Non-CME Webinar Series
designed with the trainee in mind
first Tuesday of the month

ASRA PAIN MEDICINE
THE ASSOCIATION OF PAIN PROGRAM DIRECTORS

Dorsal Column Spinal Cord Stimulation

Ryan S. D'Souza MD

Tuesday, January 4, 2022

7-8:30 pm ET

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ASRA PAIN MEDICINE

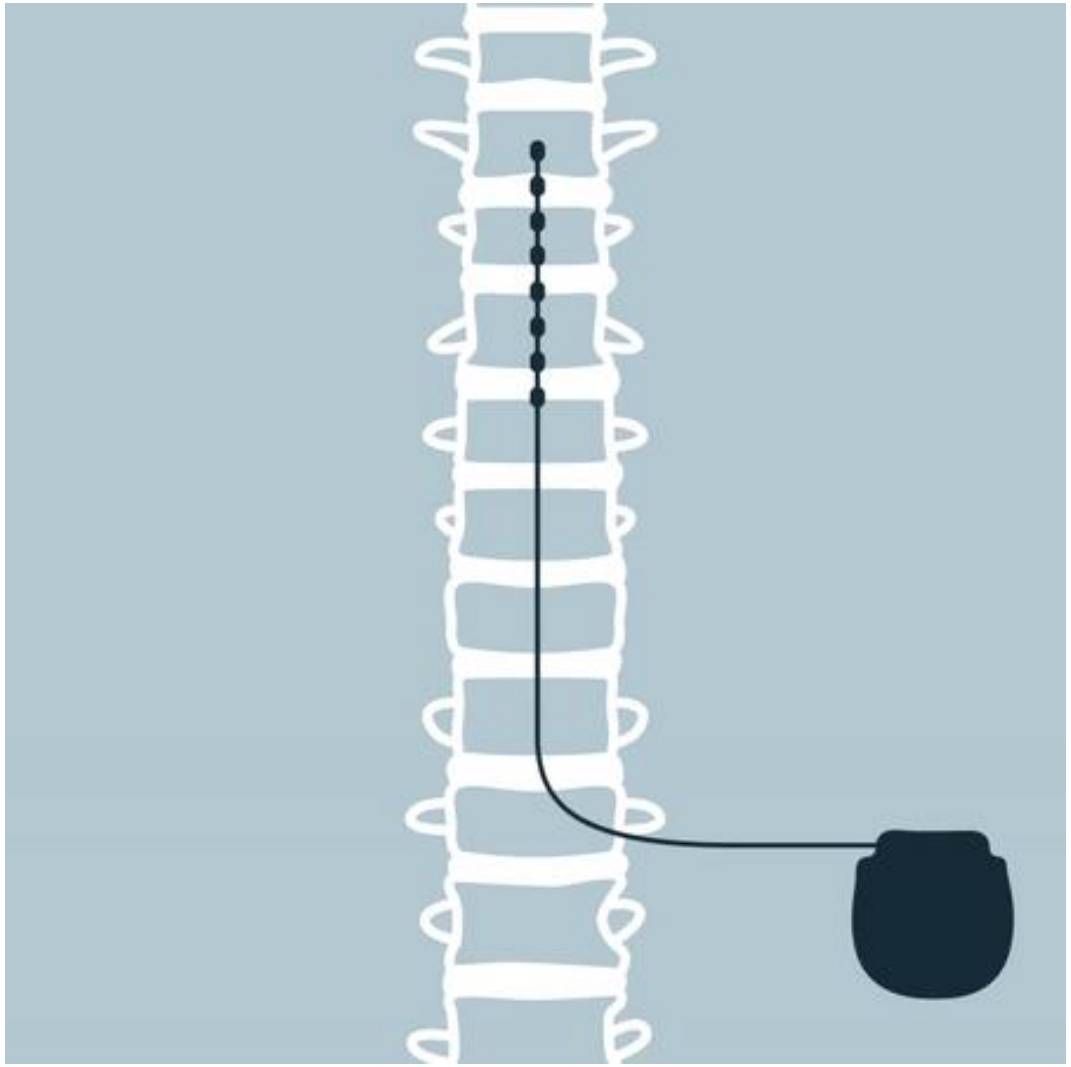
THE ASSOCIATION OF PAIN PROGRAM DIRECTORS

ADVANCING EDUCATION IN MULTIDISCIPLINARY PAIN MEDICINE

- To discuss proposed biochemical mechanisms of action
- To review commonly approved pain conditions
- To discuss how to choose the appropriate candidate
- To review the actual surgical steps involved in trial + implant
- To review landmark RCTs that led to emergence of dorsal column SCS
- To review various waveforms (tonic, burst, 10-kHz, DTM, closed-loop)
- To review common complications

@Ryan_S_DSouzaMD

What is Dorsal Column SCS?



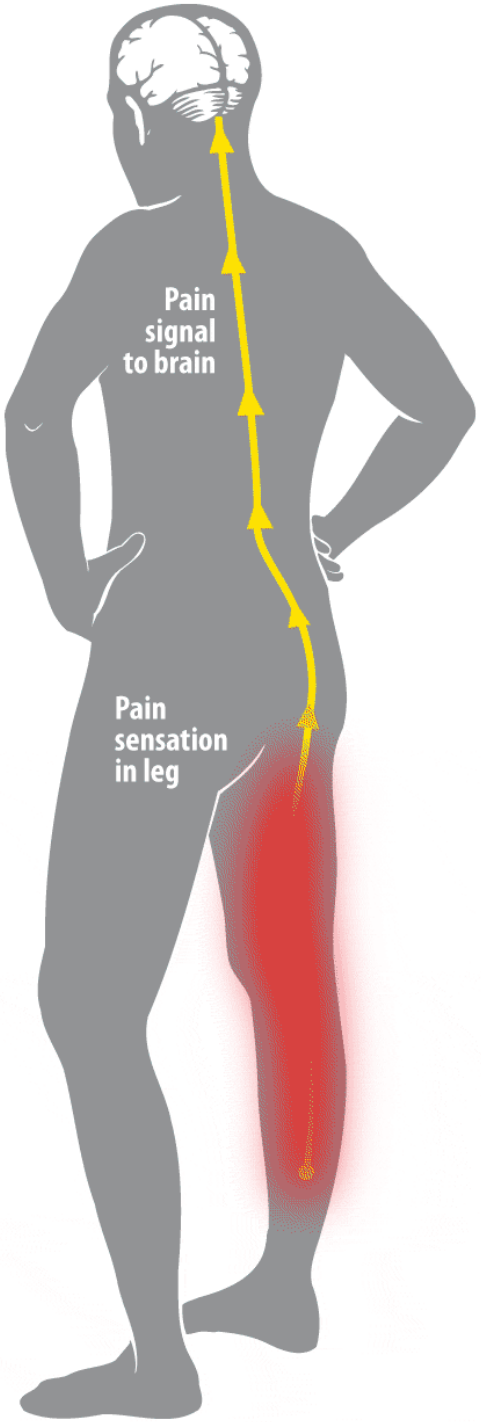
PROPOSED MECHANISMS OF ACTION

- Gate Control Theory

- Activate specific receptor subtypes
(5-HT, GABA, NE, Dopamine, Ach)

- Glial activation

WE DON’T REALLY KNOW…



APPROVED INDICATIONS FOR SCS

- Failed Back Surgery Syndrome
- Refractory Angina Pectoris
- Complex Regional Pain Syndrome (CRPS)
- Painful Diabetic Neuropathy
- Limb Ischemia

LANDMARK STUDIES

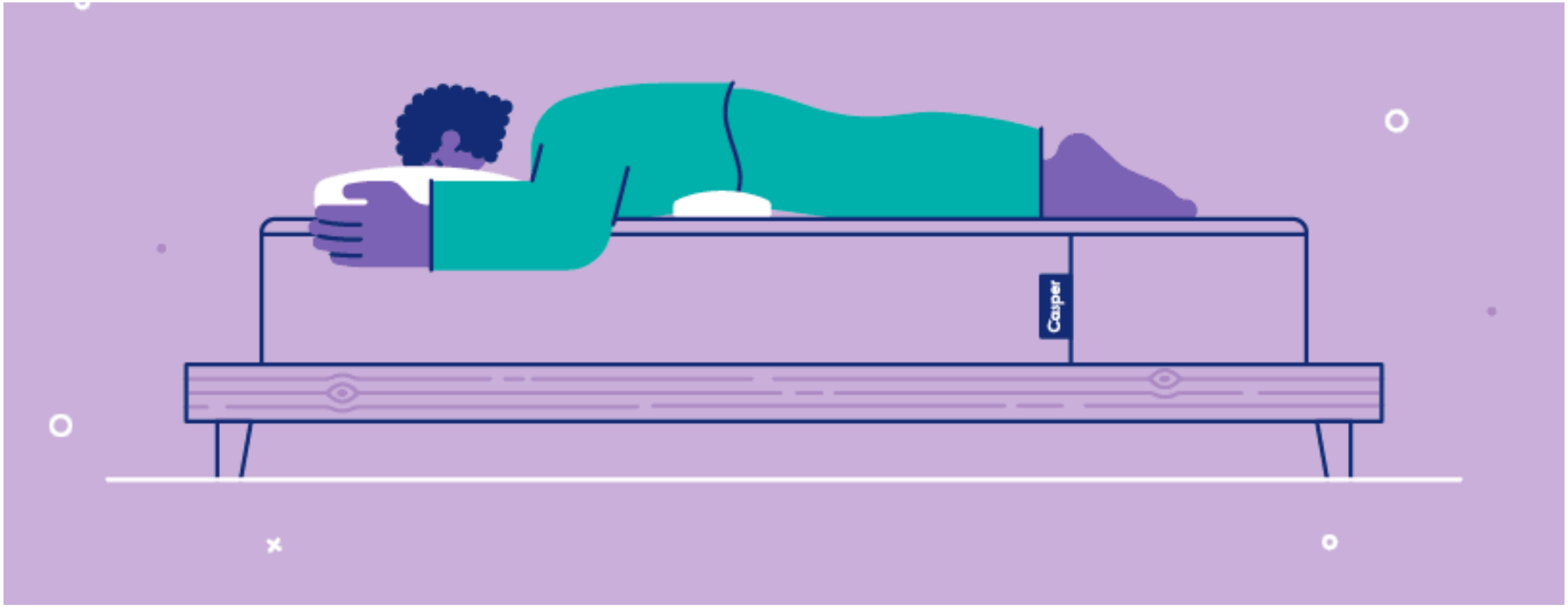
- **Kemler et al (NEJM)**: First RCT, SCS+PT vs PT alone in reflex sympathetic dystrophy; intention-to-treat analysis showed that SCS+PT group had a 2.4 cm reduction in intensity of pain at 6 months compared to an increase of 0.2 cm in PT only group
- **North et al (Neurosurgery):** SCS versus spine surgery, pts w/ prior back surgery; SCS > repeat surgery (pain relief, satisfaction); SCS cohort less likely to cross over to the repeat surgery cohort, reoperation cohort required increased opioids
- **PROCESS trial (Kumar et al):** Multicenter RCT, SCS for FBSS, more SCS patients (48% vs 9%) versus controls undergoing conventional medical management achieved 50% of more pain relief in the legs

LANDMARK STUDIES

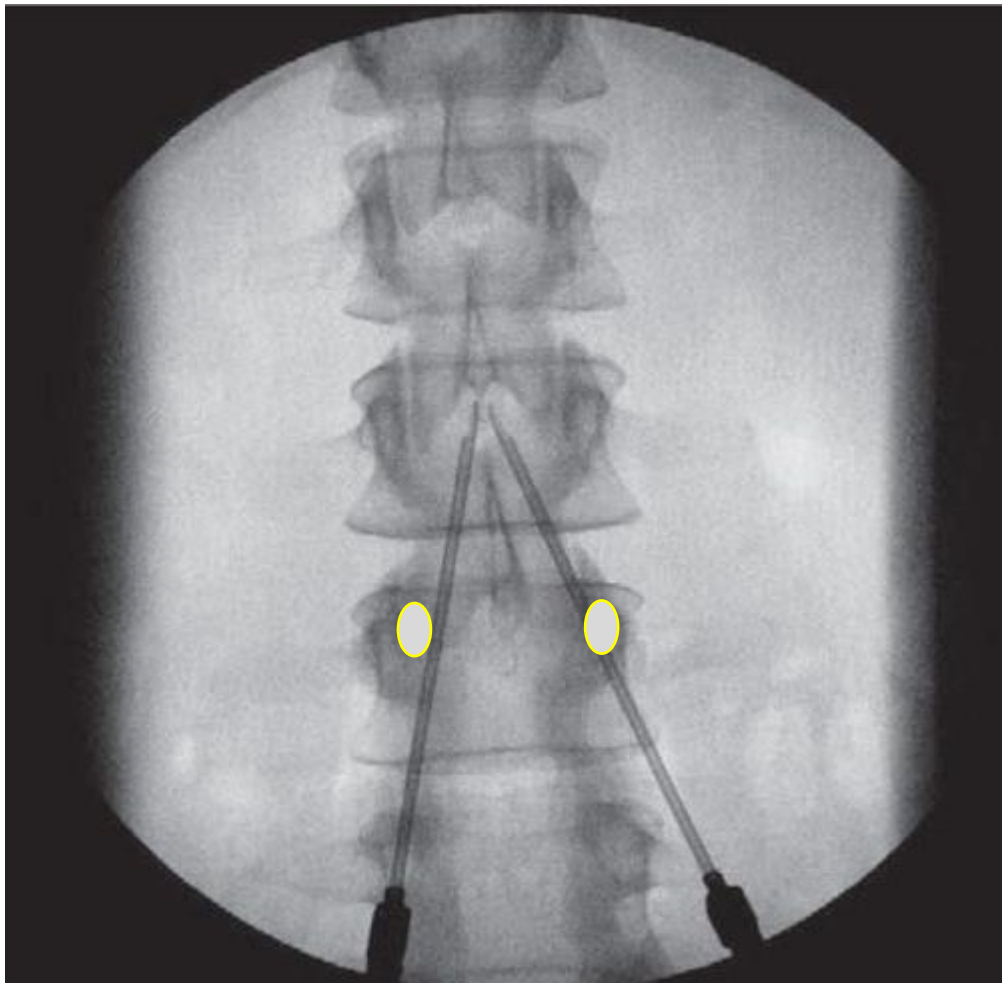
- **SENZA trial:** 10-kHz SCS vs traditional paresthesia-based SCS
- **SENZA-PDN trial (JAMA Neuro):** 10-kHz vs BMT for PDN
- **ACCURATE trial:** DRG vs tonic SCS for lower extremity CRPS
- **DTM trial:** DTM SCS vs traditional SCS
- **EVOKE trial:** ECAP-controlled closed loop SCS vs fixed open-loop SCS
- **Ubbink et al (1999, ESES):** SCS vs BMT for critical limb ischemia

STEPS IN PERFORMING AN SCS TRIAL

- Positioning is key



STEPS IN PERFORMING AN SCS TRIAL



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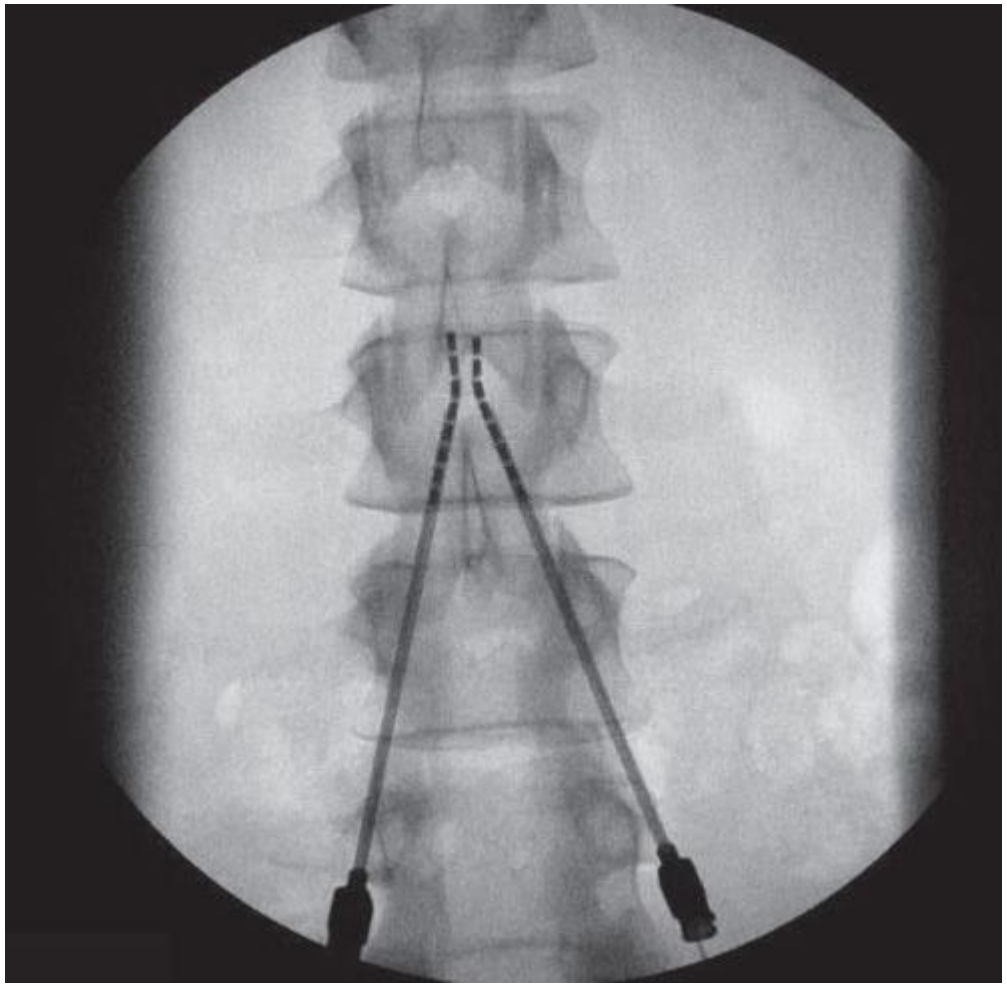
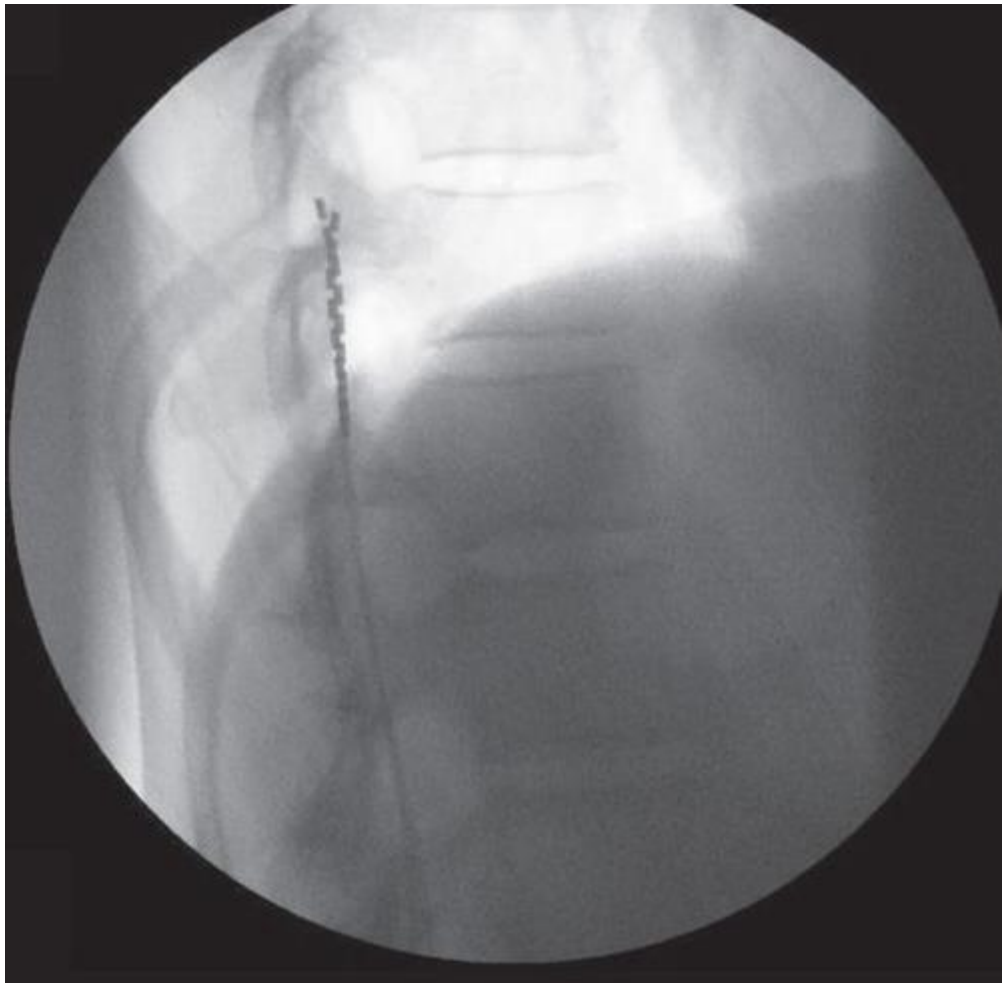
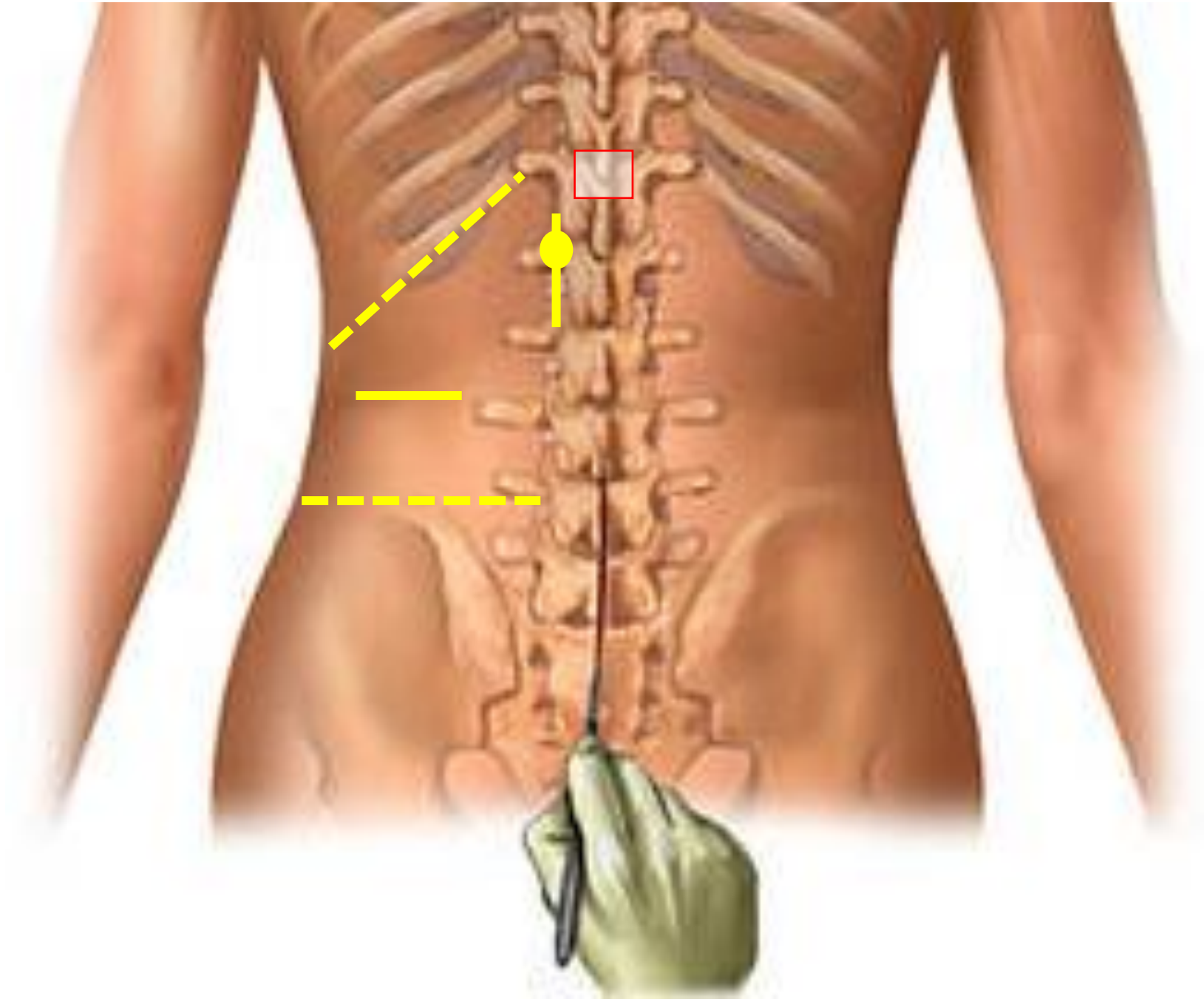
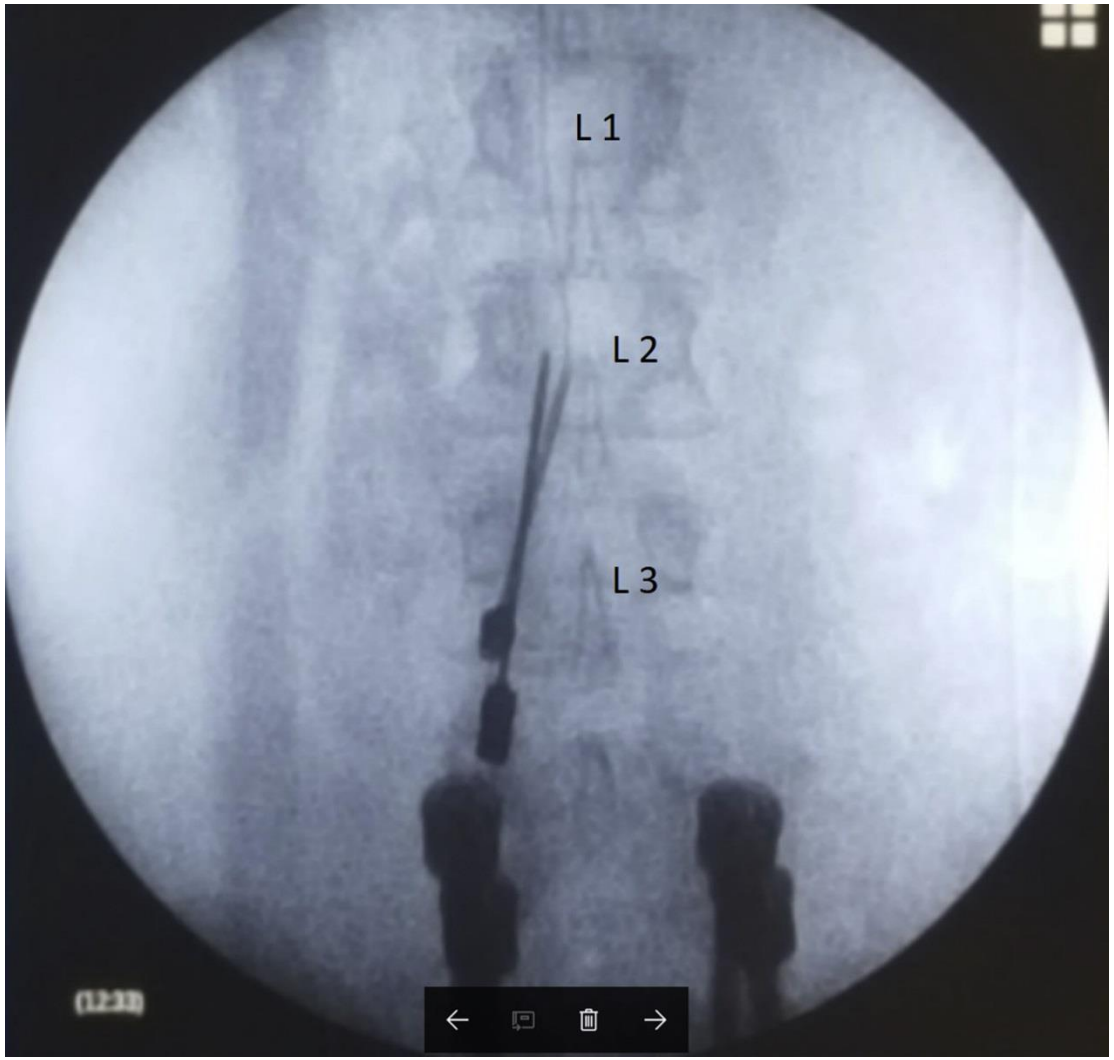


STEPS IN PERFORMING AN SCS TRIAL





STEPS IN PERFORMING AN SCS IMPLANT



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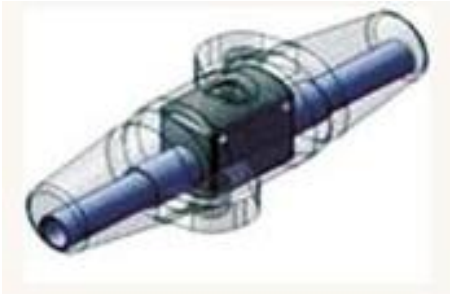
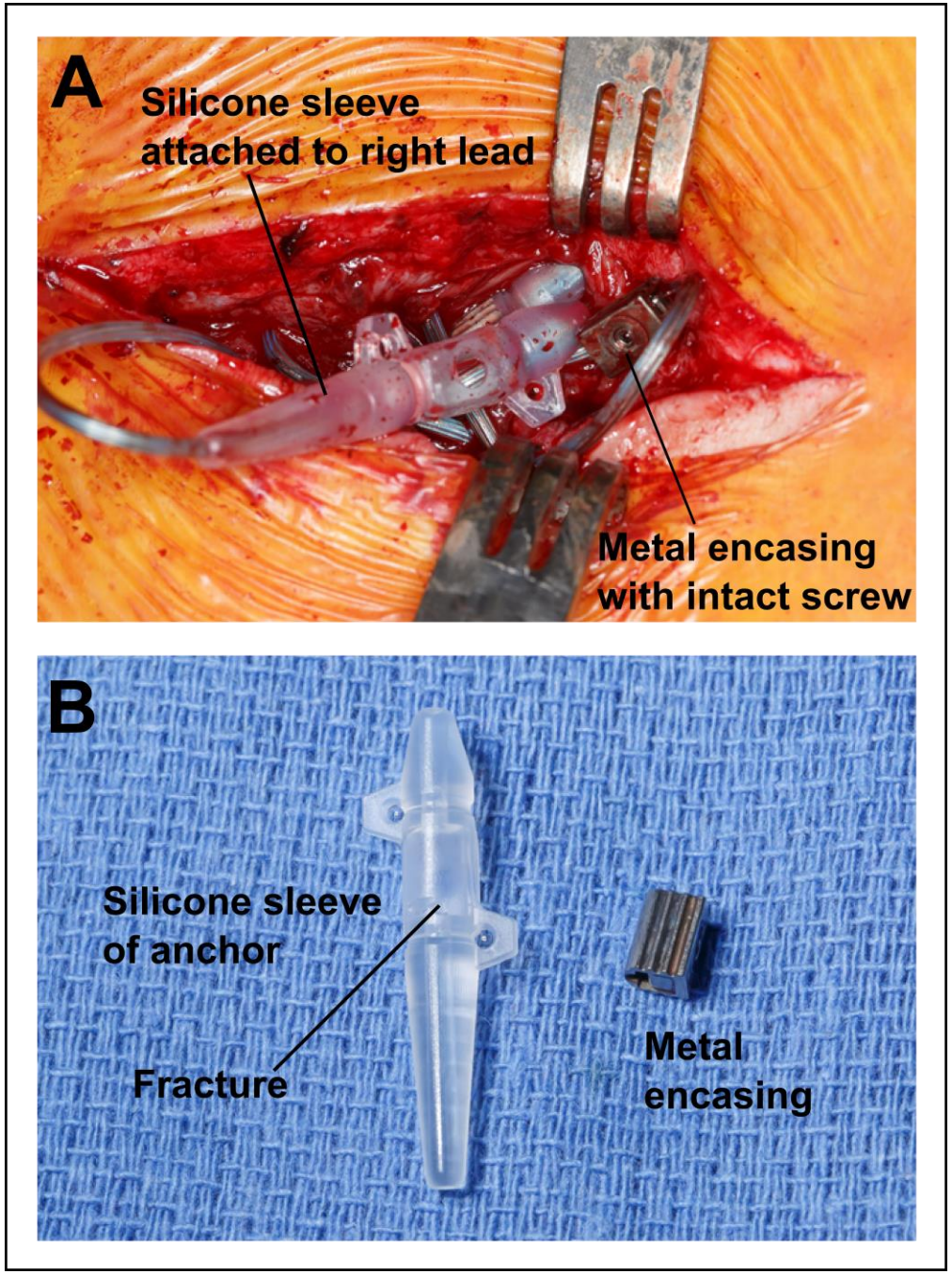


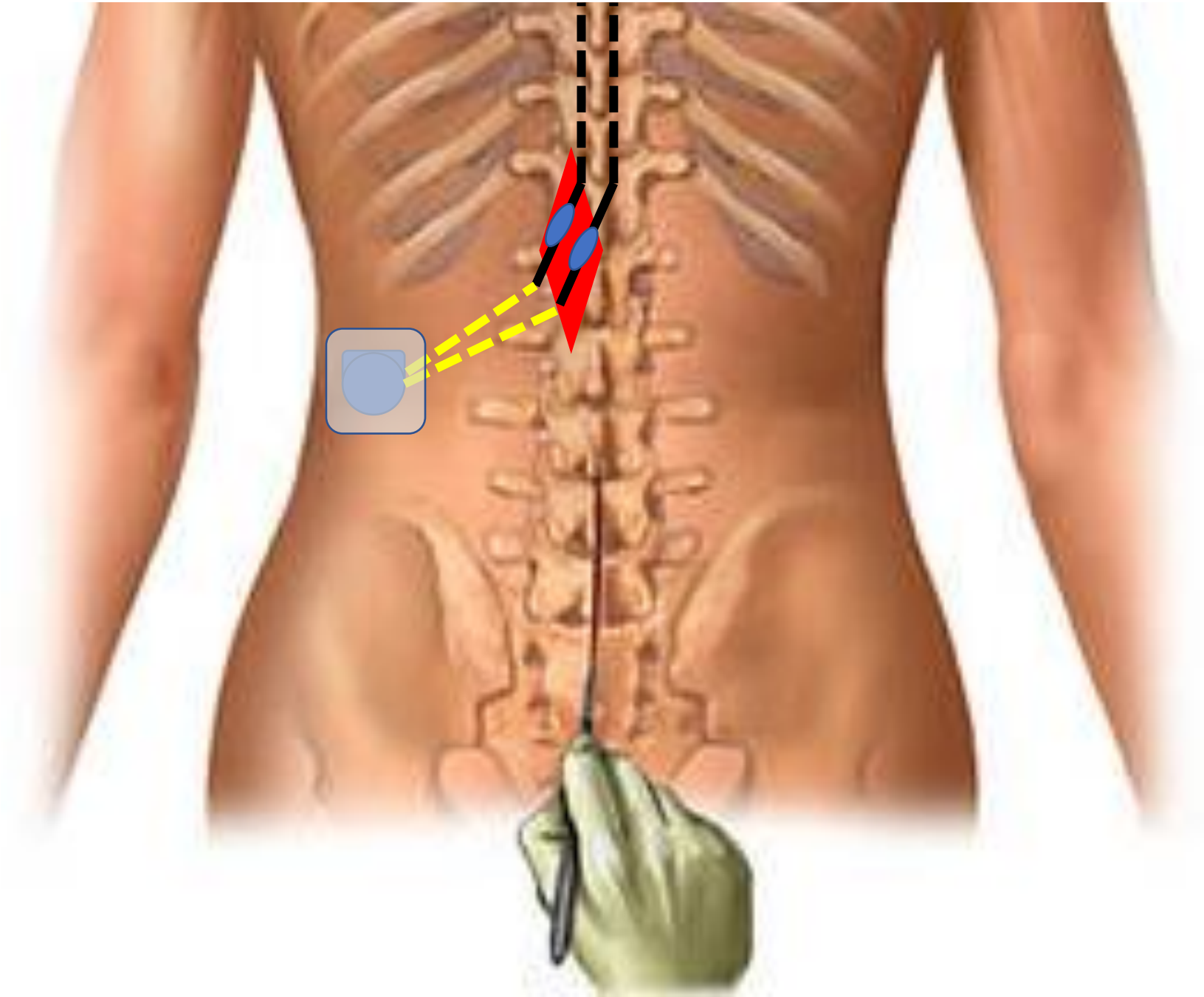


D'Souza RS, Hunt CL. Neuromodulation. 2021 Sep 6.

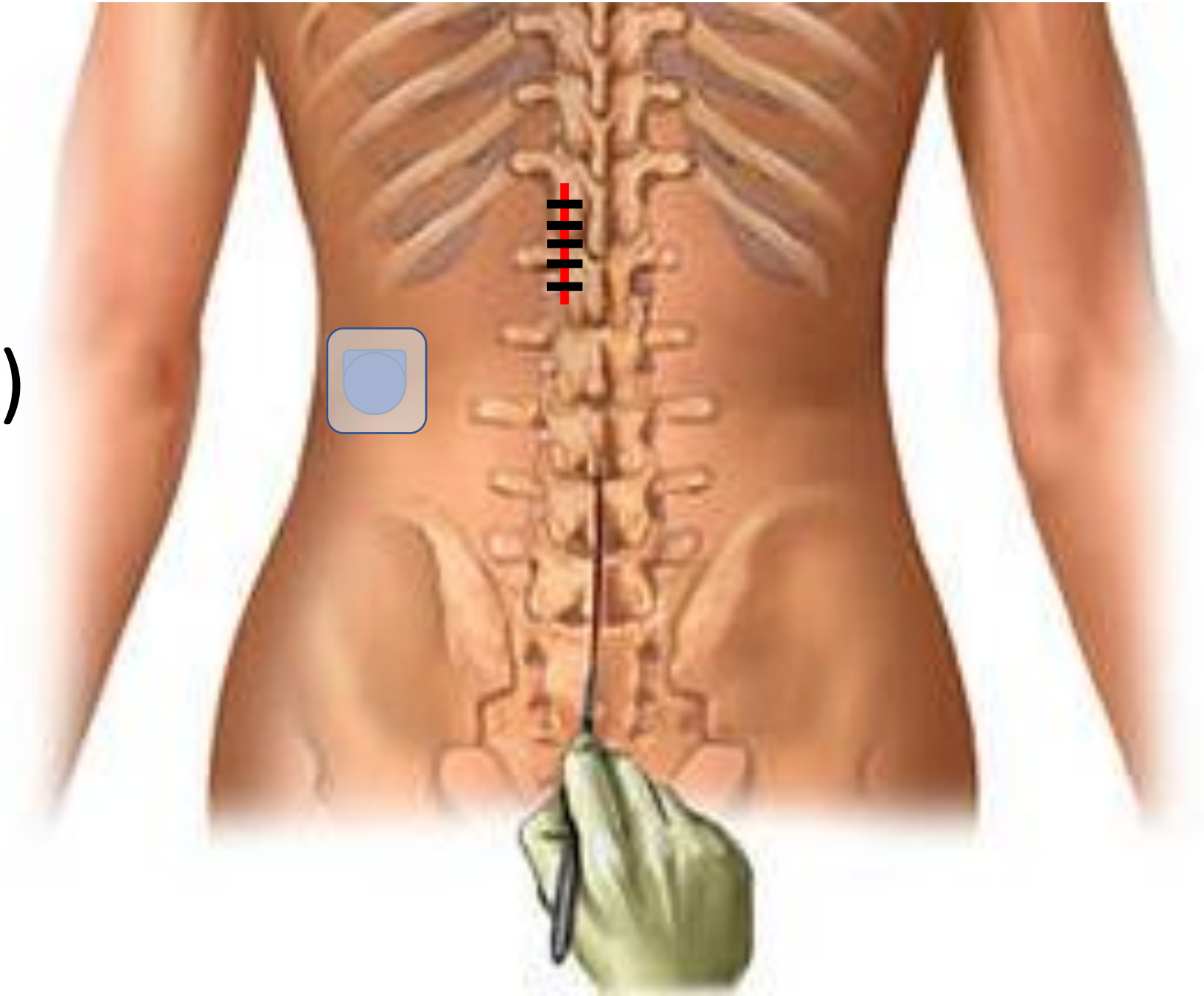
STEPS IN PERFORMING A STAGED SCS IMPLANT

- Strategy for patients with high risk of bleeding
- Stage 1: surgically place and anchor percutaneous leads with cutdown, tunnel to external battery
- Stage 2: open midline incision, disconnect connector, remove external battery, and tunnel to opposite side for internal IPG
- Strategy allows for least manipulation of neuraxial space

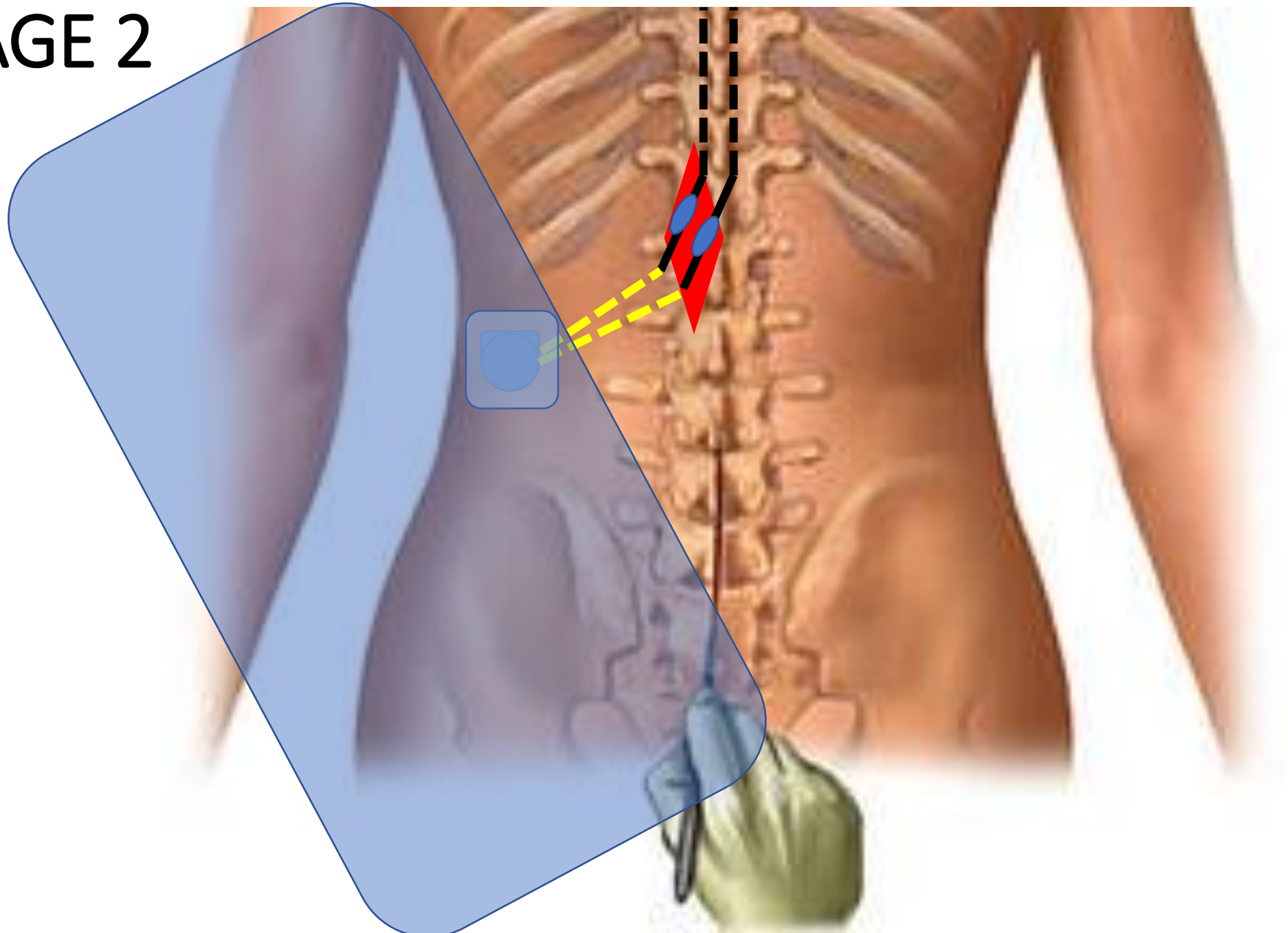
STAGE 1



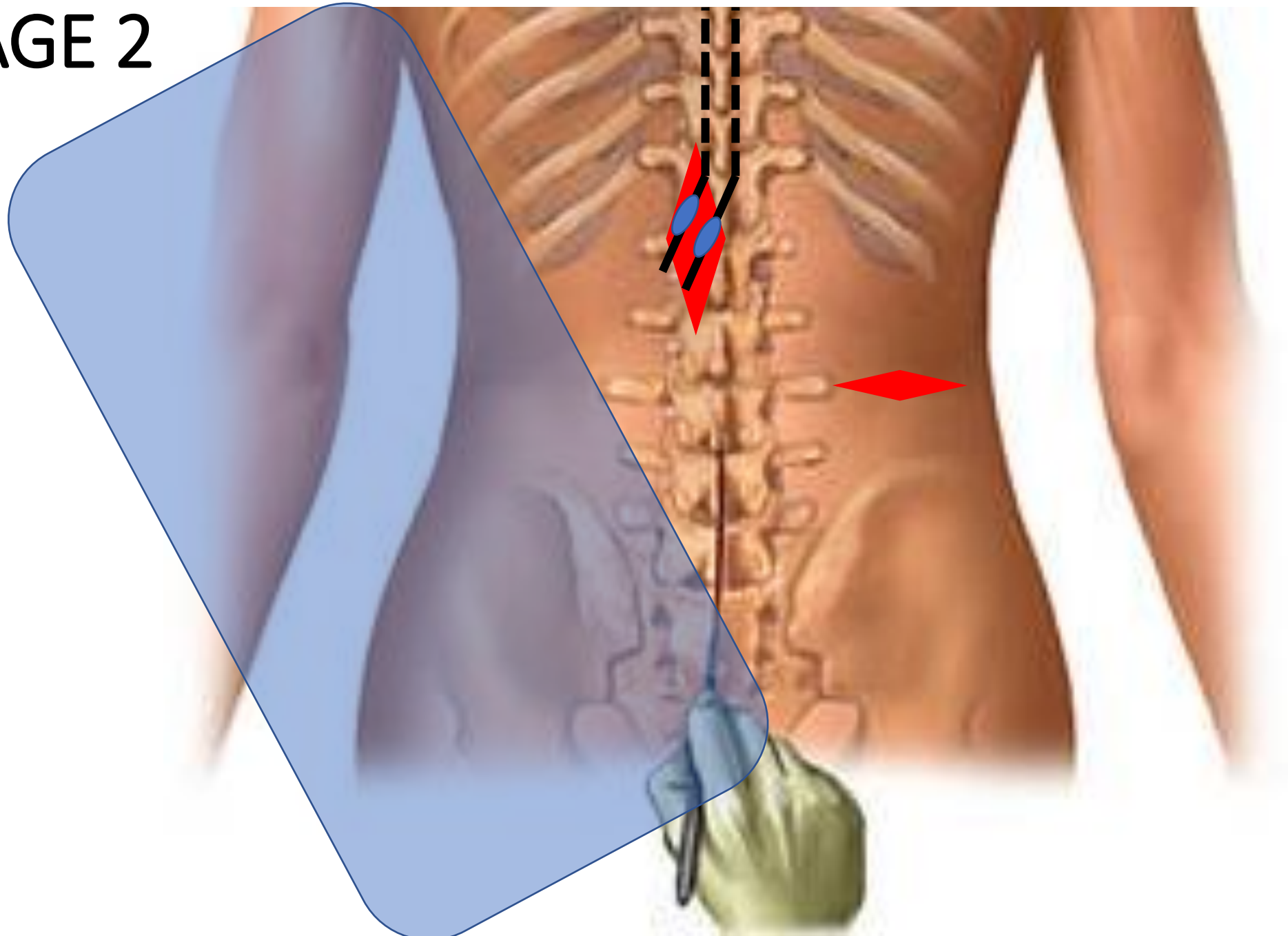
STAGE 1
END
(Trial for
5-7 days)



STAGE 2



STAGE 2



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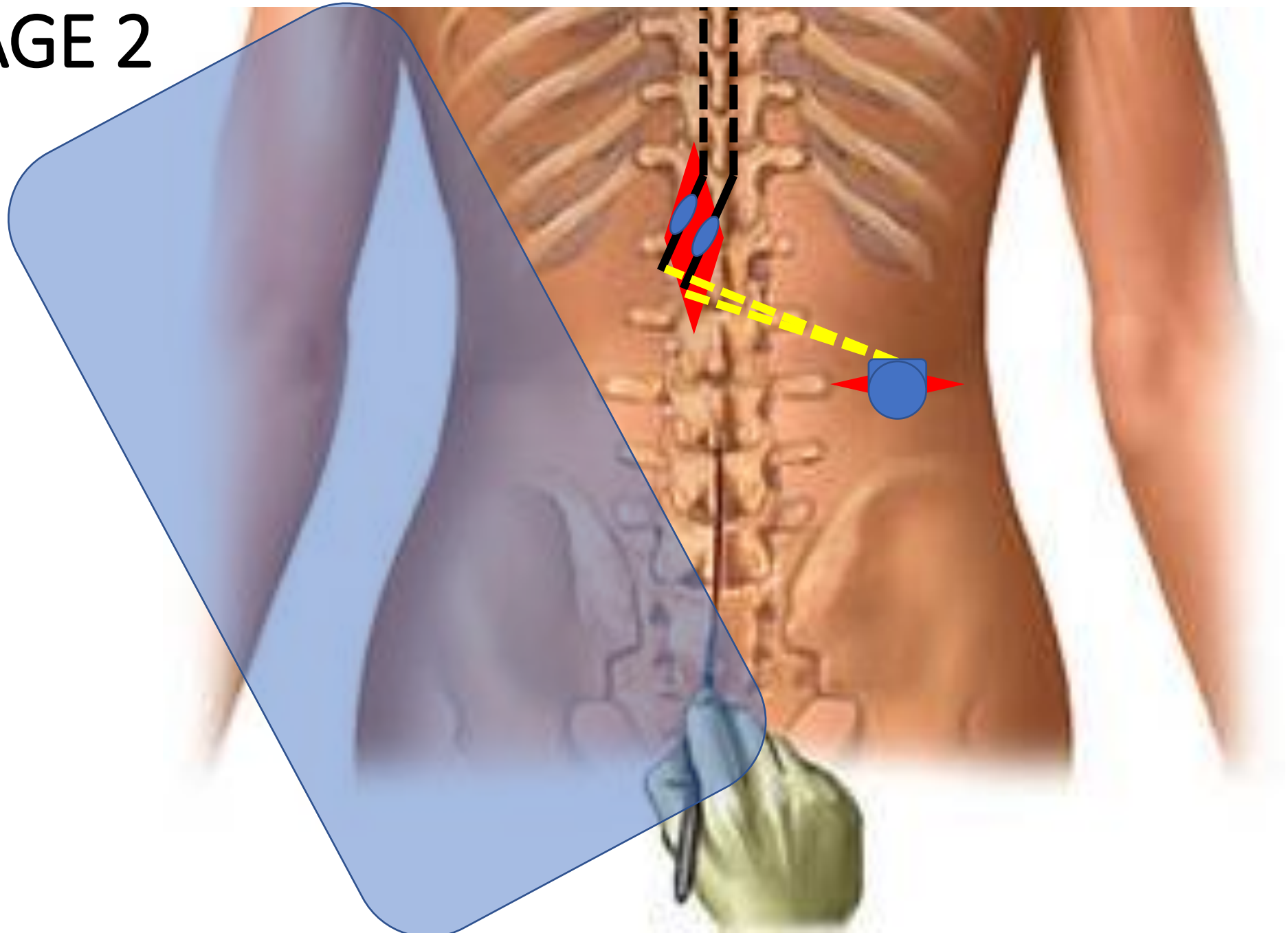
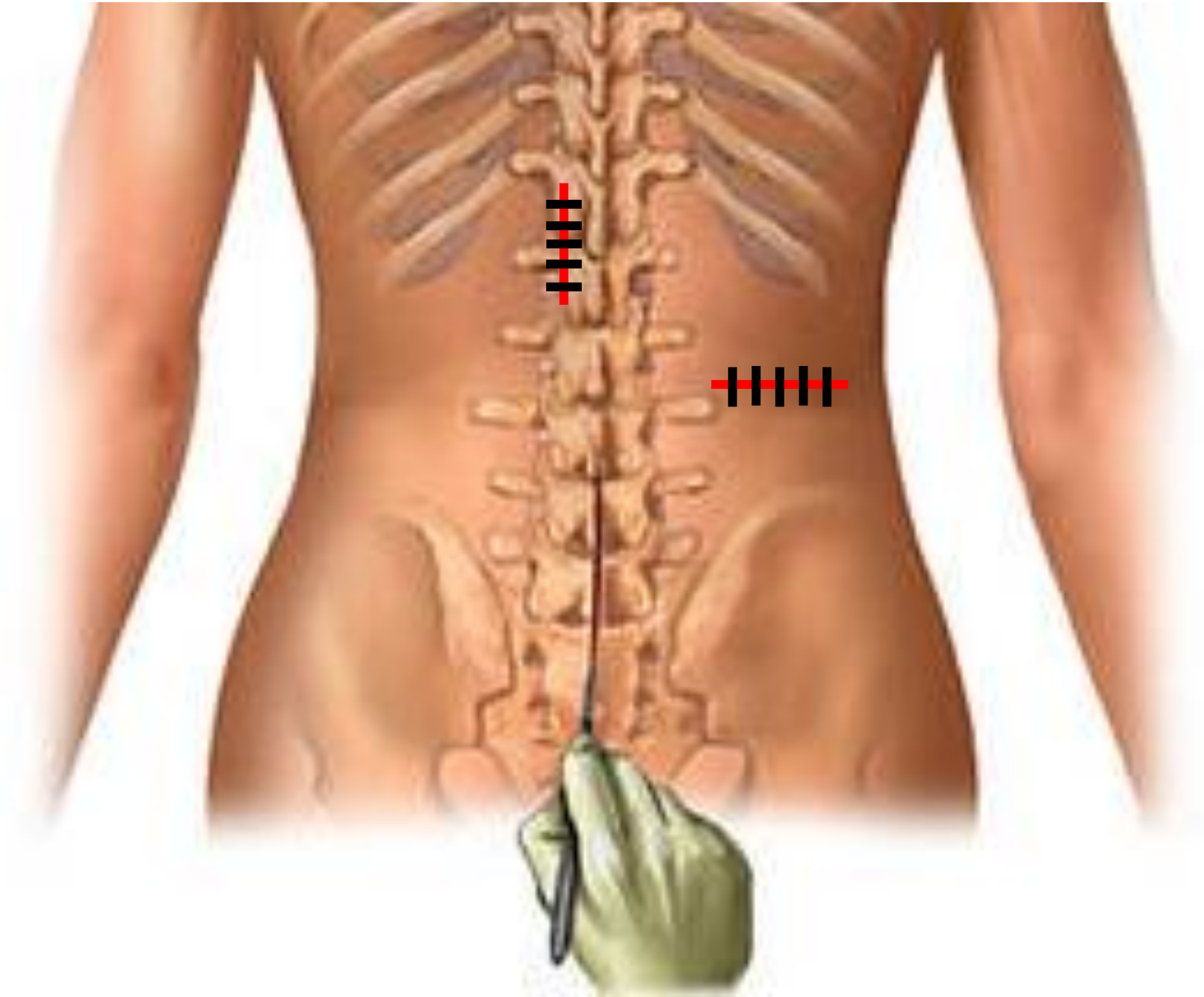
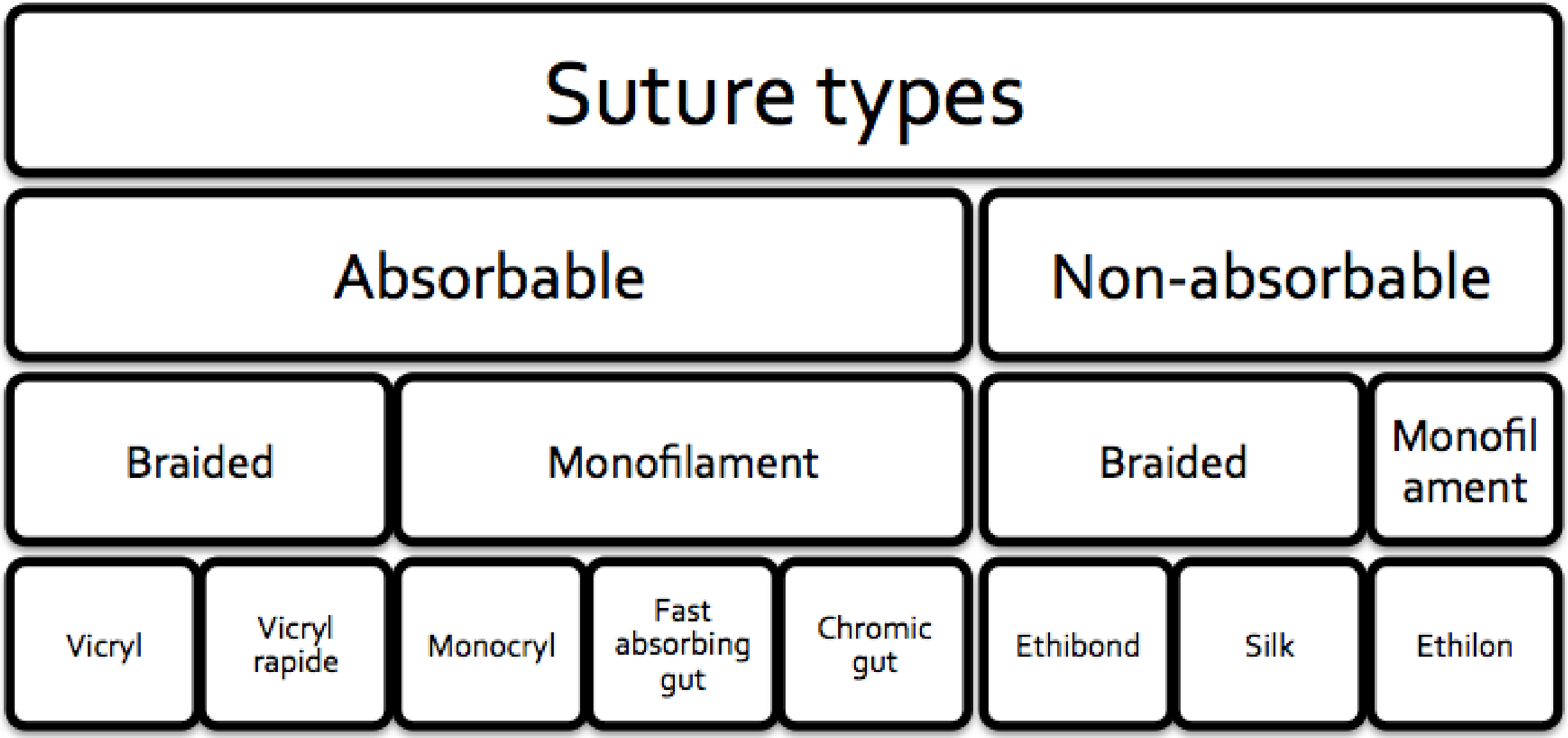


STAGE 2




Suture types
Absorbable
Non-absorbable
Braided
Monofilament
Braided
Monofil ament
Vicryl
Vicryl rapide
Monocryl
Fast absorbing gut
Chromic gut
Ethibond
Silk
Ethilon

ASRA Best Practices Regarding Closure

- Synthetic, nonabsorbable suture for anchoring: polyester (Ethibond), polypropylene (Prolene®), or nylon (Ethilon®)
- Nonabsorbable sutures retain most of their tensile strength after 60 days
- Although silk is nonabsorbable suture, it does degrade with a variable rate and therefore loses its tensile strength quicker
- Nylon sutures: high tensile strength, low tissue reactivity, inexpensive; more cumbersome in deeper fascia
- Polypropylene: high tensile strength, low tissue reactivity, good infection resistance; low elasticity
- Polyester suture (Ethibond): good strength and durability; braided
- Five throws required to maintain knot security

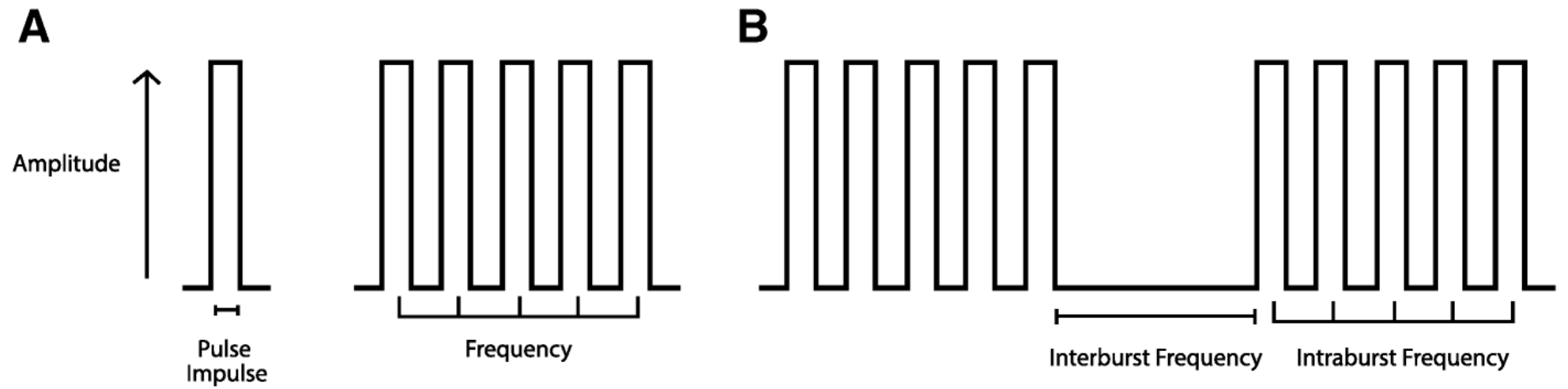
ASRA Best Practices Regarding Closure

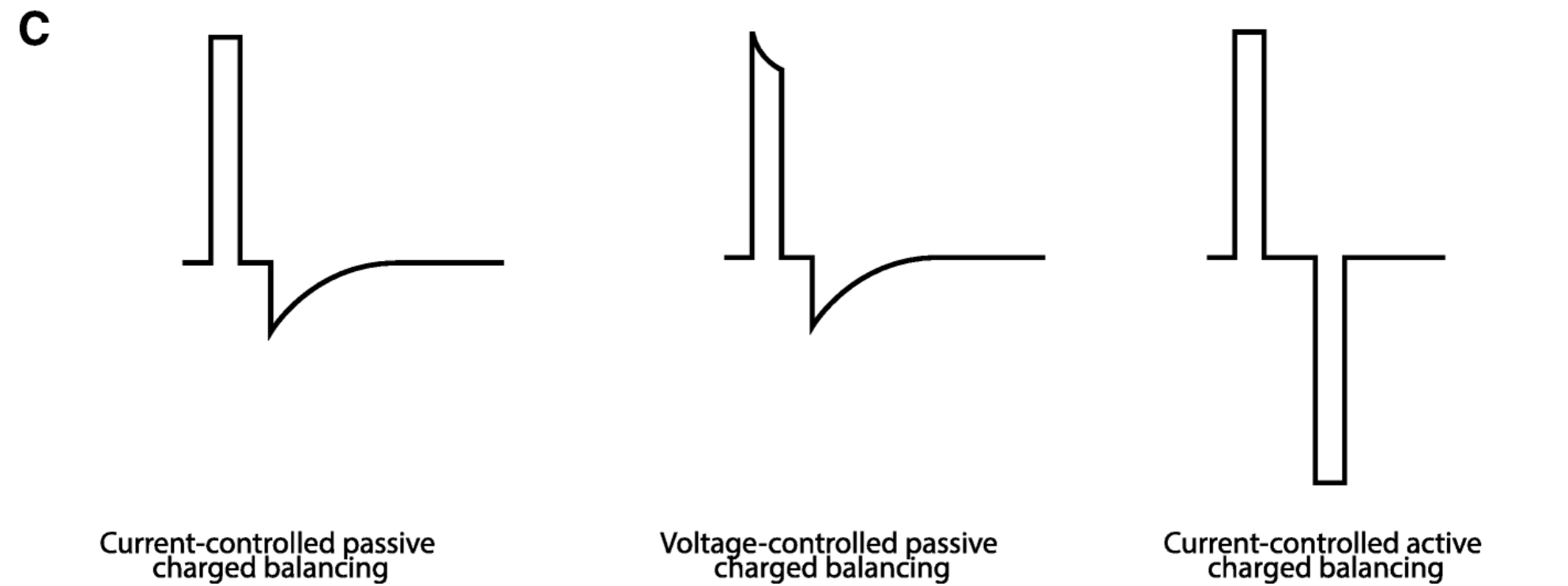
- Absorbable sutures: decrease dead space and encourage subcutaneous wound approximation in deep layers prior to superficial skin closure
- Polyglactin (Vicryl®): braided suture (increased bacterial adherence up to 10 times > monofilament suture)
- Monocryl: good for superficial closure; retains 60-70% of its original strength at 7 days post-implant and 30-40% strength at 14 days post-implant
- Staples: increased risk of infection in some surgical settings vs subcuticular closures (low quality evidence)

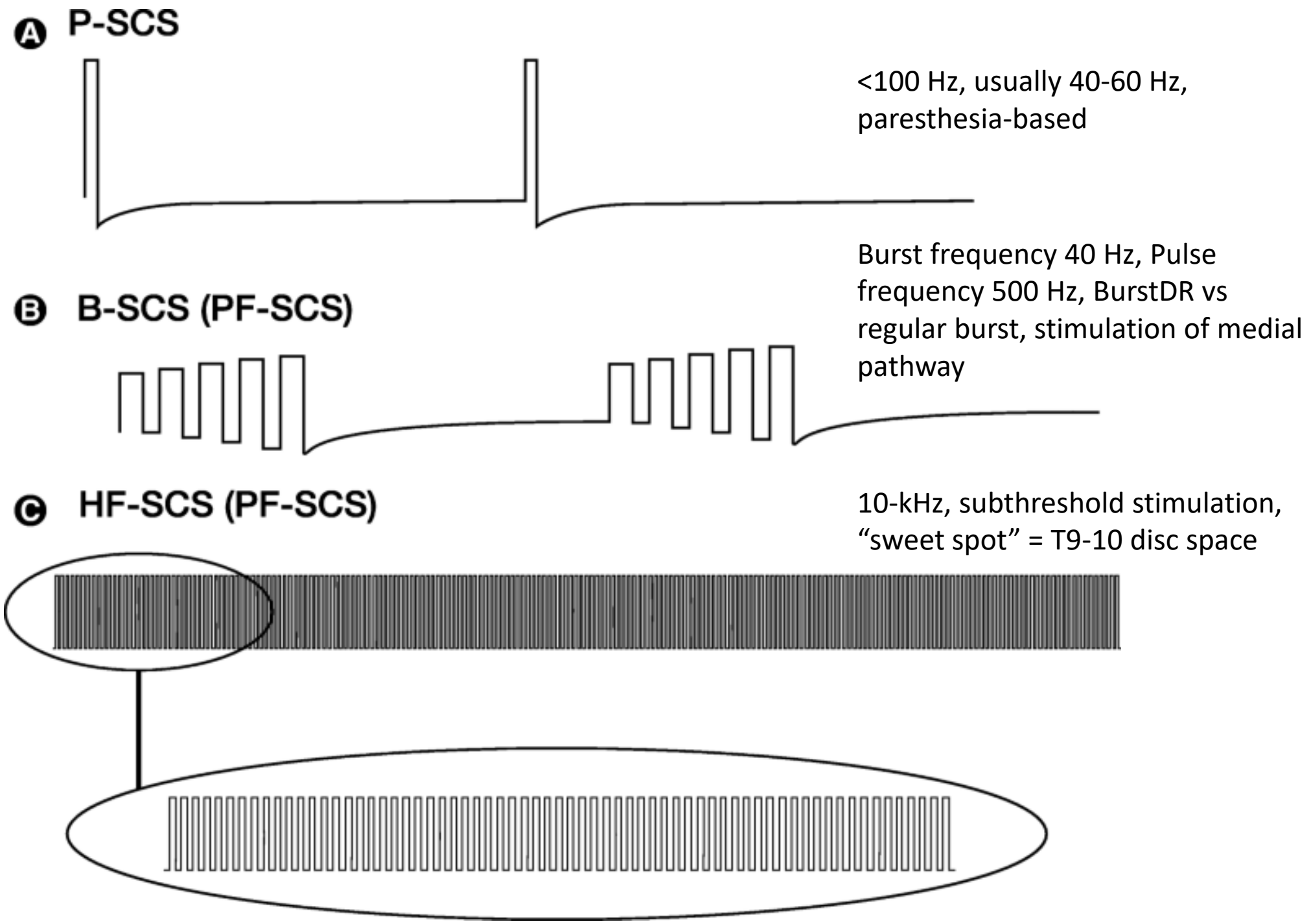
CHOOSING THE APPROPRIATE PATIENT

- Approved indication
- Failed 1st line/2nd line treatment
- Benefits > risks (example: factor XI deficiency)
- Mental health and behavioral issues
- Optimization (smoking, immunosuppression, pre-op opioid use)
- Appropriate expectations (define what success entails)
- Balance of patient selection (sensitivity vs specificity)

Parameters for the Spinal Cord Stimulation

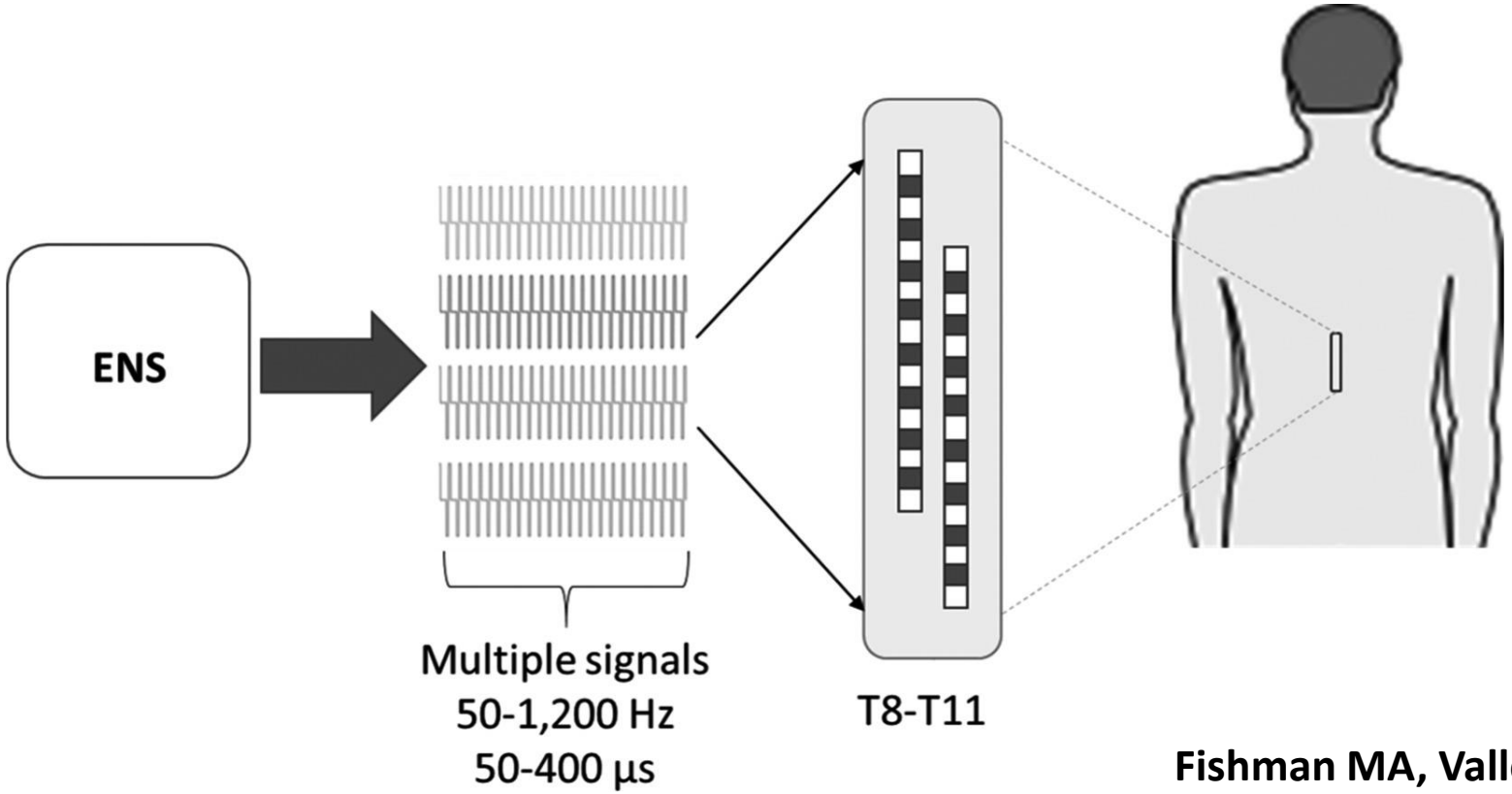





A P-SCS
<100 Hz, usually 40-60 Hz, paresthesia-based
B B-SCS (PF-SCS)
Burst frequency 40 Hz, Pulse frequency 500 Hz, BurstDR vs regular burst, stimulation of medial pathway
C HF-SCS (PF-SCS)
10-kHz, subthreshold stimulation, “sweet spot” = T9-10 disc space

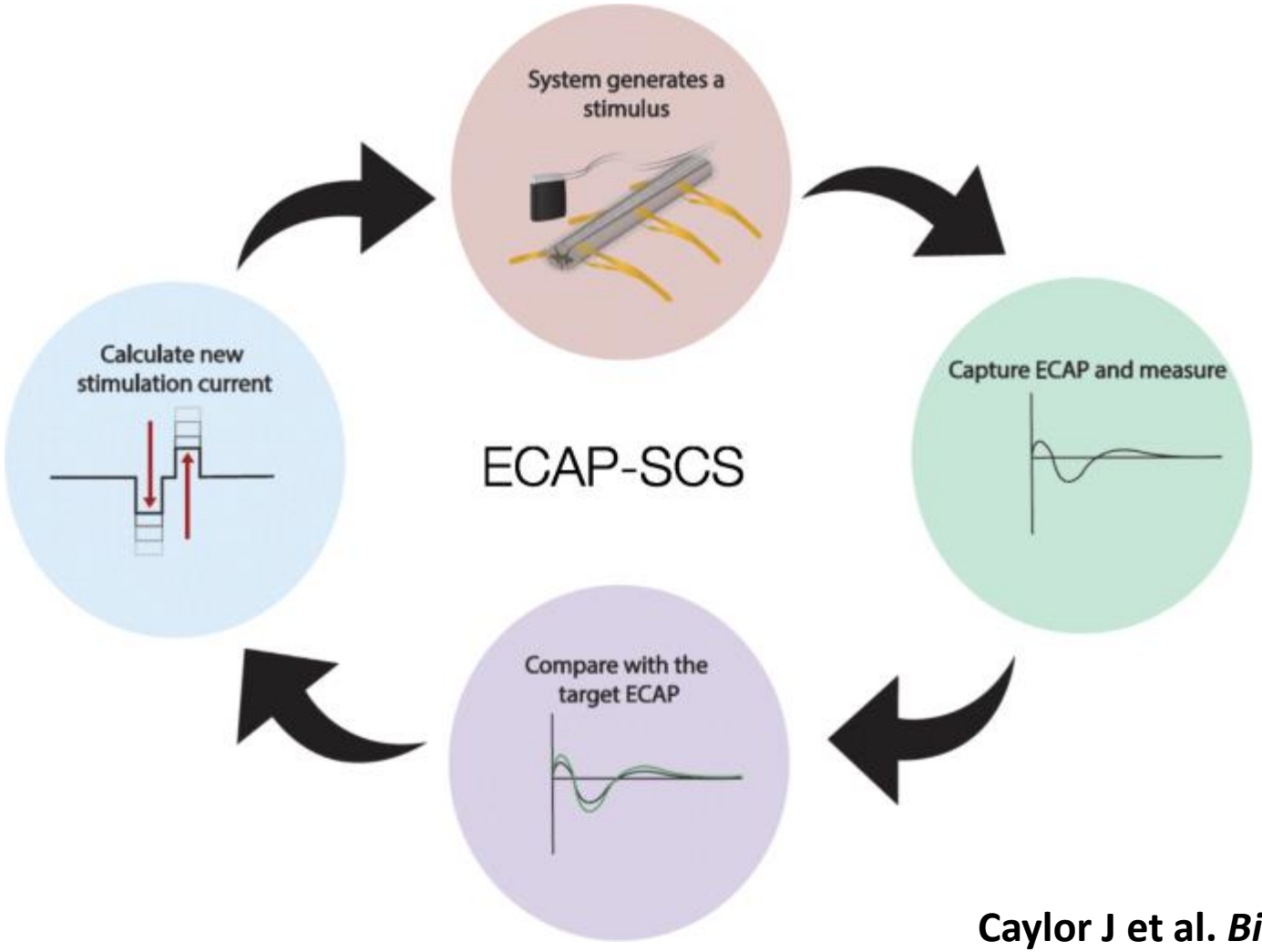
DIFFERENTIAL-TARGET MULTIPLEXED SCS WAVEFORM

- Multiple electrical signals for modulating glial cells and neurons and rebalance their interactions



Fishman MA, Vallejo R et al. *Pain Practice*

CLOSED-LOOP SCS WAVEFORM



Caylor J et al. *Bioelectronic Medicine 2019*

COMBINATION SCS WAVEFORMS

Journal of
Clinical Medicine

MDPI

Article

Real-World Outcomes Using a Spinal Cord Stimulation Device Capable of Combination Therapy for Chronic Pain: A European, Multicenter Experience

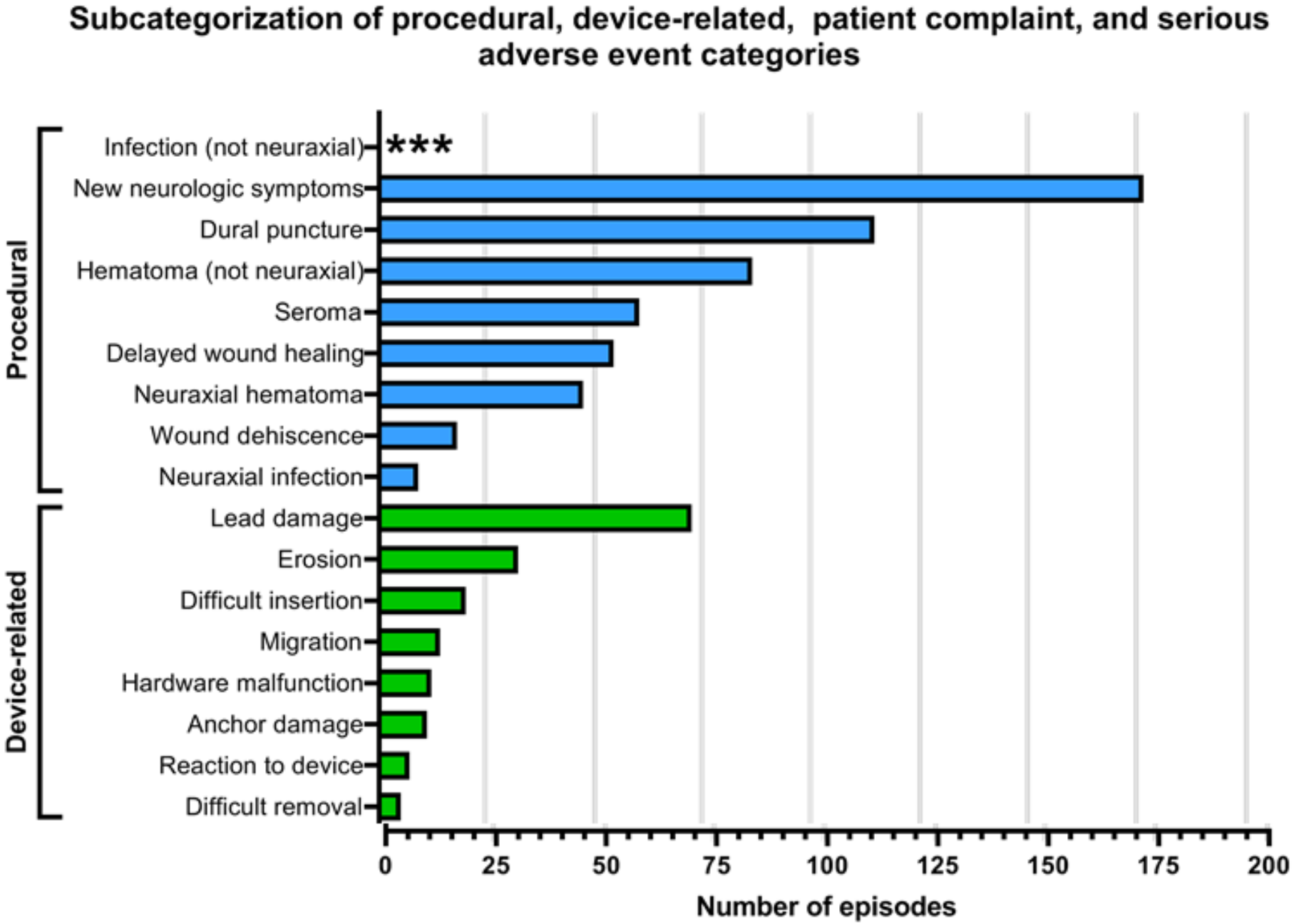
Jan Willem Kallewaard [1,*], Jose Francisco Paz-Solis [2], Pasquale De Negri [3], Maria Angeles Canós-Verdecho [4], Hayat Belaid [5], Simon J. Thomson [6], David Abejón [7], Jan Vesper [8], Vivek Mehta [9], Philippe Rigoard [10], Paolo Maino [11], Sarah Love-Jones [12], Isaac F. Peña [13], Simon Bayerl [14], Christophe Perruchoud [15], Renaud Bougeard [16], Cleo Mertz [17], Yu Pei [18] and Roshini Jain [18]

COMPLICATIONS WITH DORSAL COLUMN SCS

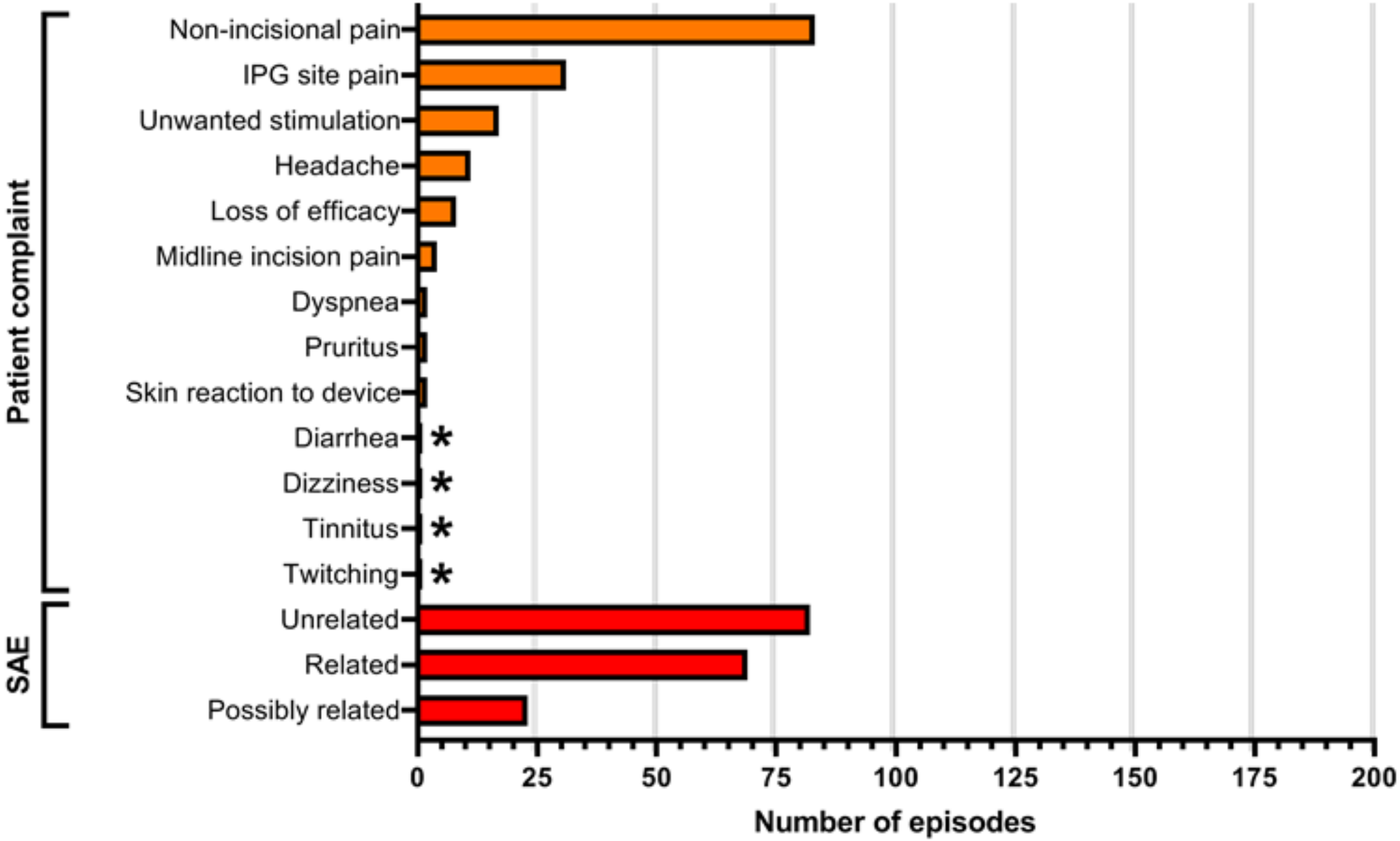
FDA U.S. FOOD & DRUG ADMINISTRATION

- **MOST CONCERNING**: epidural hematoma, abscess, meningitis, nerve injury
- **OTHER CONCERNS**: lead migration, loss of efficacy, hardware complications

D'Souza RS et al. Clin J Pain 2021, in press



D'Souza RS et al. Clin J Pain 2021, in press



NACC GUIDELINES: PRE-OPERATIVE RISK RECOMMENDATIONS

RECOMMENDATION	USPSTF GRADE
Obtain preoperative MRI prior to SCS implant	III
Perform pre-operative optimization of diabetes	II-1
Optimize risk factors that increase infection risk such as immunosuppression	III
Address platelet counts of 100k or less	II-3
Obtain preoperative CBC and BMP	III
Preoperative screening + decolonization of MSSA/MRSA with mupirocin BID and daily chlorhexidine washings for five days	I
Address systemic or local skin infection at site of planned implant	III

NACC GUIDELINES: INTRAOPERATIVE AND POSTOPERATIVE RISK RECOMMENDATIONS

RECOMMENDATION	USPSTF GRADE
Laminar flow OR to reduce outdoor airborne pathogens	II-2
Chlorhexidine-alcohol or povidone-iodine prep	I
Removal hair by clipping (if required)	I
Minimize OR traffic and surgical time	III
Non-pressured irrigation of wounds by saline solution	II-1
Sterile occlusive dressing for 24-48 hours postoperatively	I
Inspect wound within 7-10 days postoperatively	III
Successful trial = at least 50% pain relief	III

NACC GUIDELINES: INFECTION PREVENTION

LEVEL I

RECOMMENDATION
Decolonize MSSA/MRSA carriers through application of mupirocin ointment and chlorhexidine baths
Use preoperative abx within 1 hour prior to surgical incision
Remove hair immediately prior to surgery with electrical clippers
Use iodophor-impregnated drapes.
Use laminar flow and high-efficiency particulate air (HEPA) filters in the OR for implants
Limit procedure room traffic
Do not continue postoperative antibiotics beyond 24 hours.

NACC GUIDELINES: INFECTION PREVENTION

LEVEL II

RECOMMENDATION
Identify and treat all remote infections prior to trials/implants
Optimize glucose control
Discontinue tobacco use
Perform preoperative surgical scrub for a minimum of 2-5 minutes
Keep nails short (no artificial nails)
Wear a surgical mask and cap or hood to fully cover hair
Use sterile gown and gloves; double glove
Limit operative time
Apply an occlusive dressing for 24-48 hours

NACC GUIDELINES: INFECTION PREVENTION
LEVEL III

RECOMMENDATION
Do not wear arm or hand jewelry
Limit tissue trauma, maintain hemostasis, eradicate dead space, and avoid electrocautery at tissue surface
Maximum time of 1 year for defining a deep SSI of an implantable device Educate patient on proper incision care, symptoms of SSI, and importance of reporting symptoms
Wash hands before and after dressing changes, and use sterile technique
When SSI is suspected, prescribe an appropriate antibiotic that covers the likely causative organisms (consider local resistance patterns and culture results)

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- Contact e-mail: dsouza.ryan@mayo.edu
- Mentoring opportunities
- ***@Ryan_S_DSouzaMD***

QUESTIONS?