Radiofrequency Treatments

- Usually require a series of treatments with multiple passes for desired result
- Possible complications include epidermal burns and fat atrophy or indentations as a result of too much energy delivered to an area
- Pain management essential and indicator of clinical endpoint
**Collagen Production**

- Radiofrequency energy causes collagen fibrils to contract immediately after treatment
- Production of new collagen induced by tissue contraction and wound healing


**Collagen Contraction**

- Arrhenius equation
  
  \[ K = A \times \exp(-\frac{E_a}{RT}) \]
  
  - \( K \): rate
  - \( E_a \): activation energy
  - \( T \): temperature


- Arrhenius equation show:
  - For every 5°C decrease in temperature, a 10-fold increase in time is needed to achieve collagen contraction
  - At longer exposure, immediate contraction is possible at lower temperatures
Effect of Radiofrequency


- Higher treatment fluences led to improved results
- The greater the surface area treated, the better the results
- Younger age predictor of increased efficacy

Monopolar Radiofrequency

- Energy travels from active electrode through body into grounding plate
- High power density with deep penetration
- Delivers uniform heating at controlled depths to deep dermis and subdermal skin
- Causes immediate collagen contraction and subsequent dermal remodelling

Bipolar Radiofrequency

- Current flows between two identical electrodes set a small distance apart
- Depth of penetration limited to have the electrode distance
Combined Electrical & Optical Energy

- Selective electrothermolysis
- Bipolar radiofrequency combined with either IPL, diode, or Infrared
- Mechanism of action:
  - RF component penetrates skin \( \frac{1}{2} \) distance between bipolar electrodes, heating deeper tissues
  - Diode- superficial lentigines/telangiectasias
  - Infrared- collagen
- Theory that target is preheated with optical energy have greater conductivity, less resistance, greater selective heating

Hybrid Monopolar & Bipolar RF

- Monopolar heats via rotation of water in the current of the electromagnetic field
- Results in volumetric heating at deep levels (20 mm)
- Bipolar more superficial (2-6 mm) localized heating via tissue resistance to RF current

Vacuum Assisted Bipolar RF

- Bipolar RF and functional aspiration controlled electrothermal stimulation
- Theory that suction allows more targeted treatments utilizing lower energy
- Physical action of suction may also lead to collagen formation
### Radiofrequency Devices

- ThermaCool (Thermage): monopolar RF
- Aluma (Lumenis): bipolar RF, vacuum assisted
- Accent XL (Alma): unipolar & bipolar RF
- EndyMed PRO (Eclipse Med): unipolar & bipolar RF
- VelaSmooth (Syneron): vacuum, bipolar RF, IR
- ReFirme ST (Syneron): bipolar RF and IR
- VelaShape (Syneron): bipolar RF, IR, mechanical massage

### Patient Indications for RF

- 30-70 years
- Medium skin thickness
- Mild to moderate skin laxity
- All skin types

### Contraindications

- Pregnancy
- Pacemaker
- Low pain tolerance
- Unrealistic expectations
Side Effects & Complications

- Discomfort during and after treatment
- Edema
- Blistering
- Scarring
- No improvements
- “Fat atrophy”

Electro-Optical Synergy

- Blend of optical and electrical radiofrequency energies simultaneously to tissue
  - Creates synergistic effect between two forms of energy
  - Lower levels of both energies used reducing the risk of side effects associated with either modality alone


Electrical Optical Synergy

- Preheats the target utilizing appropriate wavelengths (580 nm – 980nm)
- Lowers the target’s impedance
- Directs the RF energy to the target tissue
- Can be used on all skin types (Fitzpatrick I – VI)
Clinical Studies: Electro-Optical Synergy

- Skin rejuvenation
- N=100, skin types II-IV
- Treatment settings Aurora SR
  - Optical 28-34 J/cm²
  - RF 20 J/cm²
- Improvement in erythema and telangiectasias (70%), lentigines and other hyperpigmentations (78%), average wrinkle reduction 60%


Clinical Studies: Monopolar Radiofrequency

- Objective: evaluate efficacy of monopolar RF for treatment of eyelids
- N=72
- One treatment with follow-up for 6 months
- Upper eyelid tightening and reduction of hooding noted in 88% and 86% of subjects
- Lower lid tightening noted in 71-74% of subjects
- Most patients achieved at least 25% improvement


Before & After Photos
Radiofrequency by Thermage

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Radiofrequency by Thermage

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Electrical Optical Synergy

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**Bipolar Radiofrequency by Aluma**

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