



Tehran Jarah Novin Co. Presents:

Electrosurgery

Introduction, application & Hazards

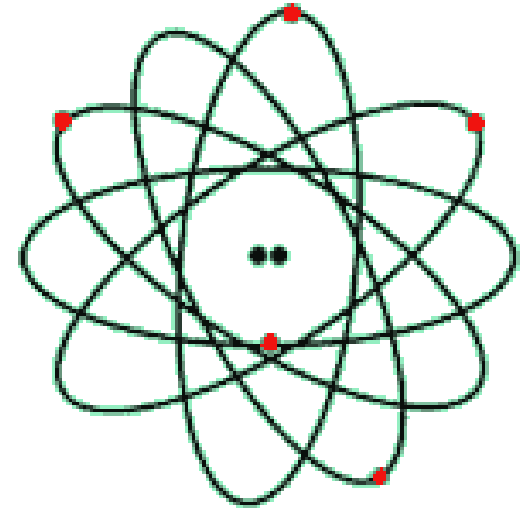
By: Eng. Ehsan Abbasi

Medtronic



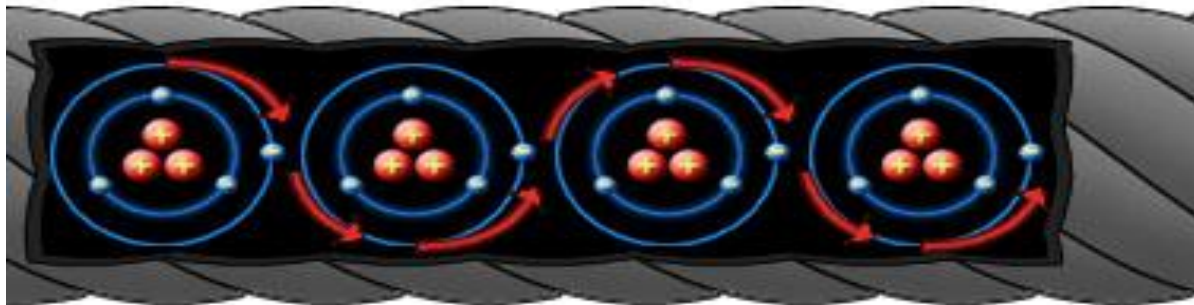
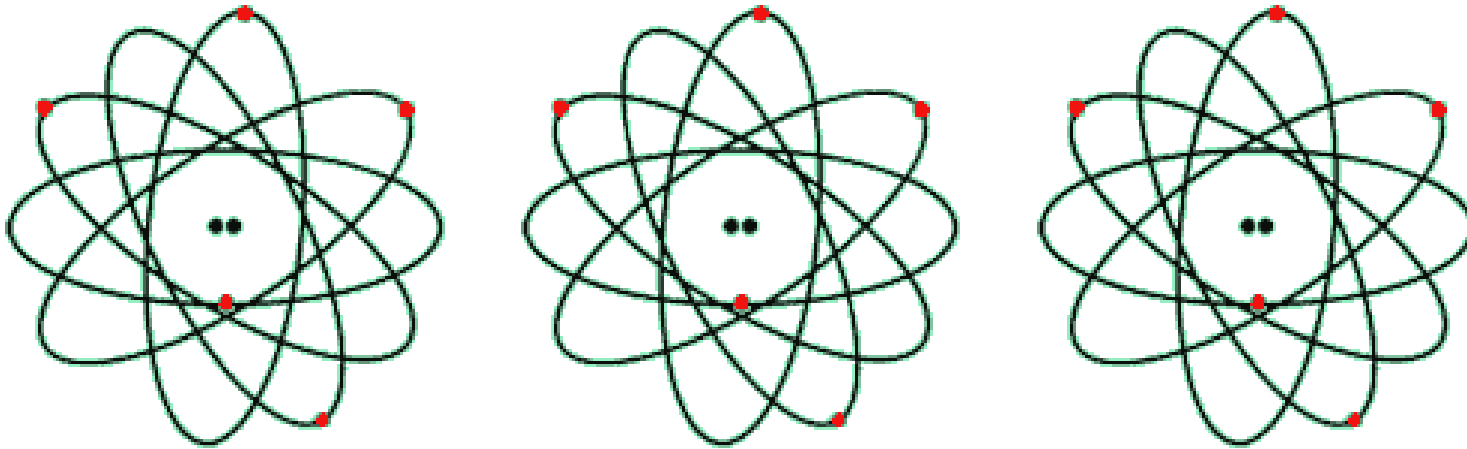
What is electricity

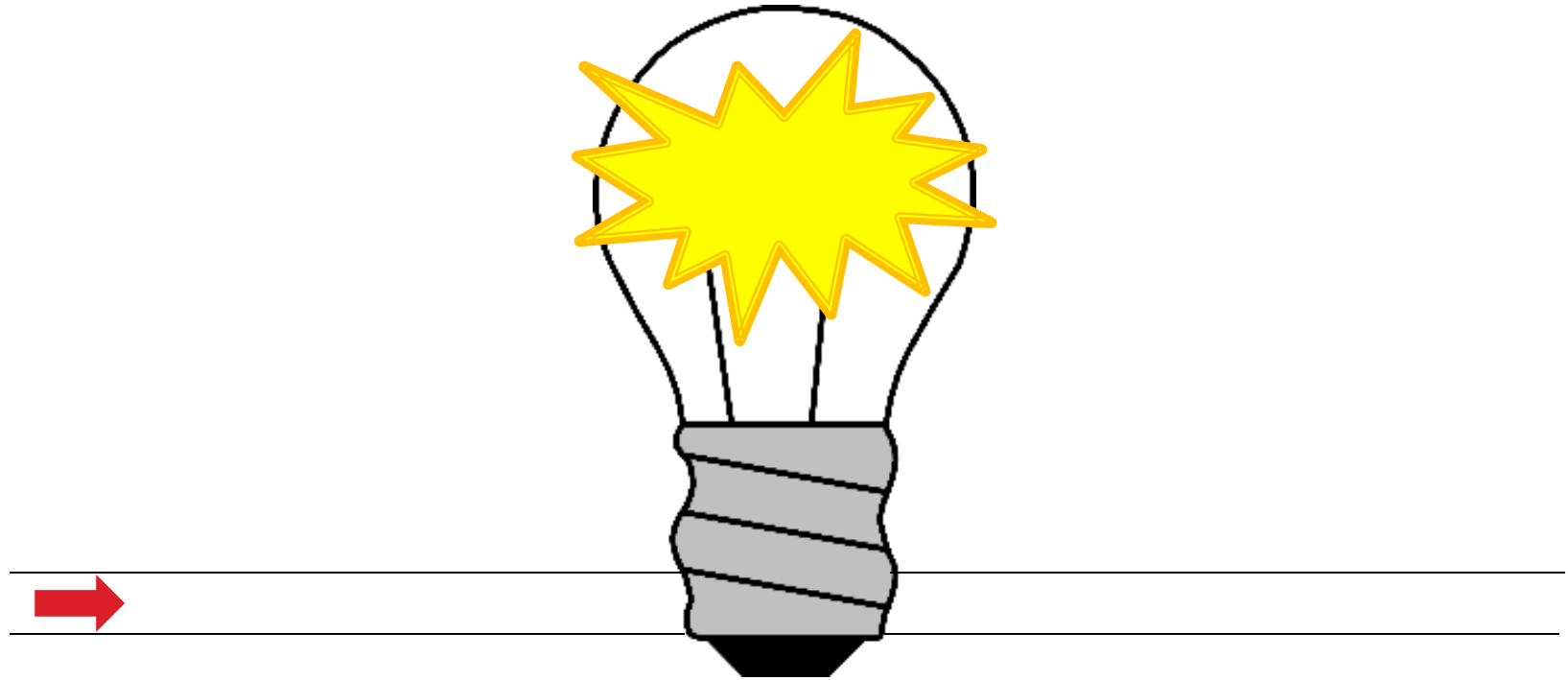
- ▶ Atoms
- ▶ Electrons
- ▶ Protons
- ▶ Neutrons
- ▶ Equal Number in Electrons and Protons = neutral Atom



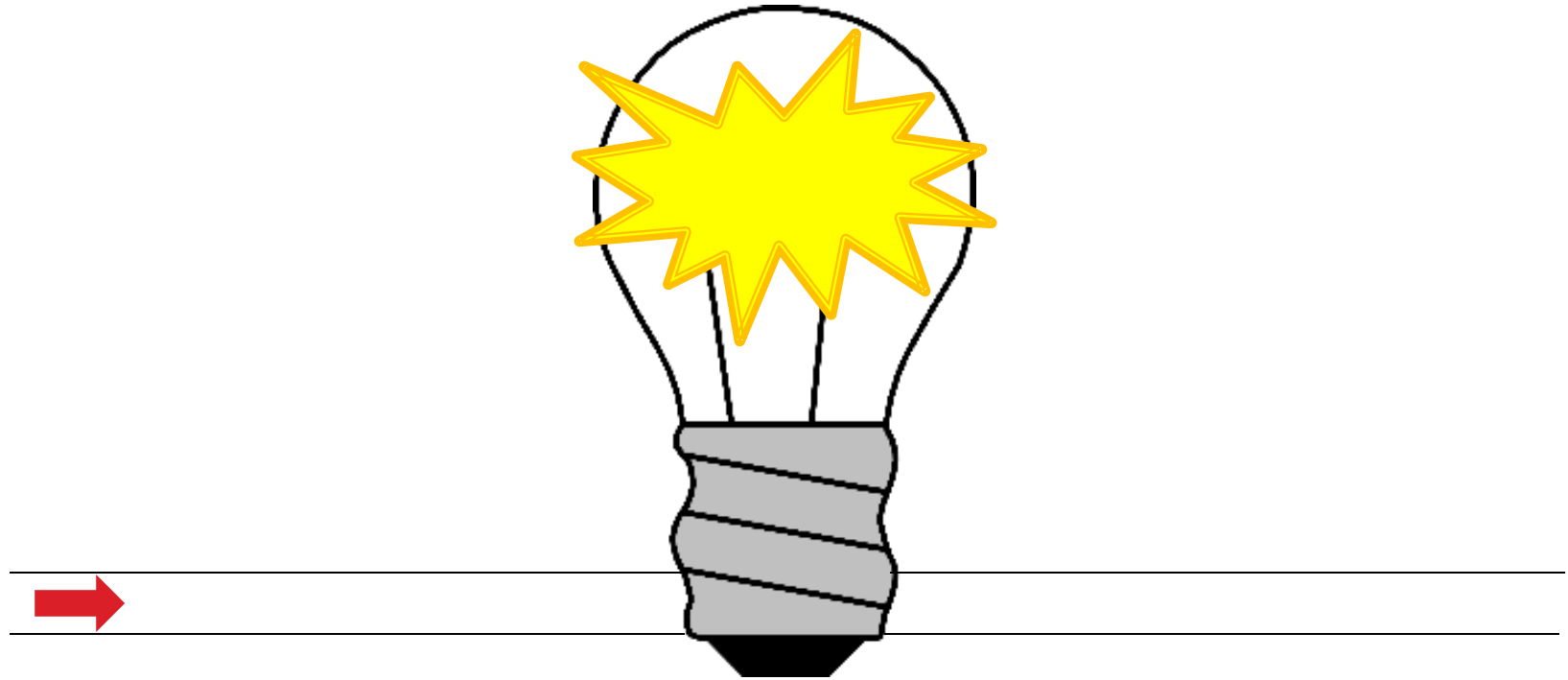
WHAT IS ELECTRICITY

- ▶ Electricity can be created by forcing electrons to flow from atom to atom.

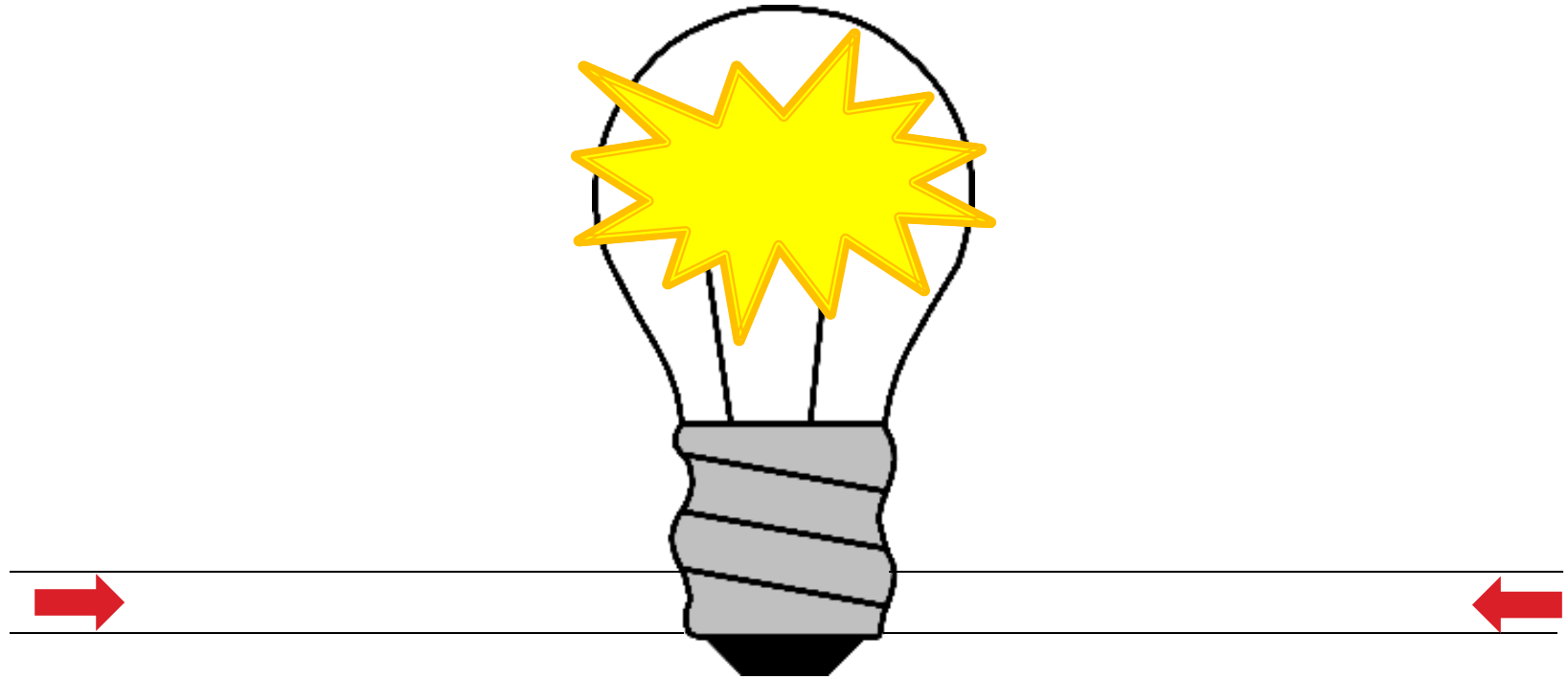




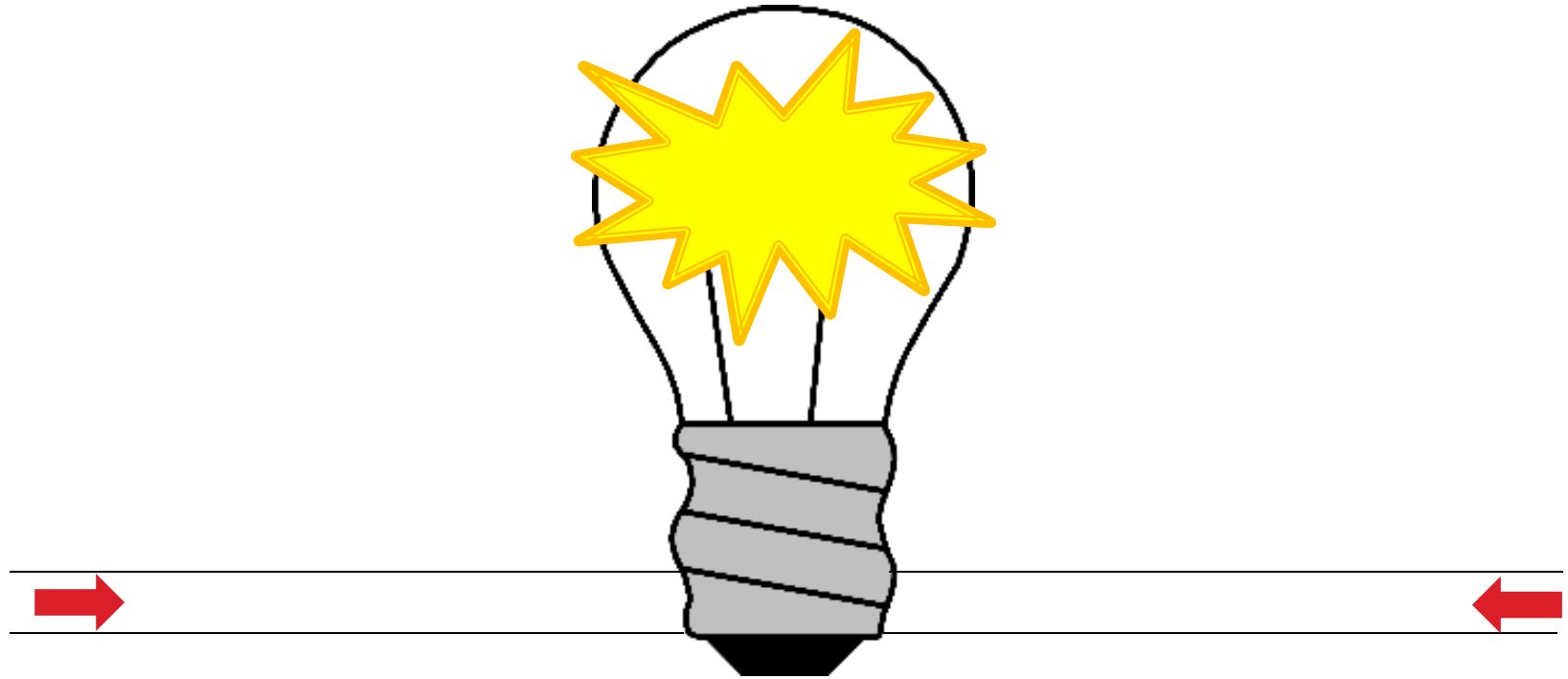
DC
(Direct Current)



DC
(Direct Current)

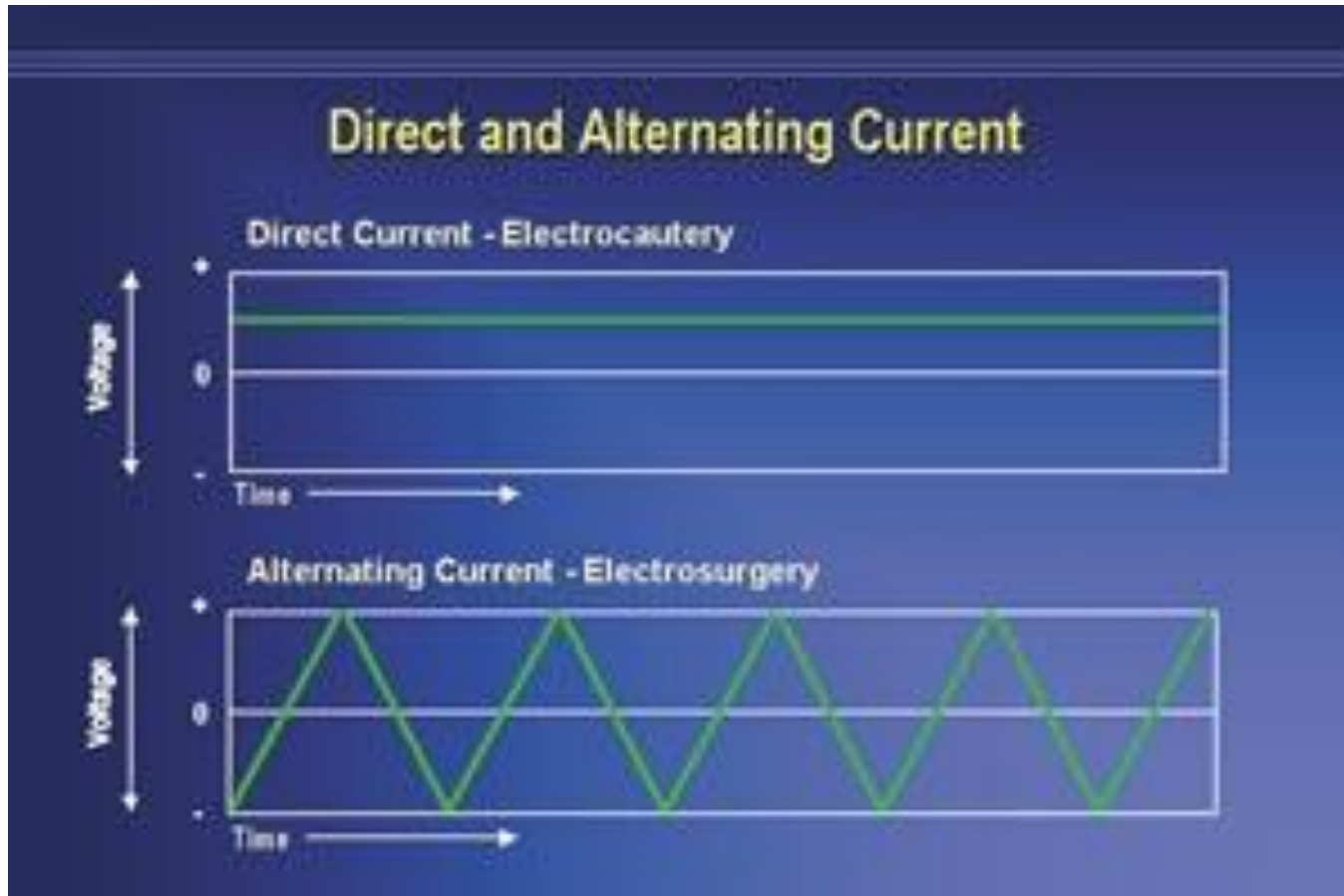


AC
(Alternative Current)



AC
(Alternative Current)

Electrical current



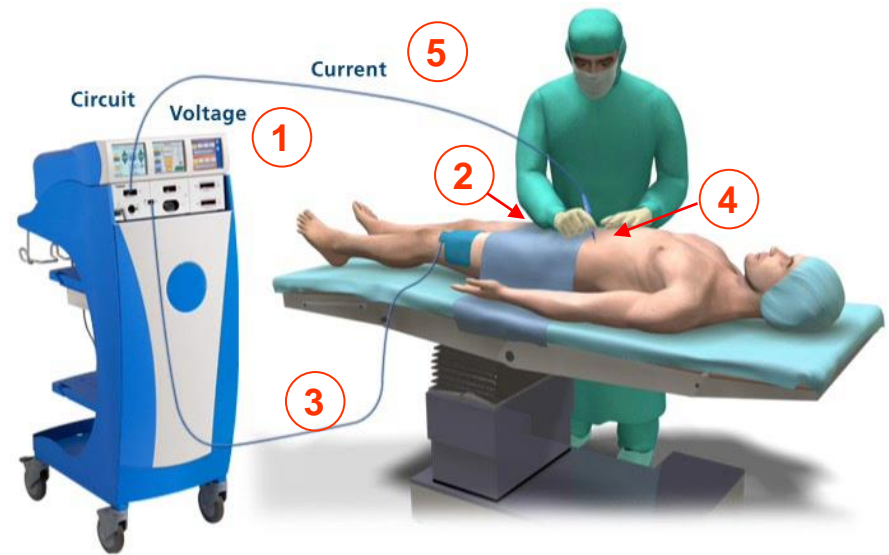
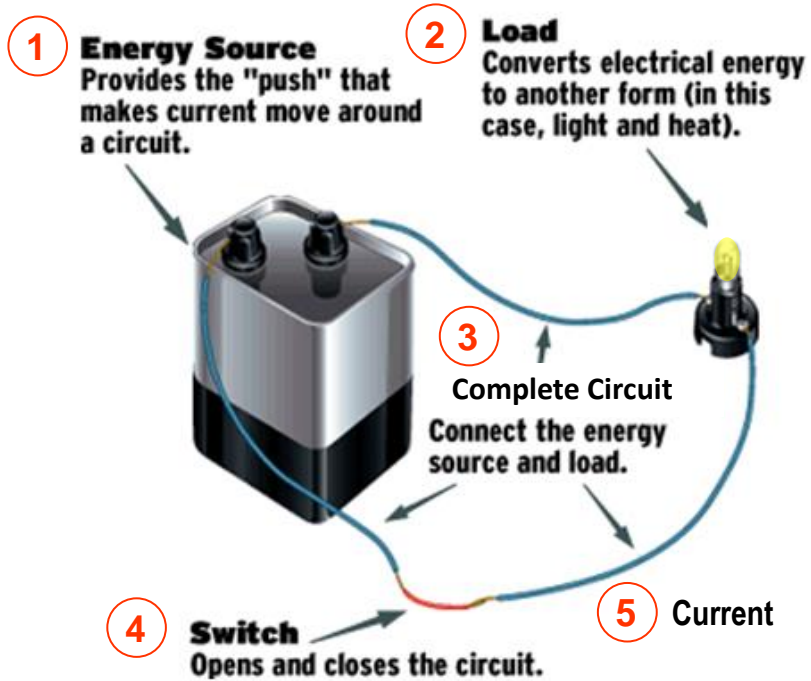
Measuring Electricity

- ▣ **Voltage : Volts – V**
 - ▣ Force pushing current through the resistance,
 - ▣ measured in Volts
- ▣ **Current : Amperes – I**
 - ▣ Flow of electrons during a period of time,
 - ▣ measured in amperes
- ▣ **Resistance : Ohm – Ω**
 - ▣ Obstacle to the flow of current, measured in ohms
 - ▣ (impedance = resistance)
- ▣ **Power : Watts – P** **$P=I \times V$**

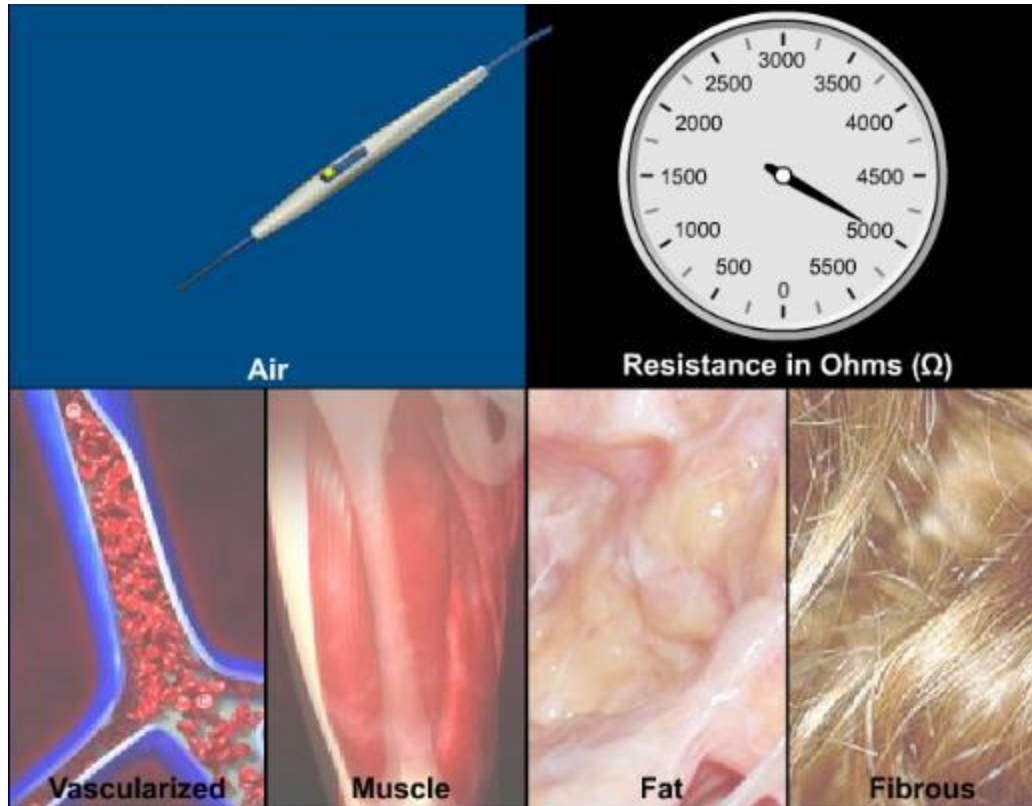
- ▣ **Frequency : Hertz – HZ**

Electrical Circuit

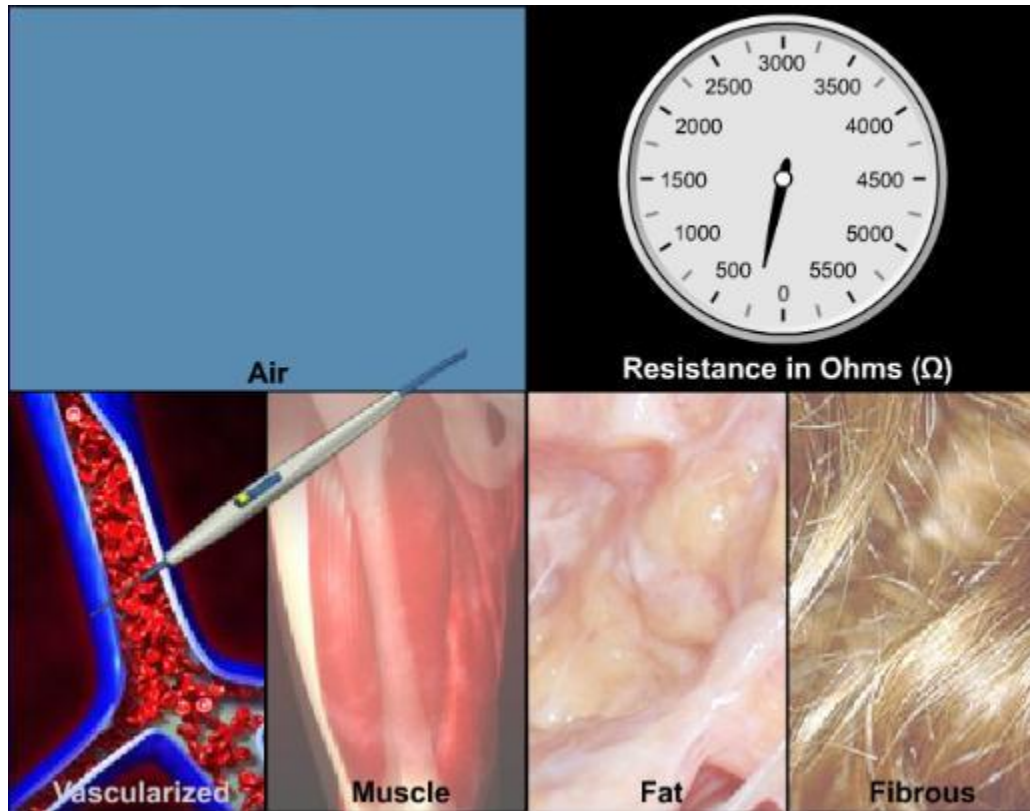
Four Parts of the Circuit



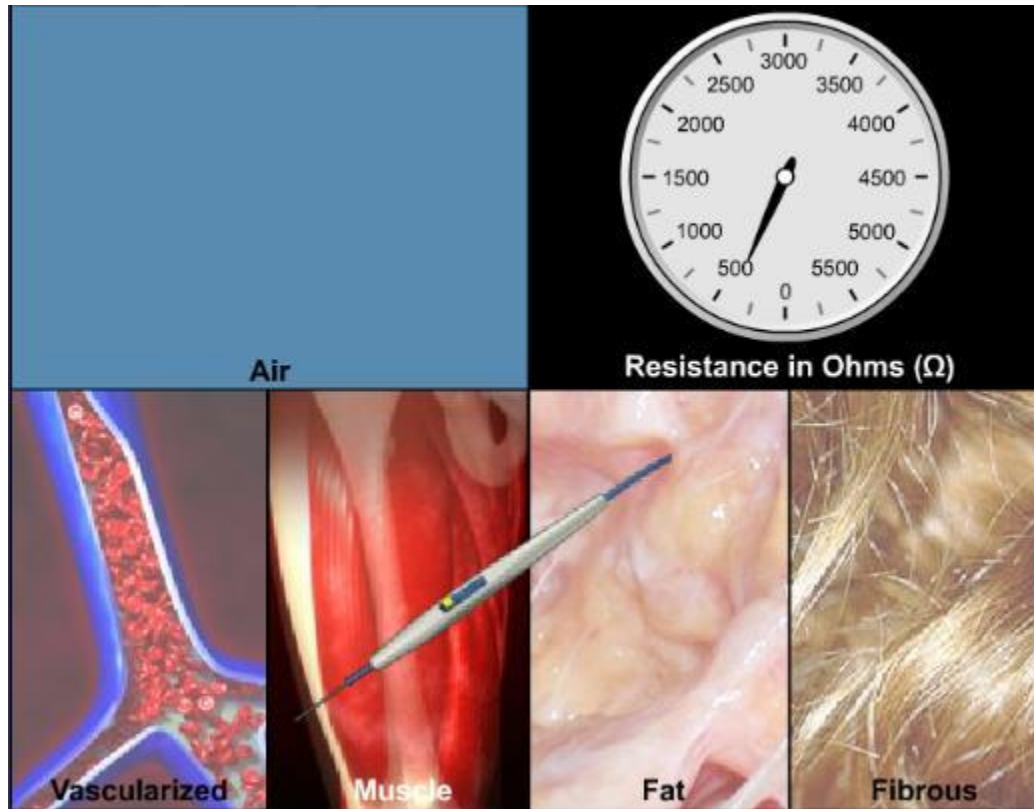
Resistance in different Tissues



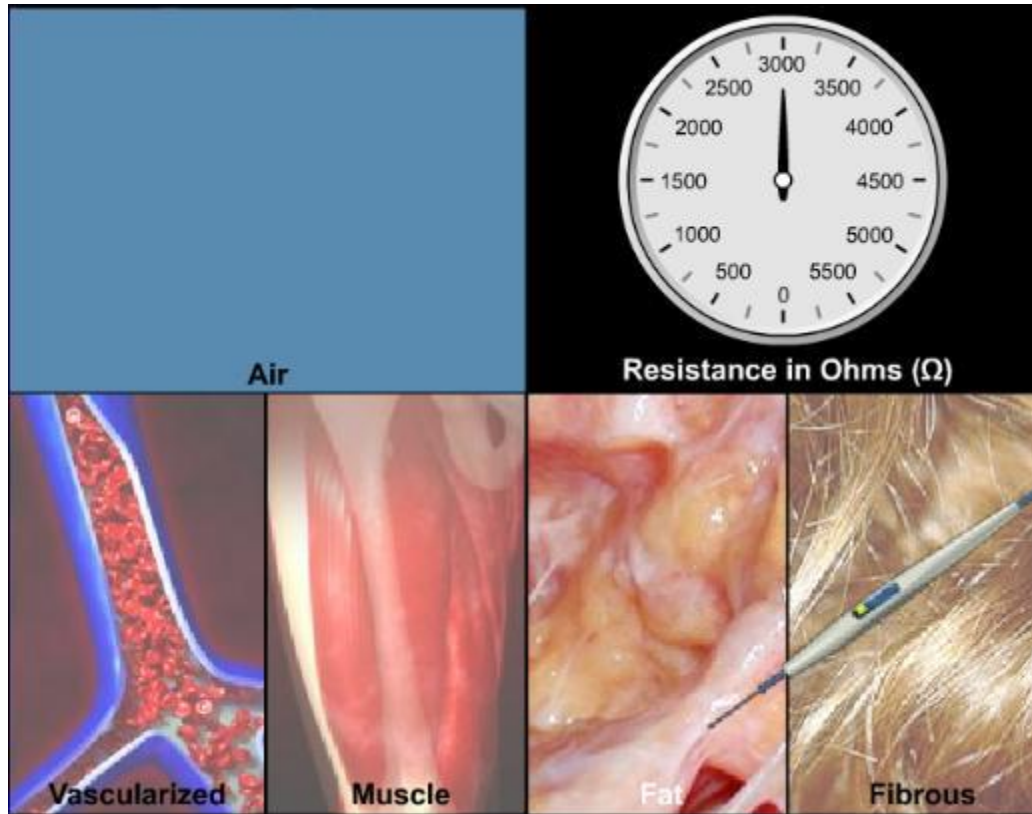
Resistance in different Tissues



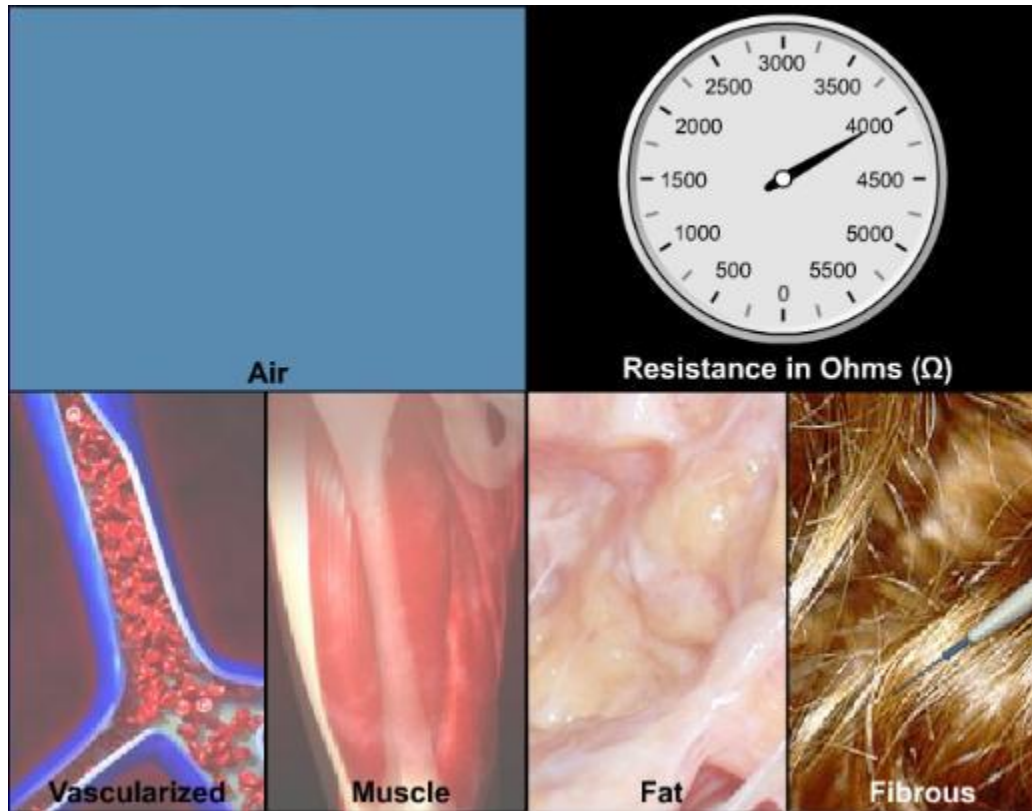
Resistance in different Tissues



Resistance in different Tissues



Resistance in different Tissues



Primary Rules : Electricity Always

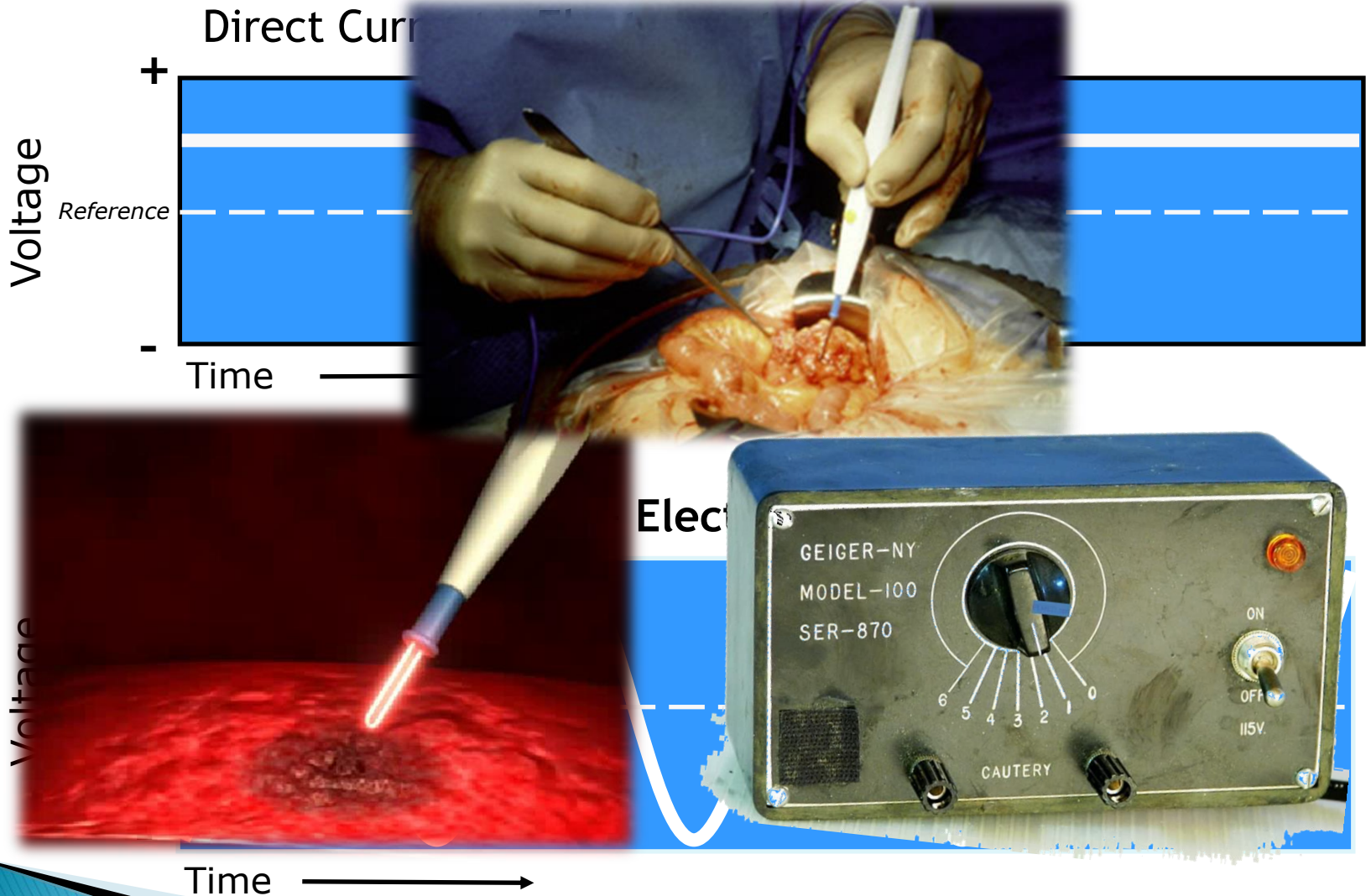
- ▶ Flows to ground
- ▶ Follow path of least resistance .



Electrosurgery To control Blood loss

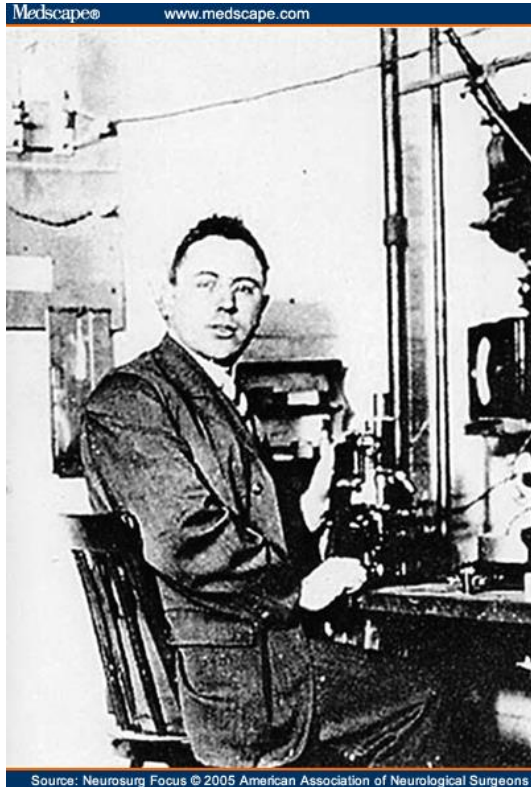


Direct and Alternating Current



Medtronic

▶ Developed in 1926 by



Dr. William Bovie, a Harvard physicist



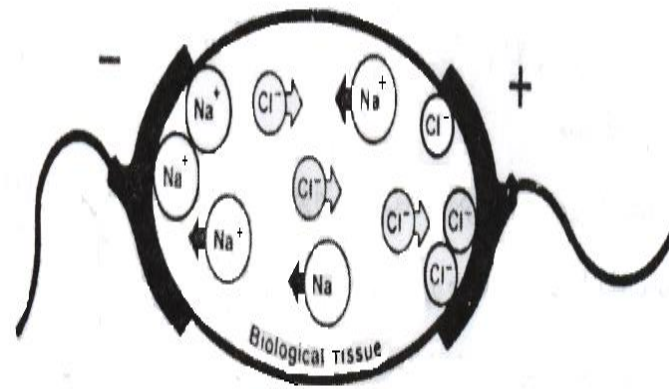
Dr. Harvey Cushing (a neurosurgeon)

Electrical current effect

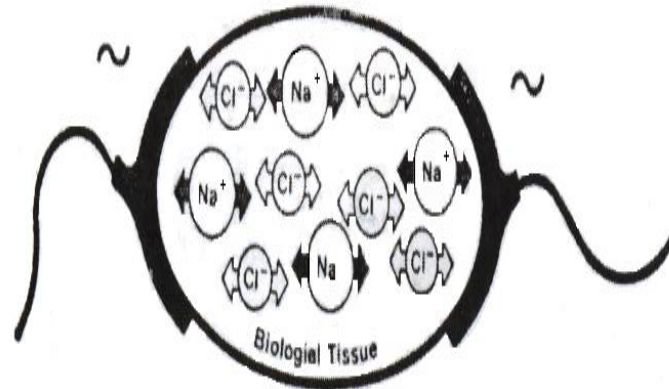
- ▶ – Electrolyte
- ▶ – Faradic
- ▶ – Thermal

Electrical current effect

- DC current -
ionizing

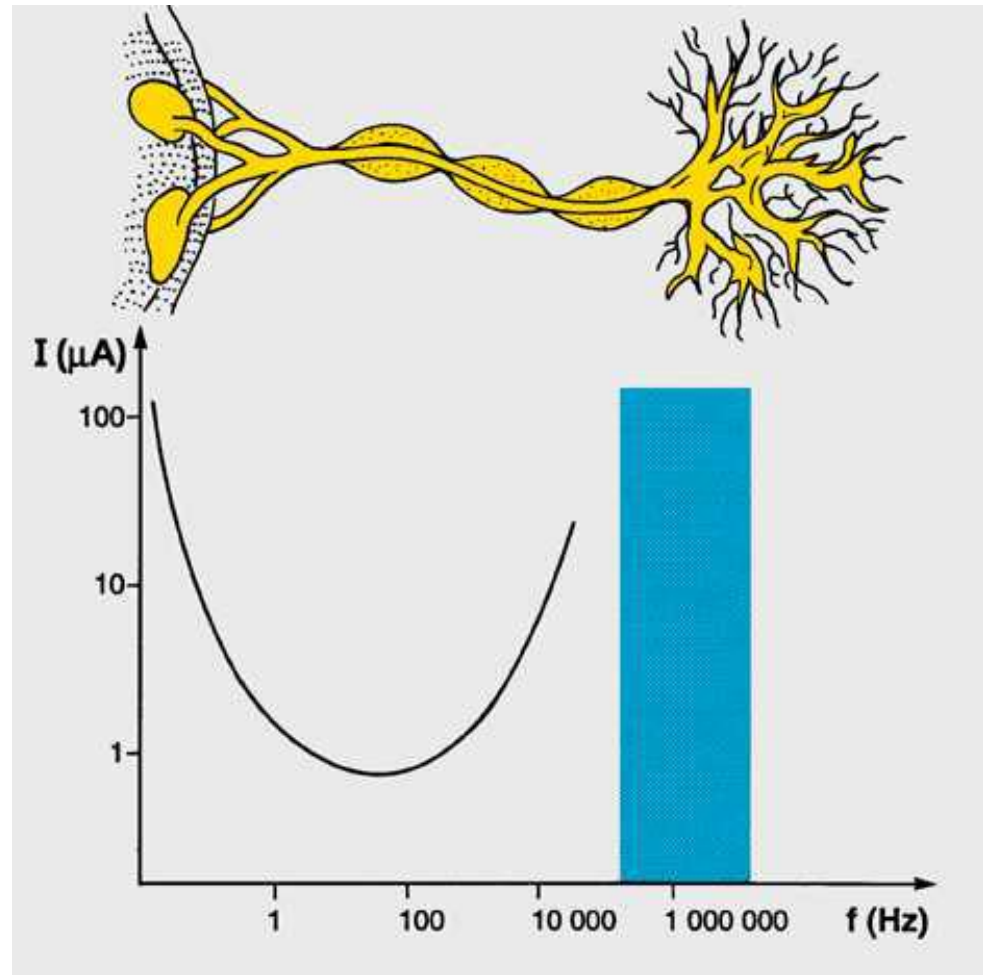


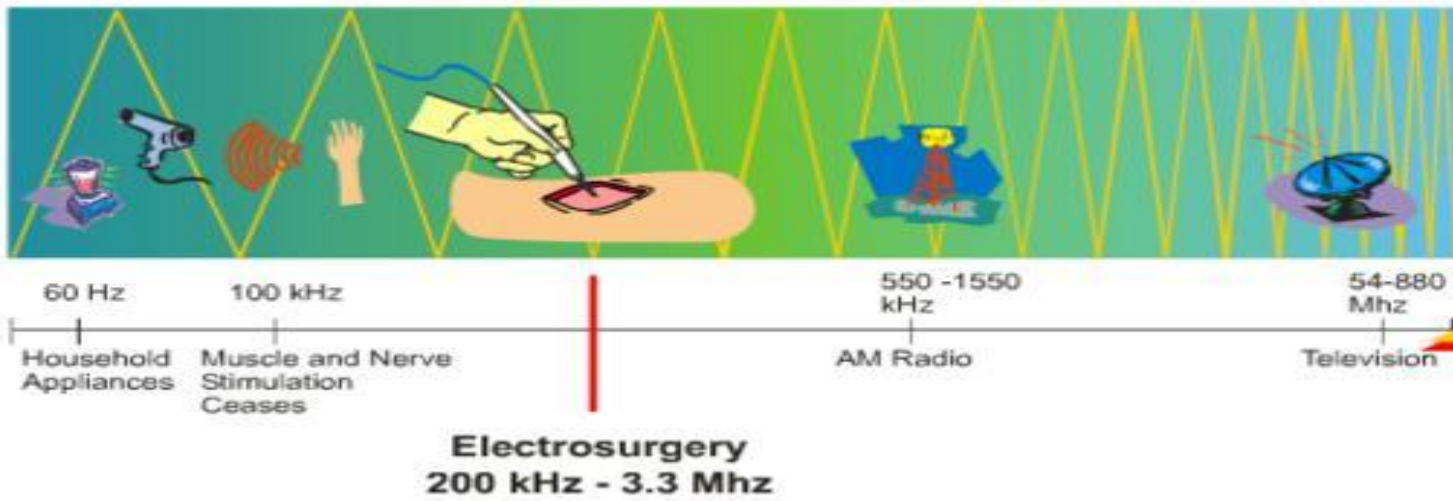
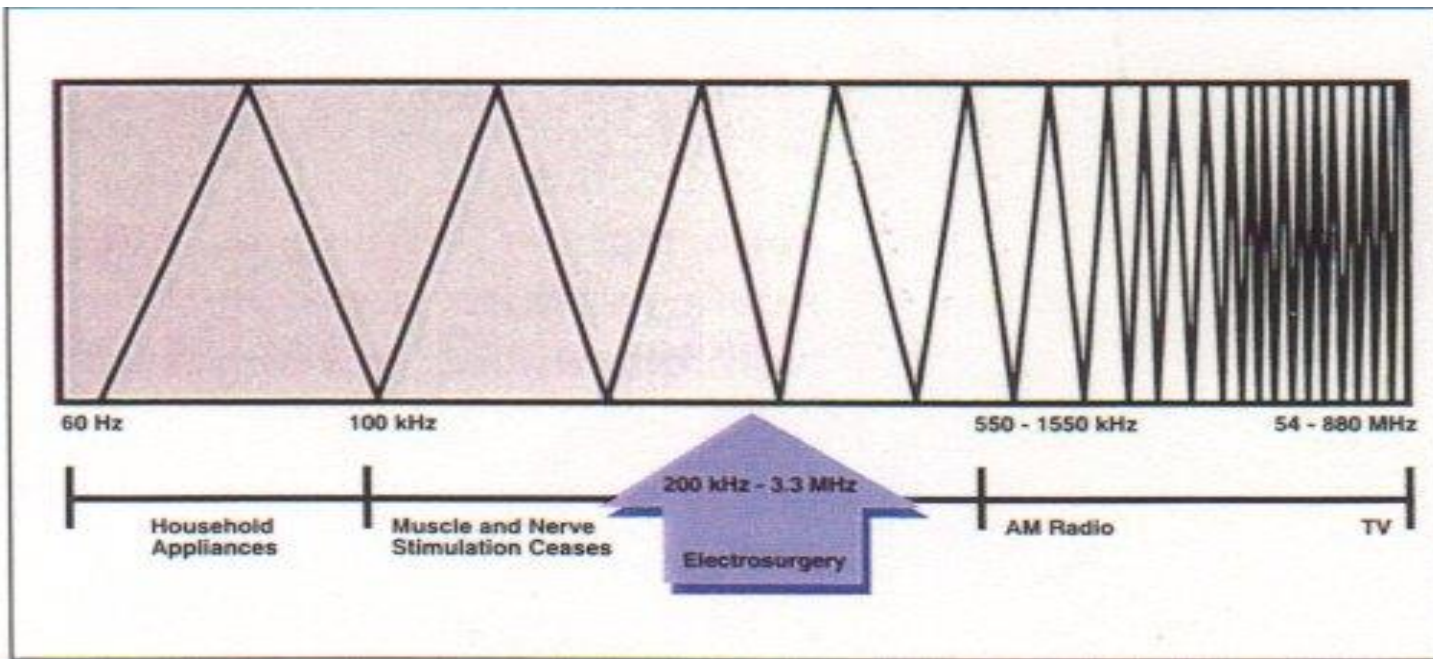
- - AC current -
Vibration



Electrical current effect

- ▶ – Faradic





Types of Electrosurgical Generators:

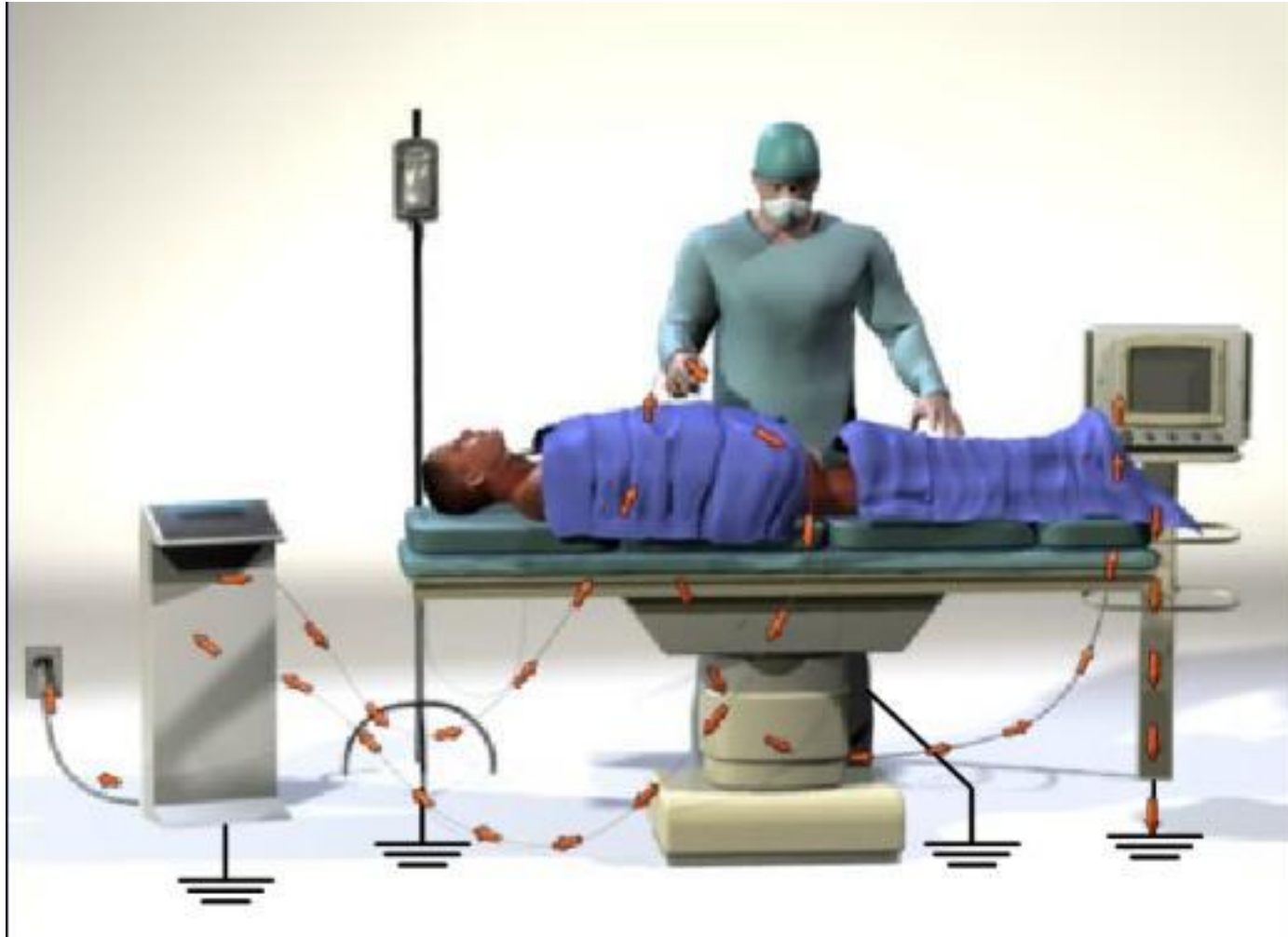
- Grounded Systems
- Isolated Systems

Grounded System



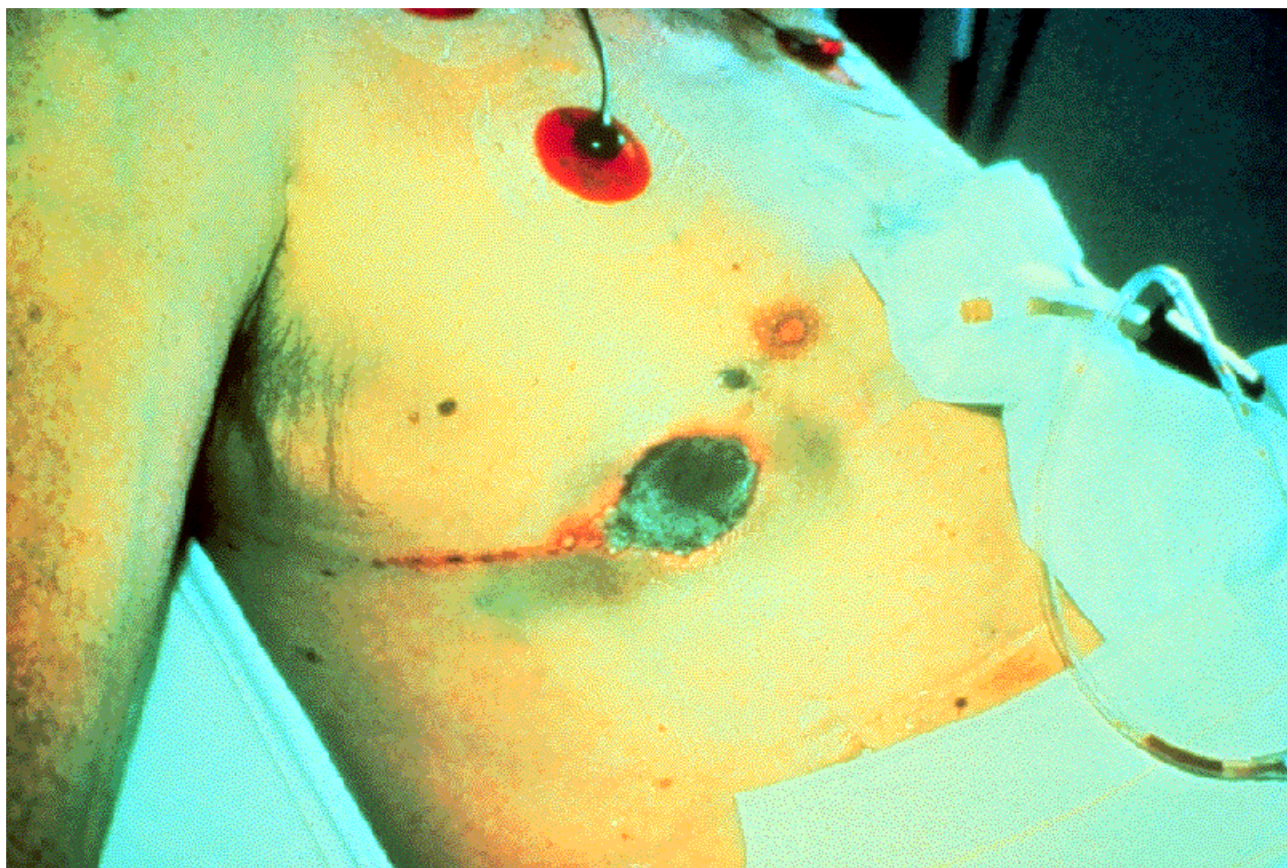
Medtronic

Why Alternate Site Injuries Occur



Medtronic

Alternate Site Injuries



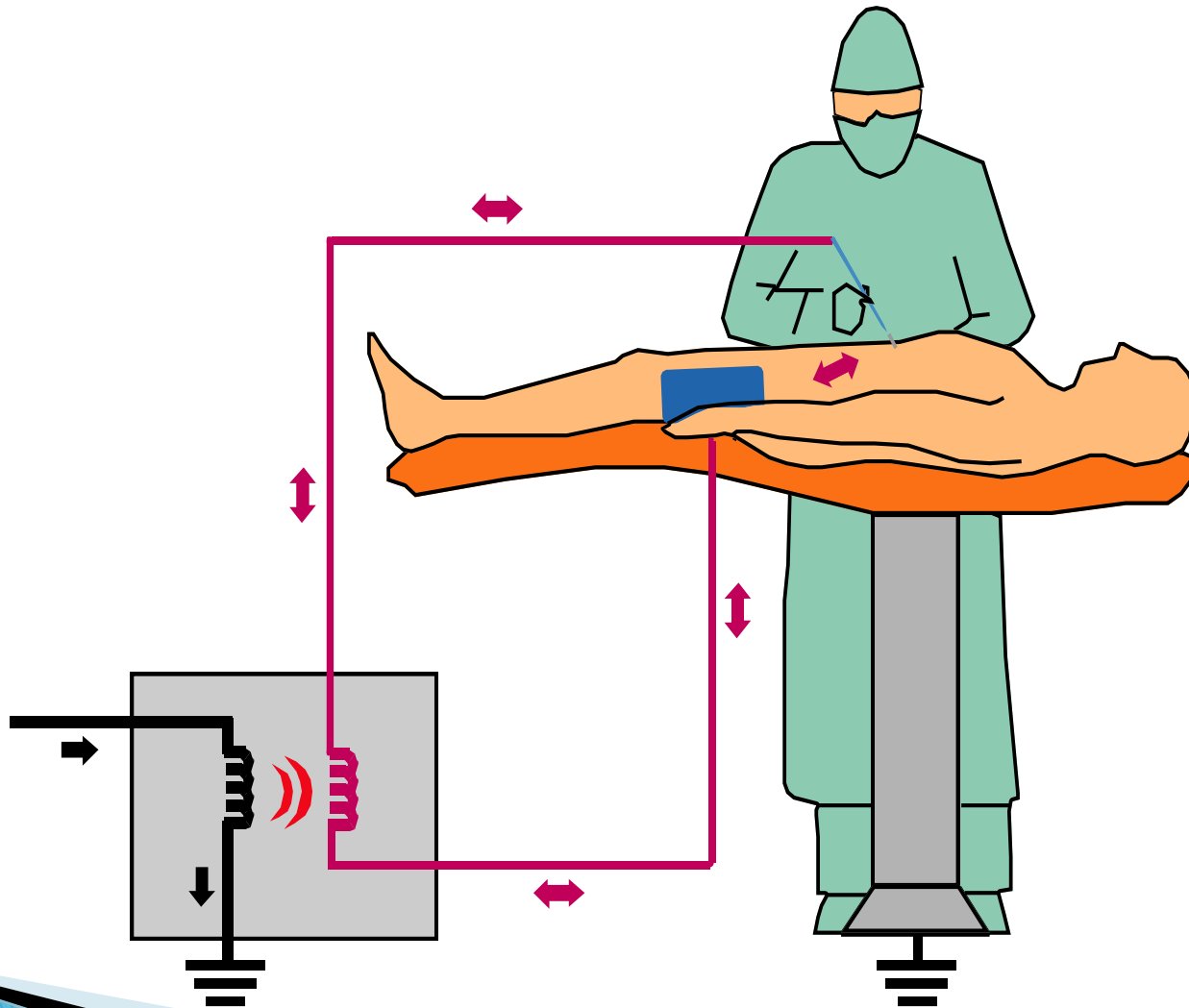
Medtronic

Isolated System



Medtronic

Isolated System



Medtronic

Maximum Leakage current allowed

- ▶ High Voltage – High Leakage
- ▶ Return current may exit in ways other than the patient – may cause a burn .
- ▶ Safety Standard is :
 - ▶ 100 KHZ – 150000 Microamperes

In Isolated ESU , the leakage is the RF current that regains its ground reference

Electrosurgical Tissue Effect

- ▶ Electrosurgery : 2 Types : Bipolar and Monopolar
- ▶ Monopolar –Cut & Coagulate
- ▶ Bipolar – Coagulate

Monopolar



Medtronic

Monopolar Electrosurgery

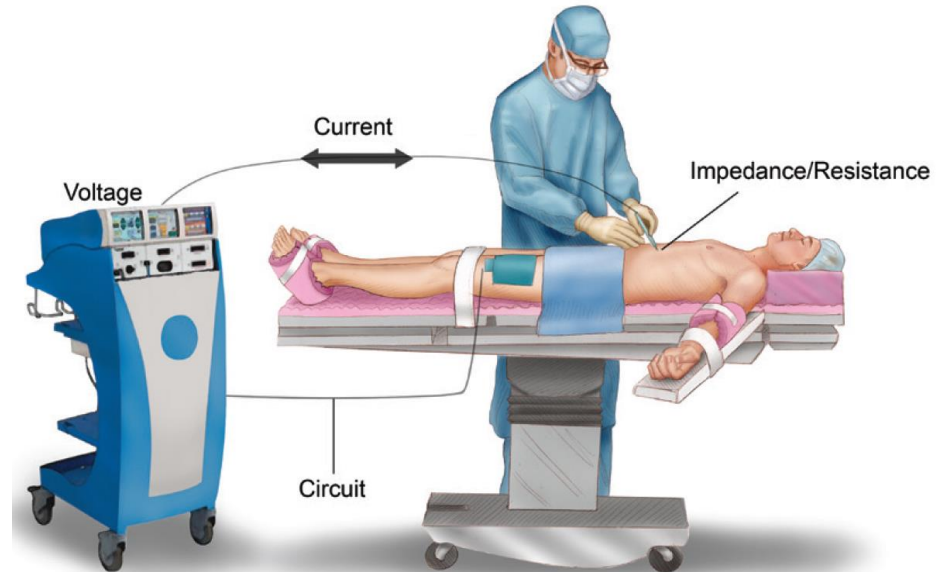
Active electrode at surgical site

Return electrode at another site

Current flows through the body between the electrodes

Voltage ranges:

- Cut: 1350 – 4,000 V
- Blend: 2975 – 4500 V
- Coag: 3000 – 9,000 V



Monopolar Electrosurgical Pencils



Footswitching
Pencil



Rocker Switch
Pencil



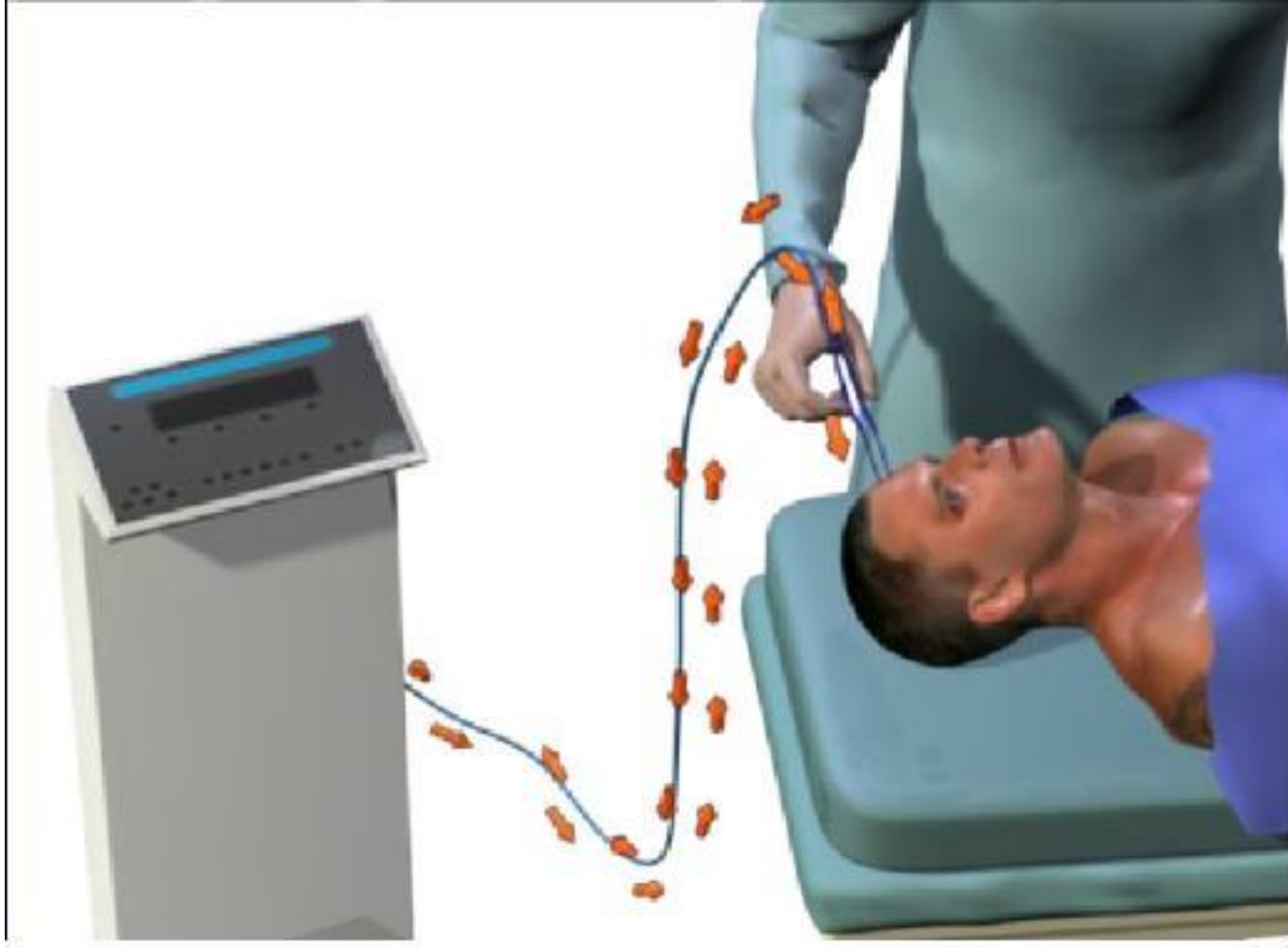
Two-Button
Pencil



Three-Button
Pencil

Medtronic

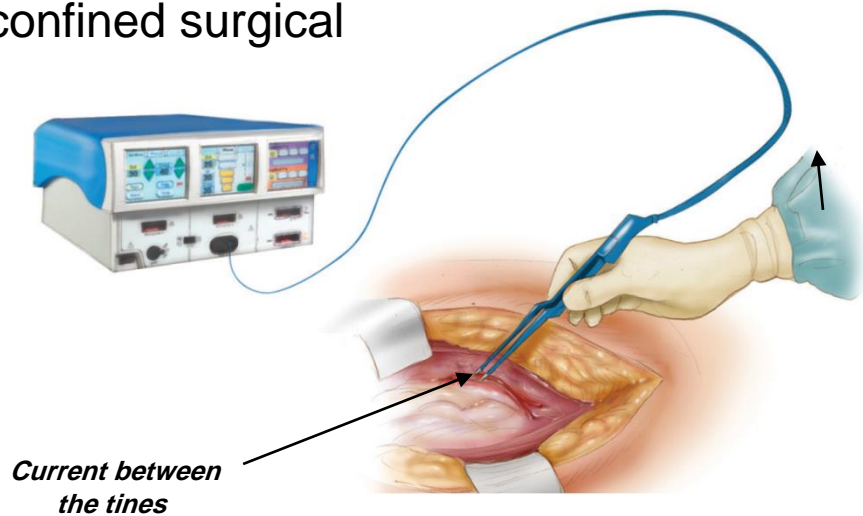
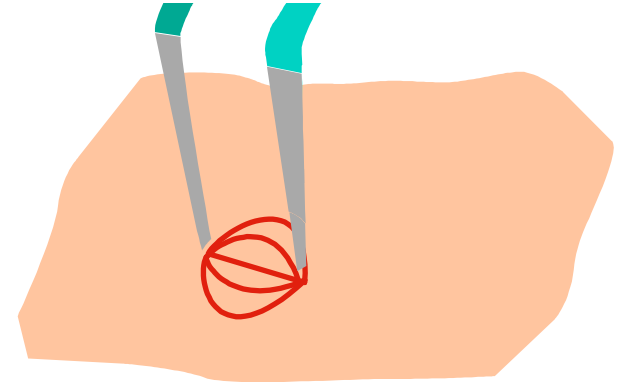
Bipolar



Medtronic

Bipolar Electrosurgery

- Active and return electrodes within the instrument;
no patient return electrode (pad) required
- Current flow is confined to tissue between electrodes
- Relatively low voltage (300V – 1200V)
- Used for delicate tissue and confined surgical sites:
 - Laparoscopy
 - Spinal
 - Neurosurgery
 - Ophthalmology

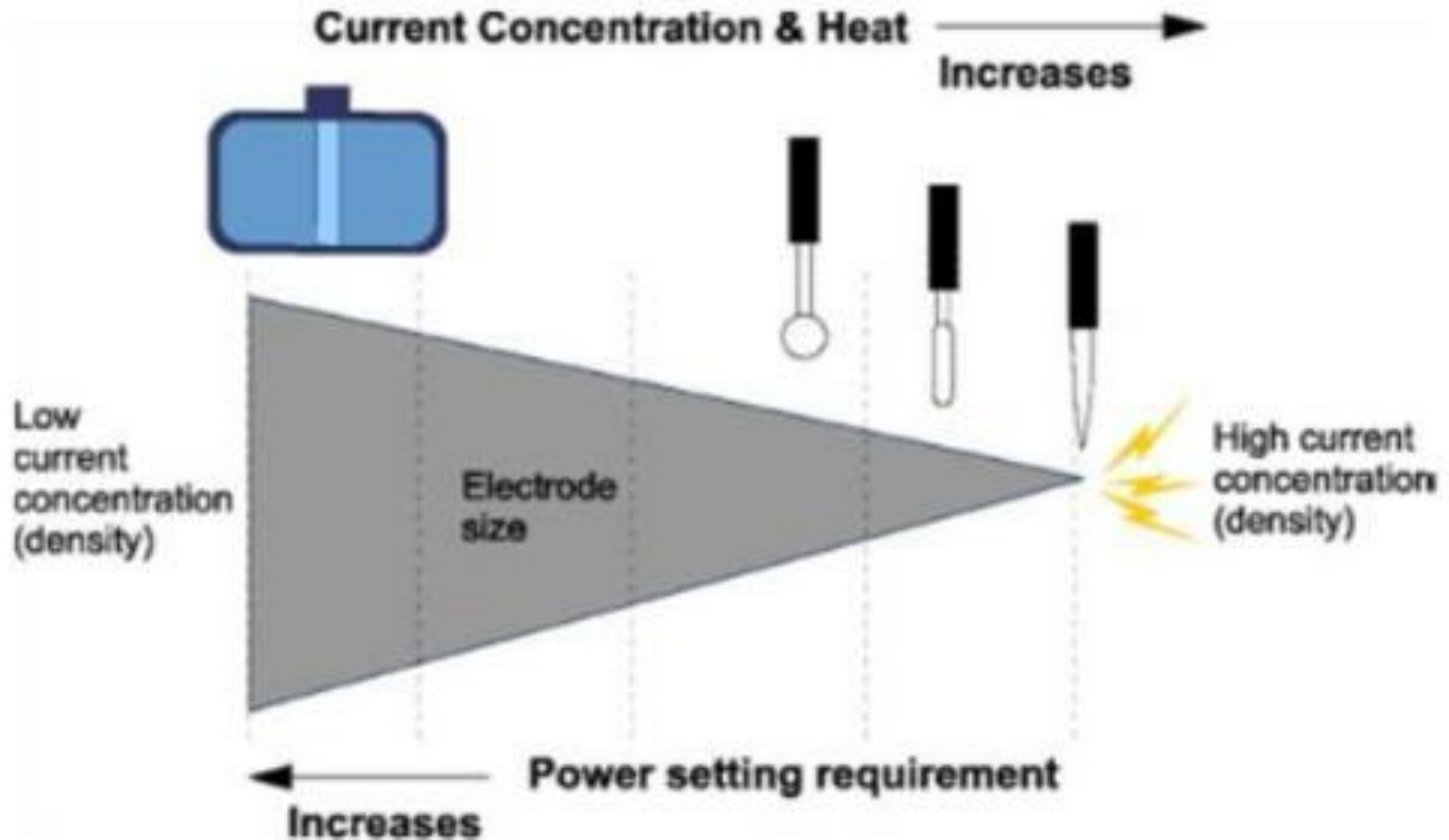


Typical Bipolar Instruments



Medtronic

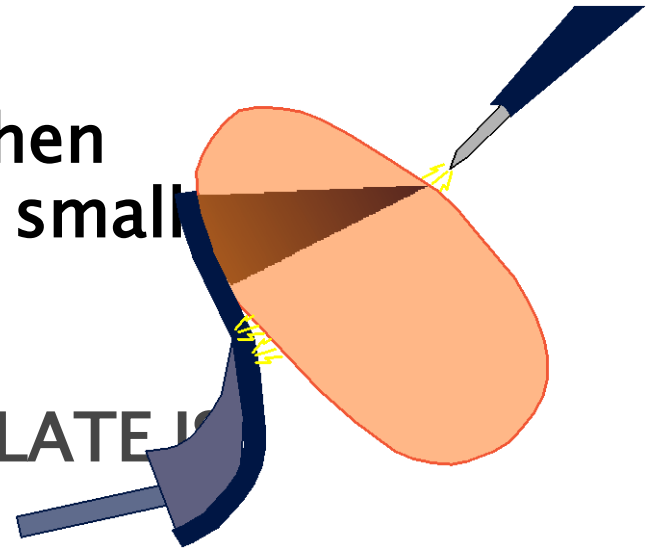
Why The Plate side does not burn?



▣ Pad Site burns are caused by adverse conditions at the pad- patient interface which result in increased current density .

- ▣ Current density increases when
- Current removal area is too small
 - Heat is applied for too long
 - Power setting is too high

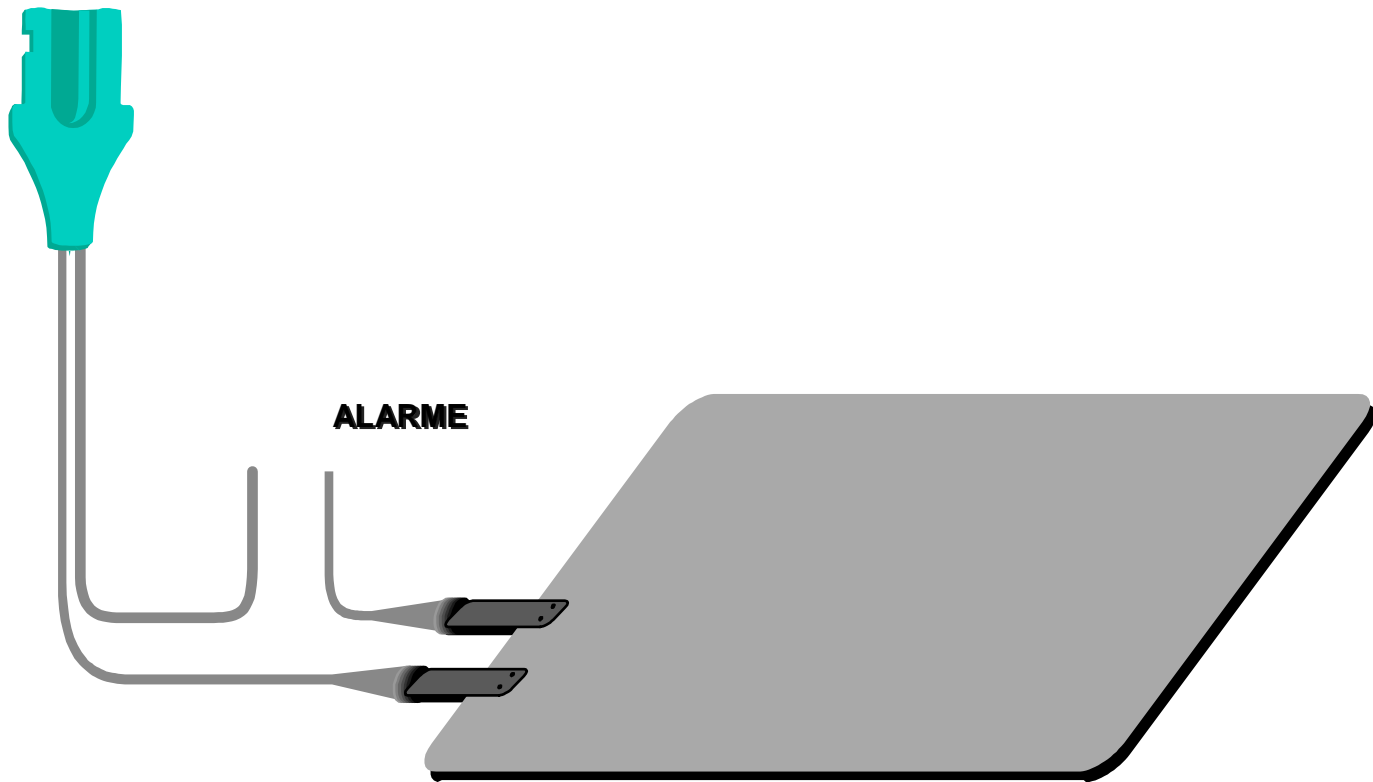
A BURN UNDER THE PATIENT PLATE IS
ALWAYS
NEGLIGENCE



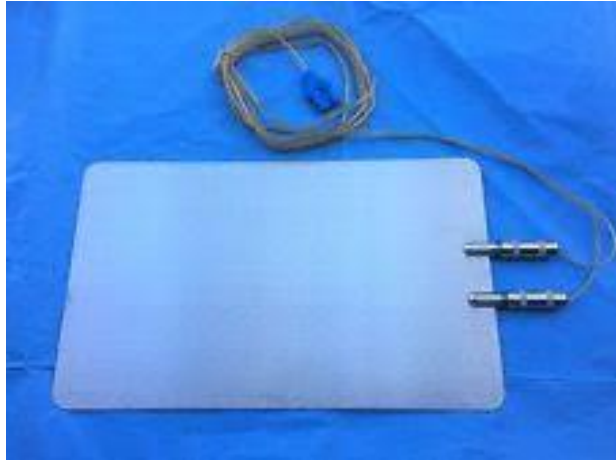


Medtronic

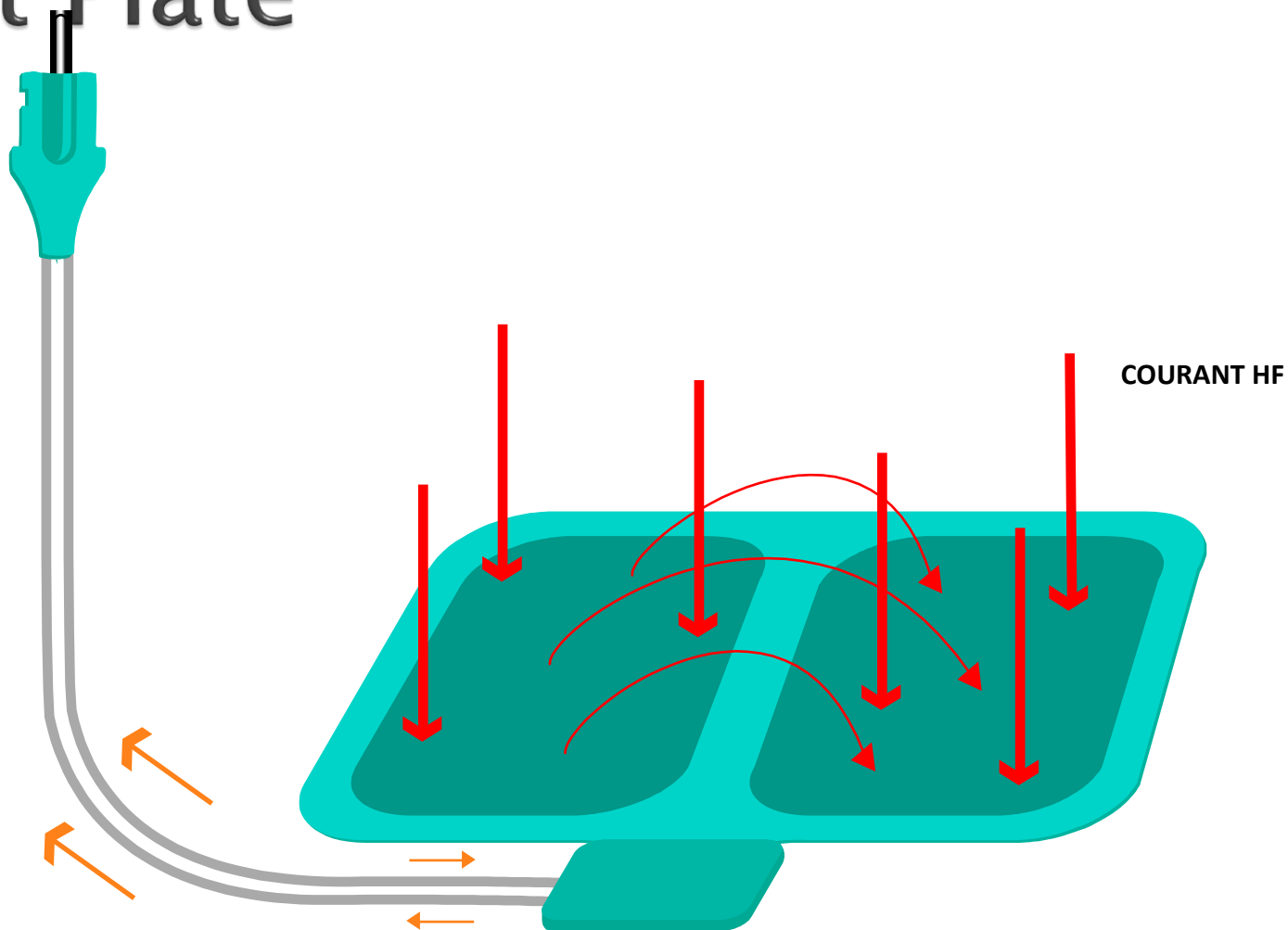
Single Plate



Single Plate



Split Plate



Split Plate

E7509

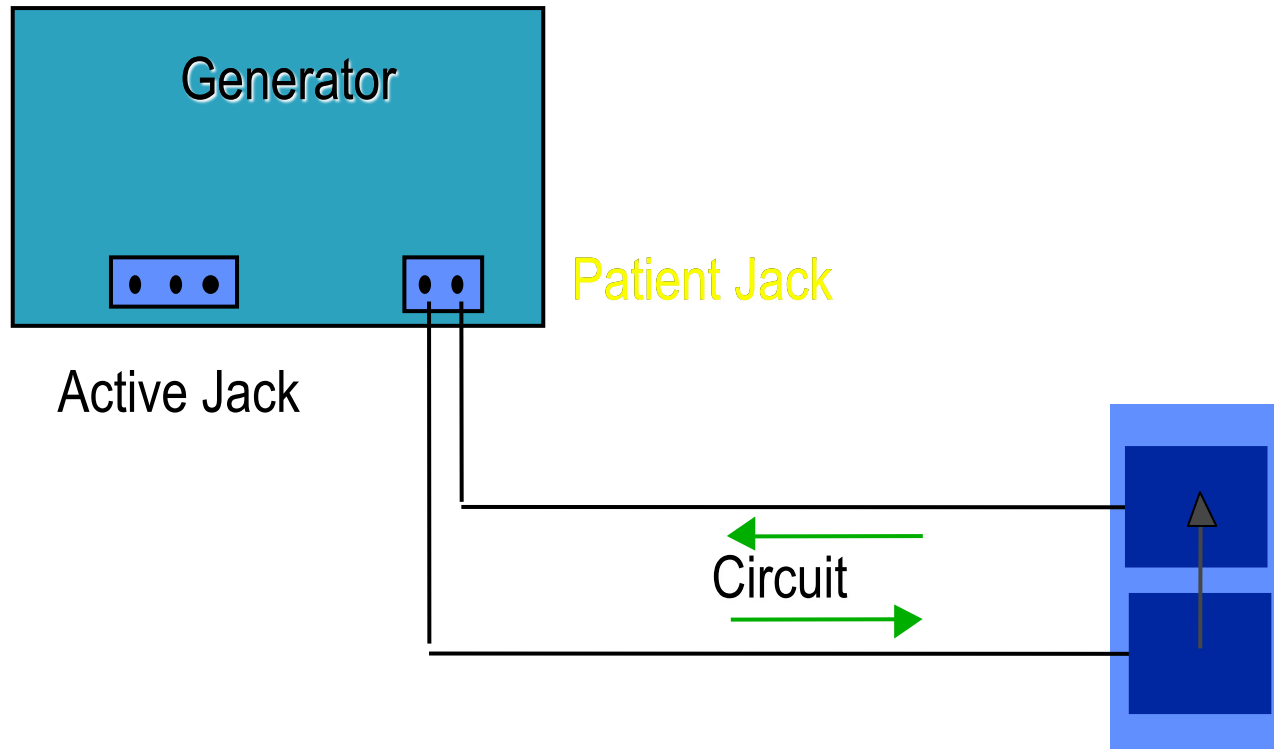


HRA5



Medtronic

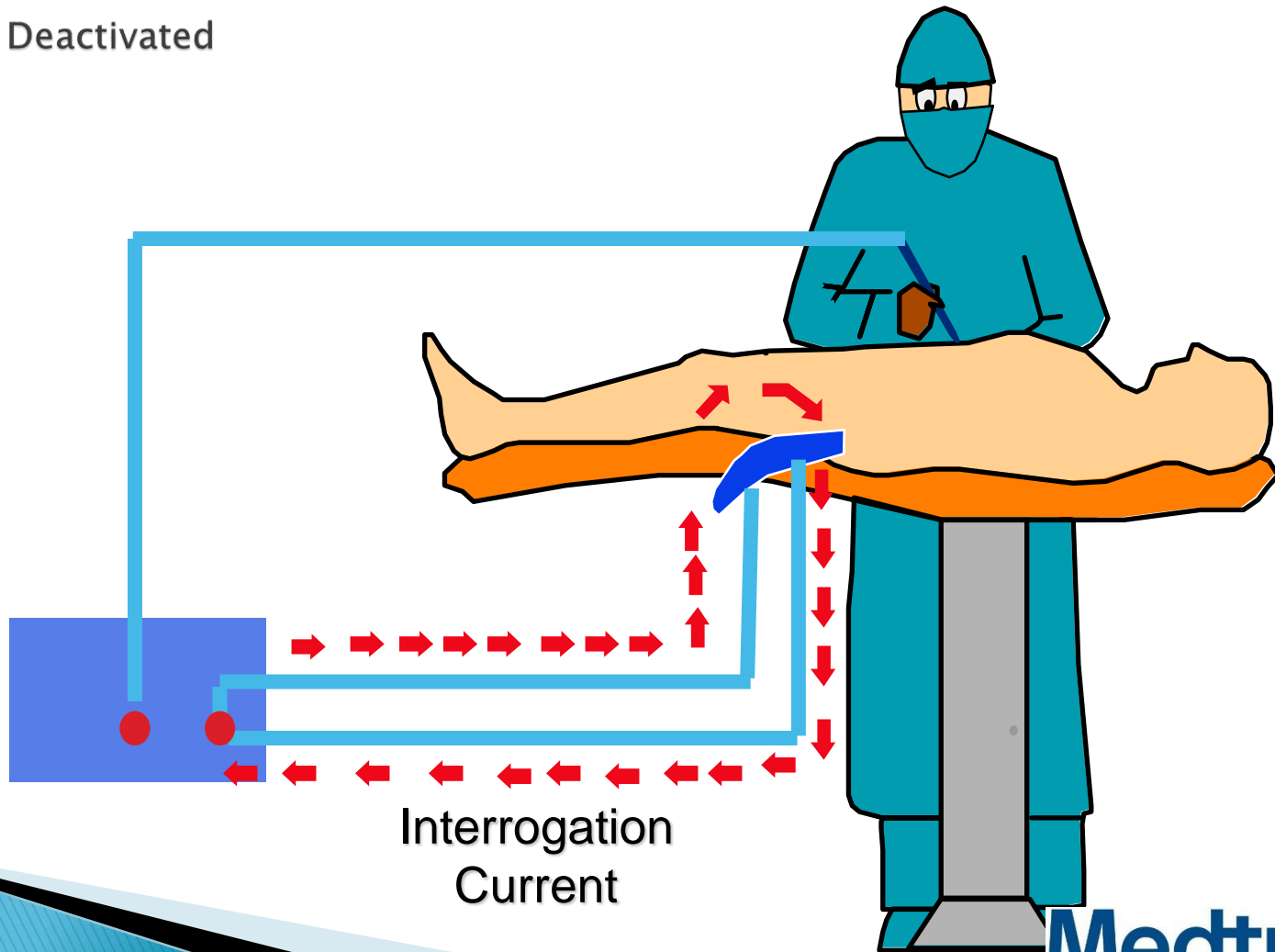
Contact Quality Monitoring System



Medtronic

Contact Quality Monitoring System in State of Alarm

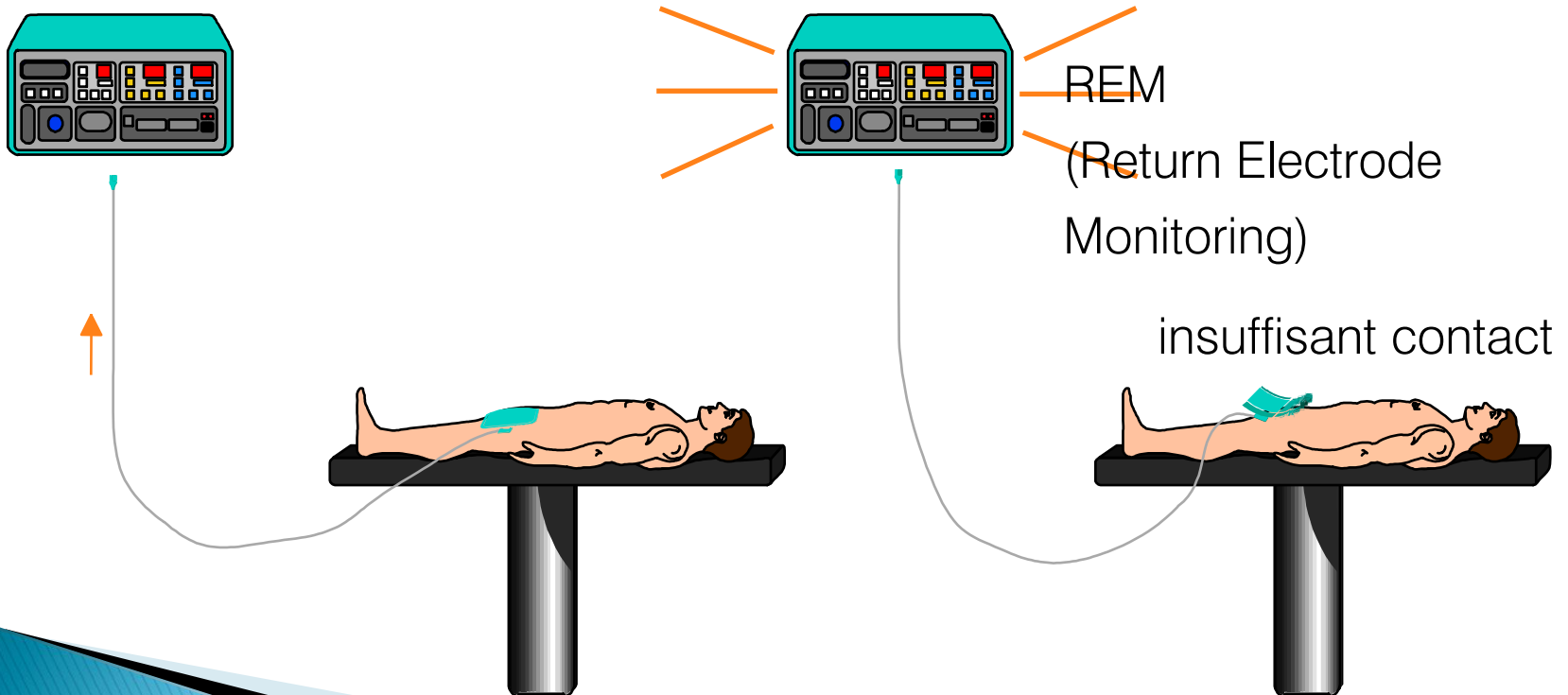
Generator Deactivated



Medtronic

REM

Measures the change in impedance at the skin level of the patient .. When the change is risky – Alarm

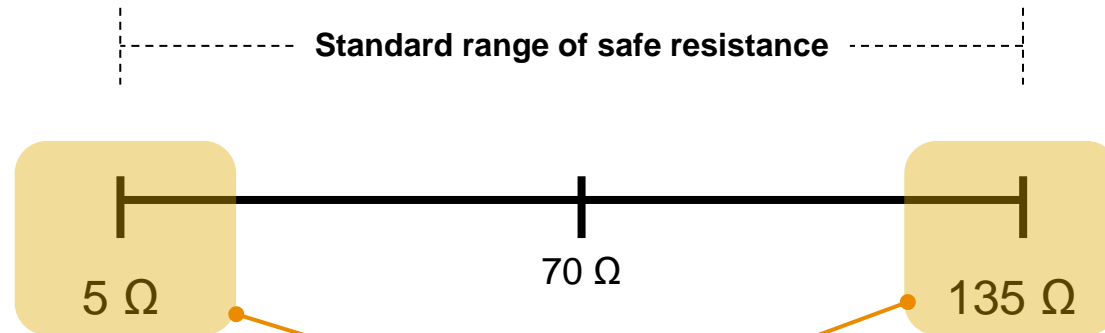


Medtronic

Return Electrode Monitoring

- ▶ No Plate Burns
- ▶ Generator More Efficient
- ▶ 100,000,000 cases without any incidence

Adaptive REM™ Technology



Decreased resistance changes the baseline, so the 40% upper limit changes as well.



RE Site Burning:

1. Single Plate
2. Quality of Pad
3. NO REM



Alternate Site Burning:

1. Small Area
2. Sharp Surrounding
3. Very Deep (third degree)
4. Happens Immediately

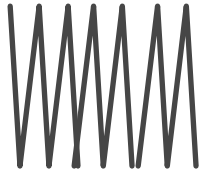


Other Sores :

1. Bed Sore
2. Chemical Sore
3. Pressure Sore
4. Humidity Sore

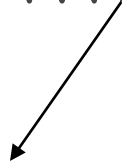
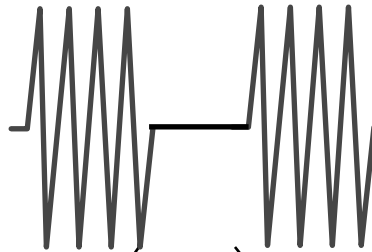


Wave Forms



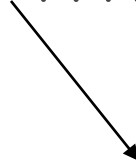
Pure Cut

100 % ON
Less Volts

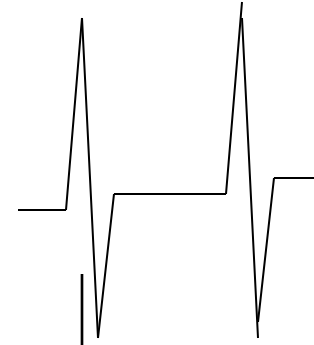


Blend Cut

60 % ON – 40 % OFF
Higher Voltage



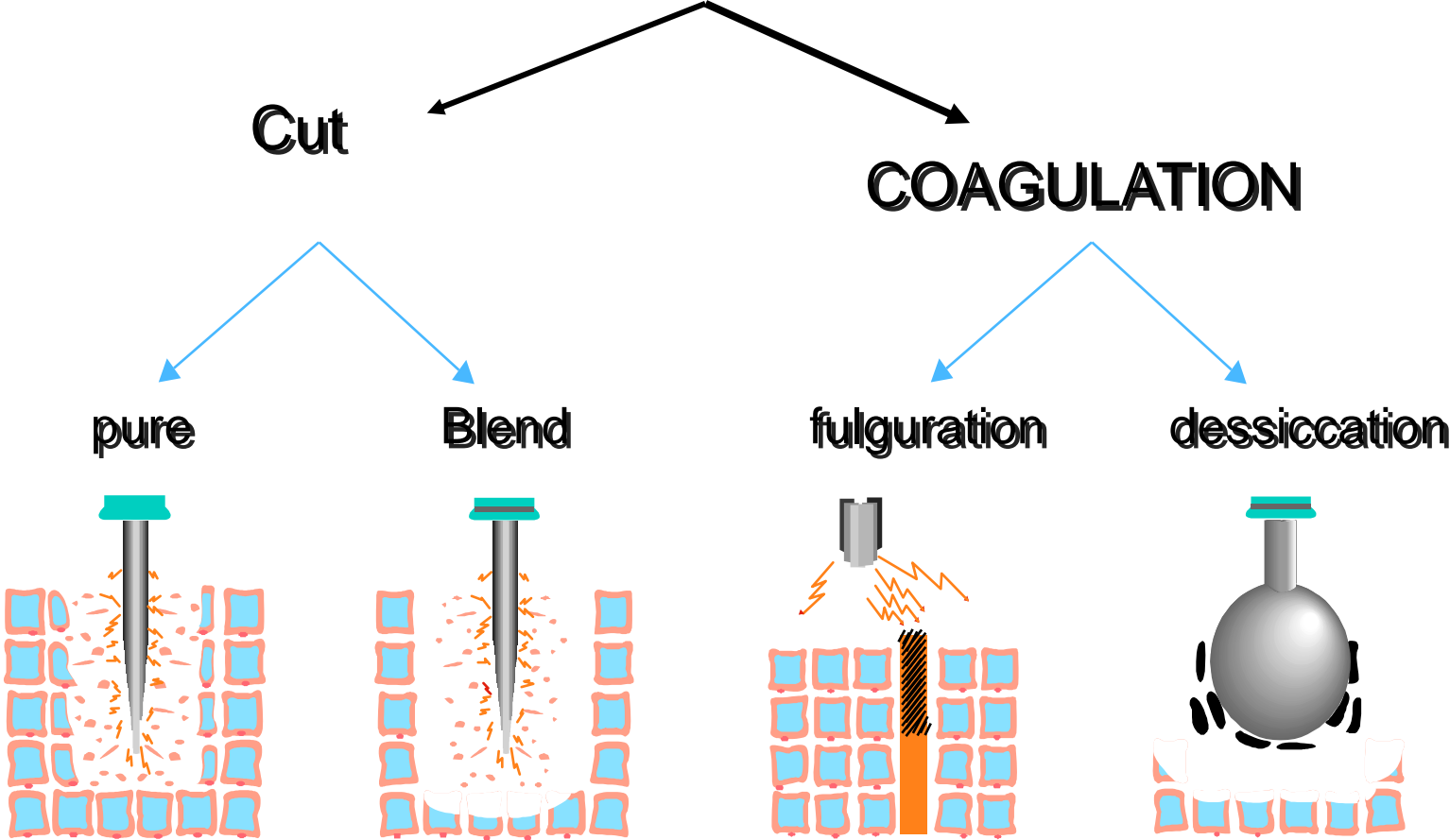
Desiccate



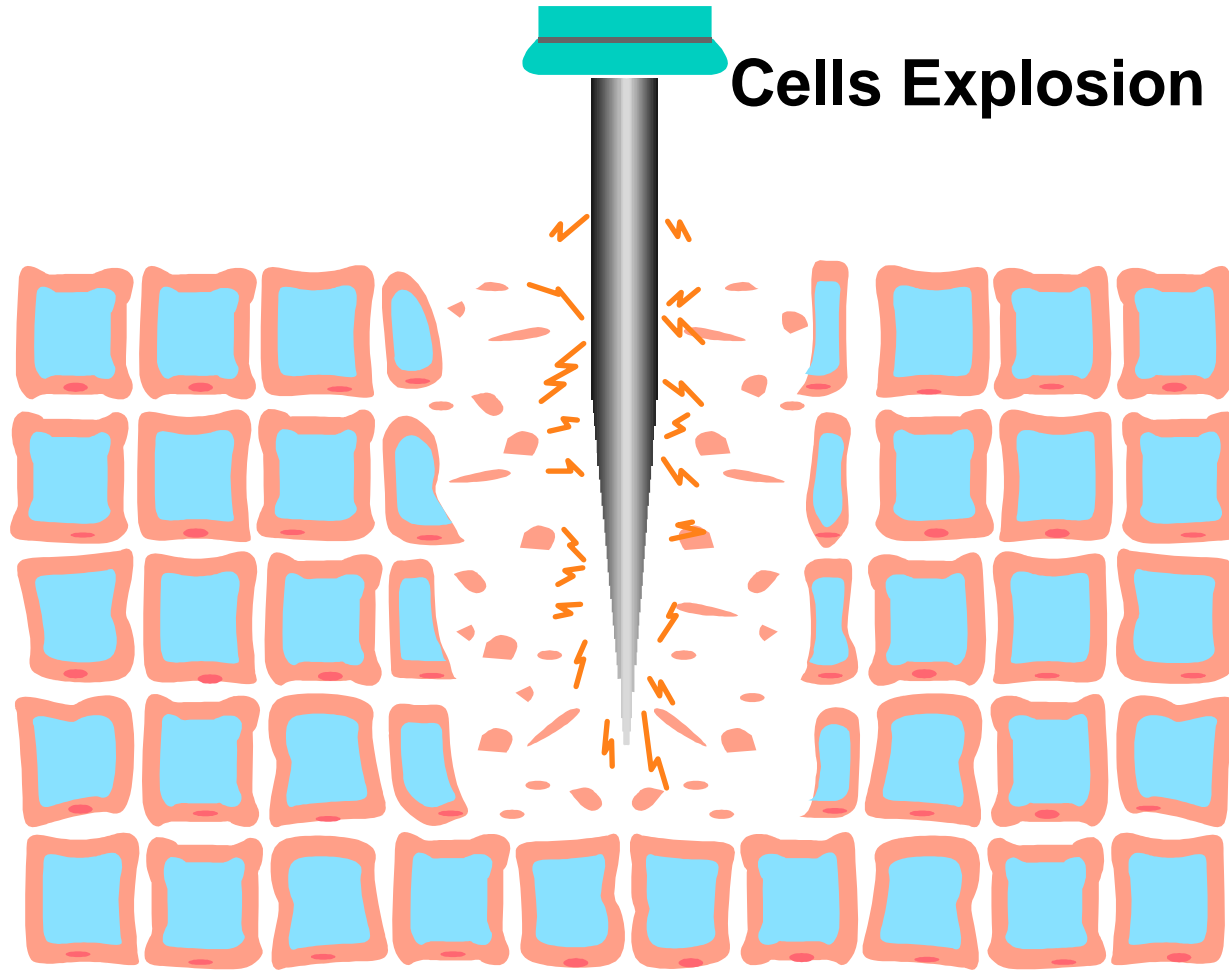
Fulgurate

Very High Voltage to
push thru Air

Electrosurgery

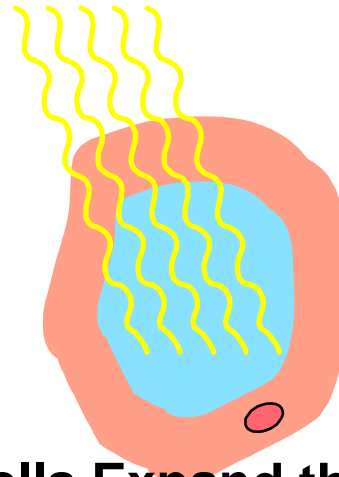
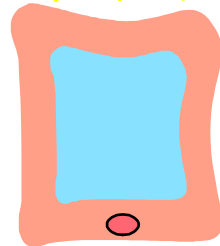
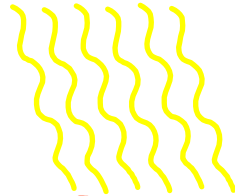
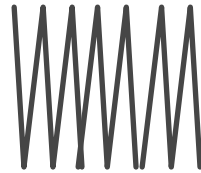


Pure Cut

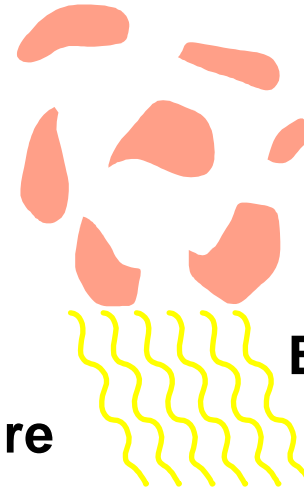


Cut

Energy



**Cells Expand thru
Increase in Pressure**



Exploded Cells

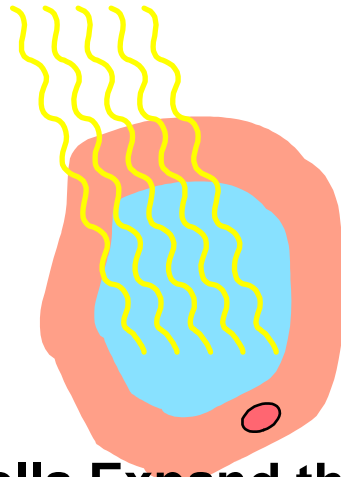
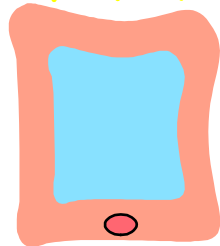
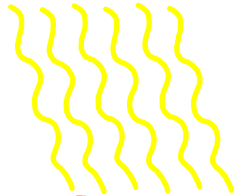
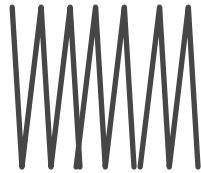
Electrodes preferred for Cutting : Needle / Fine Needle/ Loop



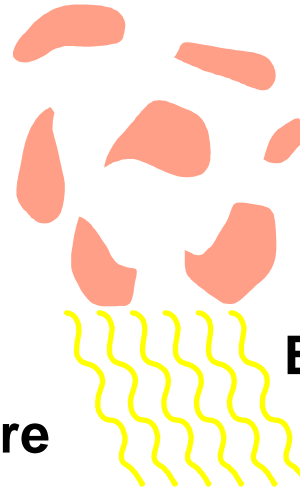
Medtronic

Cut

Energy



**Cells Expand thru
Increase in Pressure**

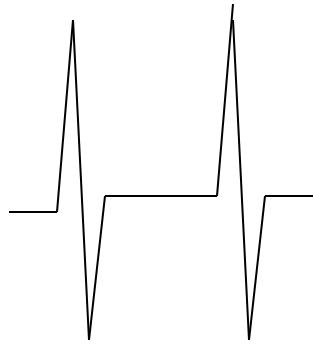


Exploded Cells

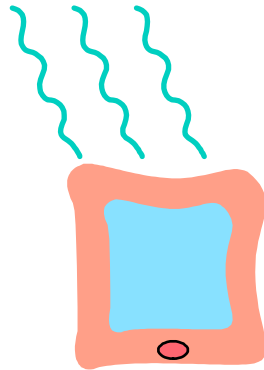
Electrodes preferred for Cutting : Needle / Fine Needle/ Loop

Coagulation

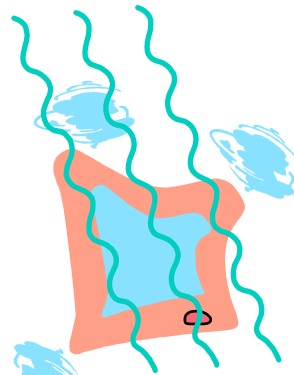
Energy



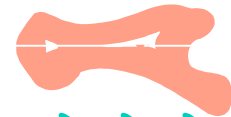
BLADE/ BALL/
FORCEPS



Dehydration thru
heating



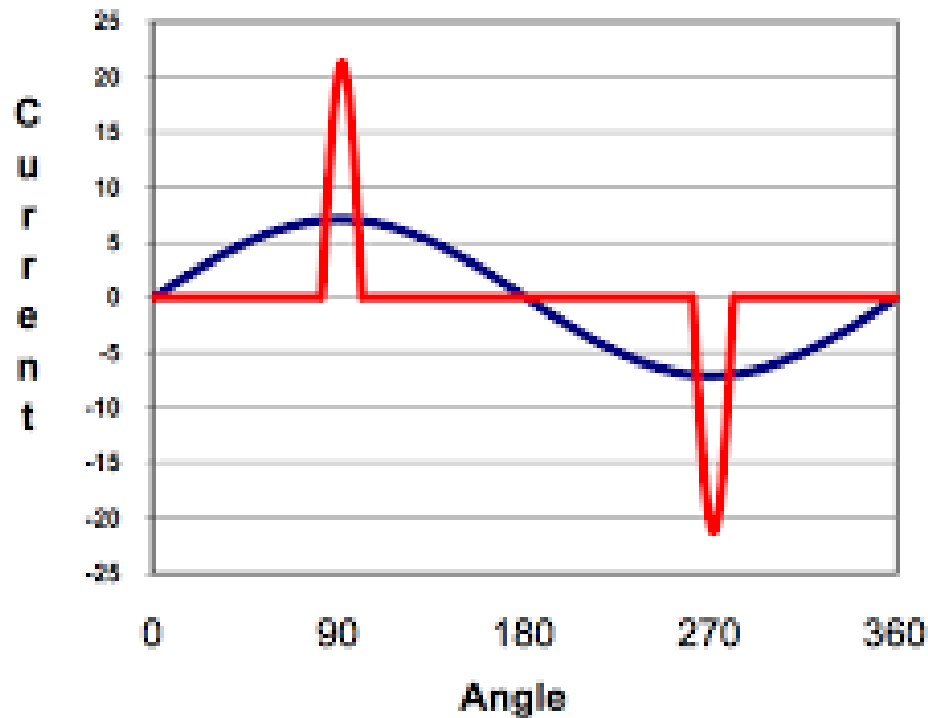
Lower current density
causes dehydration and
shriveling of the cells.
Intracellular fluid evaporates



Coagulated Cells

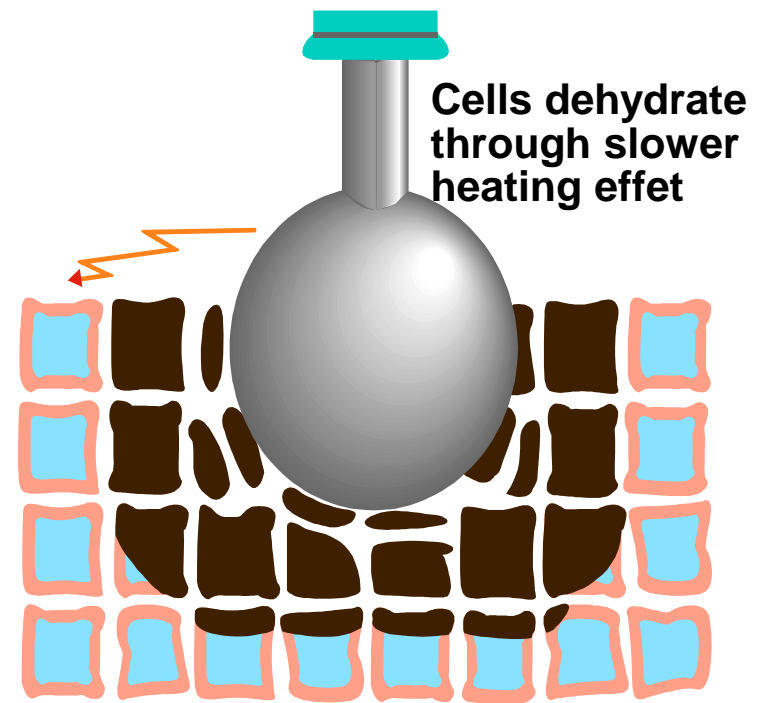
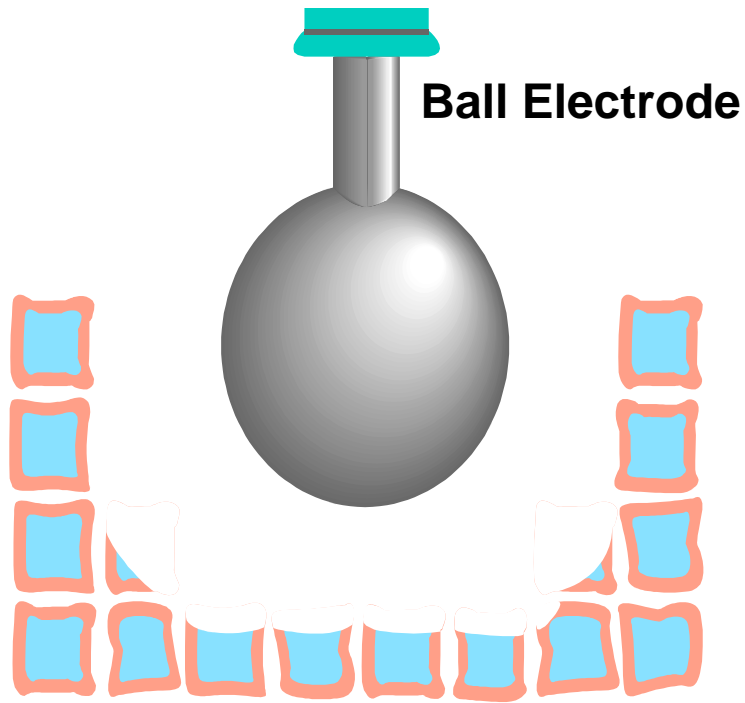
Crest Factor

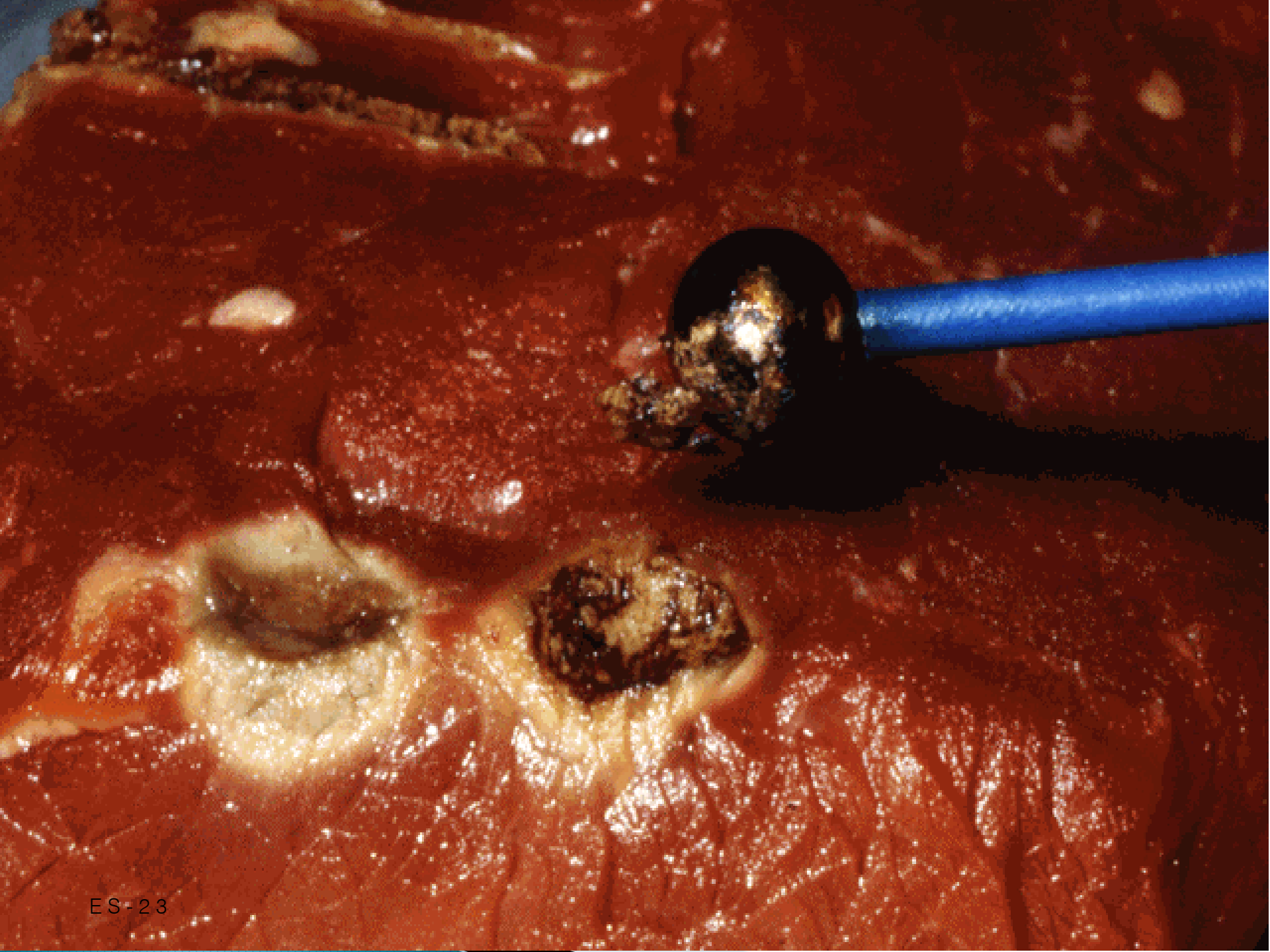
Crest Factor Example



$$\text{Crest Factor (CF)*} = \frac{V_{\text{Peak}}}{V_{\text{RMS}}}$$

Coagulation



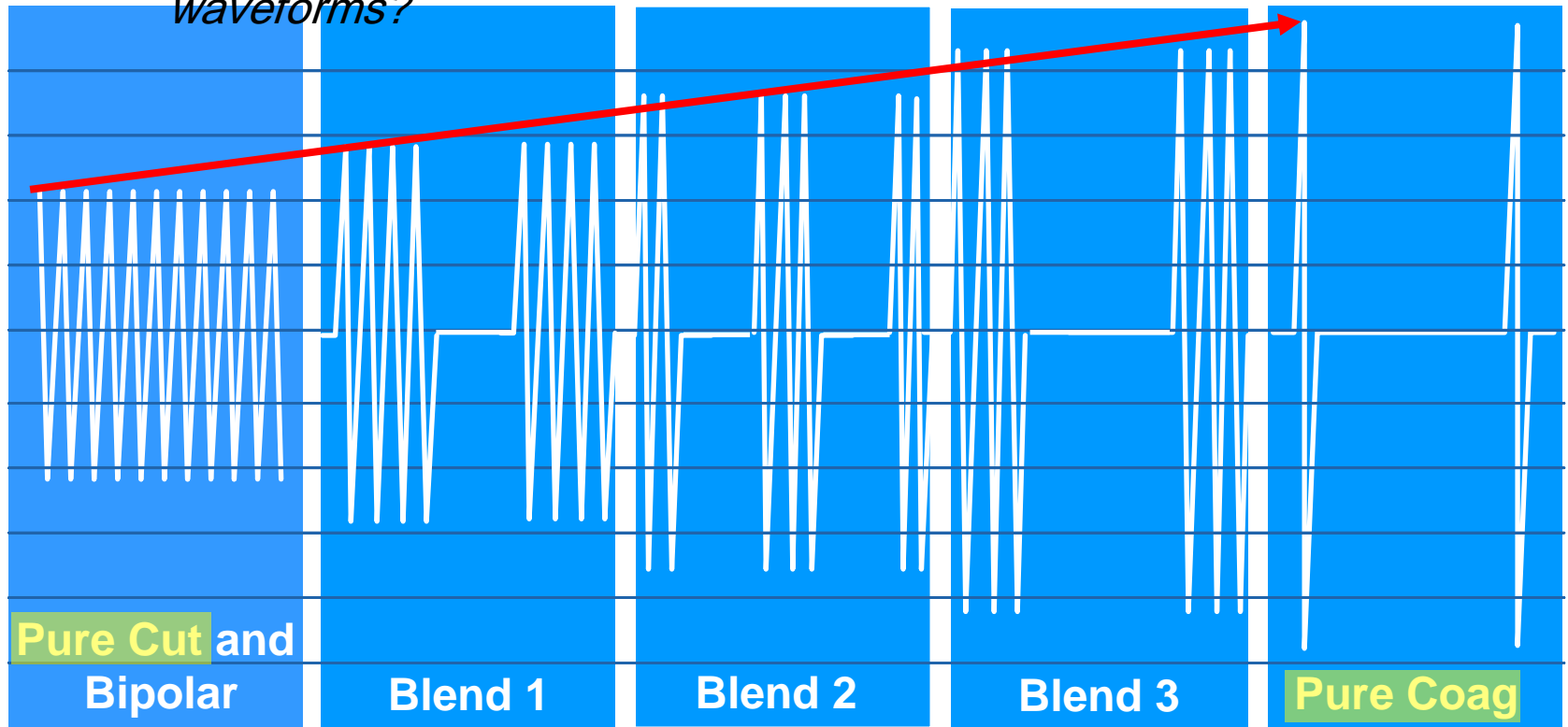


ES-23

Waveforms

With blend, we are raising the voltage
but we are decreasing the duty cycle.

*What is the difference between the **Pure Cut** and **Pure Coag** waveforms?*



100% on

50% on
50% off

40% on
60% off

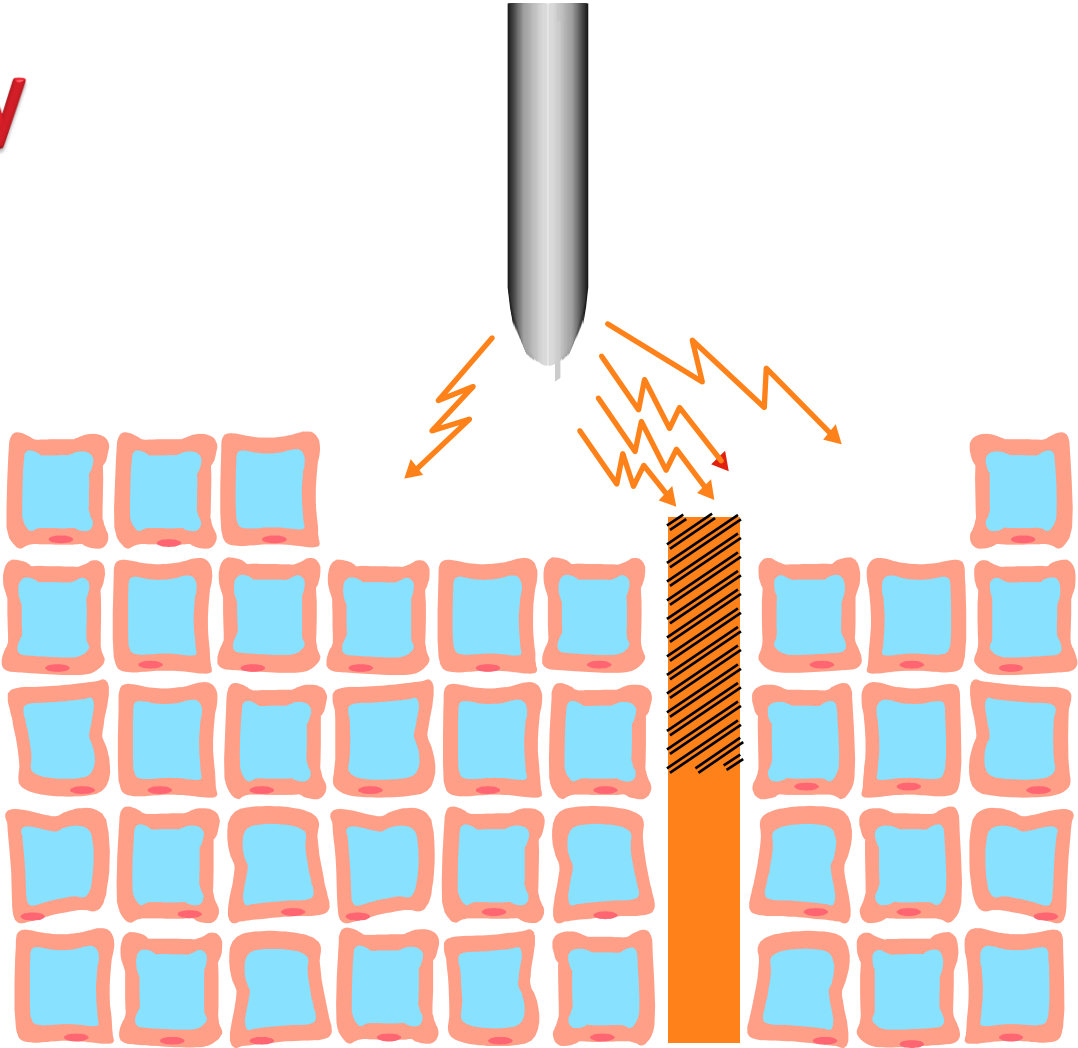
25% on
75% off

6% on
94% off

Blend is derived from the Cut waveform.

Medtronic

Spray

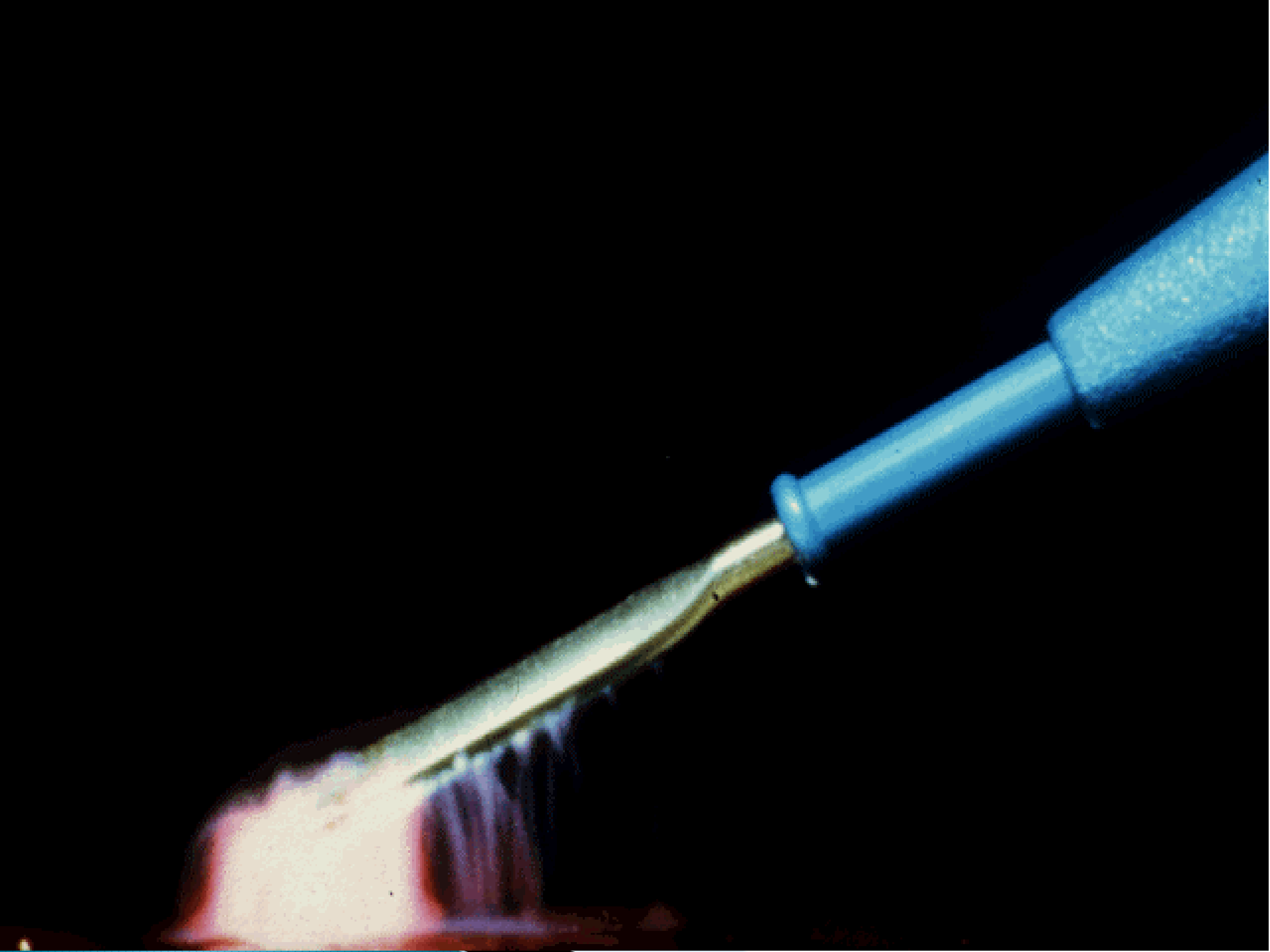


Spray Mode

Fulguration (lightning) is used to **control bleeding**. Low (6%) duty cycle, but high voltage. The tip of the electrode should be held slightly over the tissue. ForceTriad™ energy platform
Coag Duty Cycles:

Fulgurate – 6.5%
Spray – 4.6%





Force Argon™ II System



Force FX™-C
electrosurgical generator

Force Argon™
electrosurgical unit

Argon gas
tanks

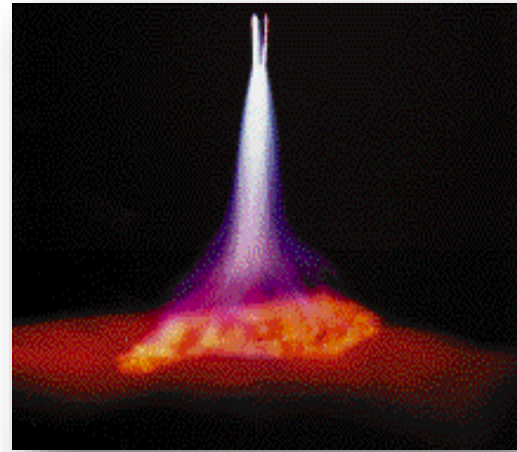


Benefits of Argon-Enhanced Electrosurgery

- Creates uniform conductive plasma bridge between electrode and tissue
- Less smoke, odor
- Non contact in coagulation
- Decreases blood loss, re-bleeding
- Less tissue damage



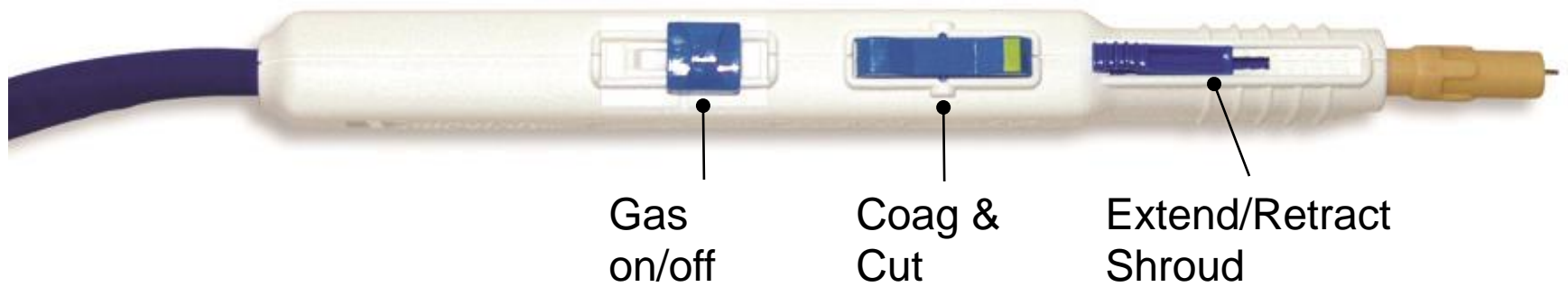
Conventional electrosurgery



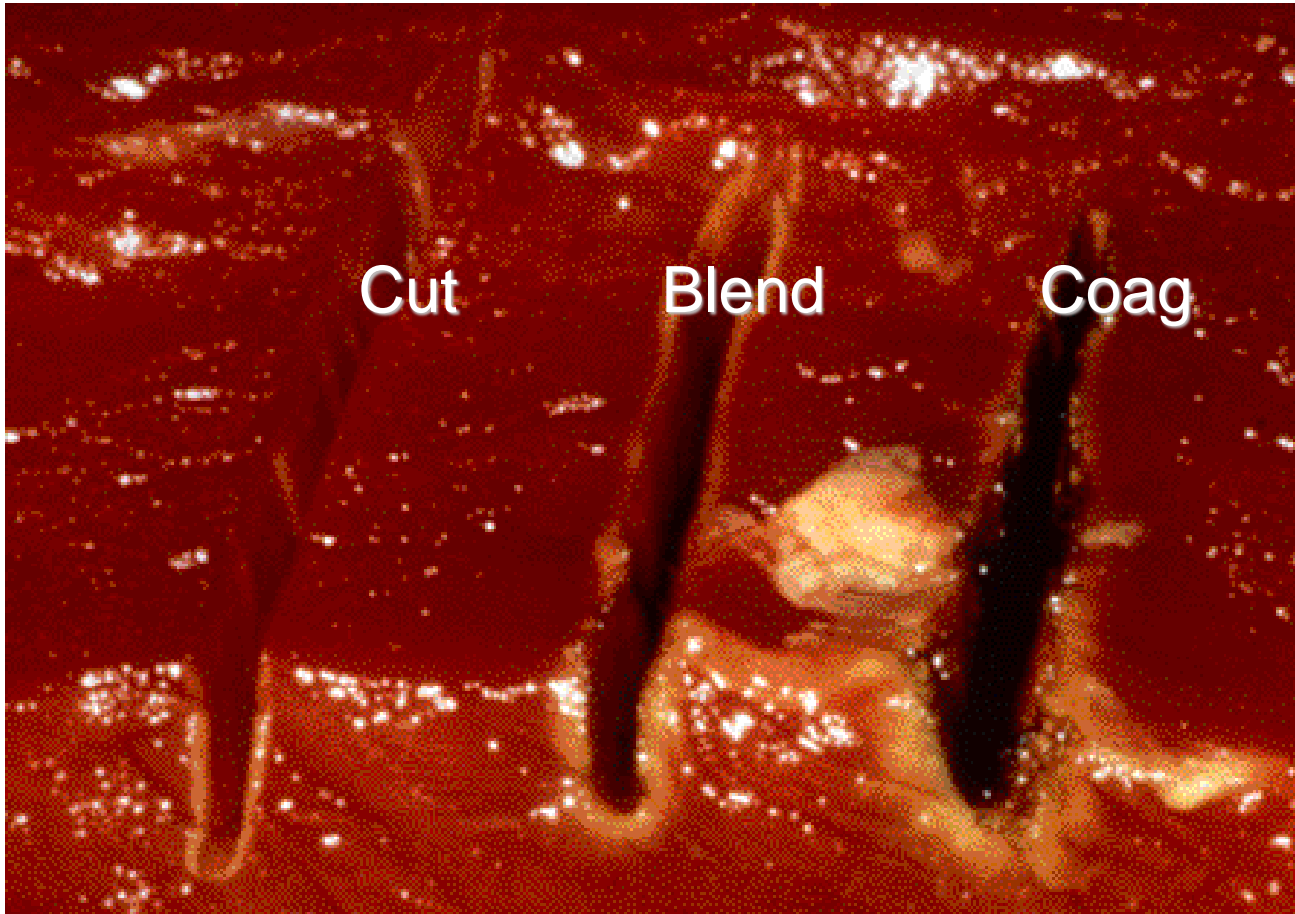
Argon-enhanced electrosurgery

Medtronic

ArgonPlus™ Handset



Medtronic



Low

Thermal Spread/Charring

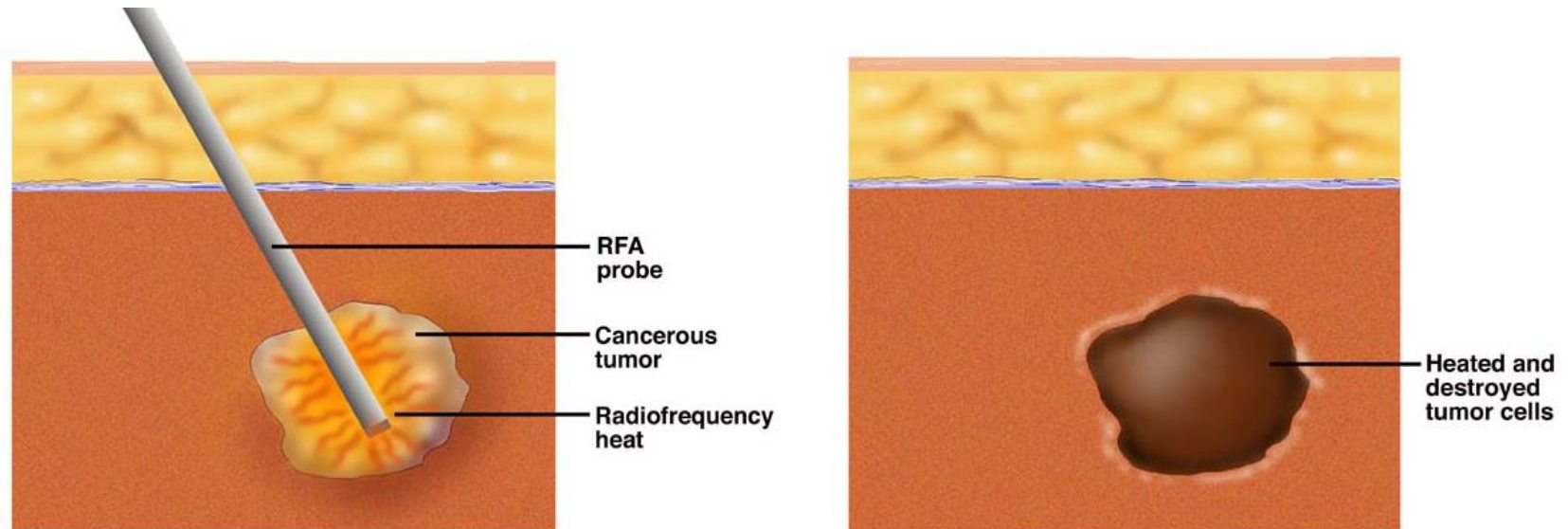
High



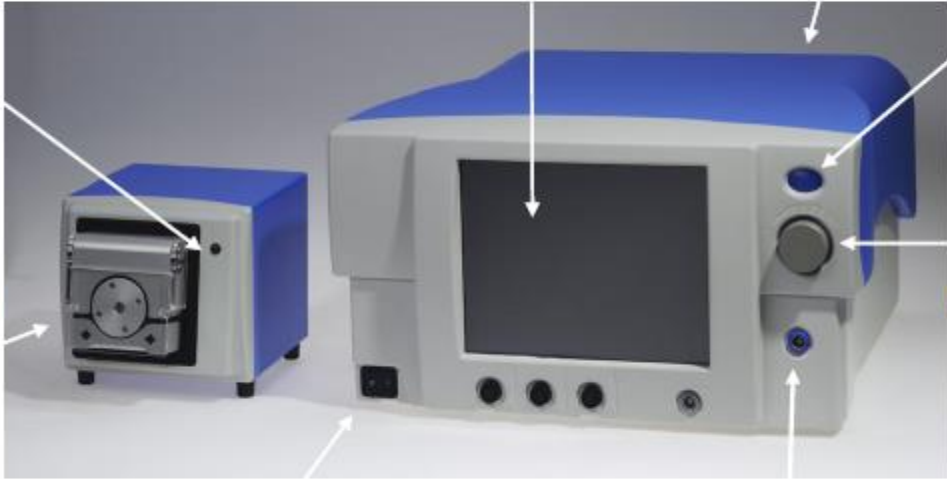
Medtronic

Ablation

- Heat is generated locally by a high frequency current that flows from the electrodes.
- A probe is inserted into the center of the tumor for about 10–15 minutes.
- The local heat melts (coagulates) the tissue that is adjacent to the probe.
- The whole procedure is monitored visually by ultrasound scanning.



RF Ablation System



Modern Design
LED light verifies power

Easy Load
Single action

Touch Screen
Simplified user-interface
Intuitive controls

Easier to set-up
Integrated design vs 2 boxes

One-Push Control
Ablation on/off
Illumination verifies ablation "on"

Power knob
LED lights & clicks verify changes

Simple Power on/off

Remote Temp Probe
NEW DISPOSABLE



Medtronic

MW Ablation System



Emprint™ ablation system with
Thermosphere™ technology:
Powerful Predictability

PREDICTABLE RESULTS

Allow more control to plan and execute procedures with predictable results regardless of target location or tissue type.¹

INCREASE CONFIDENCE

Increase confidence for achieving planned results with precision and consistency.

REDUCE TIME AND COSTS

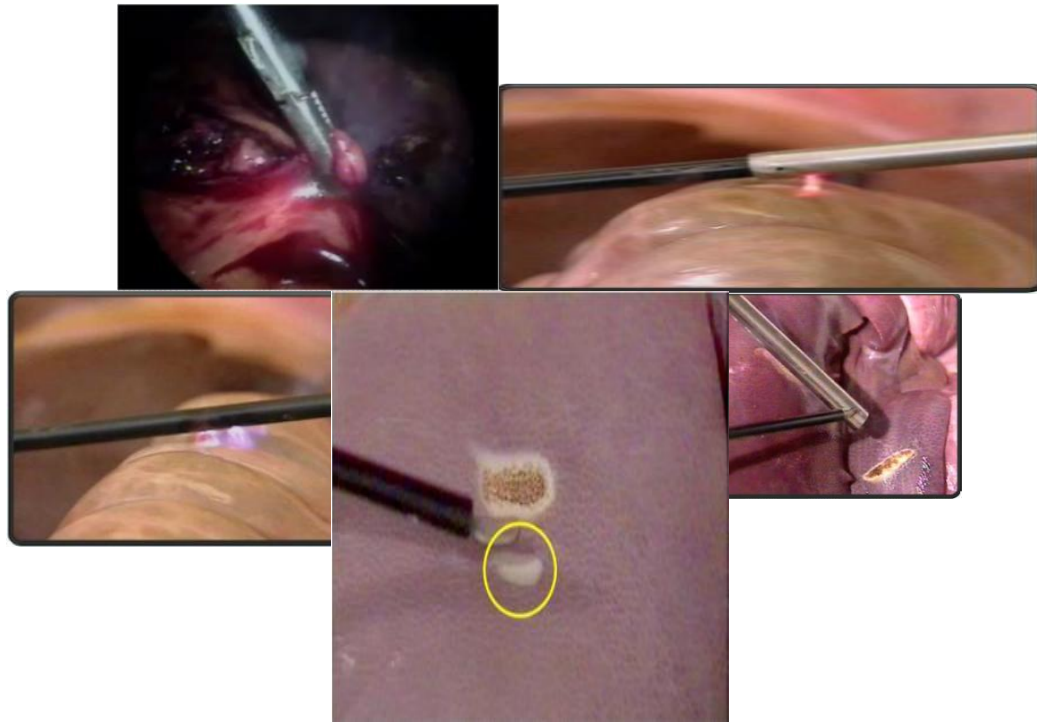
Predictable spherical ablation zones enable physicians to have more choice of approach, further simplifying needle placement and saving time in both planning and procedure.



COVIDIEN

positive results for life

Electrosurgery Hazards



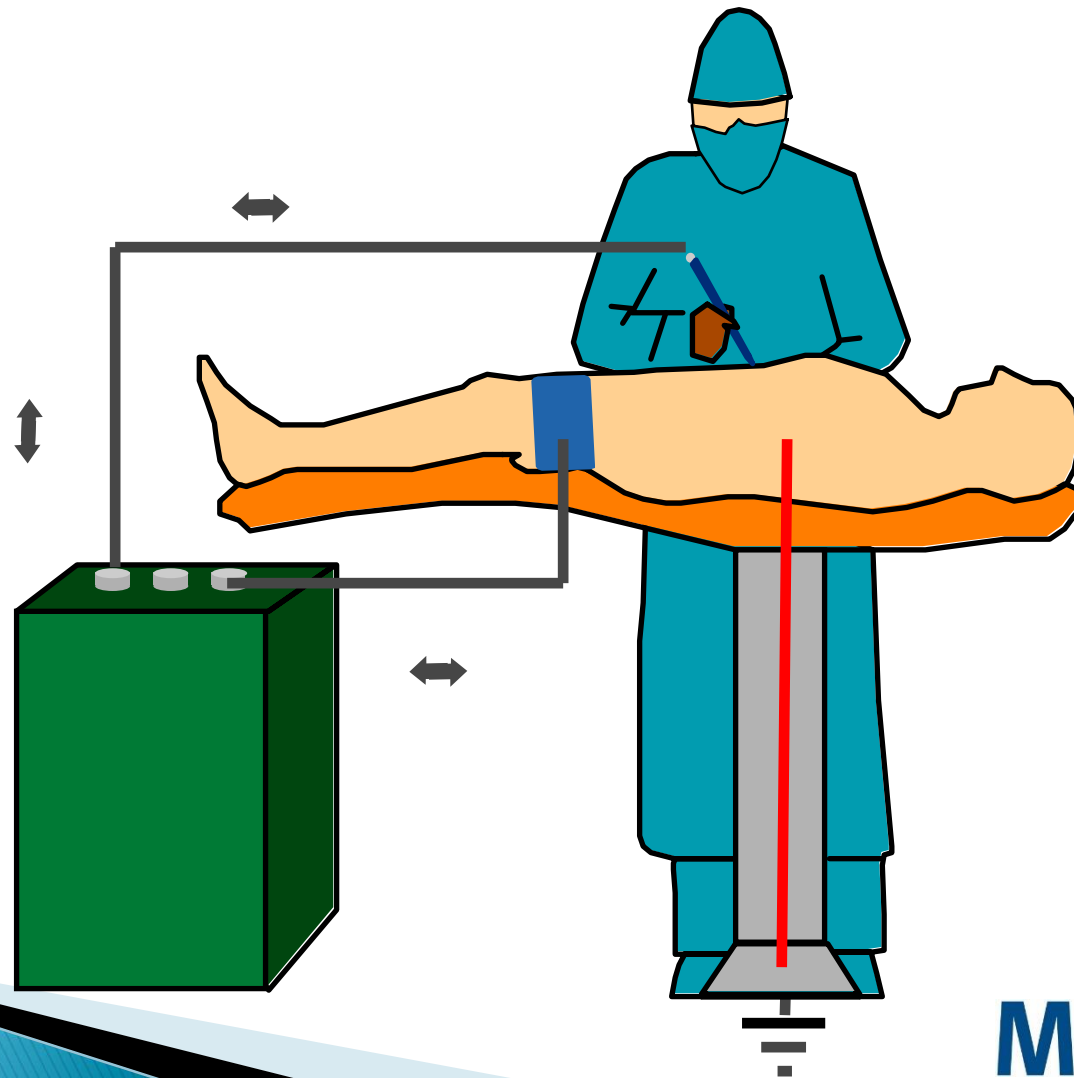
Hazards In Laparotomy surgeries:

- 1) The Leakage Current
- 2) The place of plate
- 3) Open circuit activation
- 4) Using Spray Mode in pick ups
- 5) Electrosurgical Smoke

Hazards in Laparoscopic Surgeries:

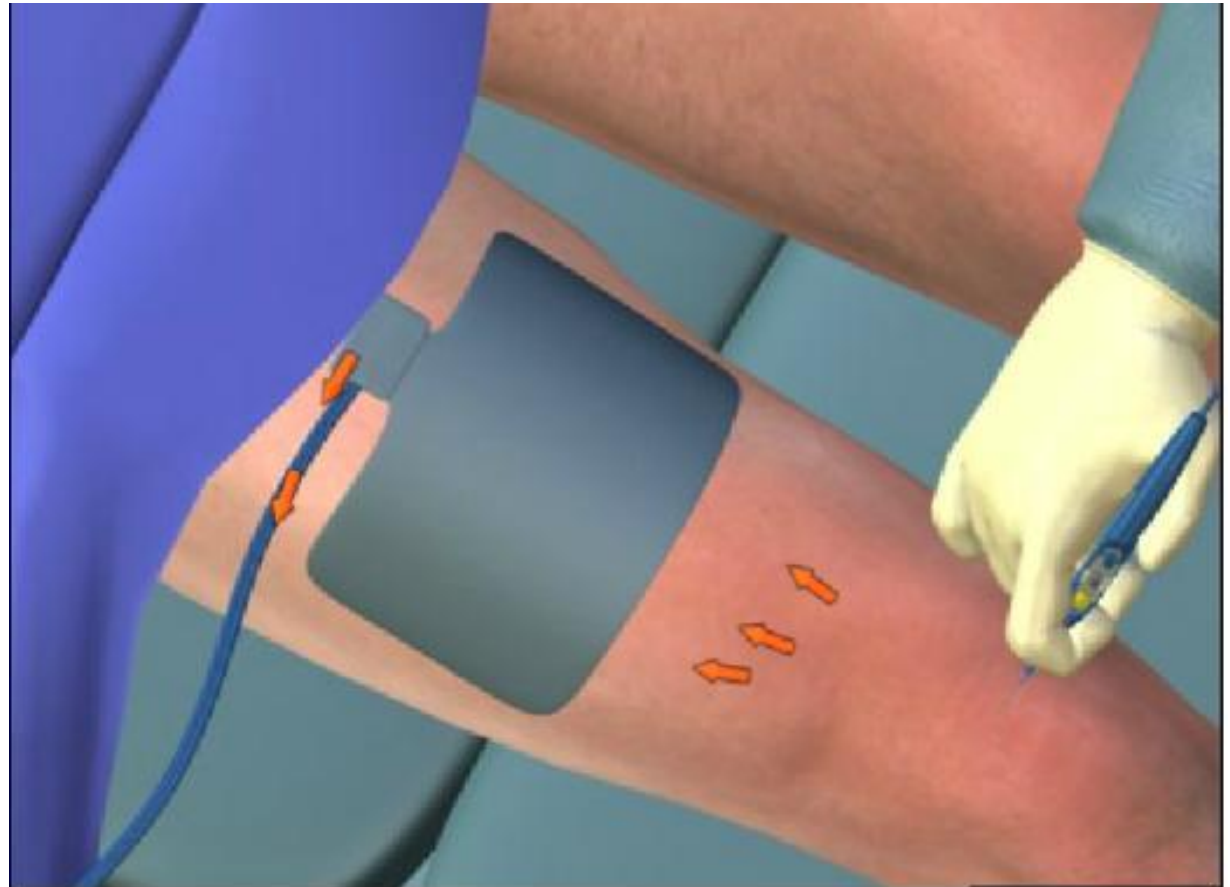
- 1) Direct Coupling
- 2) Insulation Failure
- 3) Capacitive Coupling
- 4) Residual Heat
- 5) Electromagnetic Interface
- 6) Electrosurgical Smoke

1) The Leakage Current

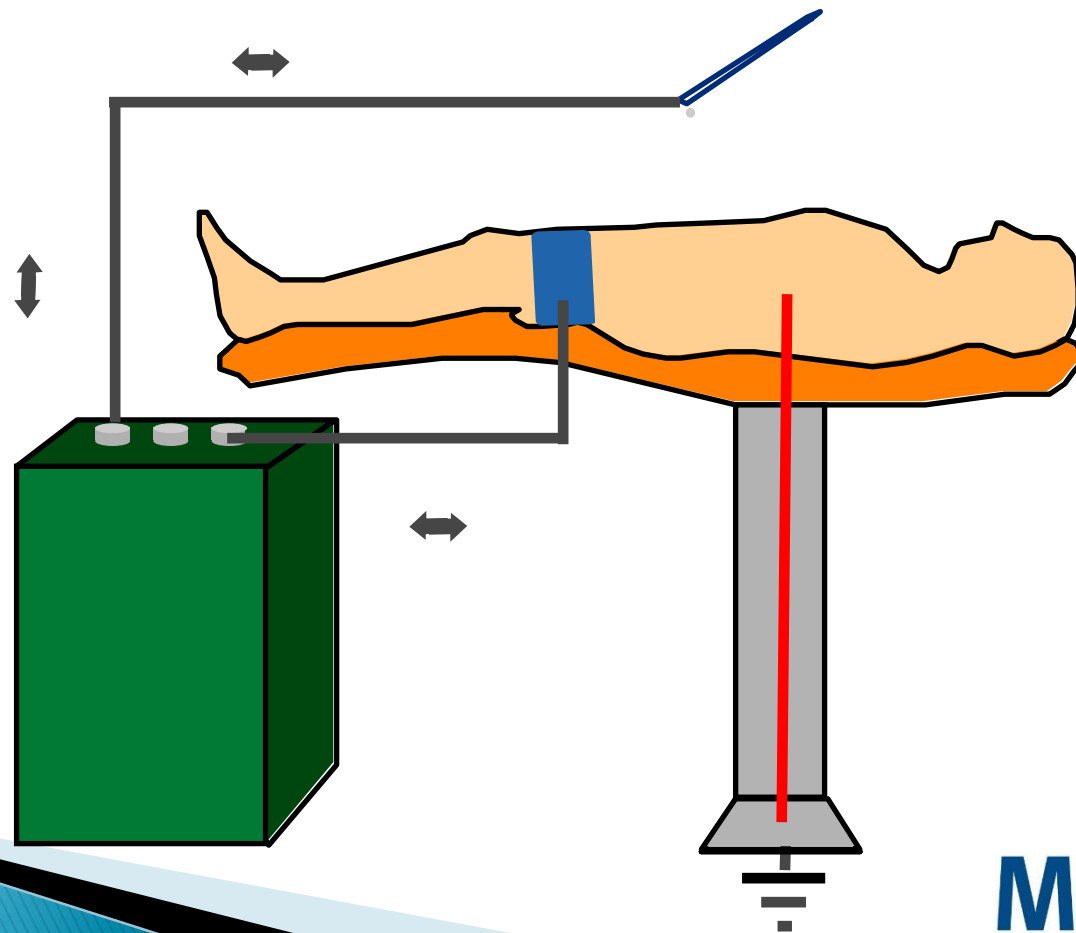


2) The Place of Plate

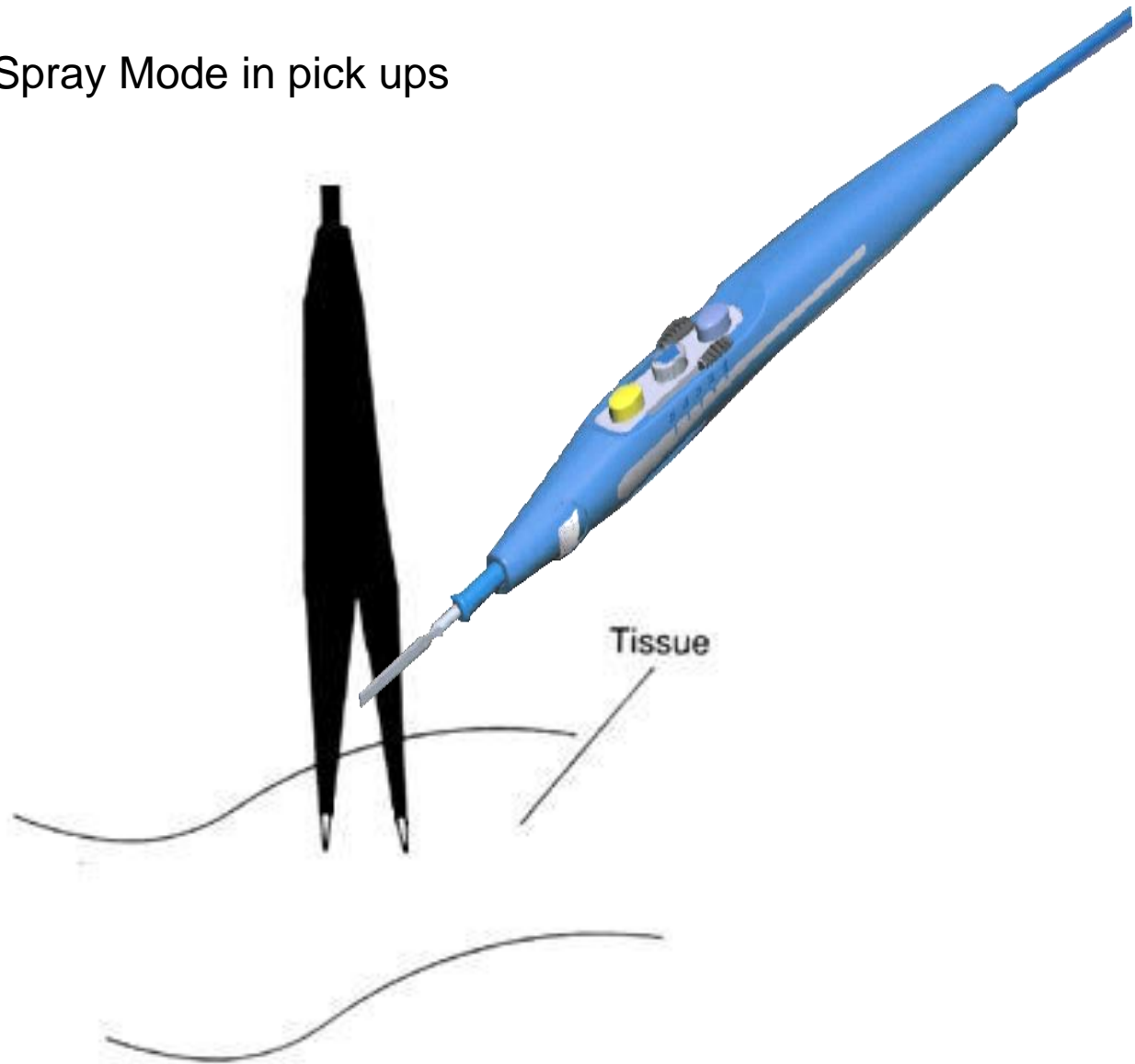
- ❖ Muscular
- ❖ No Hair
- ❖ No Scar
- ❖ Optimum 50 cm
- ❖ Direction



3) Open Circuit Activation



4) Using Spray Mode in pick ups



5) Electrosurgical Smoke



Medtronic

RapidVac™ Smoke Evacuation System



- ▶ Designed to:
 - Capture particulates and absorb smoke and odors
 - Improve visibility
 - Reduces potential health hazards
- ▶ Used in both open and laparoscopic procedures

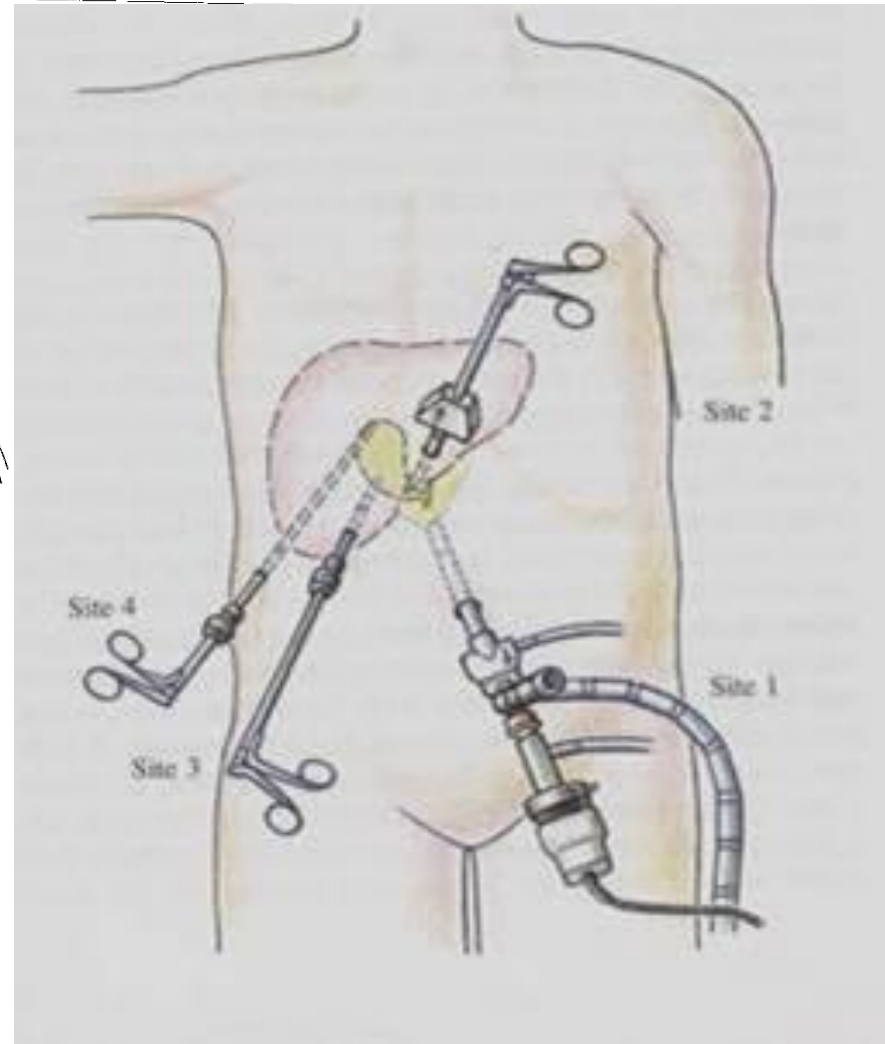
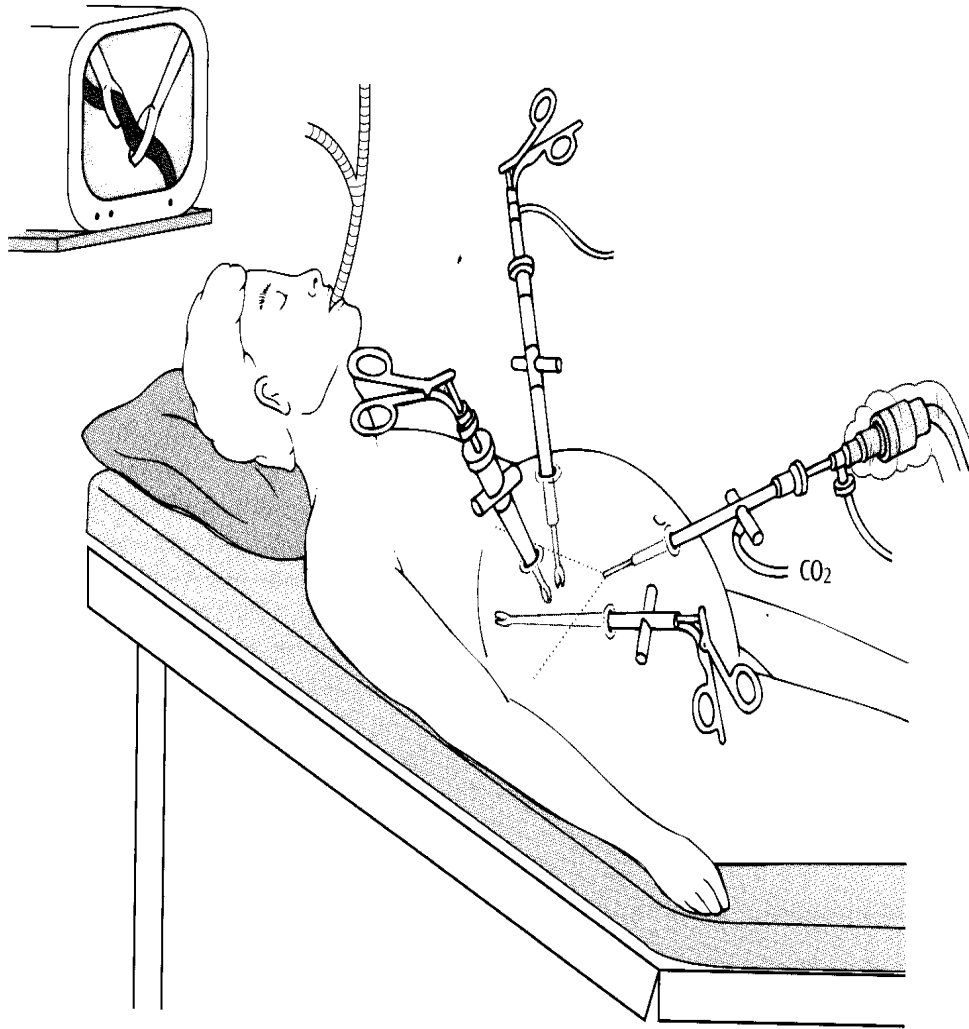


Medtronic

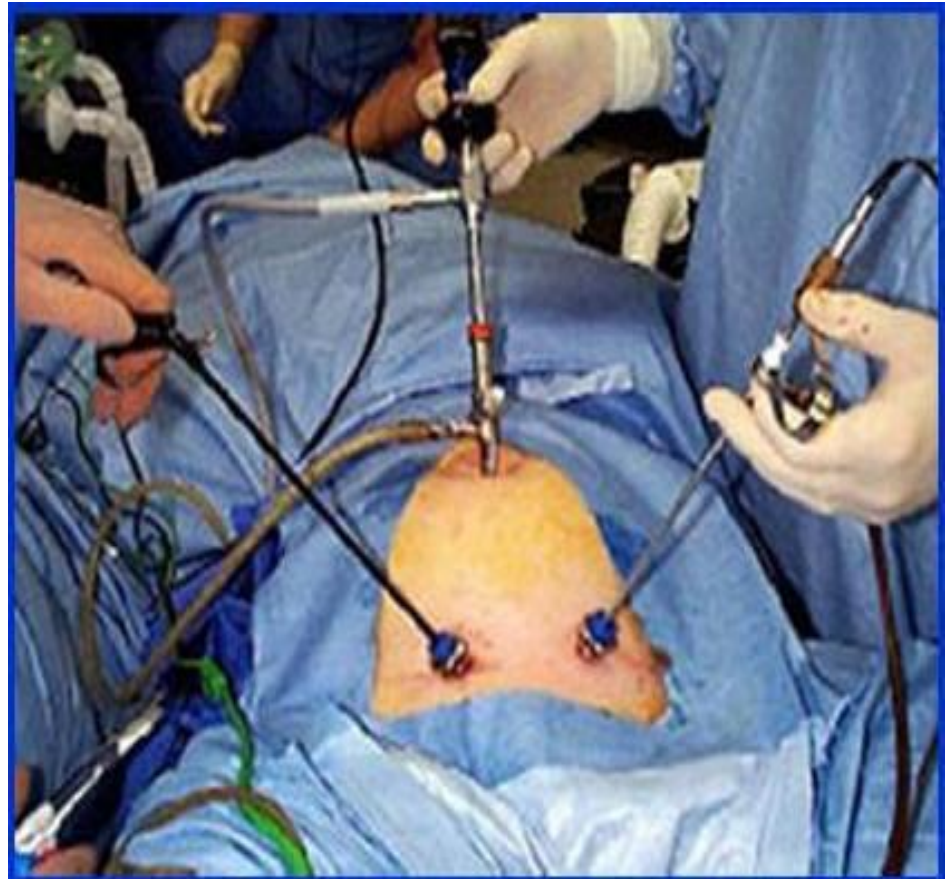
Pencil With AccuVac™ Attachment



Medtronic



Laparoscopic Appendectomy (Appendix Removal)



Medtronic

ست لاپاروسکوپ Medtronic (Covidien)



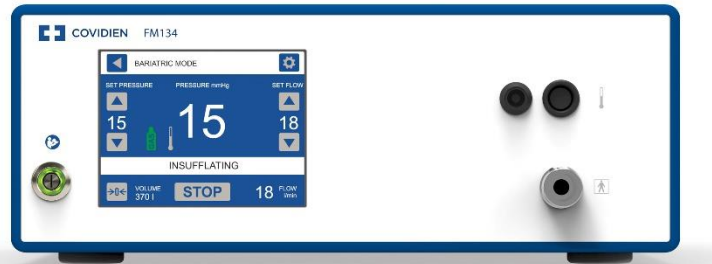
مانیتور مدیکال ←



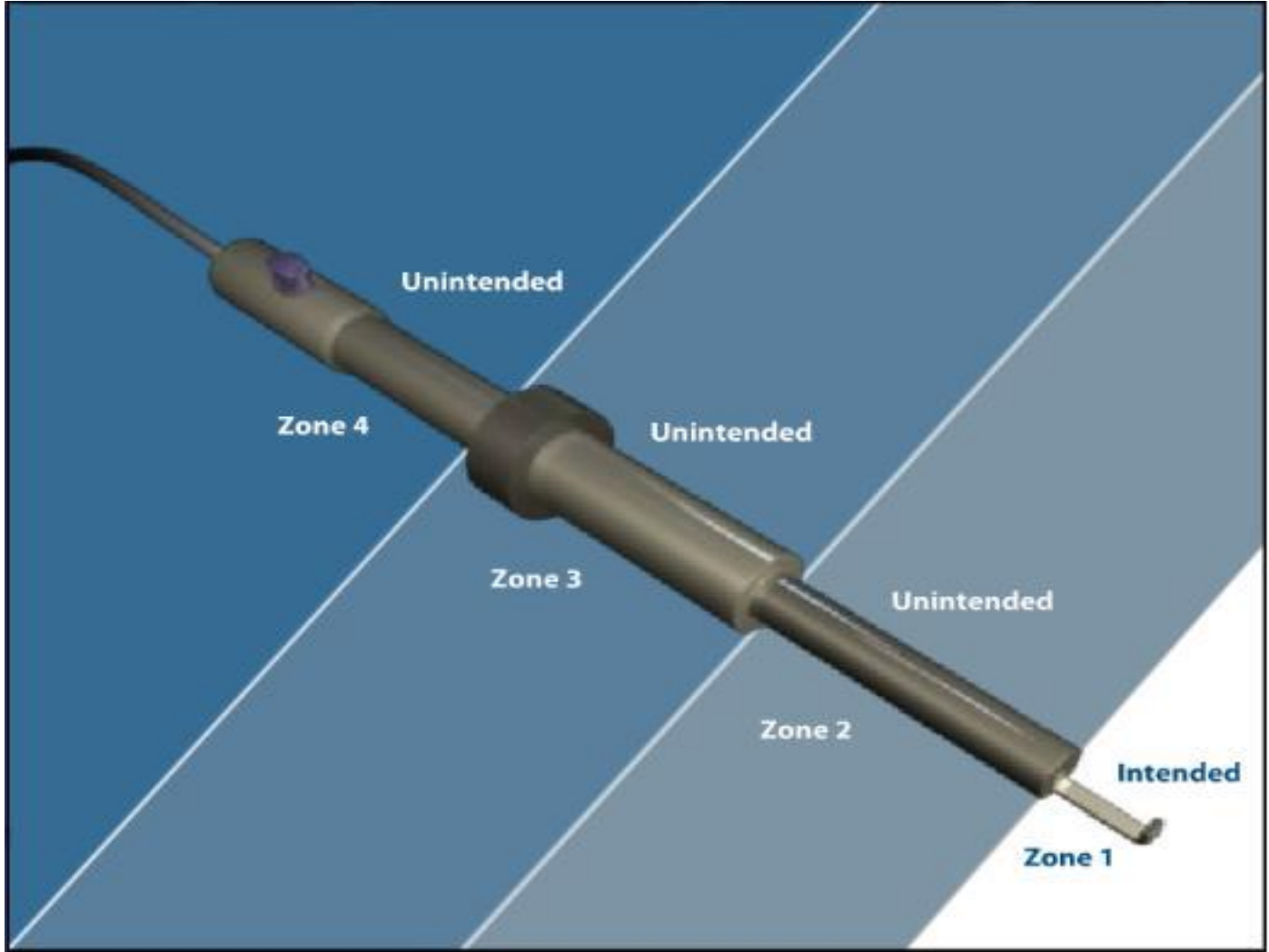
کمرا هد و پروسسور ←

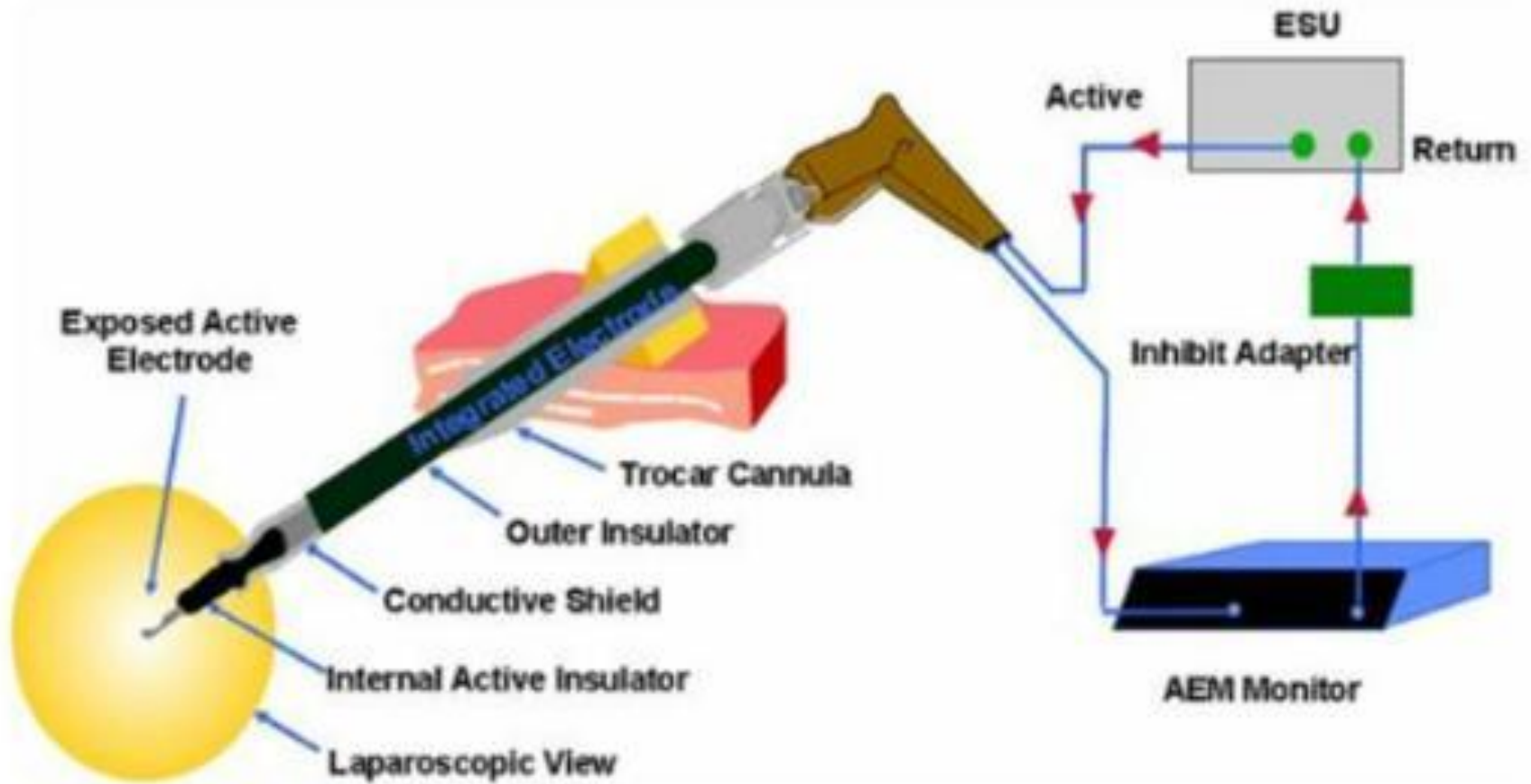
منبع نور ←

اینسافلیتور ←

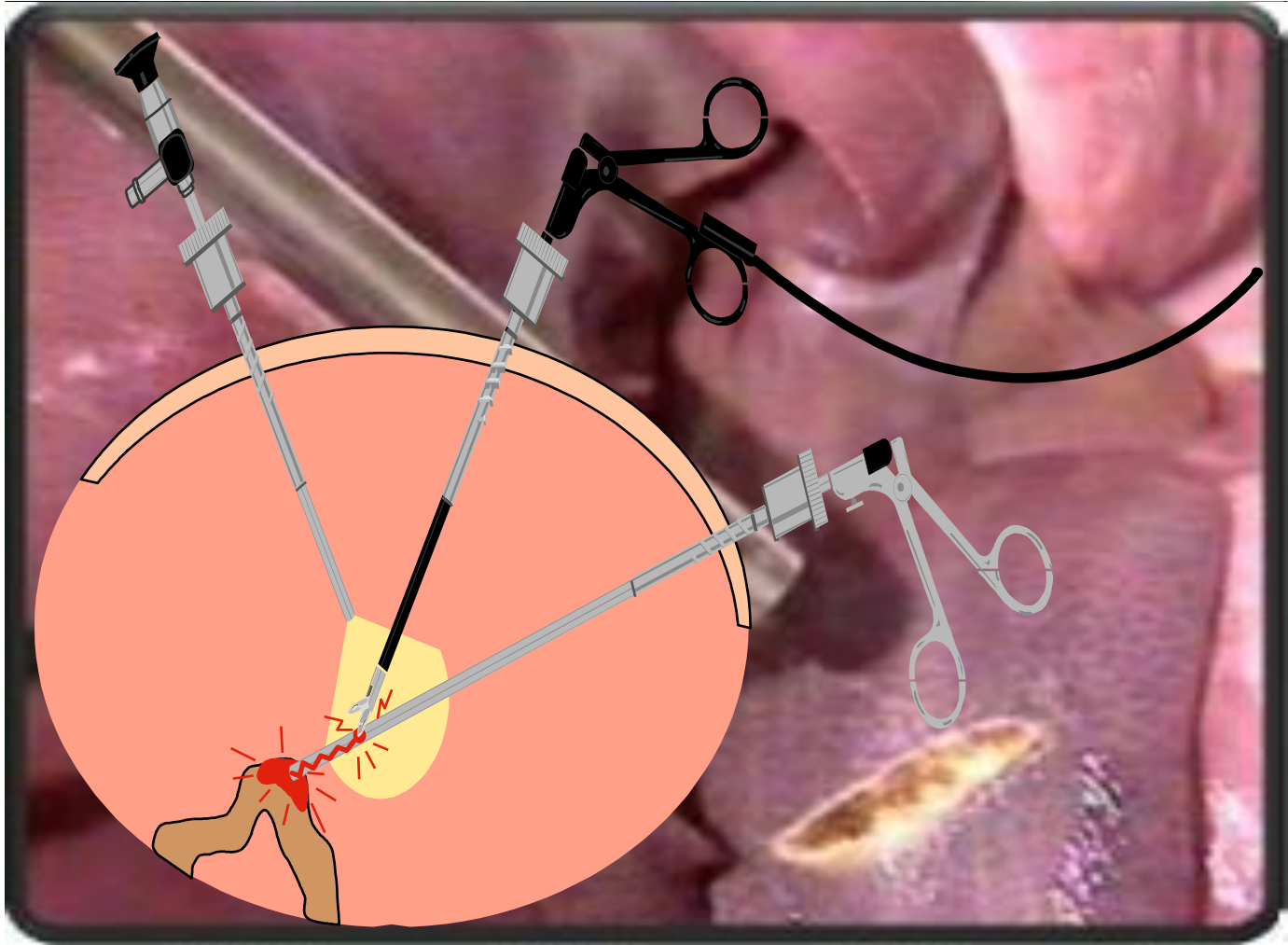


Medtronic



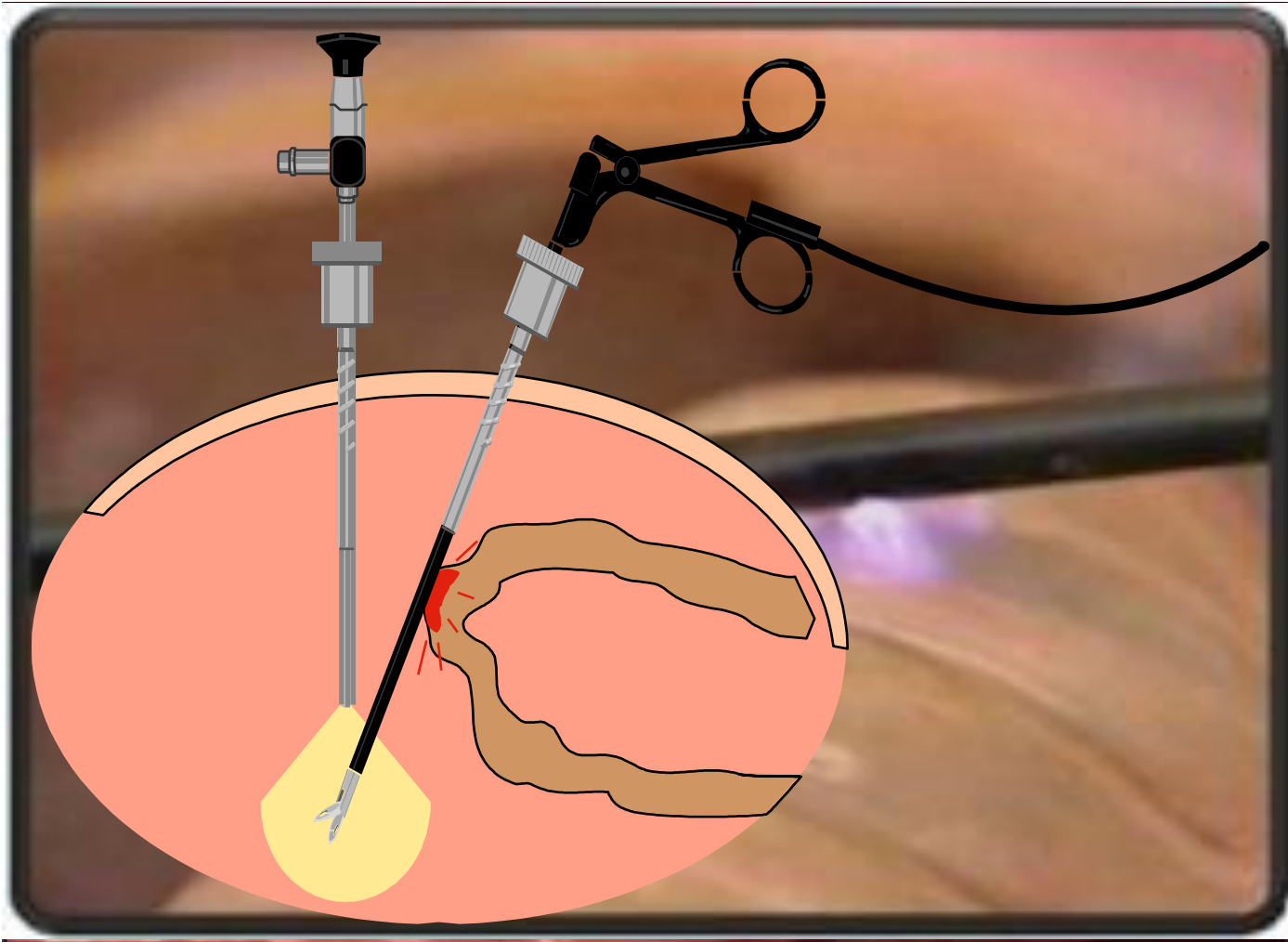


1) Direct Coupling



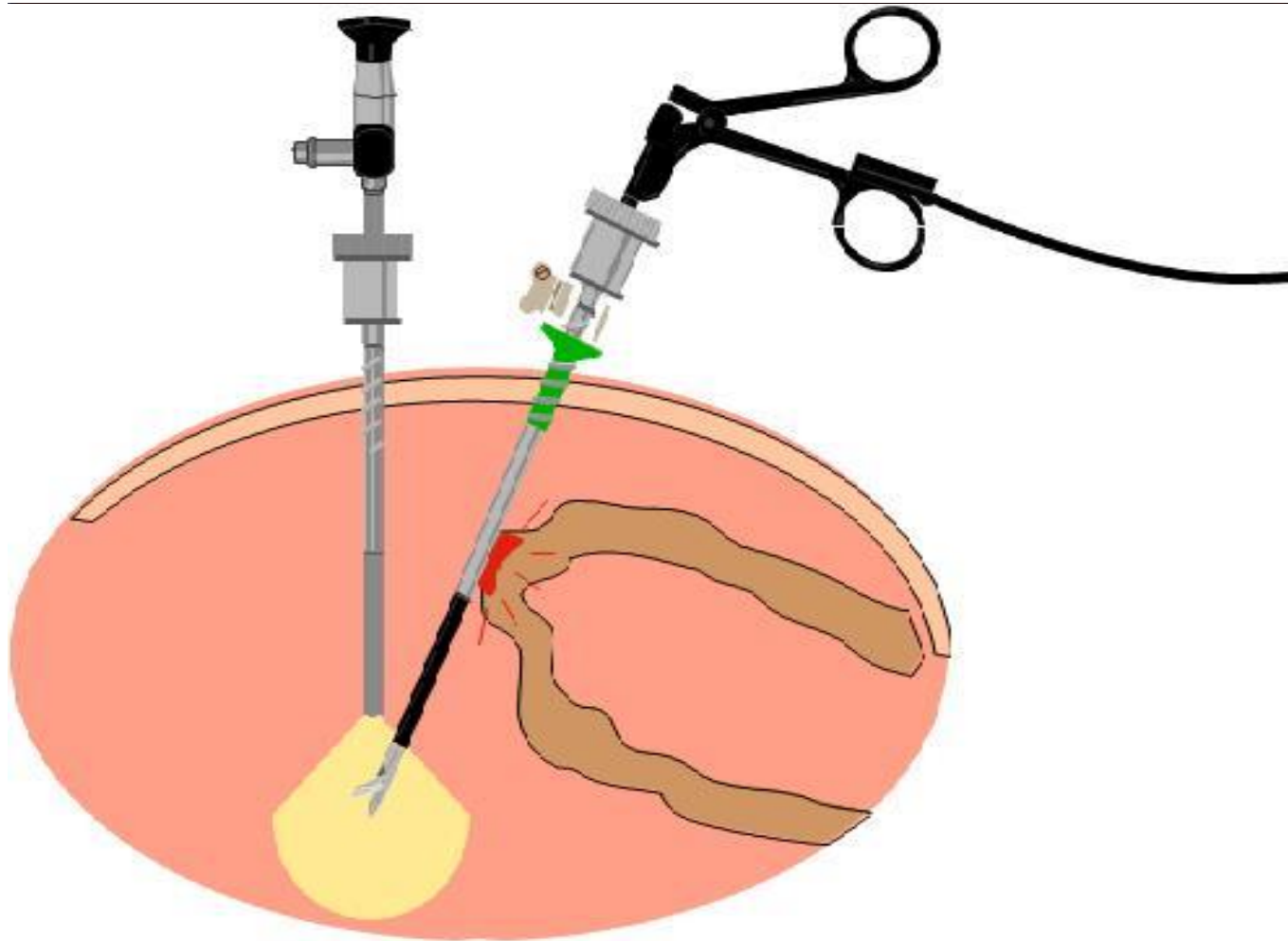
Medtronic

2) Insulation Failure



Medtronic

3) Capacitive Coupling



4) Residual Heat



5) Electromagnetic Interference



6) Electrosurgical Smoke



6) Electrosurgical Smoke



Medtronic

6) Electrosurgical Smoke

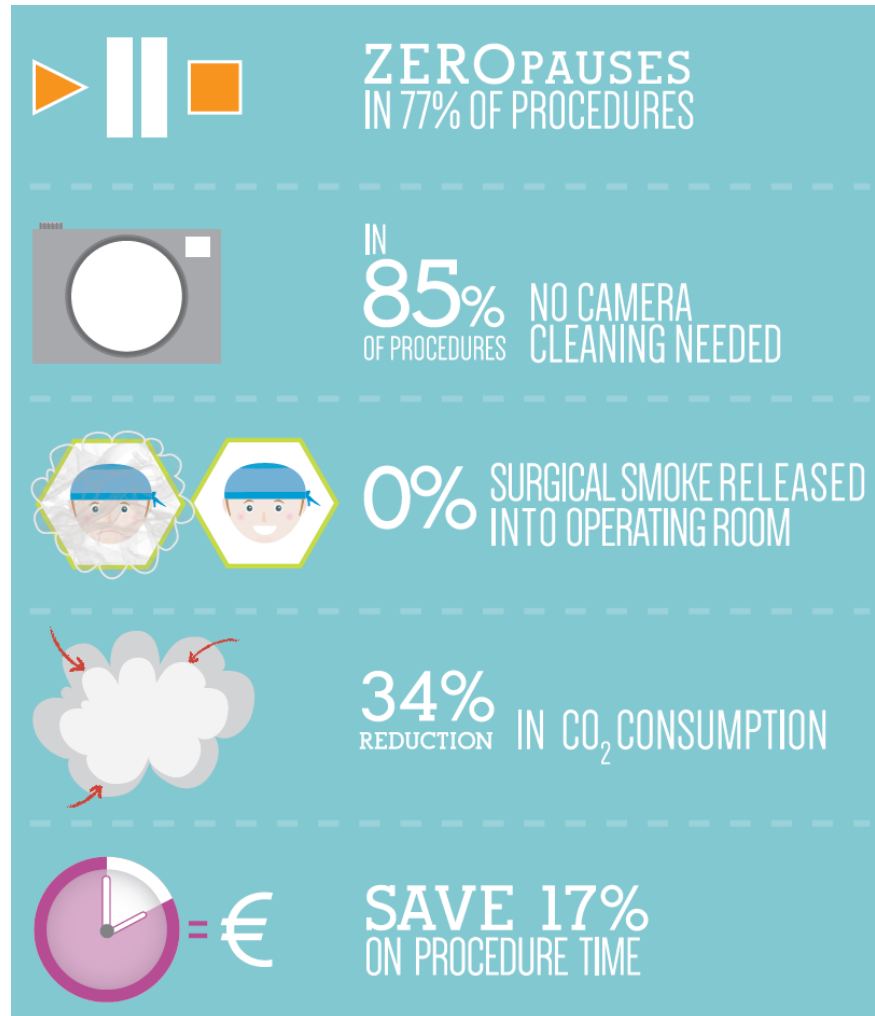
ULTRAVISION

VENTING



Medtronic

6) Electrosurgical Smoke



New Technologies

Medtronic

Valleylab History of Innovation



1967 – Valleylab Founded

1968 – Portable Solid State Generator

1970 – Isolated Generators

1973 – Disposable Pencil

1976 – Handswitching Pencil

1981 – REM™ technology

1991 – Four Function Lap Handpiece

1994 – Clinical Hotline

1995 – Instant Response™ Technology

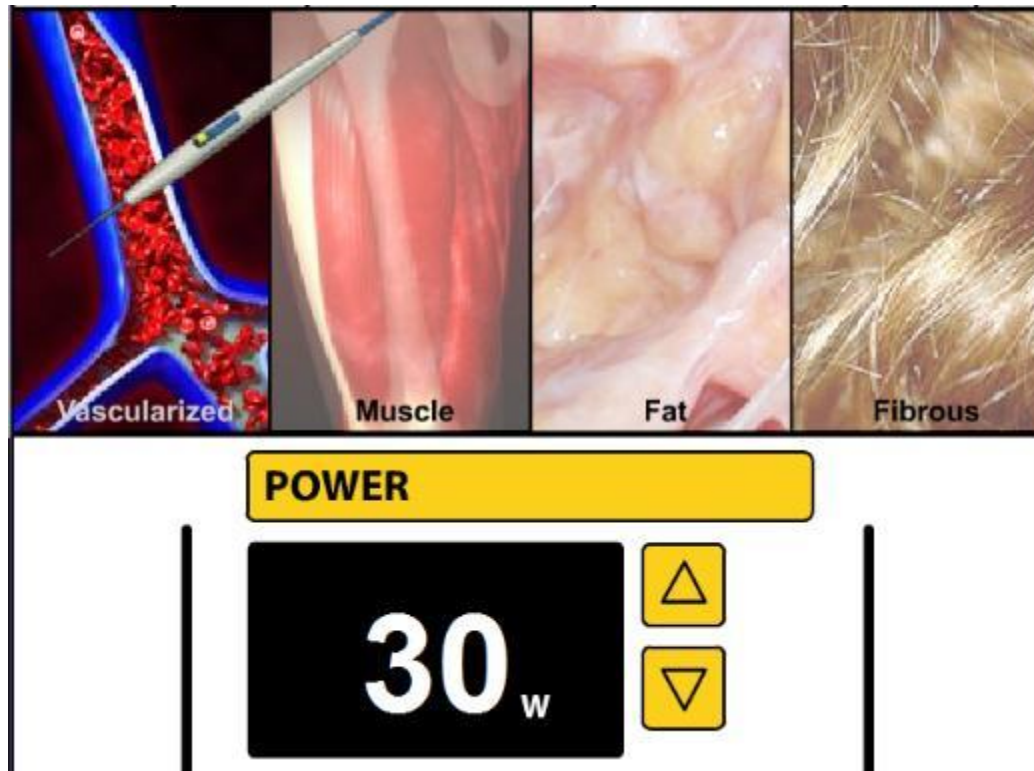
Force 2 in 1986



Medtronic

Old Technologies

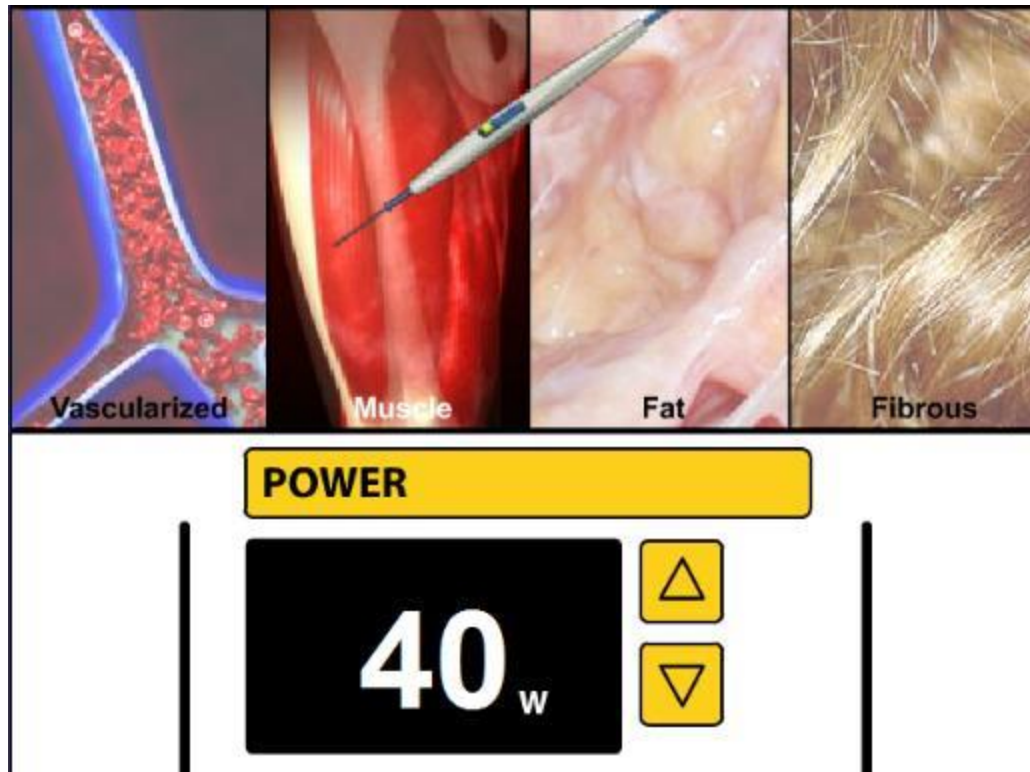
No Instant Response



Medtronic

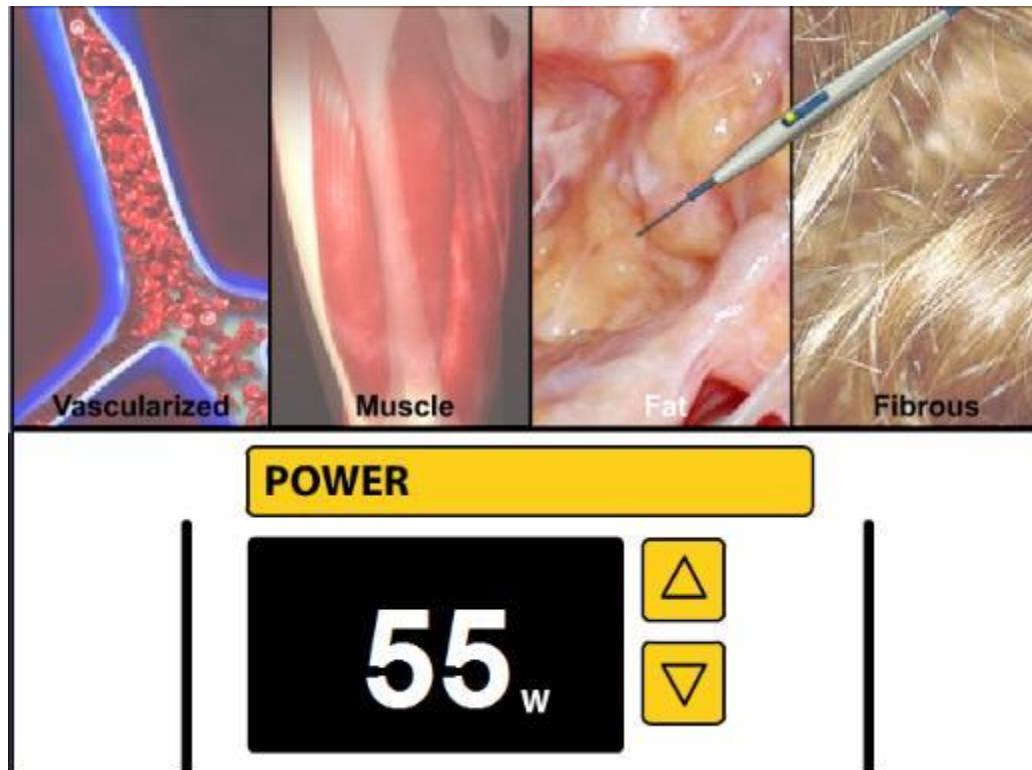
Old Technologies

No Instant Response



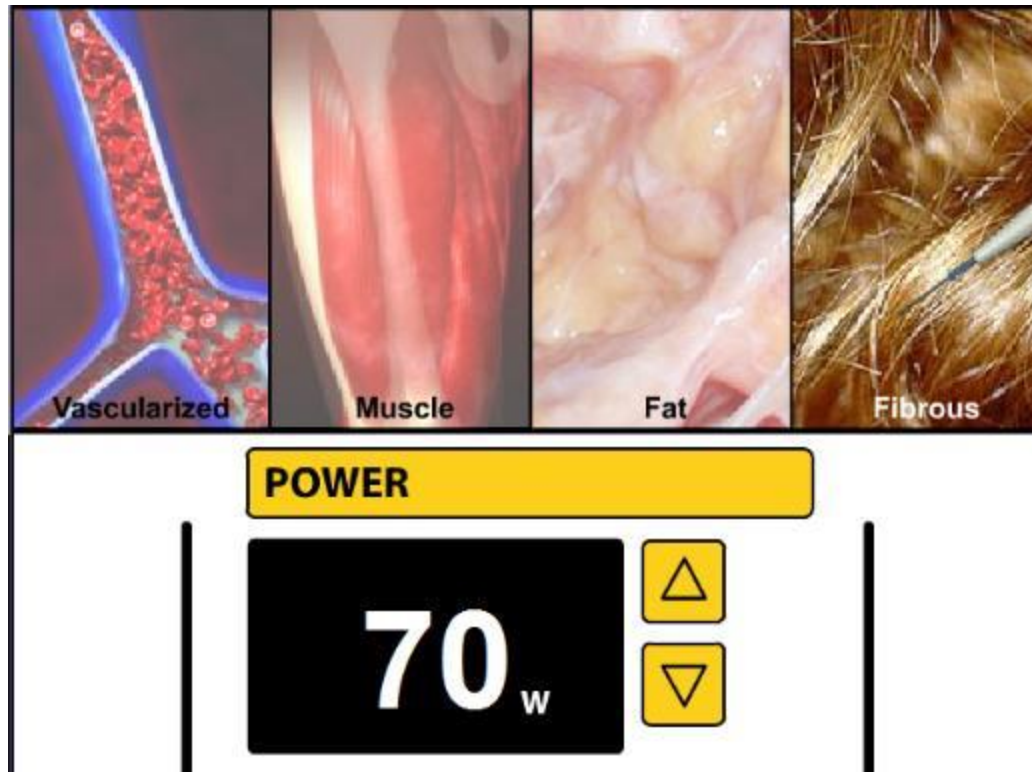
Old Technologies

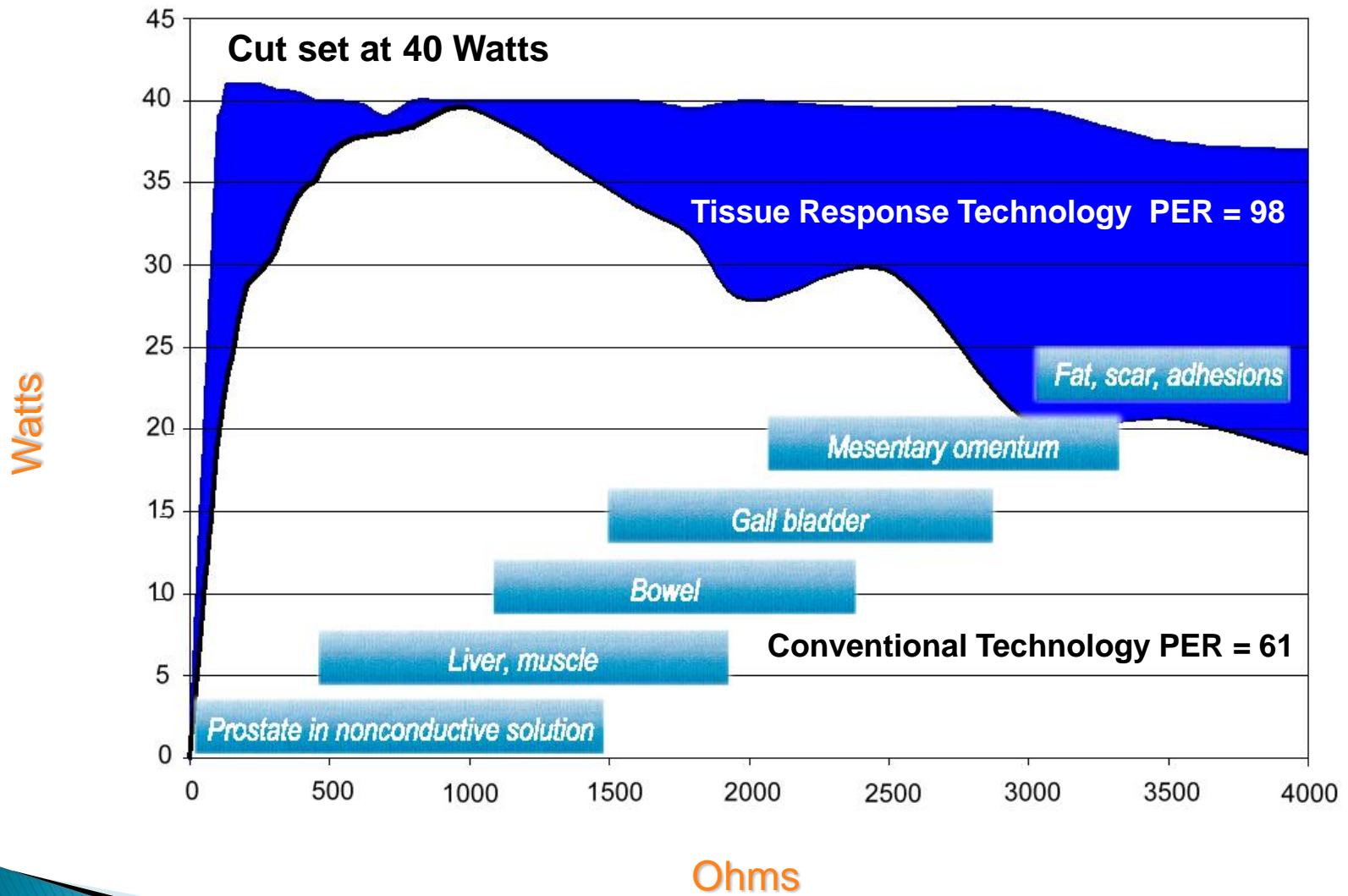
No Instant Response



Old Technologies

No Instant Response





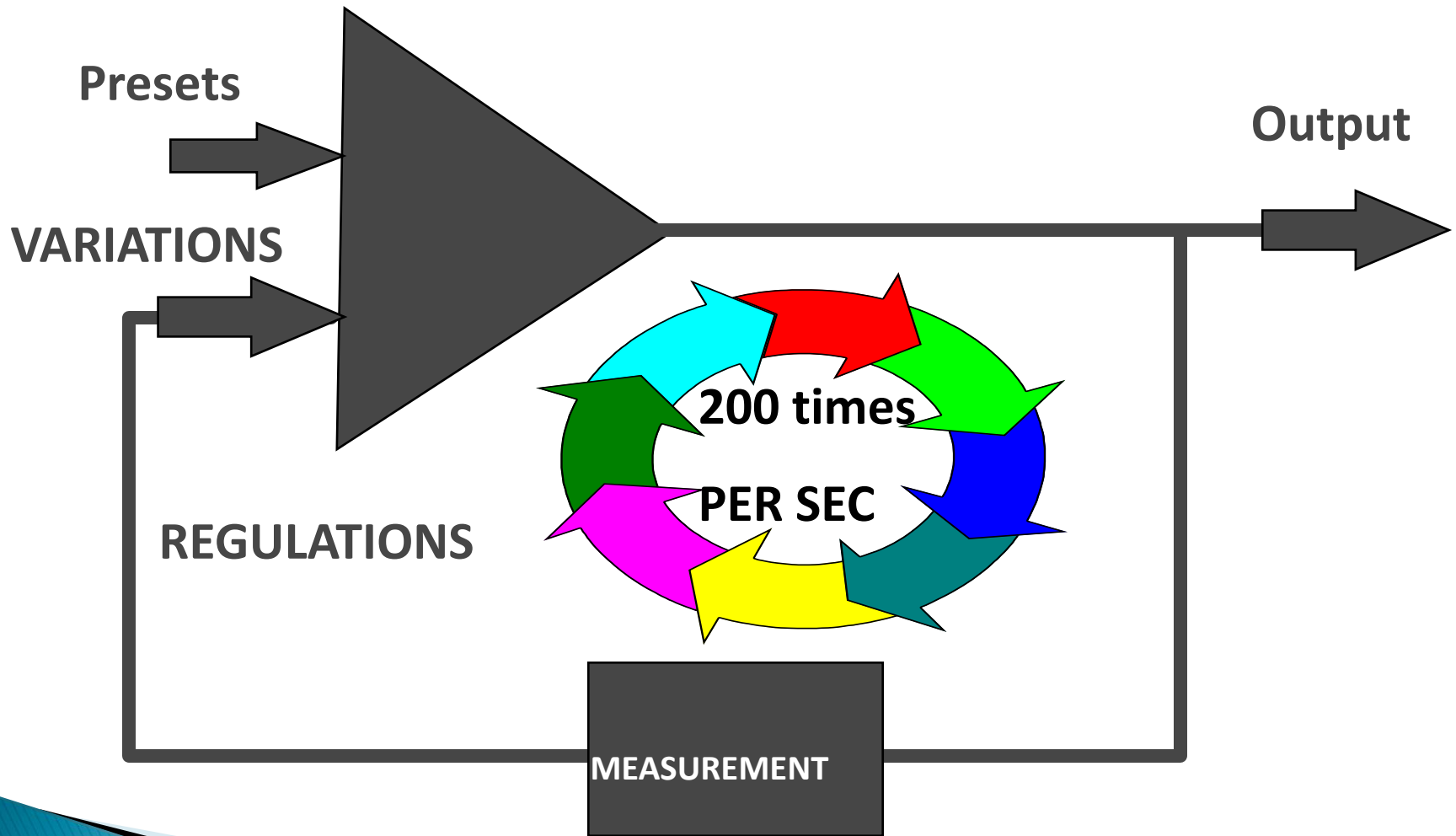
Instant Response™ Technology

(Tissue Response)

Founded in 1995

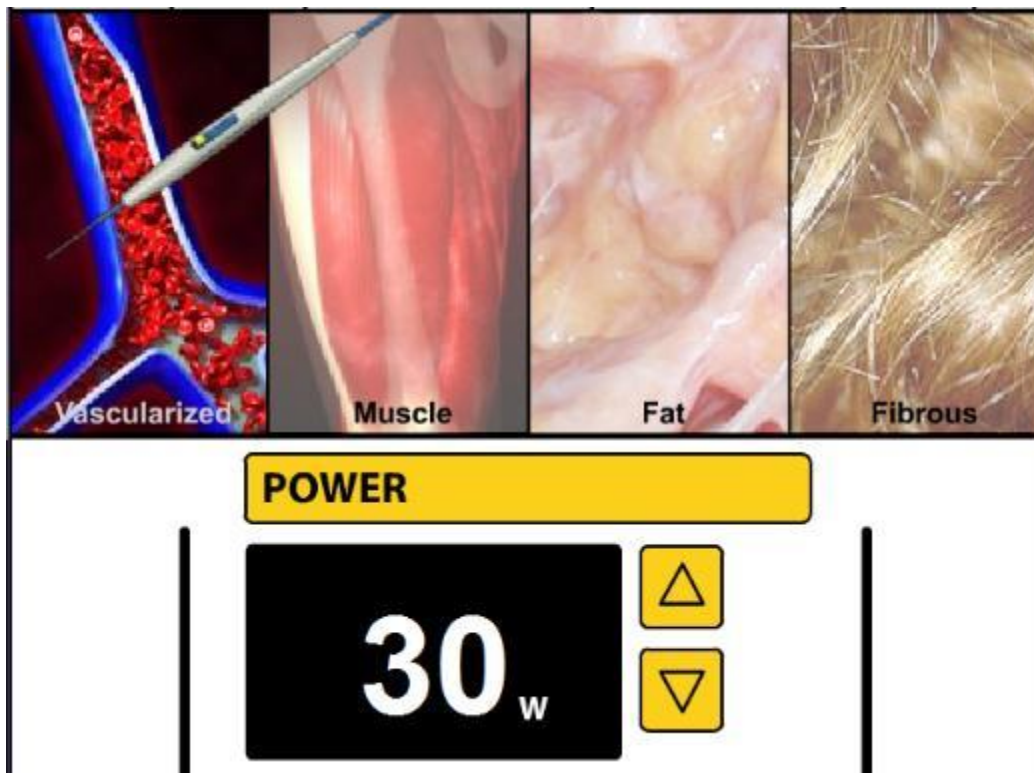
Medtronic

Instant Response™ Technology



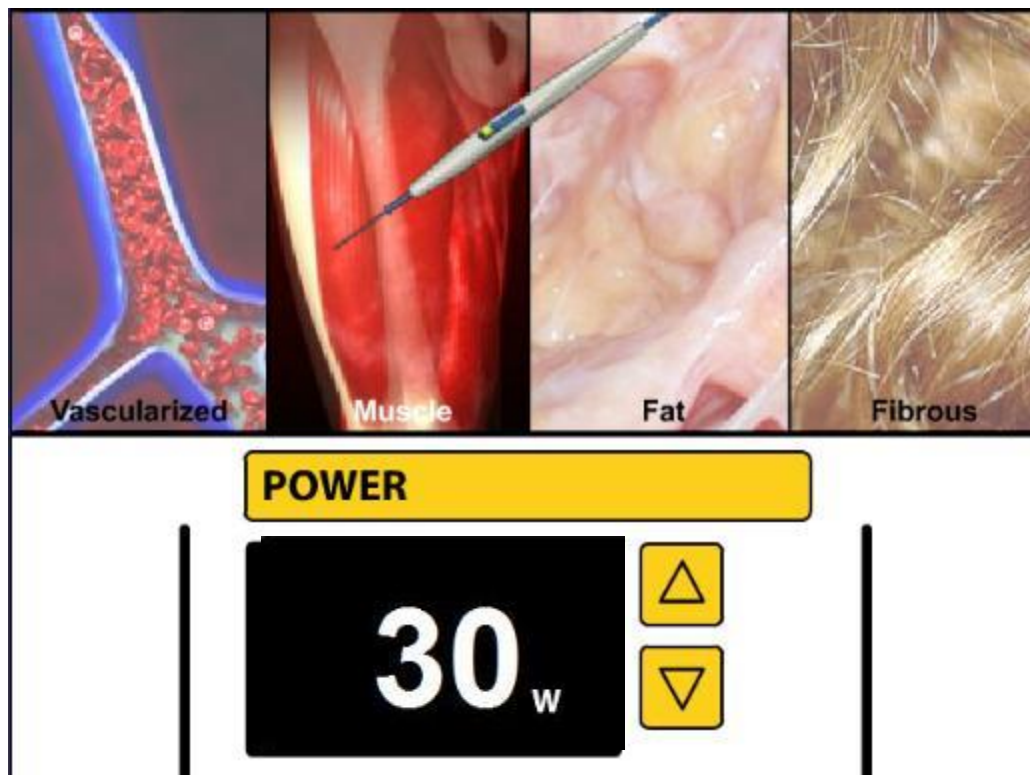
Medtronic

Instant Response™ Technology



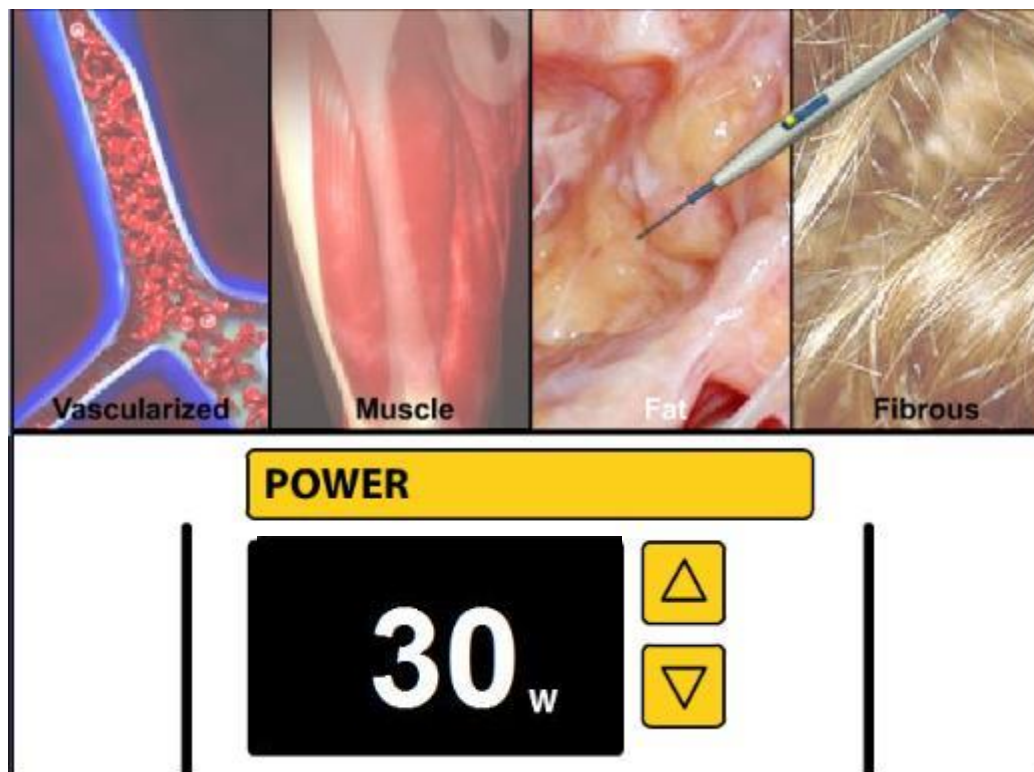
Medtronic

Instant Response™ Technology



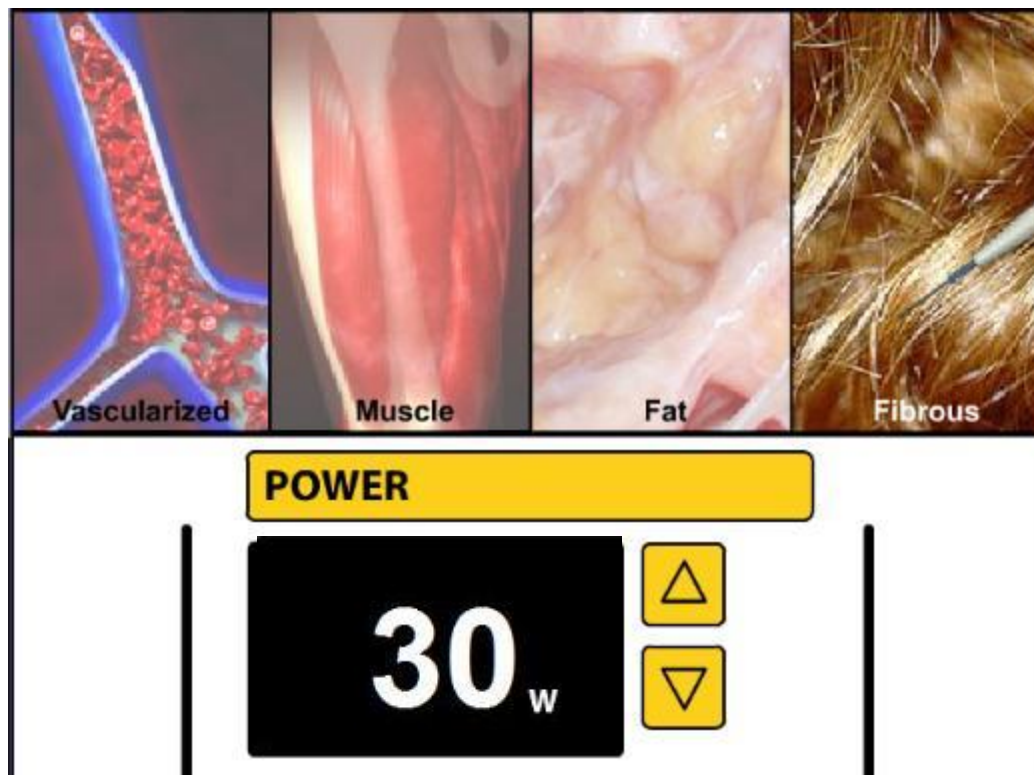
Medtronic

Instant Response™ Technology



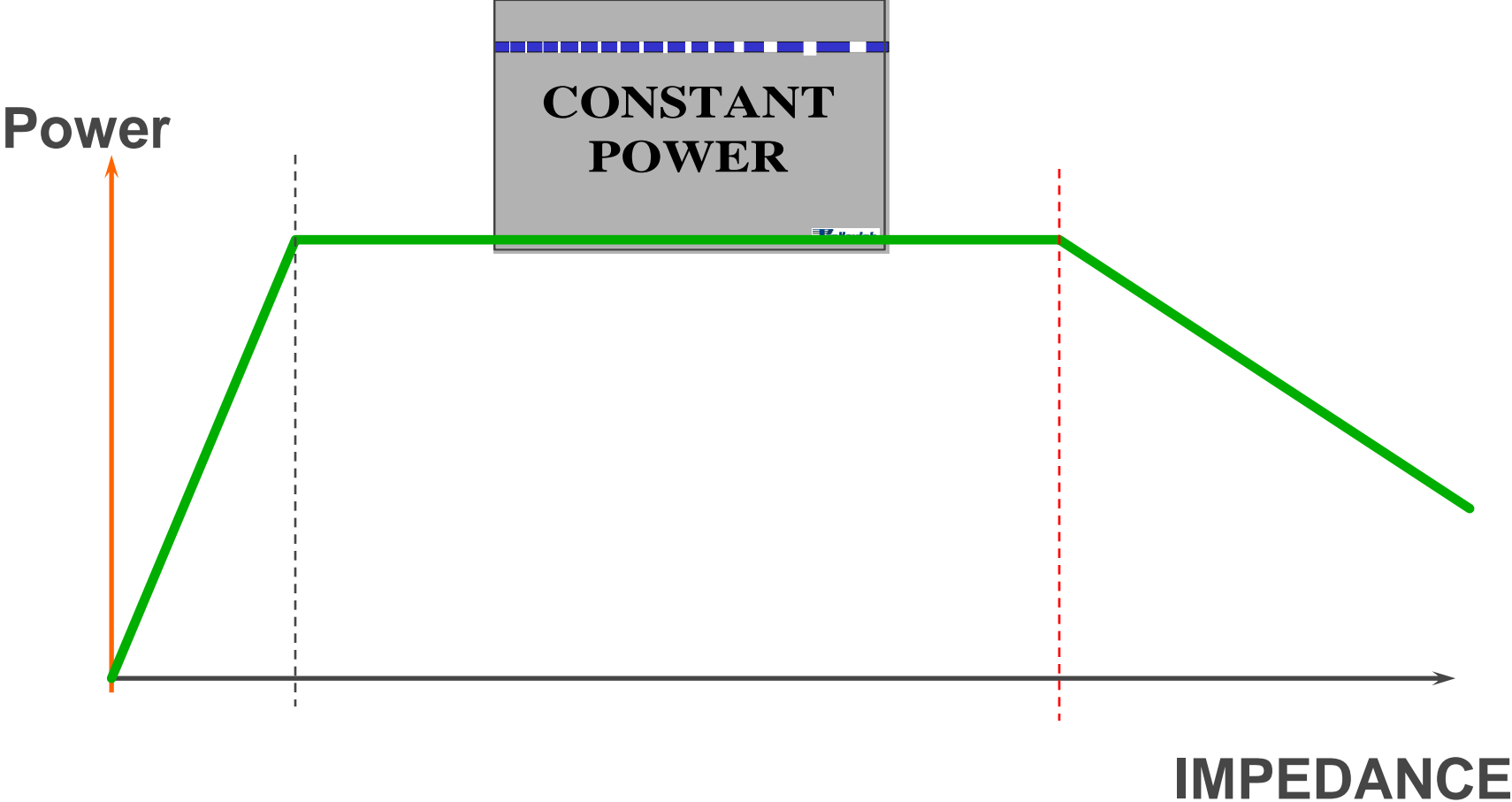
Medtronic

Instant Response™ Technology

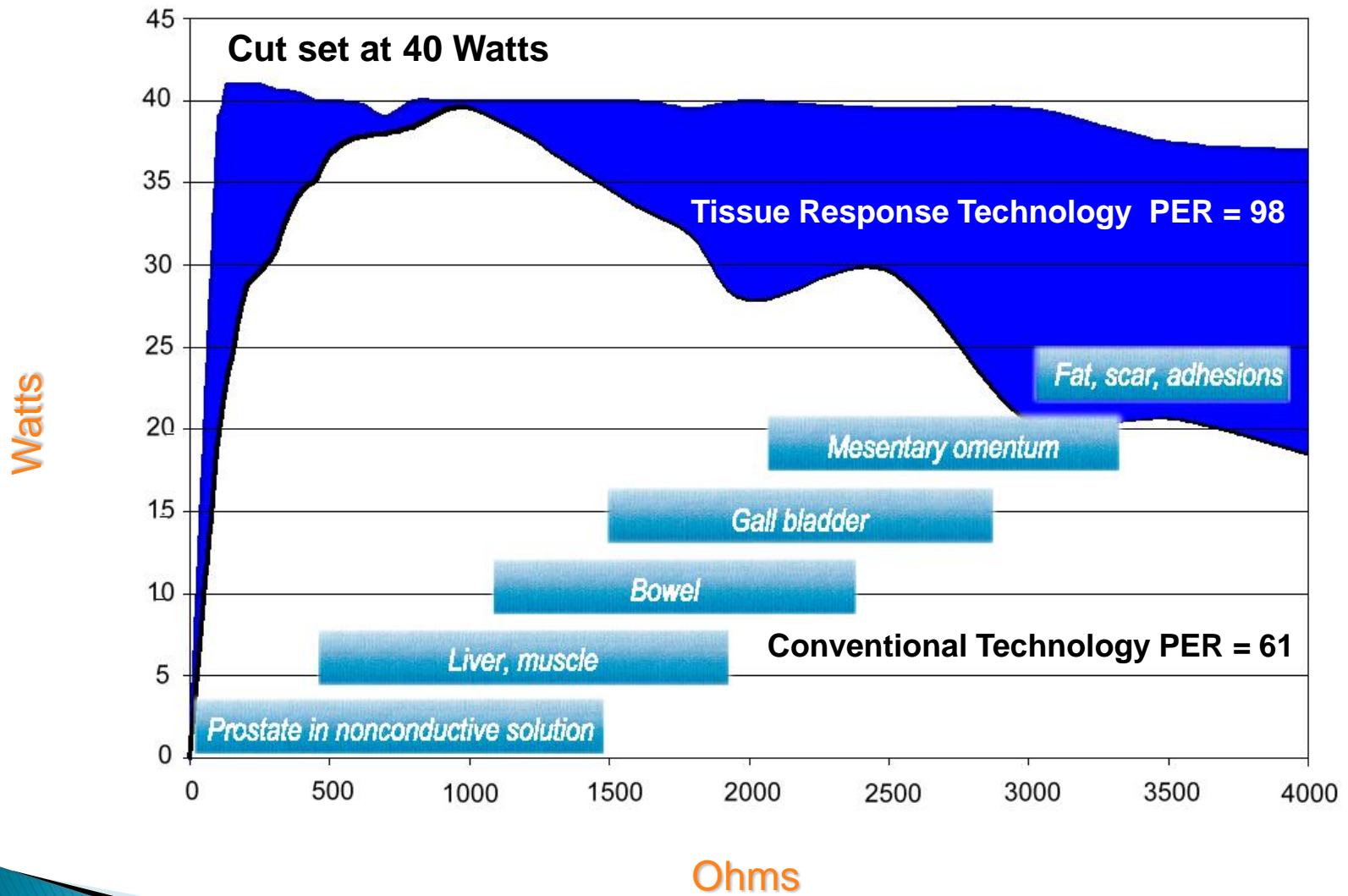


Medtronic

Instant Response™ Technology



Medtronic



Instant Response™ Technology

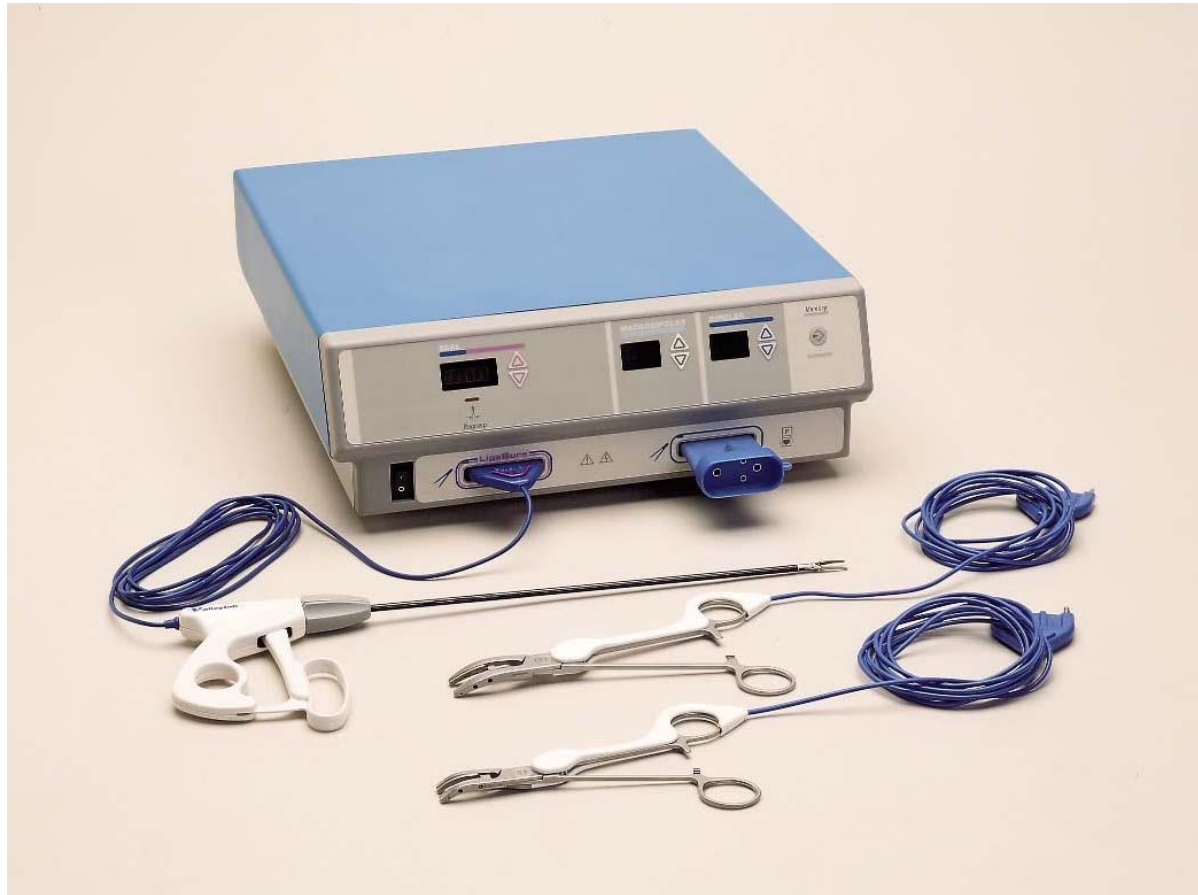
Valleylab FX8
434000/s

Force FX-8C
200/s



Medtronic

LigaSure Vessel Sealing System

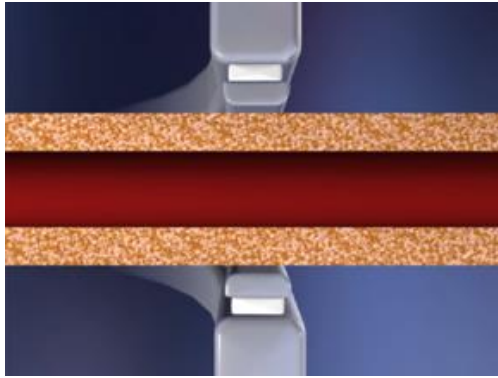


Medtronic

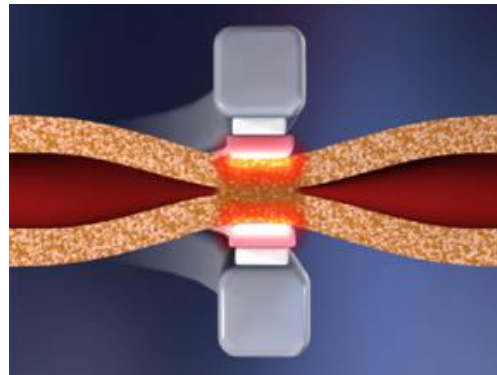
LigaSure Vessel Sealing System

LigaSure™ is a unique combination of pressure and energy used to seal vessels, tissue bundles, and lymphatics up to and including 7 mm in diameter to create a permanent, flexible seal that can withstand at least 3 times systolic pressure.

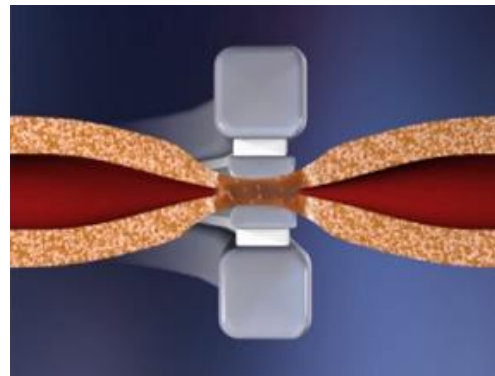
LigaSure :System Operation



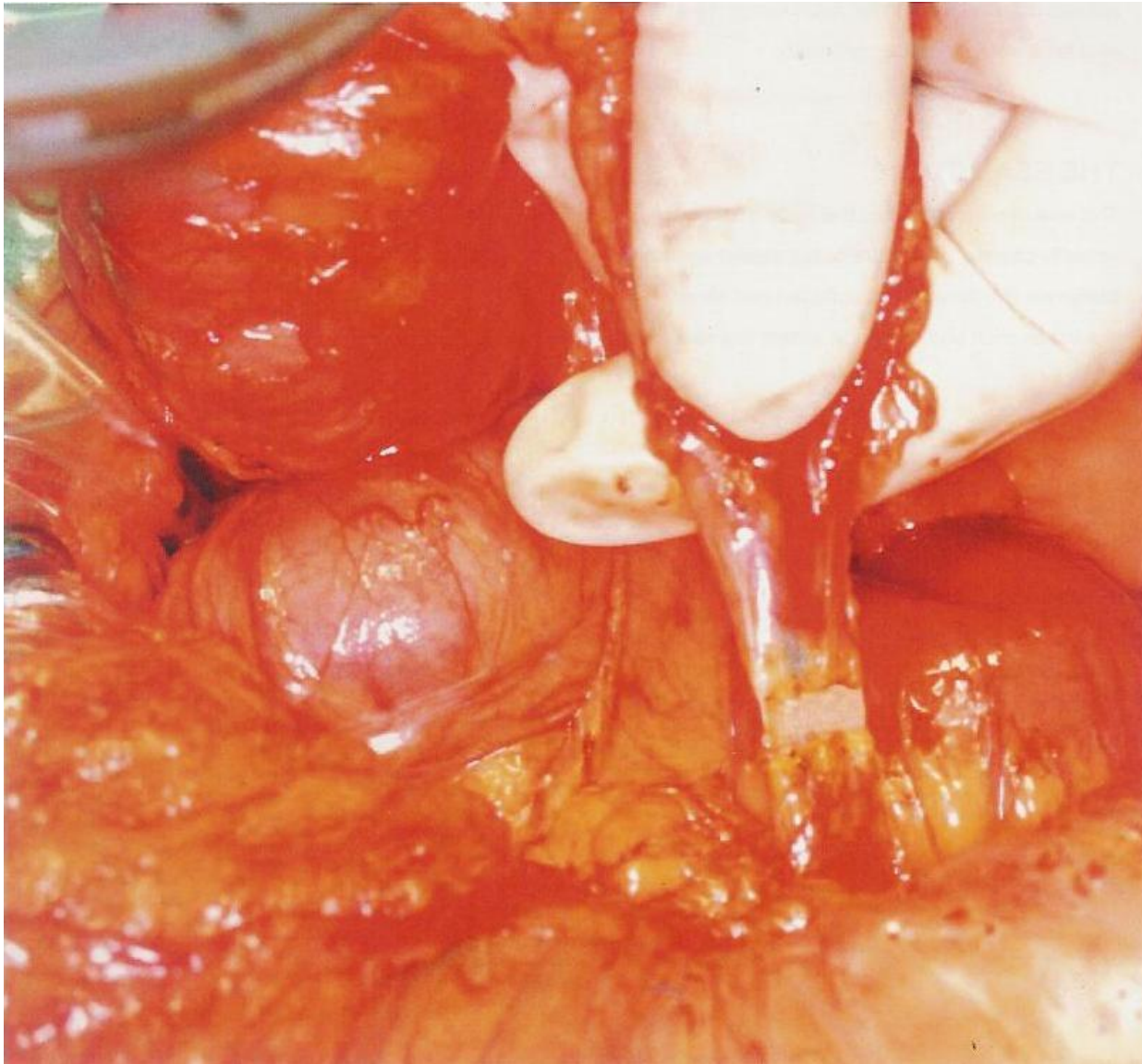
Instant Response Technology™



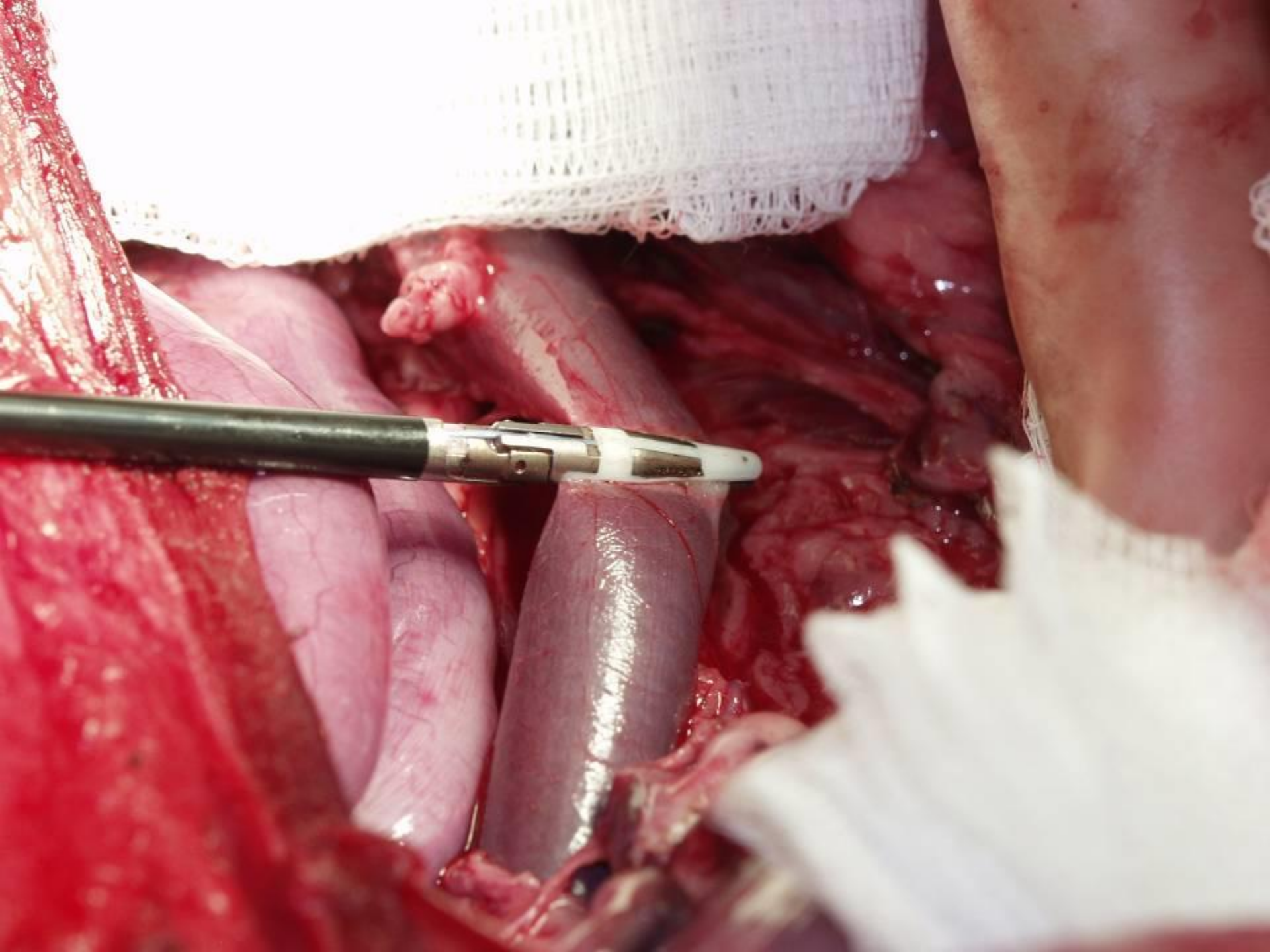
Collagen and Elastin Fusion

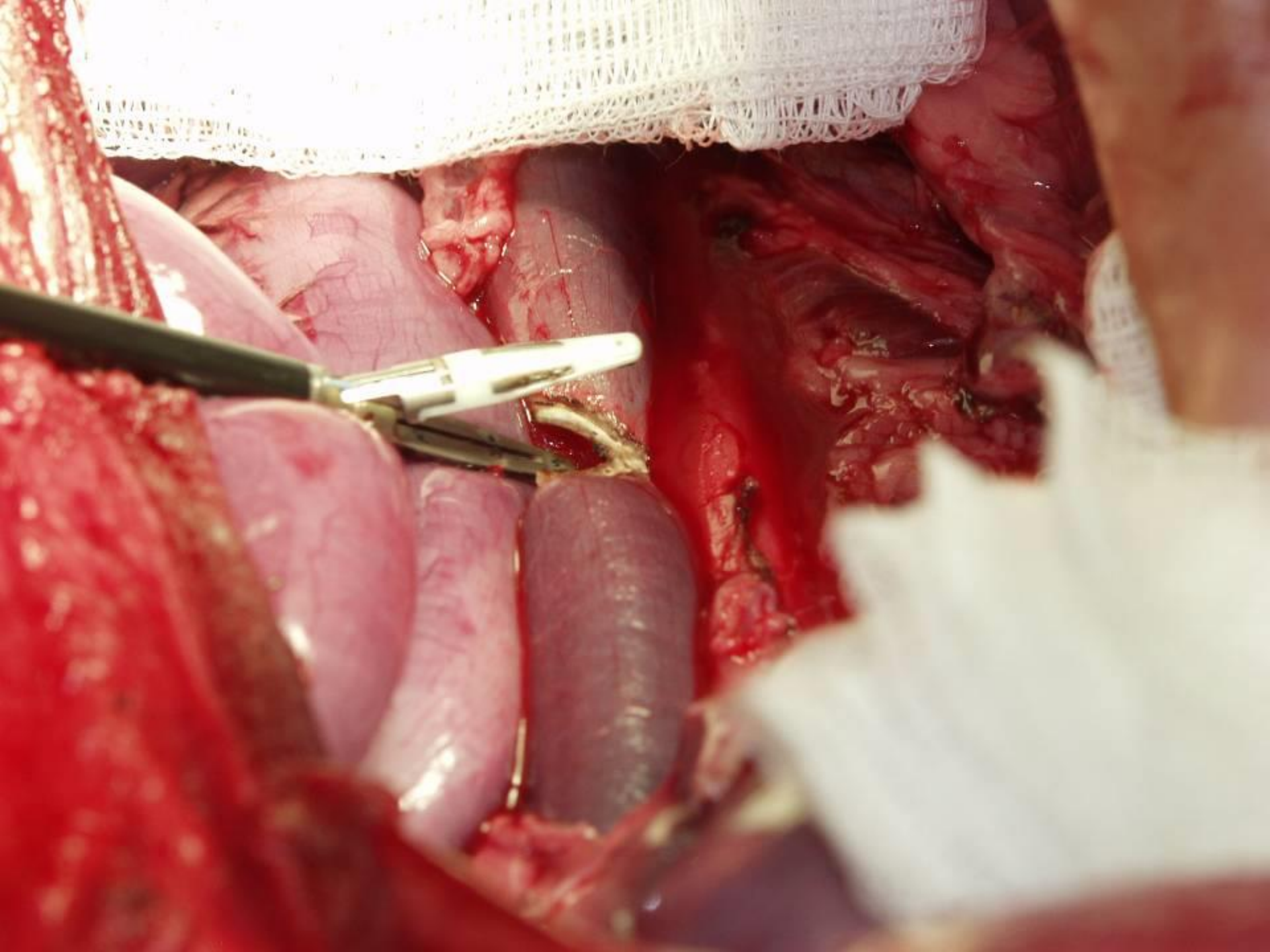


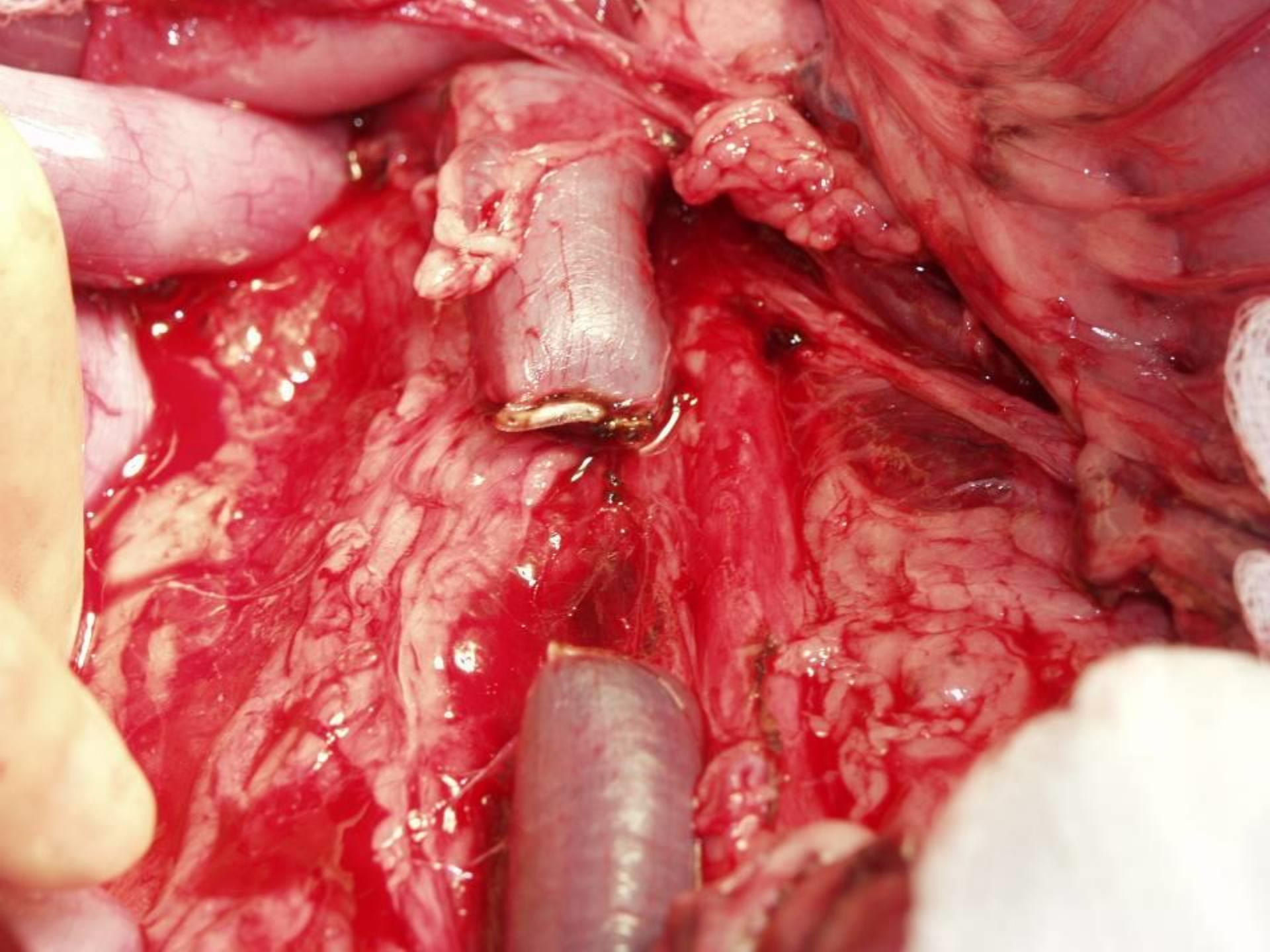
Medtronic



Medtronic







LigaSure Vessel Sealing System

LigaSure™ is a unique combination of pressure and energy used to seal vessels, tissue bundles, and lymphatics up to and including 7 mm in diameter to create a permanent, flexible seal that can withstand at least 3 times systolic pressure.

Bipolar Coagulated Vessel Characteristics

- ▶ Open Loop System – No feedback
- ▶ Relies on tissue shrinking and proximal Thrombus for Ligation
- ▶ Lumen Still Apparent
- ▶ Tissue Damage determined by Power Setting , activation time and shape of Power Curve

Traditional Bipolar
Vessel shrinkage
lumen partially open
and a thrombus is
needed for vessel
occlusion



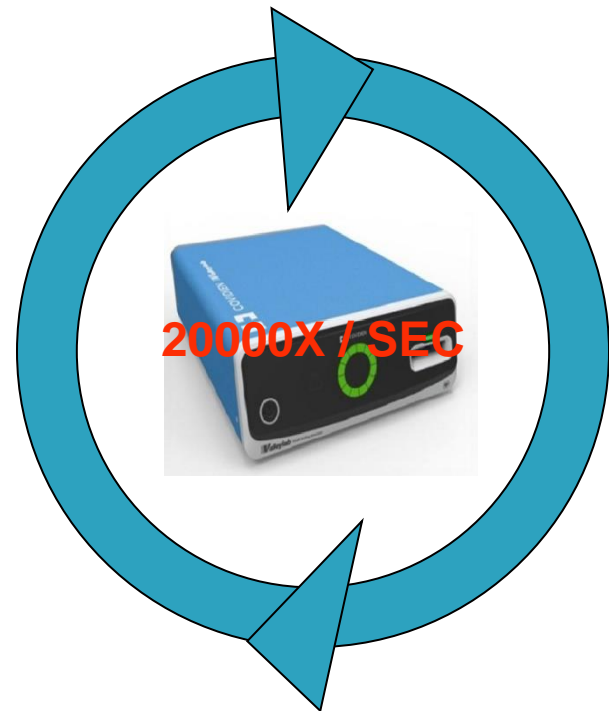
Vessel Sealing
Intimal walls of
vessel fused,
complete lumen
occlusion



Feedback Speed: TissueFect™ Tissue Sensing Technology

▶ Instant Response Technology

▶ TissueFect Technology



Medtronic

New LigaSure

LS10



Medtronic

مشخصات و قابلیت‌های

سیستم انسداد عروق کمپانی Covidien
مدل Valleylab LS10

طرح تعویض با
ژنراتور قدیمی

کاربری بسیار آسان برای
کاربر (Plug & Play)
بنمویکه نیاز به هیچگونه
تنظیم و برنامه ریزی ندارد

دارای ضریب شکست
صفر تا ۳ برابر فشار
سیستولیک (تا ۱۴۰
میلیمتر جیوه)

دارای کانکتور
هوشمند
Smart)
Connector
(جهت
شناسایی و
تشخیص
هندپیسهای
مقتلف

دارای ابعاد
کوچک و وزن
۵/۵ کیلوگرم
جهت حمل و
نقل آسان.



انسداد عروق تا
قطر ۷ میلی
متر (دارای
تاییدیه FDA
آمریکا)

اندازه گیری و
ارزایی
امپدانس
بافت ۲۰۰۰۰
بار در ثانیه

قابلیت انسداد عروق
در ۲ تا ۴ ثانیه
(بالا ترین سرعت
انسداد عروق نسبت
به تکنیکهای دیگر)

عملکرد کاملا هوشمند بنمویکه
هیچگونه قابلیت تنظیم وات برای
کاربر روی دستگاه وجود ندارد

دارای کنترل بصری
و خودآموز و
نمایش اطلاعات
ساده برای
یادگیری، درک و
عیب یابی دستگاه.

قابلیت کارکرد
با هندپیسهای
مدرن کمپانی و
هندپیسهای
قدیمی

دارای تکنولوژی Tissue Effect Plus که باعث هوشمندی در
شناسایی و ارزایی بافت هدف و تنظیم انرژی بطور خودکار در دستگاه
بوده بطوریکه میزان پخش حرارتی (Thermal Spread) به
بافت‌های جانبی حداکثر ۱ میلی متر برای هر مدل هندپیس میباشد.

FT10

TissueFect™

Software Upgradeable

Bipolar Cable Compensation

Touch Screen

New ES Settings

Dimensions

Performance

Reads tissue: 434,000 times per second¹

Ethernet connection (has WiFi capabilities that are not yet enabled)

Reads cable length and width for consistent electrosurgical output

Single, simplified touch screen

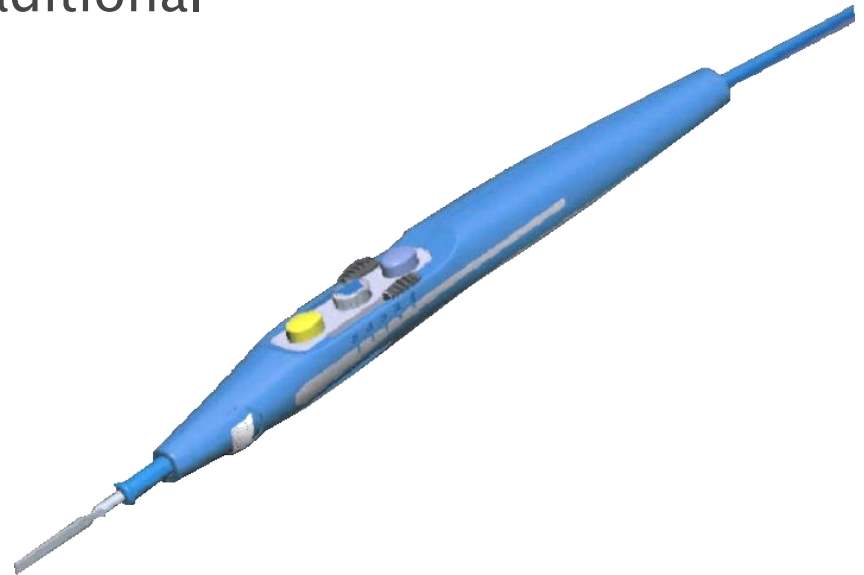
Soft coag

- Weight (kg): 10.1
- Width (cm): 35.8
- Height (cm): 17.0
- Depth (cm): 46.2
- Lower max jaw temperature³
- Faster sealing times (1-4 seconds vs. 3-6 seconds with ForceTriad™)⁴
- Automatic power settings require minimal setup and minimize need for further handling during surgery
- Simple, intuitive controls and information displays⁵



▶ Valleyslab Mode Key Message

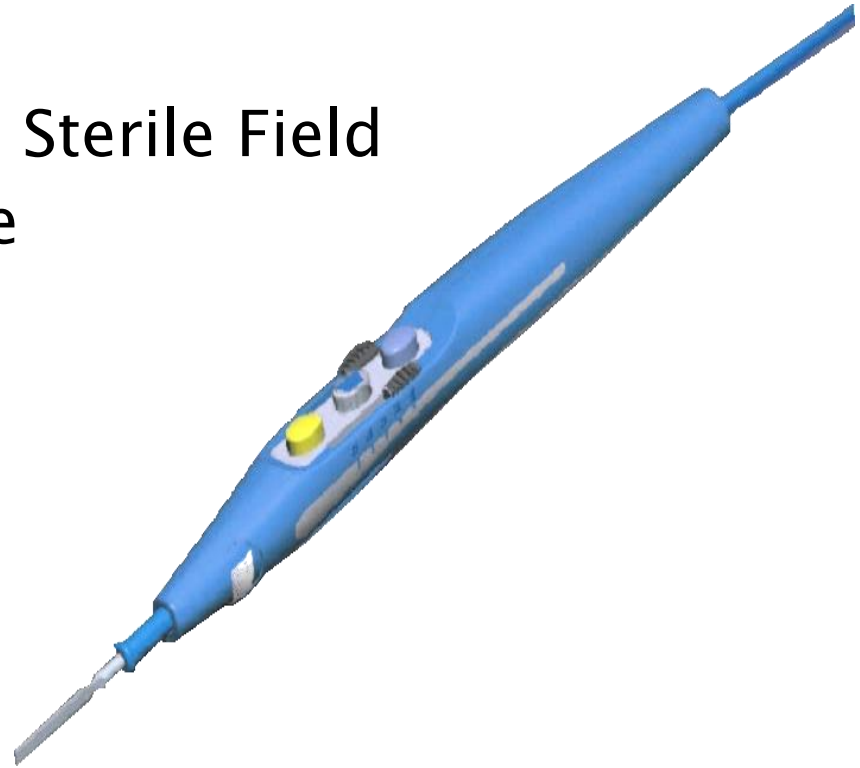
- The Valleyslab Mode provides an optimal combination of monopolar hemostasis and division while using a lower power setting resulting in less char, less thermal spread, less arcing and smoother passage through tissue than a traditional coagulation mode.



Medtronic

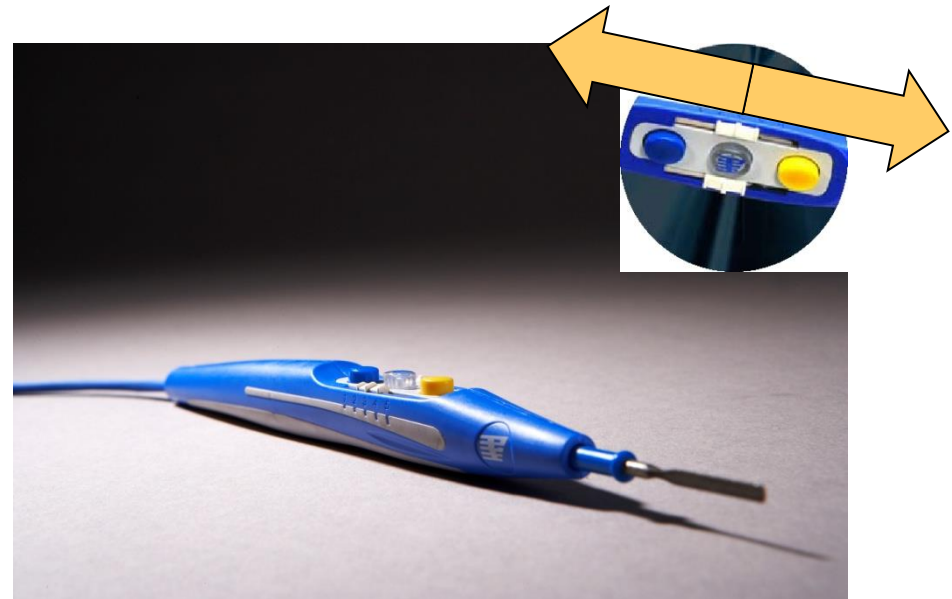
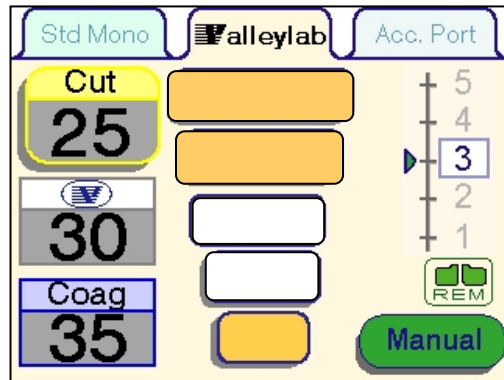
Valleylab Mode by Force Trivers

- ▶ 3 Button
- ▶ Power Control from Sterile Field
- ▶ Teflon Coated Blade



Medtronic

Concepts: You control it!



FORCE TriVerse™

- ▶ Power Control at your Finger tips

Medtronic



Sonicision™

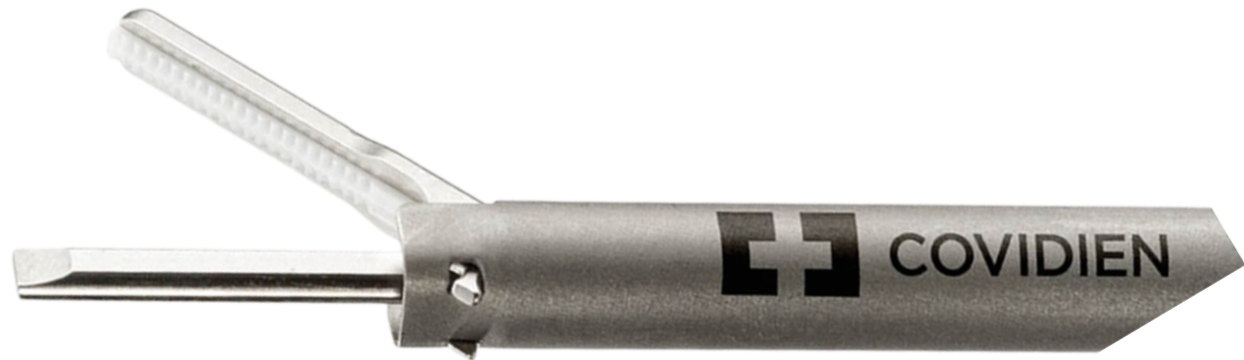
Cordless Ultrasonic Dissection
System



COVIDIEN

positive results for life™

Ultrasonic Dissection System



55500 / S

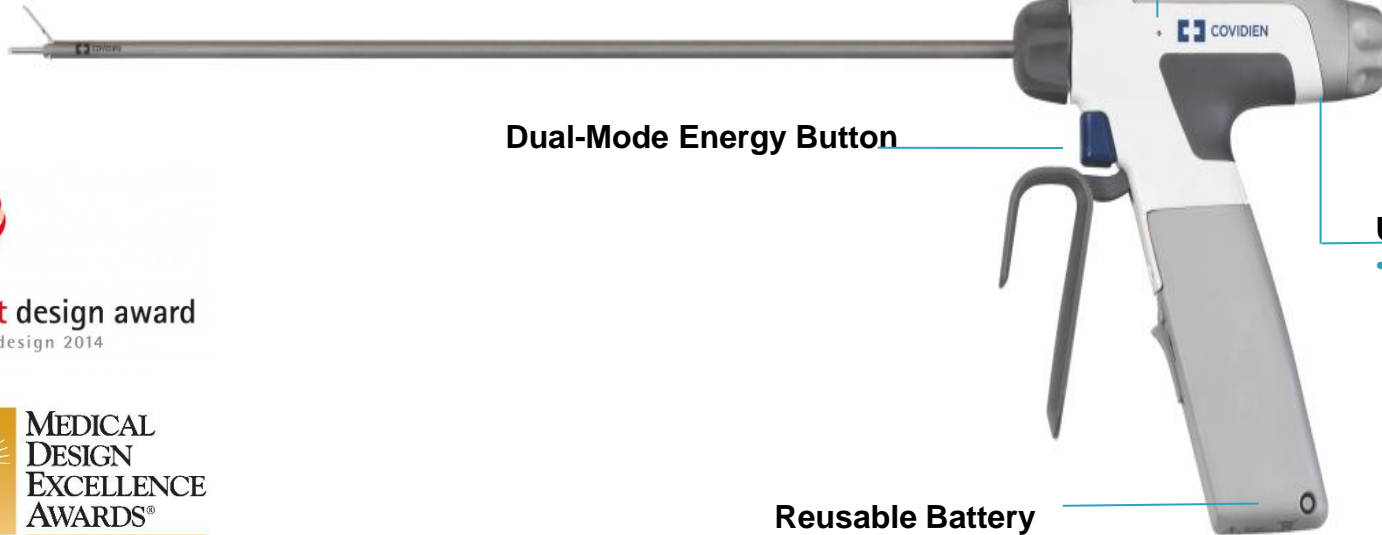
Reusable Generator

- Low temperature hydrogen peroxide gas plasma sterilization (i.e. STERRAD™*)

Indicator LED

Torque Wrench

Audio Indicator



Dual-Mode Energy Button

Ultrasonic Dissector

- Single patient use



reddot design award
product design 2014



Reusable Battery

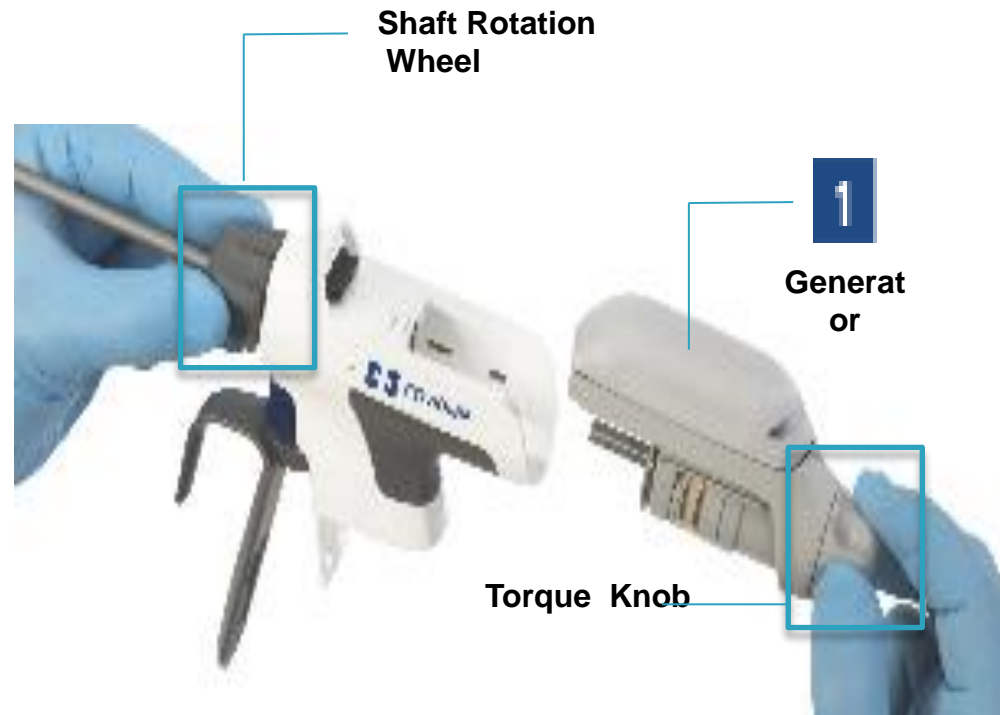
- Low temperature hydrogen peroxide gas plasma sterilization (i.e. STERRAD™*)

Medtronic

Assembly Steps

Step 1 - Attach and Torque Generator

1. Slide the generator into the opening of the ultrasonic dissector and hand tighten clockwise while holding the shaft rotation wheel.



(Refer to User Guide for complete instructions)

Medtronic

Assembly Steps

Step 2 - Attach Battery

1. Orient battery pack as shown.
2. Swing the battery forward and snap into place.

When properly assembled, a series of tones sound and the LED on the generator illuminates green.



(Refer to User Guide for complete instructions)

Medtronic

**Thanks
For Your Attention**



Medtronic