Laserneedle Acupuncture as *Neuromodulation*

ISLA- New Approaches in Medical Laser Therapy

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Goals of Presentation

1. Show EBM evidence of laser acupuncture efficacy in pain
2. Discuss concepts of acupuncture and acupuncture “pain”
3. Show neuroanatomic basis of acupuncture
4. Laserneedle acupoint stimulation as optimal acupuncture

Clinical Evidence of Low Level Laser (LLL) Acupuncture Efficacy

- Clinical effectiveness of laser acupuncture: a systematic review (18 RCTs)
- Laser acupuncture benefits
  - myofascial pain
  - postoperative nausea + vomiting
  - chronic tension headache
- "a viable alternative to more traditional forms of stimulating acupuncture points"

Baxter J Acup Merid Stud 2008;1(2):65-82

Laser Acupuncture Efficacy for Pain

- Laser acupuncture for musculoskeletal pain
- 49 RCTs were of proper quality + described laser parameters adequately
- 31/49 (63%) → + outcomes
- inadequate laser dosage ↔ - outcomes
- LLL acupuncture benefits greater in long term than short term (!)

Laws JAMS 2015; 8(1):2-16

LLL Acupuncture: Musculoskeletal Pain

Pain at end of intervention

- **myofascial pain**
- **lateral epicondylitis**
- **TMJ pain**

Standard Mean Difference of 0.49 (medium effect) favoring LLL

Laws JAMS 2015; 8(1):2-16

LLL Acupuncture: Musculoskeletal Pain

Pain at end of follow-up (6-26 weeks)

- **myofascial pain**
- **lateral epicondylitis**
- **TMJ pain**

Standard Mean Difference even higher at 0.95 (large effect) favoring LLL !

Laws JAMS 2015; 8(1):2-16

LLL Acupuncture: Musculoskeletal Pain

- Positive studies occurred when appropriate laser energy provided:
  - ≥ 10 mW laser output power

and

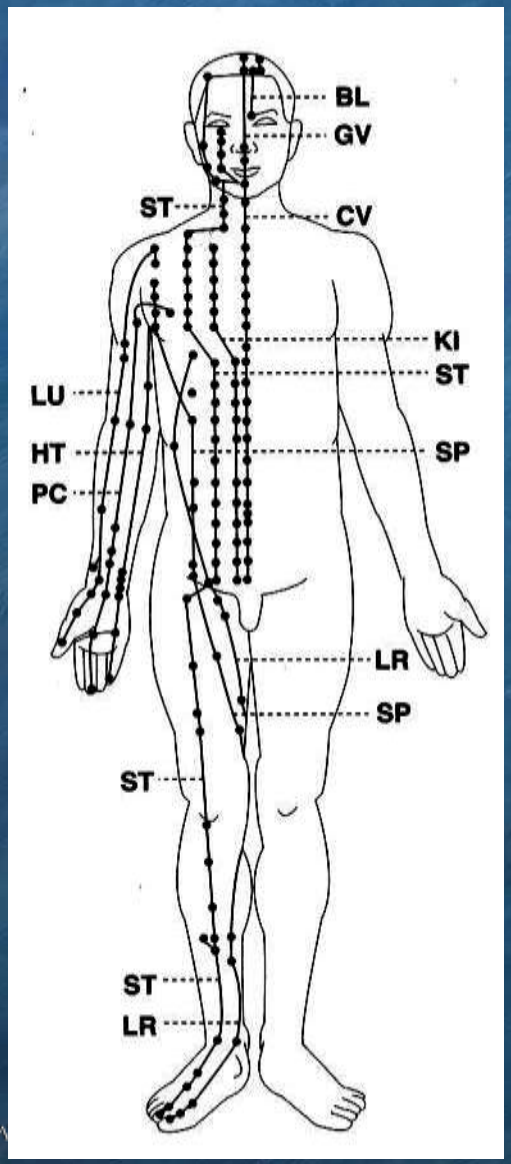
  - energy dose of ≥ 0.5 J per point
- Joules = Power (W) * Time (sec)
  - *50 sec at 10 mW or 5 sec at 100 mW*
- Negative studies either did not properly describe laser parameters or applied inadequate dosage

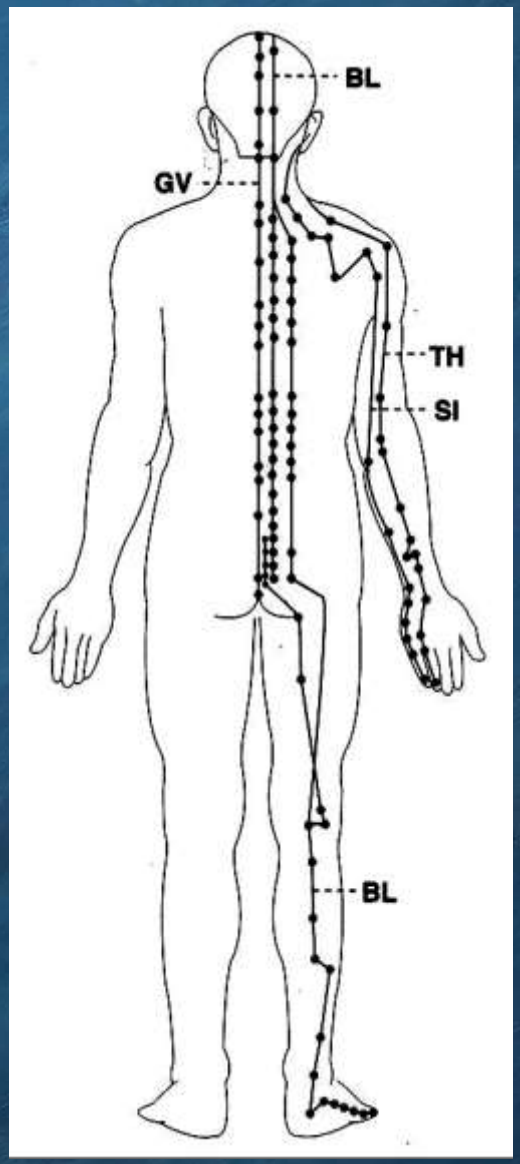
Laws JAMS 2015; 8(1):2-16

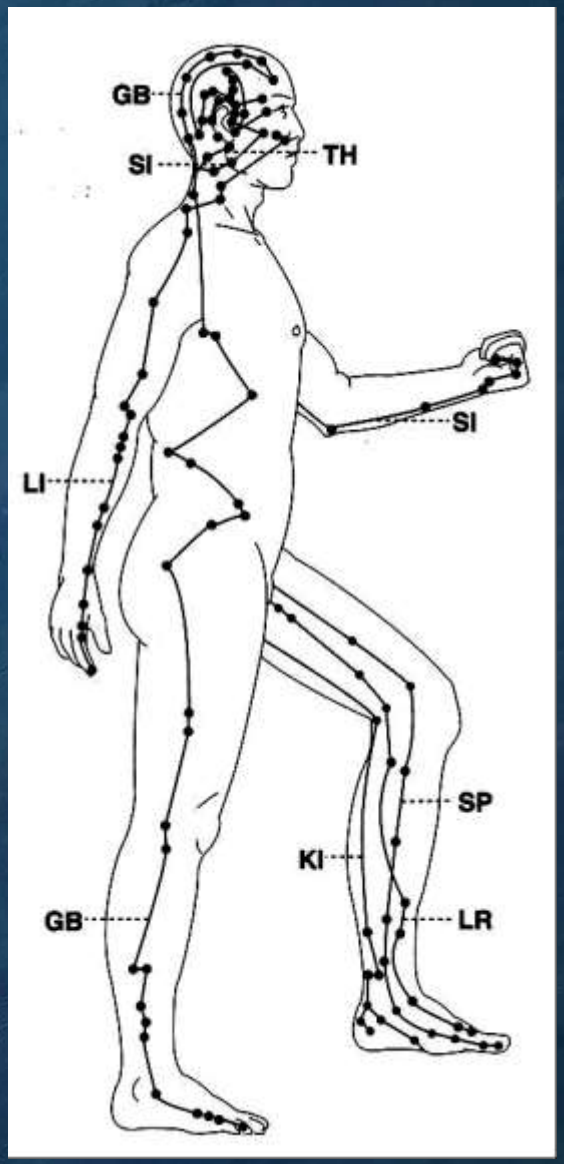
What is Acupuncture?

- *acus "needle" + punctura "to puncture"*
- a group of procedures that stimulate precise body locations (acupuncture points) to produce clinical effects
- 361 Classical acupuncture points were described by ~200 A.D.
- Classical acupoints are grouped according to those with similar therapeutic properties on 1 of 12 Principal meridians (channels)
- Meridians named for the Organ they influence (Heart, Gallbladder, Bladder, etc)

Acupuncture Meridians

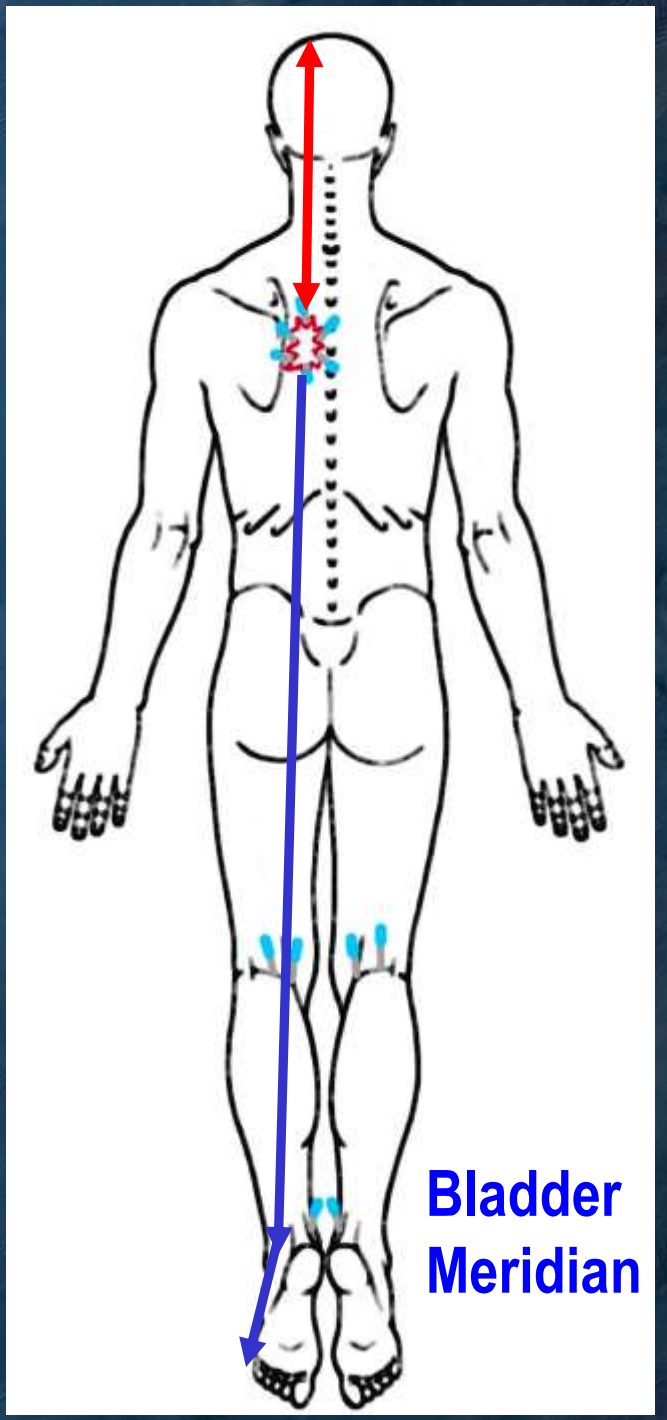




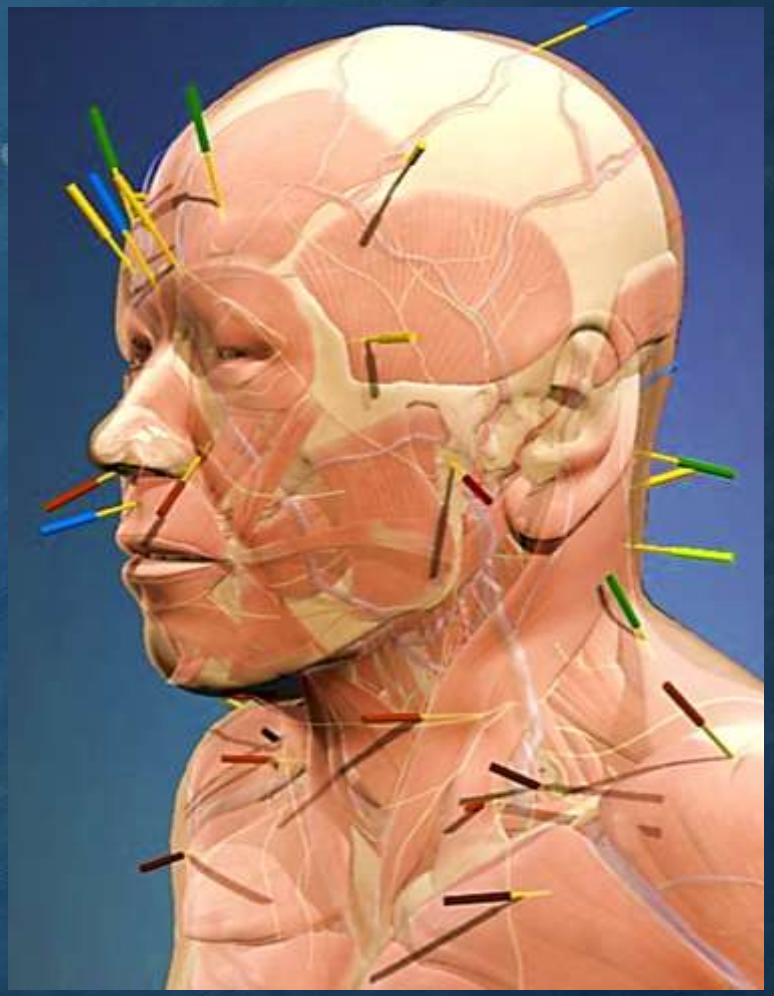


Acupuncture "Pain"

- Pain = blockage of blood +/- energy (*qi*) flow in meridian
- Pain sensation may spread along that meridian
- Local +/- distal points needled to unblock channel



What Is A Classical Acupuncture Point?



穴位 = 穴 (xué) = hole, cave + 位 (wèi) = position, location

Acupuncture Point: “Hole”

- *Palpable depression*
- *Cleft* between bones, ligaments, tendons, muscles fibers, and/or muscles

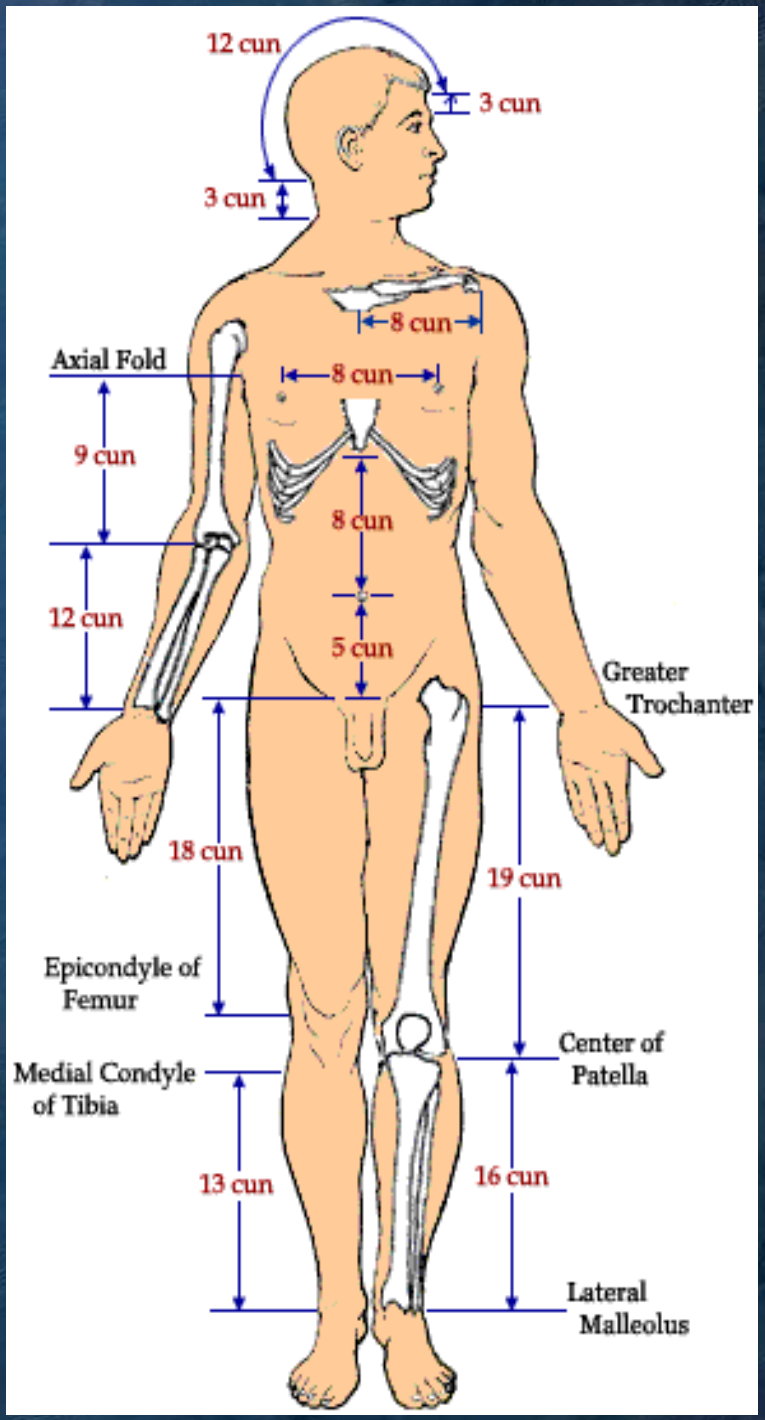
O’Connor & Bensky 1981

Acupuncture Point: "Position"

Cun system:

- Proportional measurement system
- Surface anatomic landmarks
- Normalized to patient
- *Approximate Locations*

O'Connor & Bensky 1981



Acupuncture Point: "Sensitivity"

- "Our ancestors said 'select five points to find the correct one' "

  Dr Shi Neng-yun 1996

- "…when locating the precise position of an acupuncture point, the most important single guide is *sensitivity*…"

  O'Connor & Bensky 1981

Anatomic Evidence

Acupuncture Points

Stimulate Nerves

Microscopic Evidence

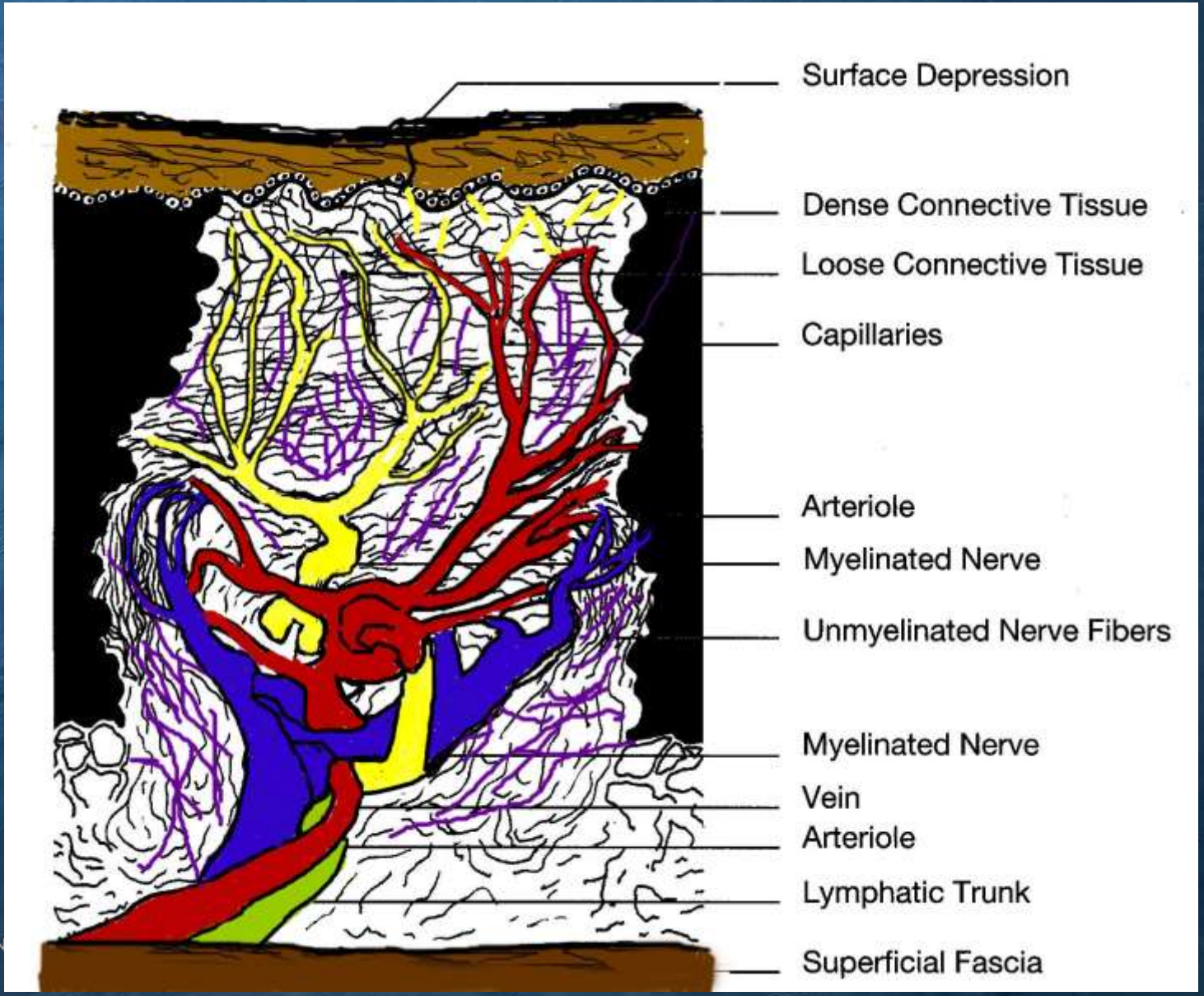
Acupuncture Point Histology

- Acupoints have been surgically isolated in
  - Humans

    Senelar 1979
  - Animals

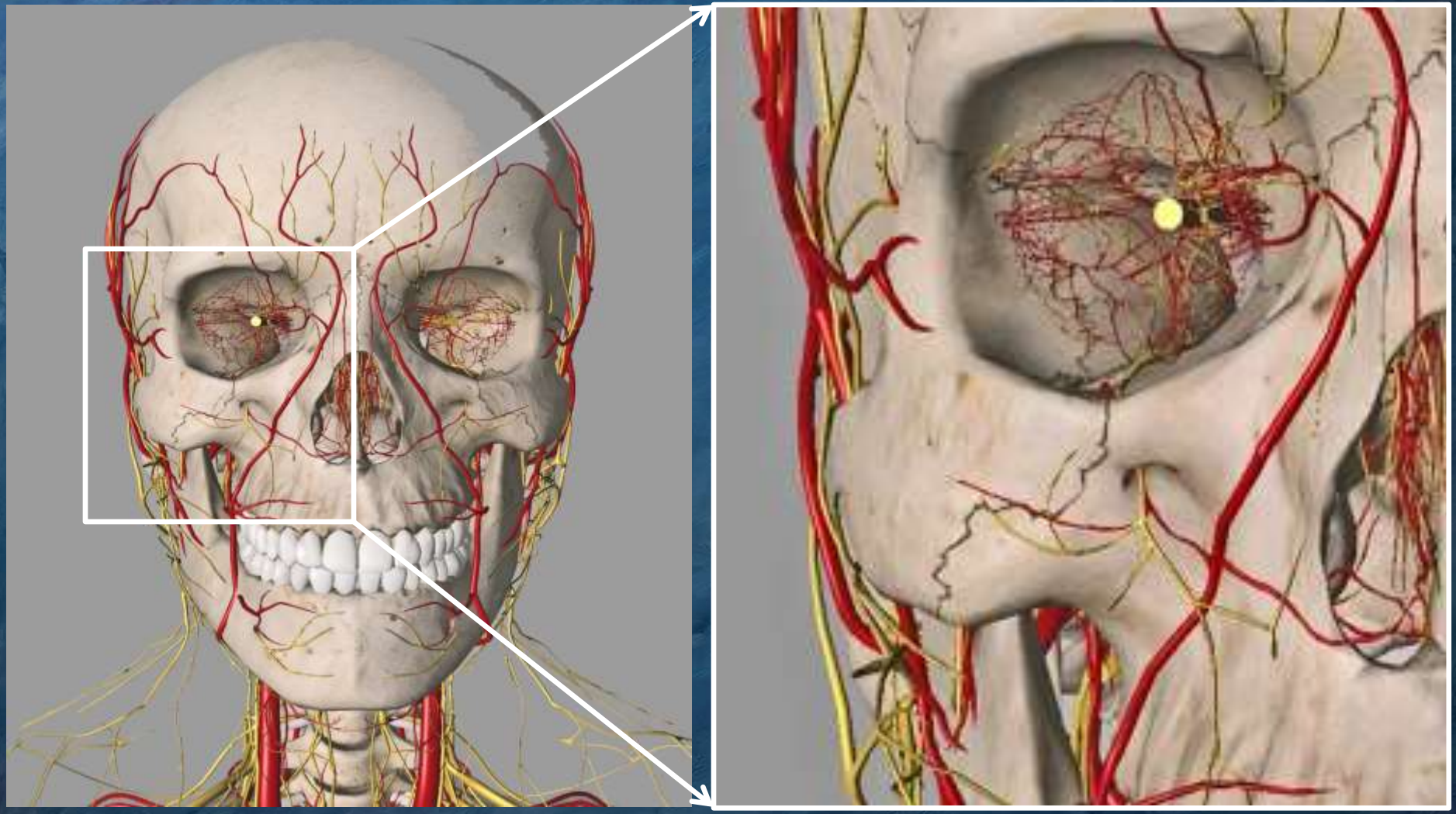
    Kim 2015
- Similar histologic findings
- Often anatomically discrete 1-2 mm

Acupuncture Point Histology

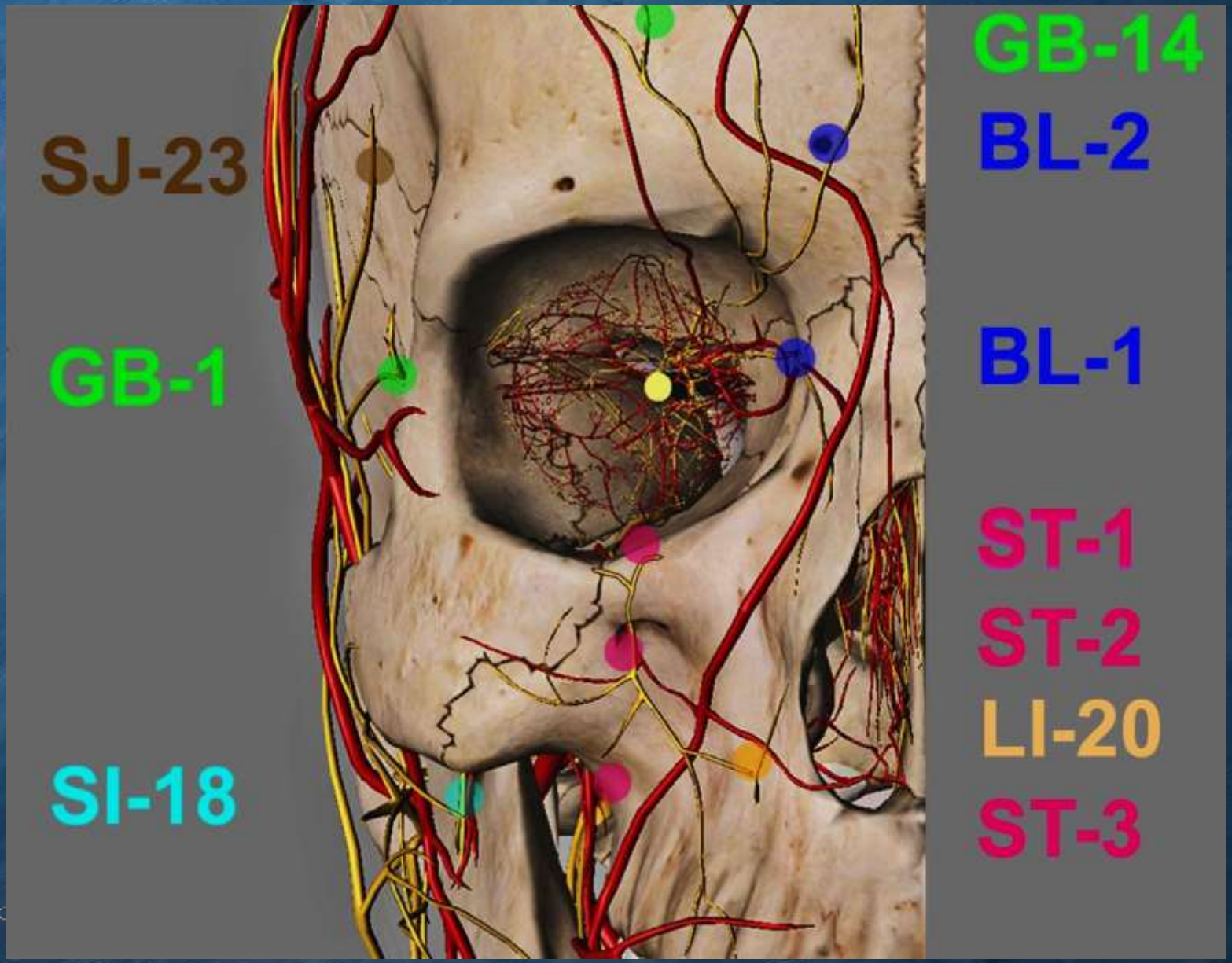


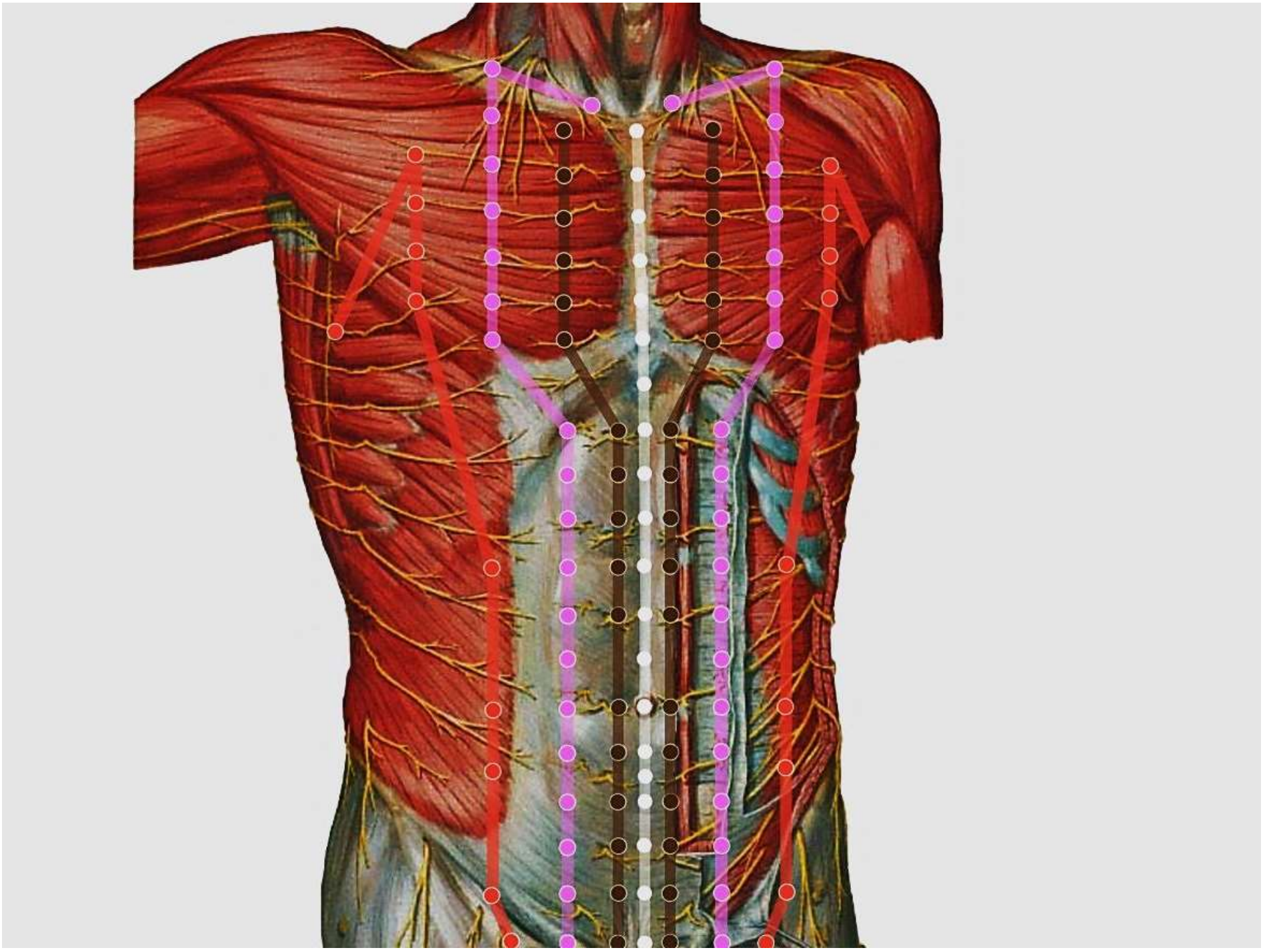
Macroscopic Evidence

Classical Acupuncture Points - Orbit and Maxilla

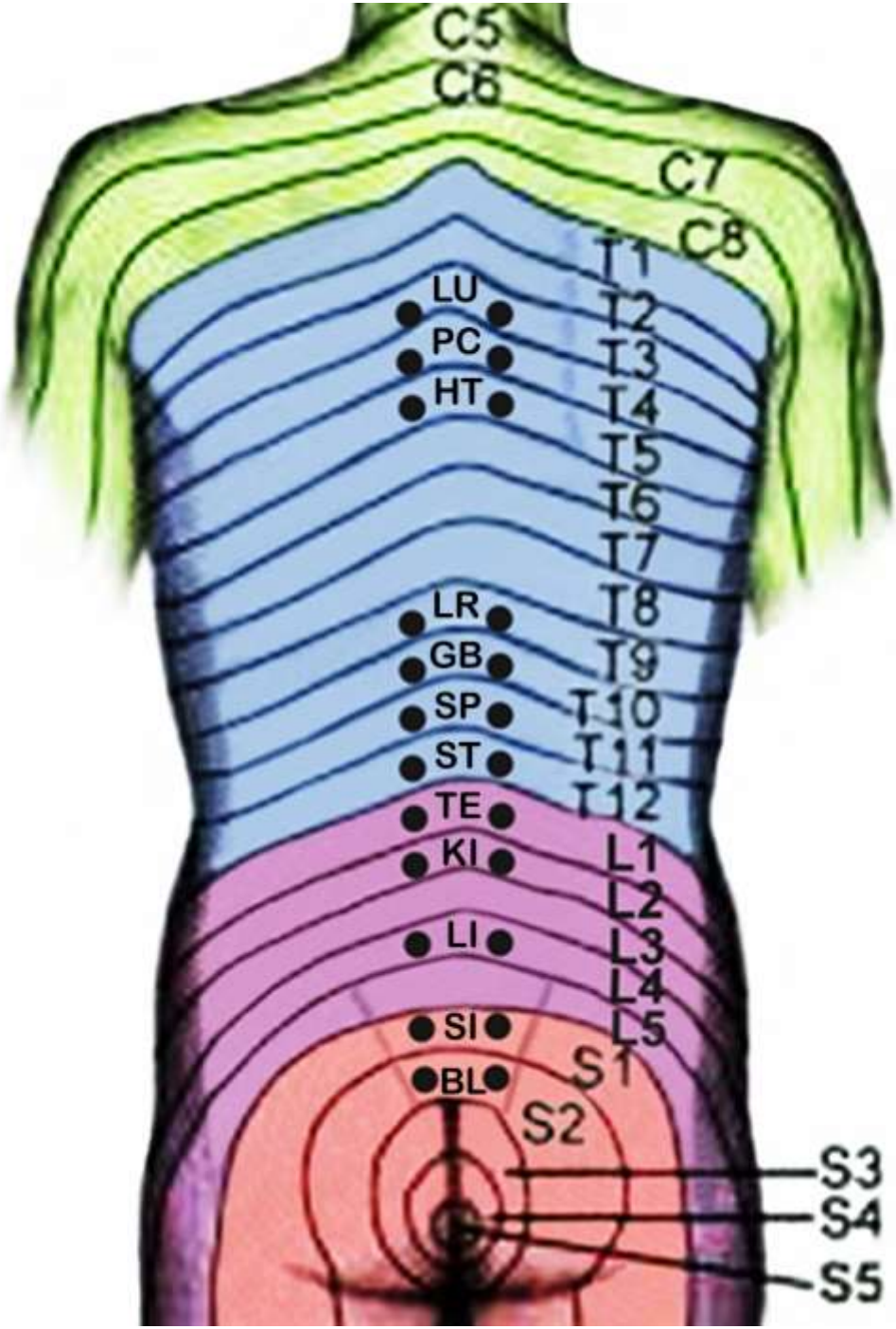


Classical Acupoints: Orbit & Maxilla





Back Shu Points



Back Shu Points + SANS Innervation

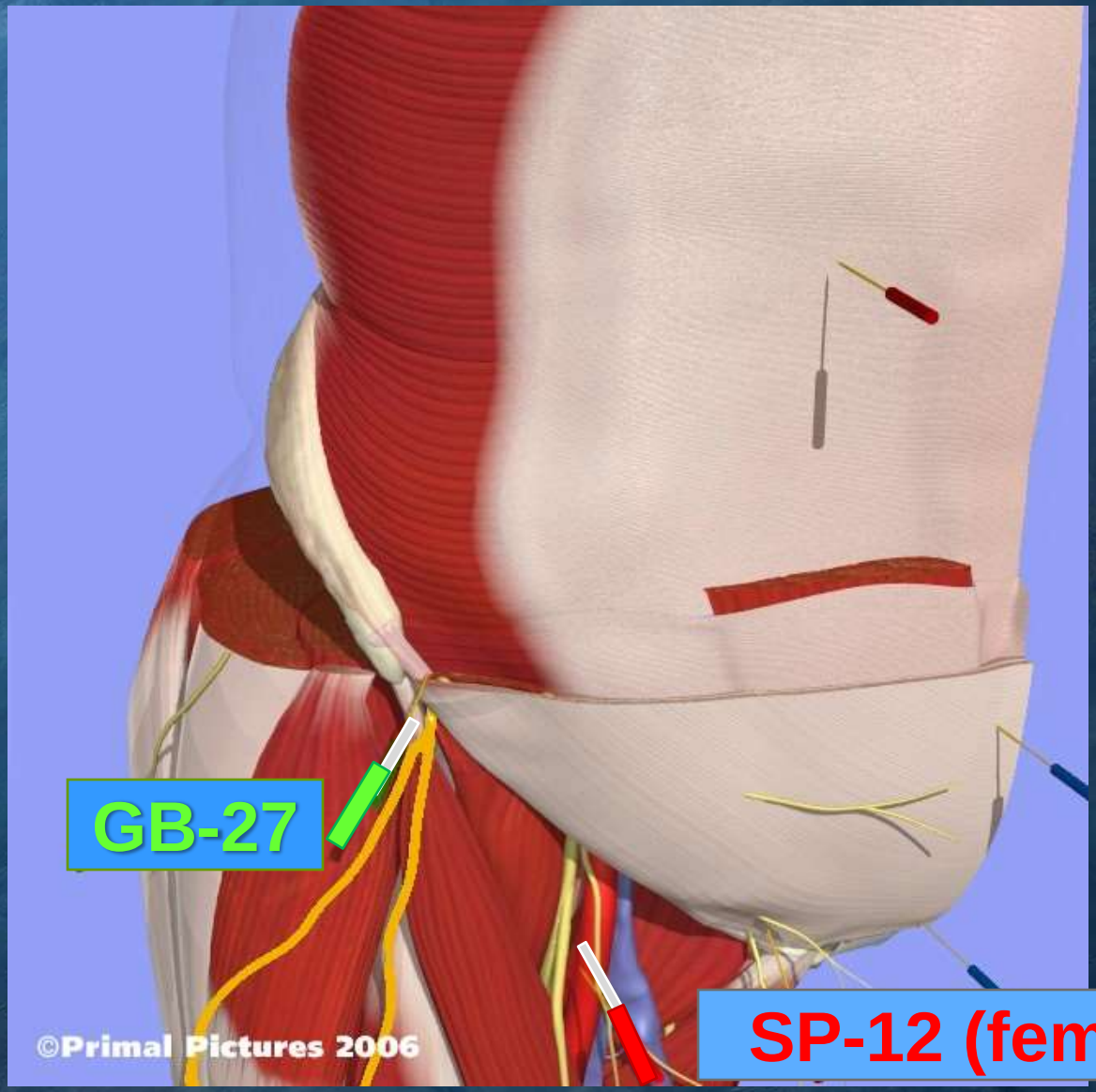
Organ	Shu Point	Spinal Level	Sympathetic Segmental Innervation	Osteopathic Level
Lung	BL-13	T3	T2-T5 (T2-T7)	T3-T9
Pericardium	BL-14	T4	T1-T4 (T1-T5)?	C8, T1-T8?
Heart	BL-15	T5	T1-T4 (T1-T5)	C8, T1-T8
Liver	BL-18	T9	T7-T9 (T5-T10)	T6-T11
Gallbladder	BL-19	T10	T7-T10 (T5-T10)	T6-T11
Spleen	BL-20	T11	T6-T10 (T5-T11)	T7-T10
Stomach	BL-21	T12	T6-T10 (T5-T11)	T7-T10
Triple Energizer	BL-22	L1	Cortex T6-L2 Medulla T11-L1	
Kidney	BL-23	L2	T11-L1 (T10-L2)	T9-L2
Large Intestine	BL-25	L4	Proximal 2/3 T11-L1 (T6-L1) Distal 1/3 L1-L2 (T6-L2) (White- afferent S2-S4)	T9-L1
Small Intestine	BL-27	S1	T9-T11 (T6-T12)	T6-T11 duodenum/jejunum
Bladder	BL-28	S2	T11-L2 (White -afferent S2-S4) S2-S3 parasympathetic	

Back Shu Points + SANS Innervation

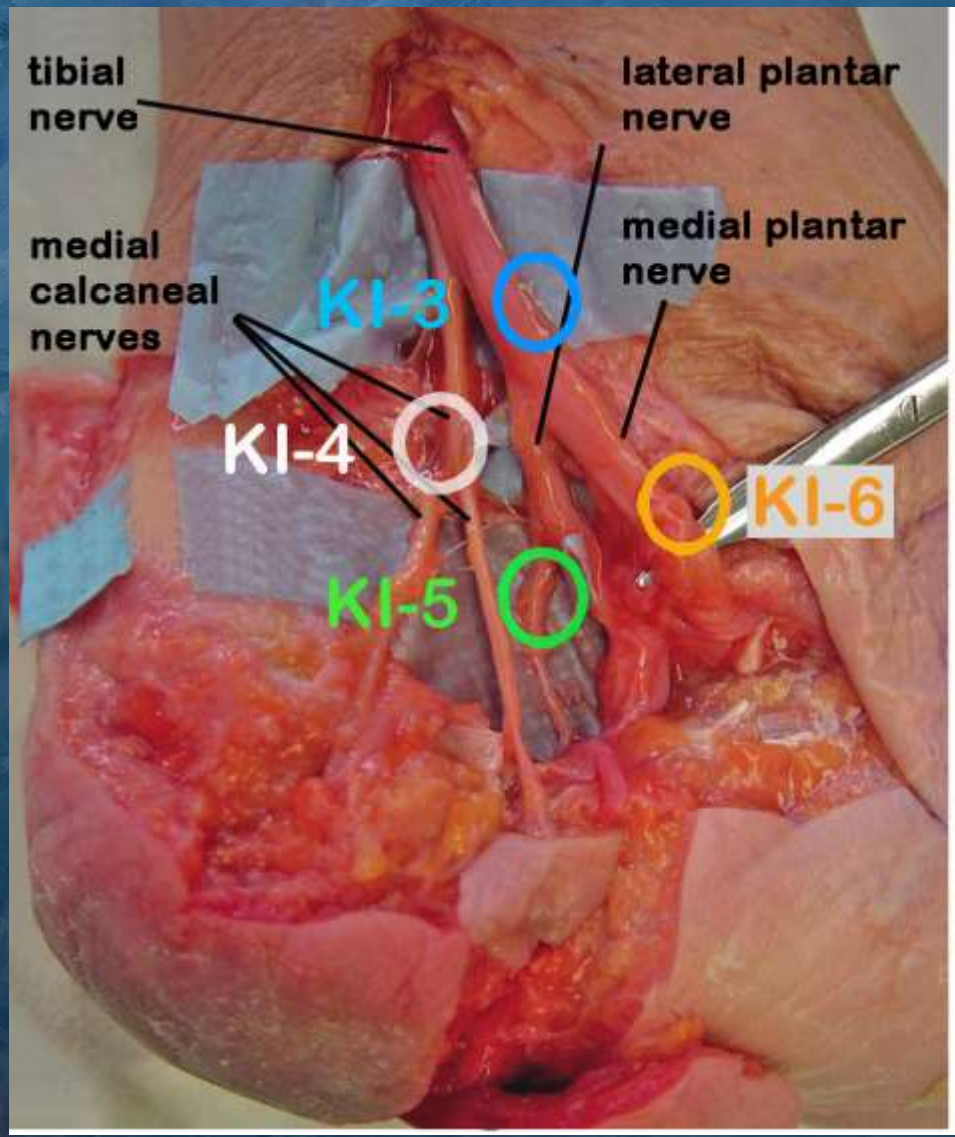
- Back Shu points used to directly influence Organ function
- 10/12 acupuncture Organs' back Shu points located at ~ same spinal levels as the ANS outflow to those organs
- Given 17 possible spine levels (12 thoracic + 5 lumbar + 2 sacral), odds this is coincidental ~ 1 in 2 trillion (1/17**10)

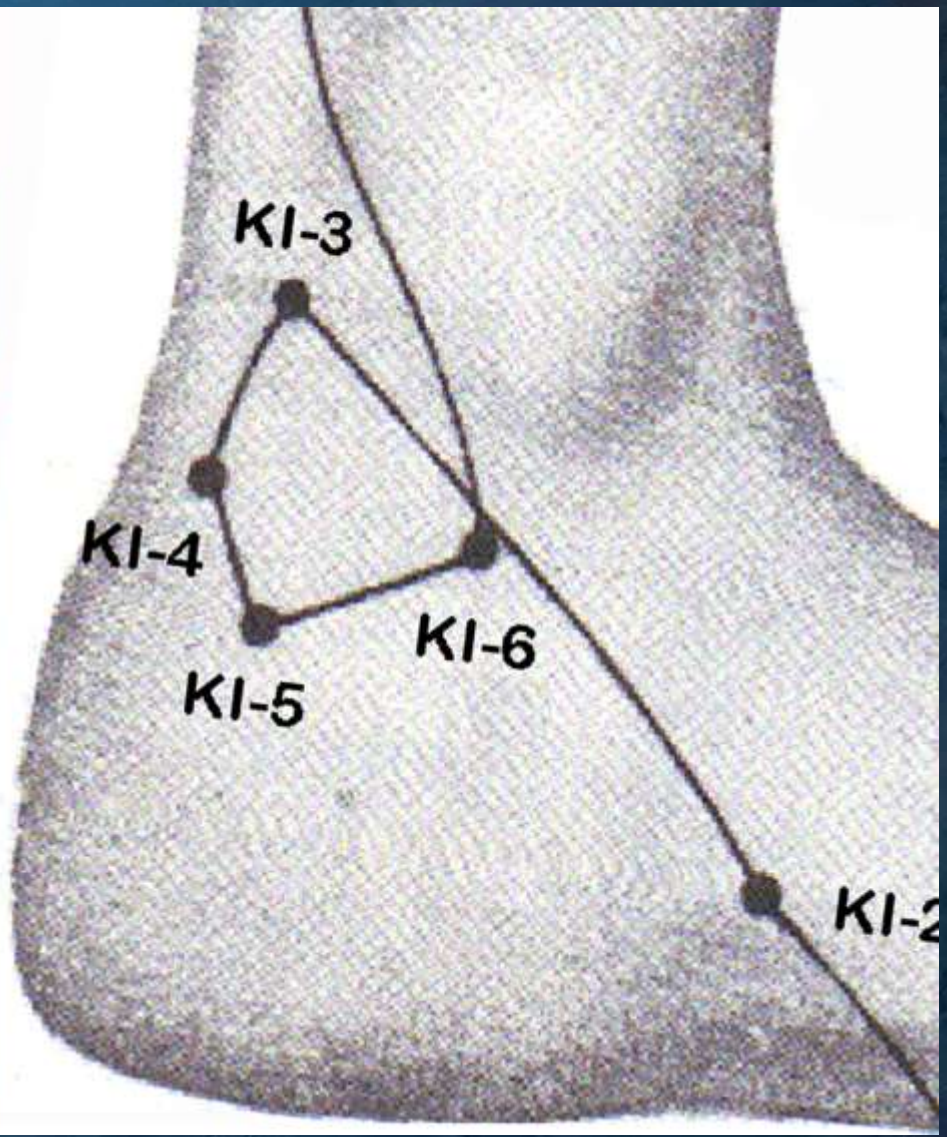
LU-1 Lateral Cord Brachial Plexus

GB-27
Lateral Femoral Cutaneous Nerve

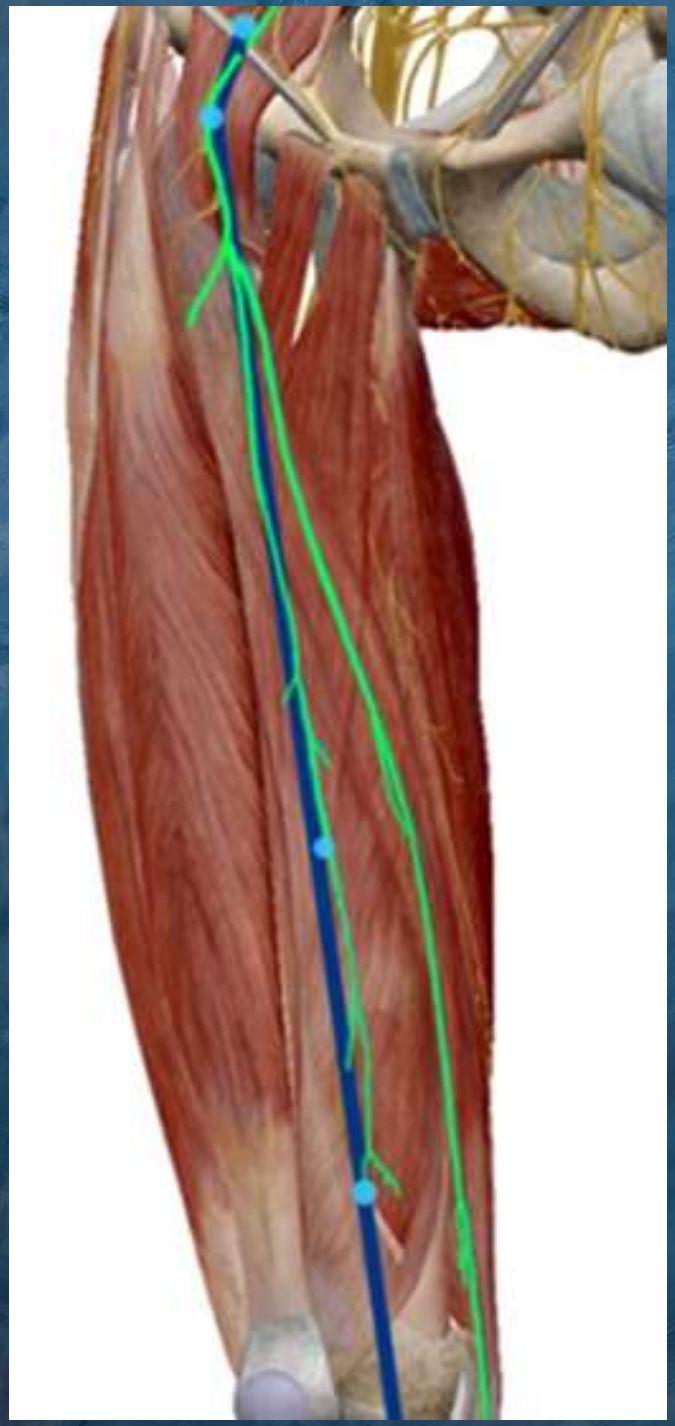


Kidney Channel Medial Heel





Comparison: Distributions of Femoral/Saphenous Nerves and the Spleen Meridian



Spleen channel in leg has six direction Δ of 10-40º ($\bar{x}$ = 20º)

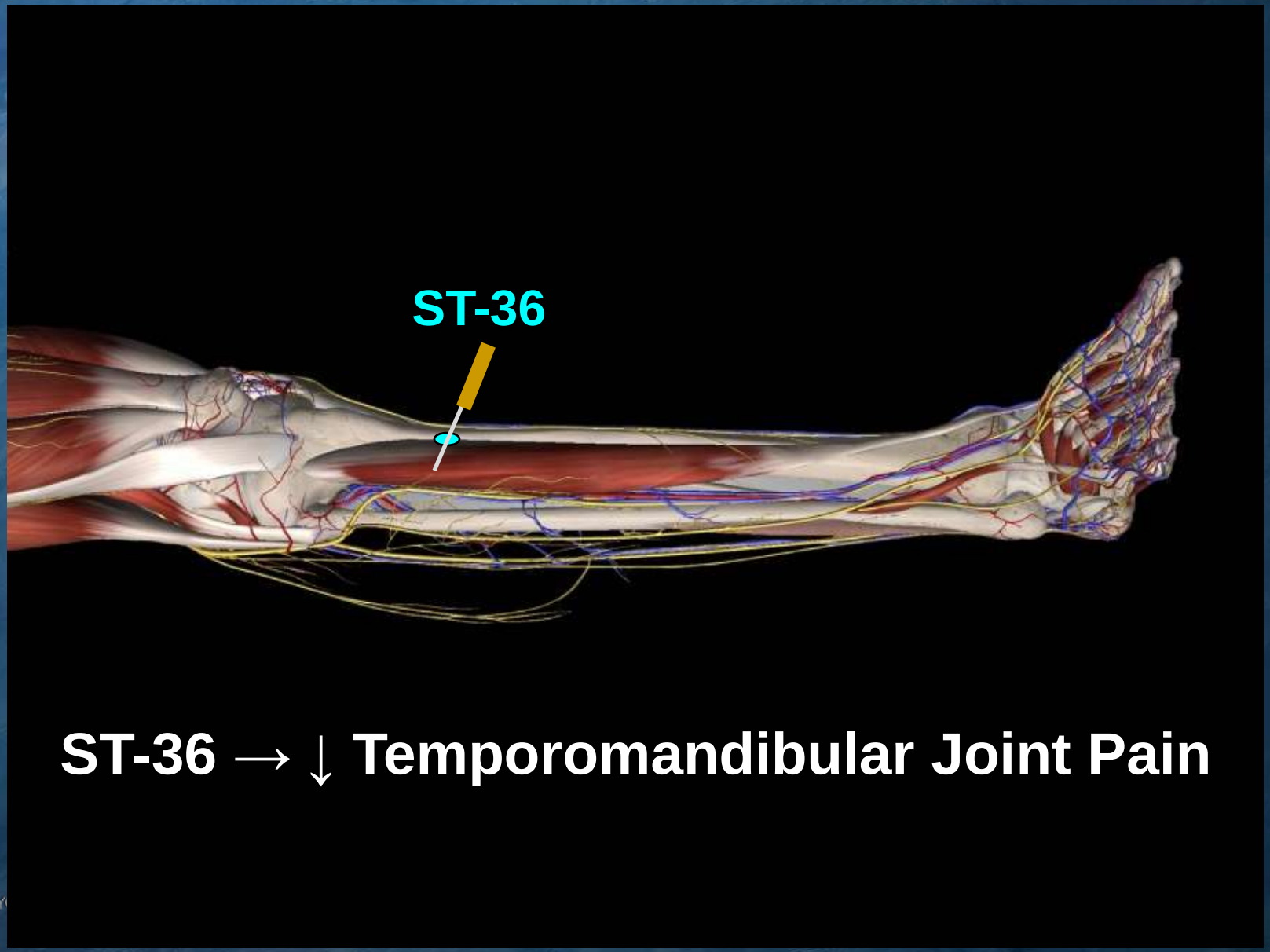
Each direction Δ follows the femoral and saphenous n. distributions from groin to instep of foot

likelihood this is by chance = 1 in 34 million

Physiologic Evidence

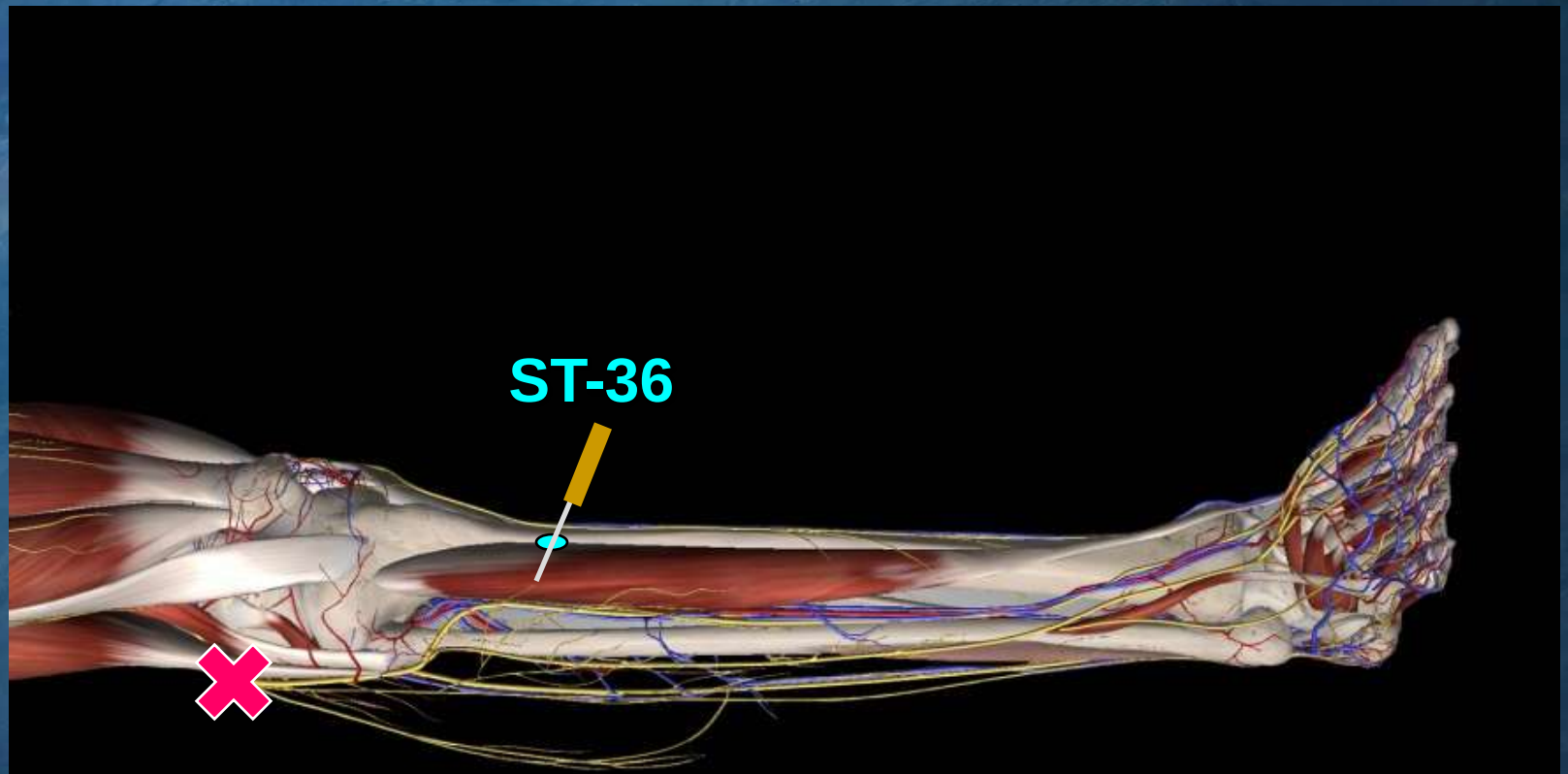
Acupuncture Effects Result from Nerve Stimulation

Peroneal Nerve and ST-36



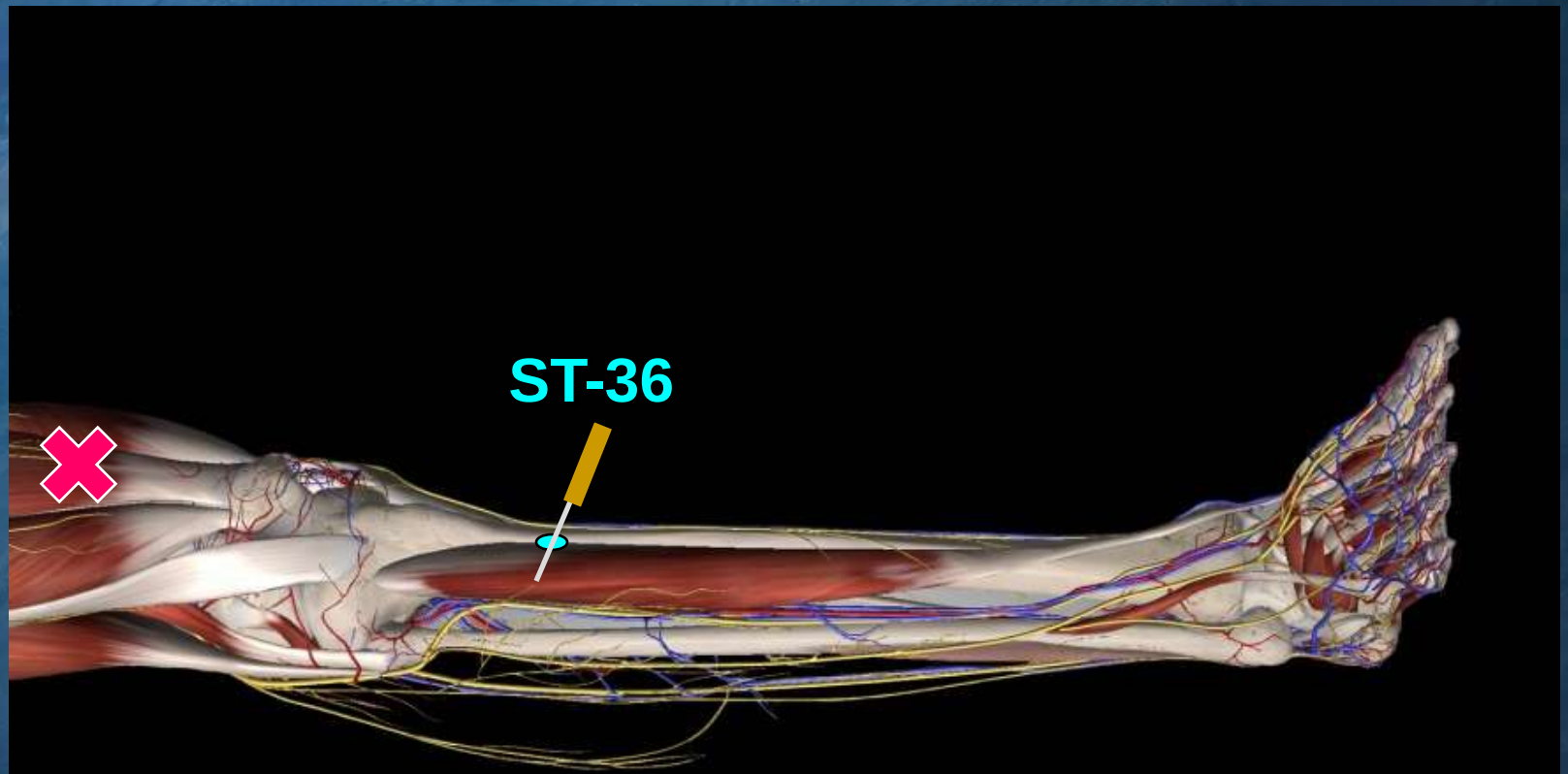
ST-36 → ↓ Temporomandibular Joint Pain

Peroneal Nerve and ST-36



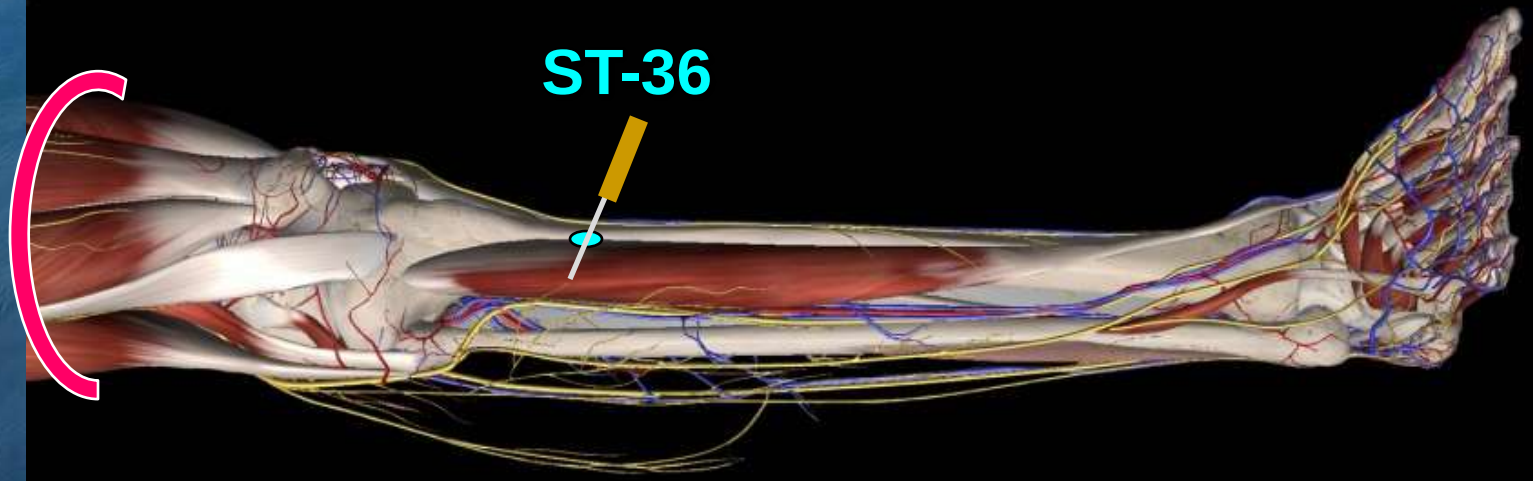
Transection (or local anesthetic block) of sciatic or peroneal nerve → eliminates analgesic effect ST-36

Peroneal Nerve and ST-36



Transection (or local anesthetic block) of femoral or tibial nerve → + analgesic effect ST-36

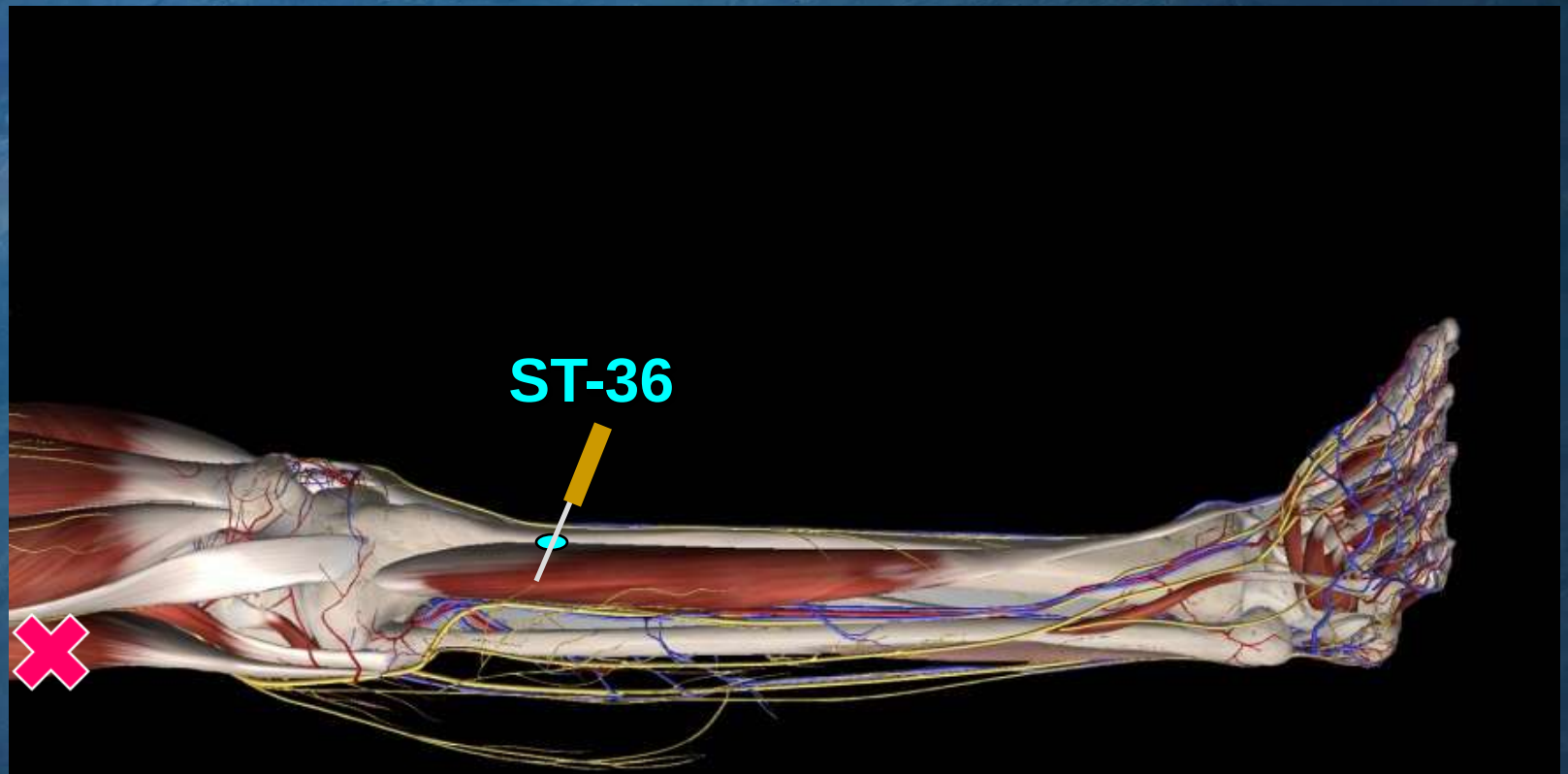
Peroneal Nerve and ST-36



Tourniquet of thigh or isolation of circulation to ST-36 → + analgesic effect

Lu GW. Am J Physiol Regul Integr Comp Physiol. 1983

Peroneal Nerve and ST-36



Pre-treating sciatic nerve with capsaicin
→ eliminates analgesic effect ST-36

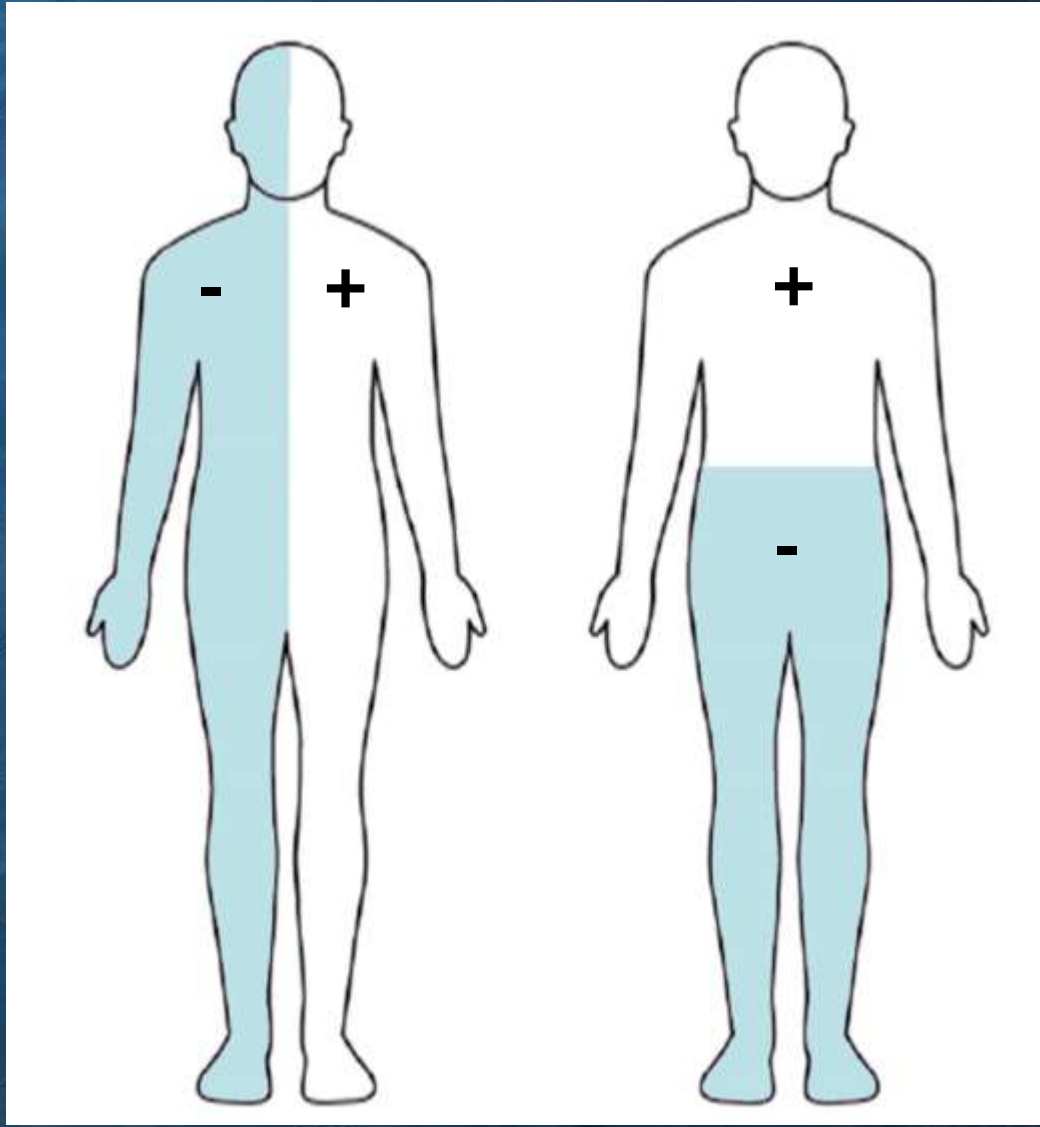
Okada Brain Res 1996

Acupuncture and CNS Damage

= neurologically intact

= motor/ sensory deficit

Research Group of Acupuncture Anesthesia, Peking Medical College, 1973



CNS Efferent Modulation of Acupuncture's Effects

- Lesion of hypothalamus' arcuate nucleus or depletion of pituitary endorphins → elimination of acupuncture analgesia

  Wang Brain Res 1990, Cheng Life Sci 1979

- Inter-collicular decerebration or thoracic cord transection eliminates effect on bladder of stimulating calf nerves

  McPherson J Phys 1966

- Sectioning Vagus nerve eliminates ST-36 stimulation effect on gastric acid secretion

  Noguchi Jap J Physiol 1996

fMRI Evidence of Acupuncture Neuromodulation of Pain

- acupuncture activates with specificity brain areas that subserve both the sensory and affective interpretation of painful stimuli
- stimulation of LI-4 + ST-36
  - activates analgesic/ anti-inflammatory structures (e.g. hypothalamus, nucleus accumbens)
  - inhibits areas subserving reaction to pain (e.g. rostral anterior cingulate cortex, amygdala + hippocampus)

Wu MT et al. Radiology 1999; 212(1):133-41

Consistent with Traditional Chinese Medicine Concepts

“channels are ‘spaces’ (間隙 jiàn xì) within body’s fibrous connective tissues …. the concept of channel includes these spaces and everything wrapped within them … this includes blood vessels, bones, lymphatics, nerves, tissues, and interstitial fluids”

Wang JY. Applied Channel Therapy in Chinese Medicine, 2008

Clinical Application

Neuroanatomic Acupuncture with Laserneedle

Mechanism of LLL Pain Relief

- ***Inhibition of A-delta and C fibers***
- Increased endorphin production
- Anti-inflammatory effect
  - Prostaglandin-2 inhibition
  - Cyclo-oxygenase- 2 inhibition
- Increased nitric oxide levels

Kingsley. Frontiers Physiology 2014; 5(306): 1-3

Why Use Laser?
Theoretical Advantages

- ***NO PAIN***
- **chronic illnesses (e.g. osteoarthritis) are Yin deficiency states -laser is inherently tonifying**
- **laser safer- use over artificial joints, near defibrillators, pacemakers, spinal cord stimulators is safe**
- **?stimulates stem cells in repair**

Why Laserneedle?

- Most commercially available lasers are single channel and low power → limited depth of energy delivered below skin
- Laserneedle has greater power + beam focus →↑ depth of energy delivery
- IR (6-8 cm), red (2-4 cm) lasers
- Treat 12 points simultaneously
- Acupoints on deeper nerves have more visceral/autonomic effects

Pilot Study of Neuroanatomic Laserneedle Acupuncture

- 30 subjects (2/3 F) of mean age 70 years (range 42-95) receiving metal needle treatment
- chronic, severe (7/10-8/10 VAS) knee or shoulder joint pain from osteoarthritis
- minimal or no response to standard medical treatments
- not surgical candidates (poor health)

Shoulder Osteoarthritis

EB

Post-Fracture Osteoarthritis

EG

Bilateral Knee Osteoarthritis

NH

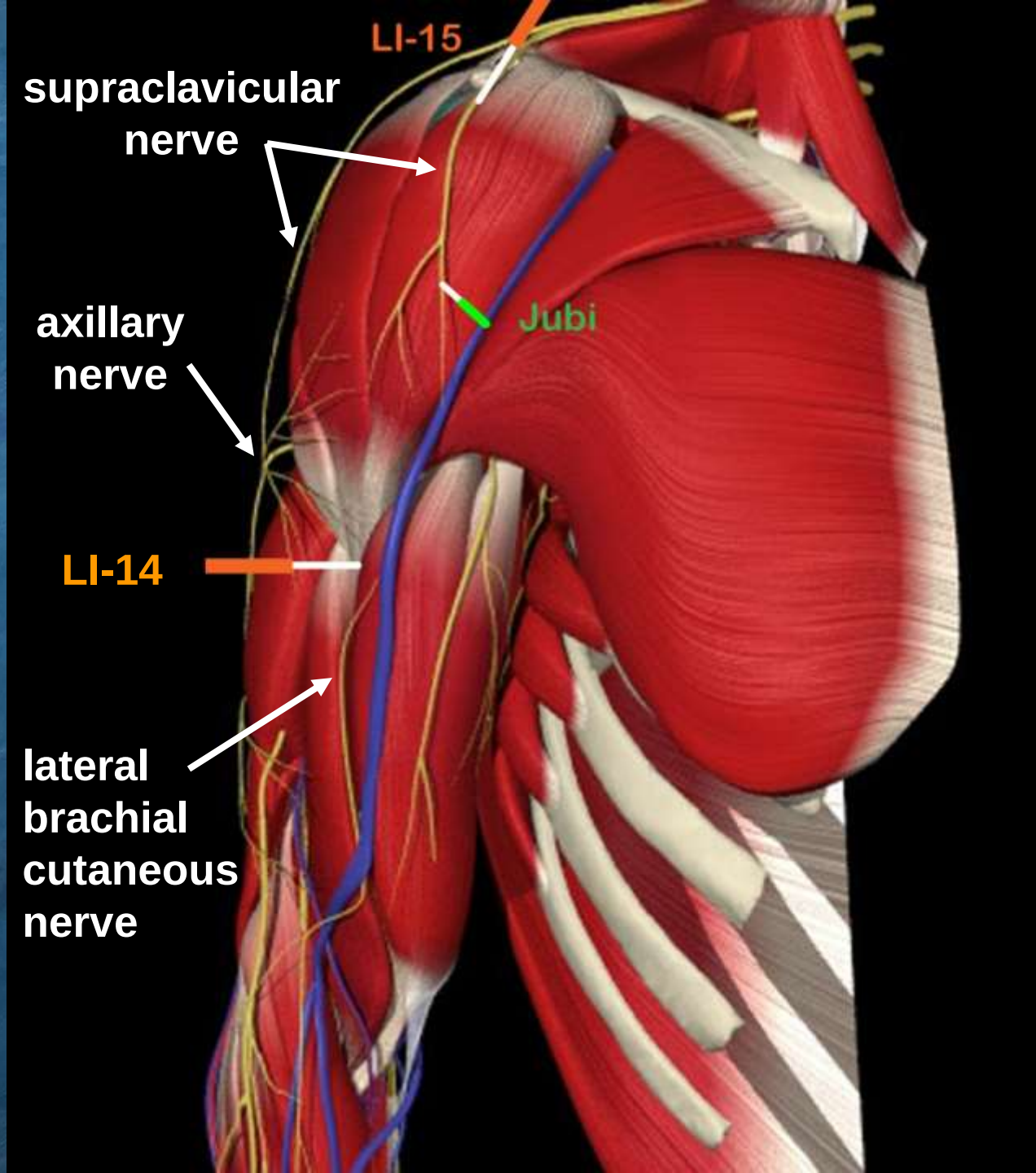
Treat the Nerves Innervating the Joints

- Shoulder
  - lateral pectoral nerve - anterior
  - suprascapular nerve - posterior
  - axillary nerve - inferior
- Knee
  - femoral nerve → superior knee + medial retinacular nerve → medial knee structures
  - sciatic nerve → posterior knee + lateral retinacular nerve → lateral knee structures
  - saphenous (medial) and peroneal (lateral) nerve branches → inferior knee structures

Treat the Nerves Innervating the Joints

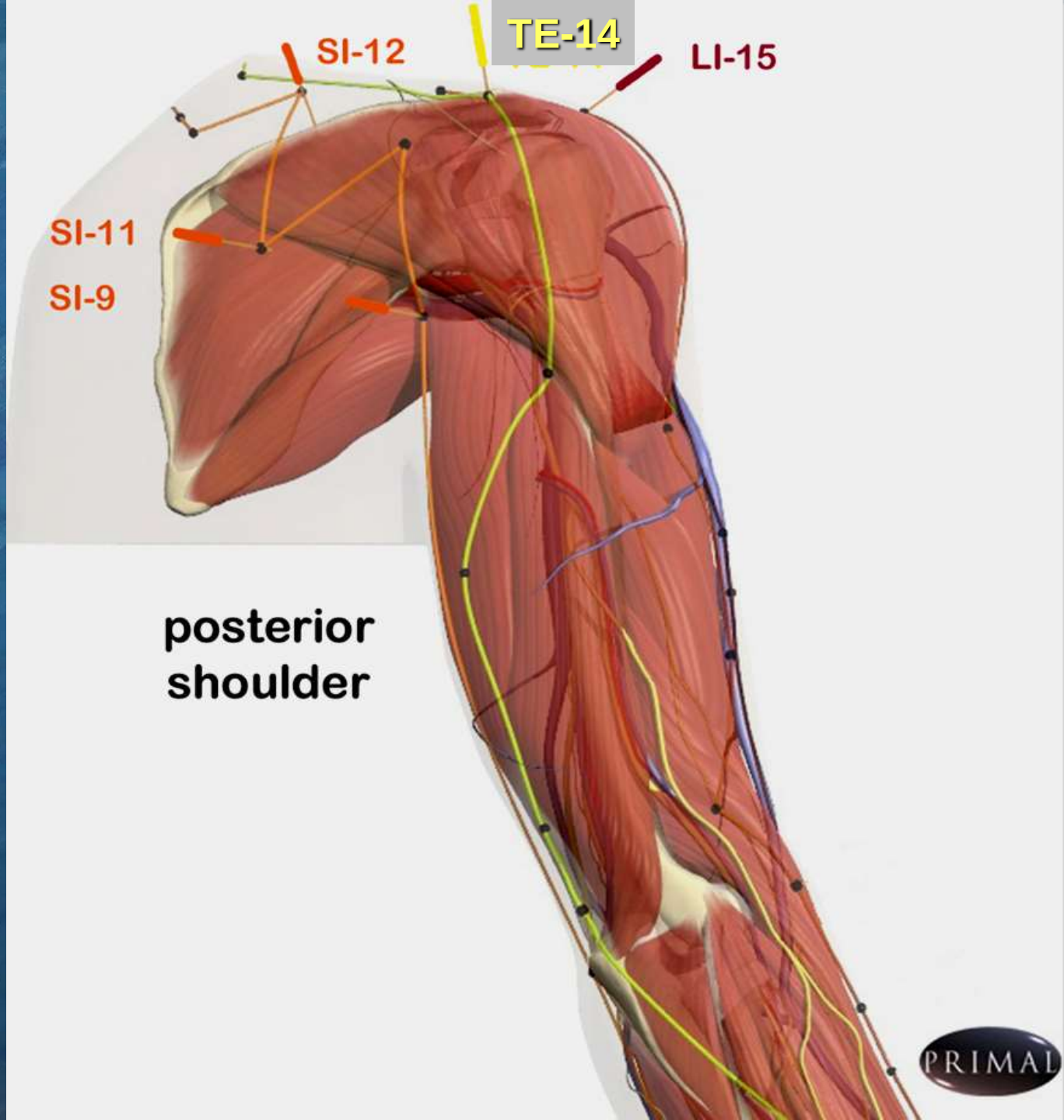
- Shoulder
  - lateral pectoral nerve - anterior
  - suprascapular nerve - posterior
  - axillary nerve - inferior

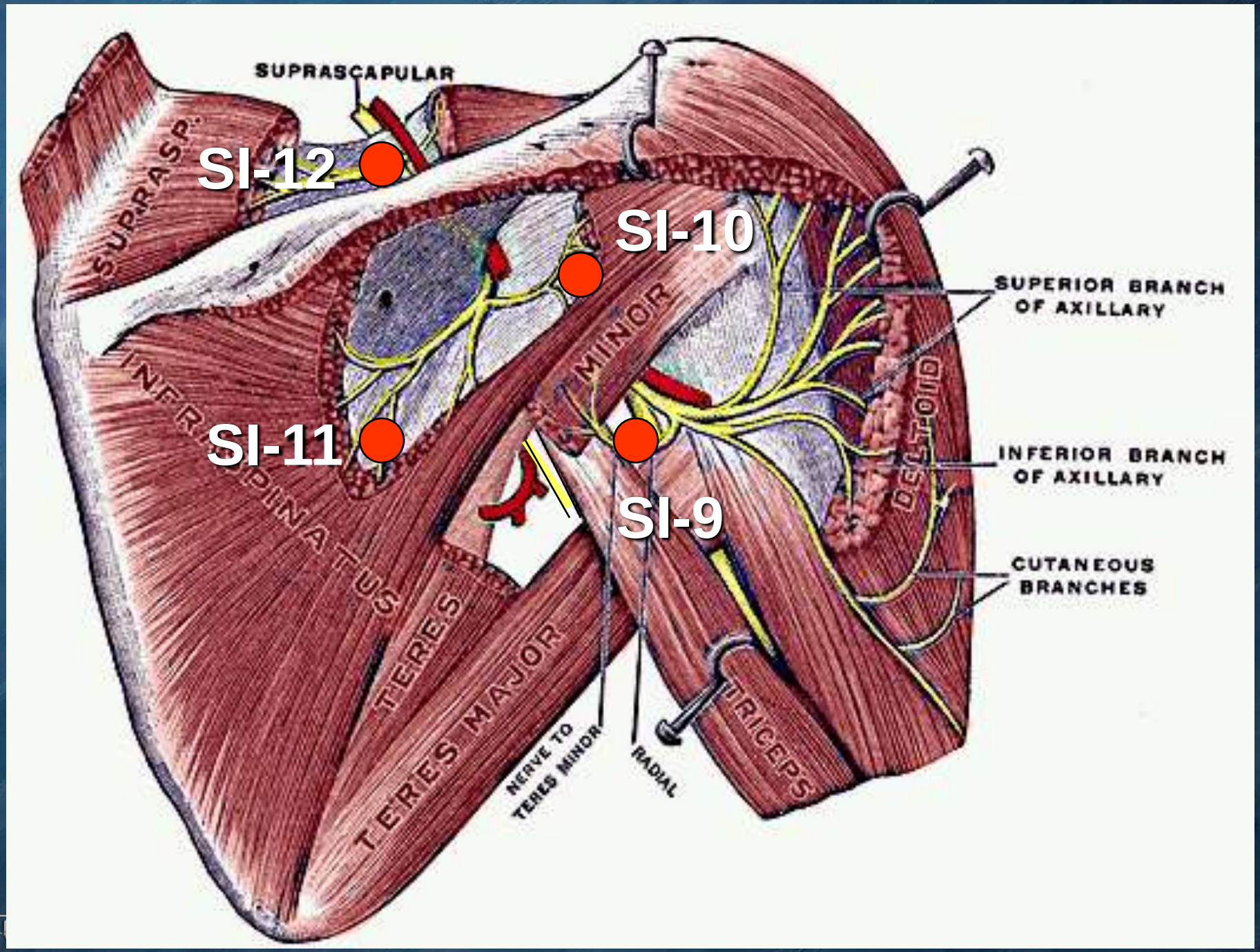
Shoulder Acupoint Selections- Anterior

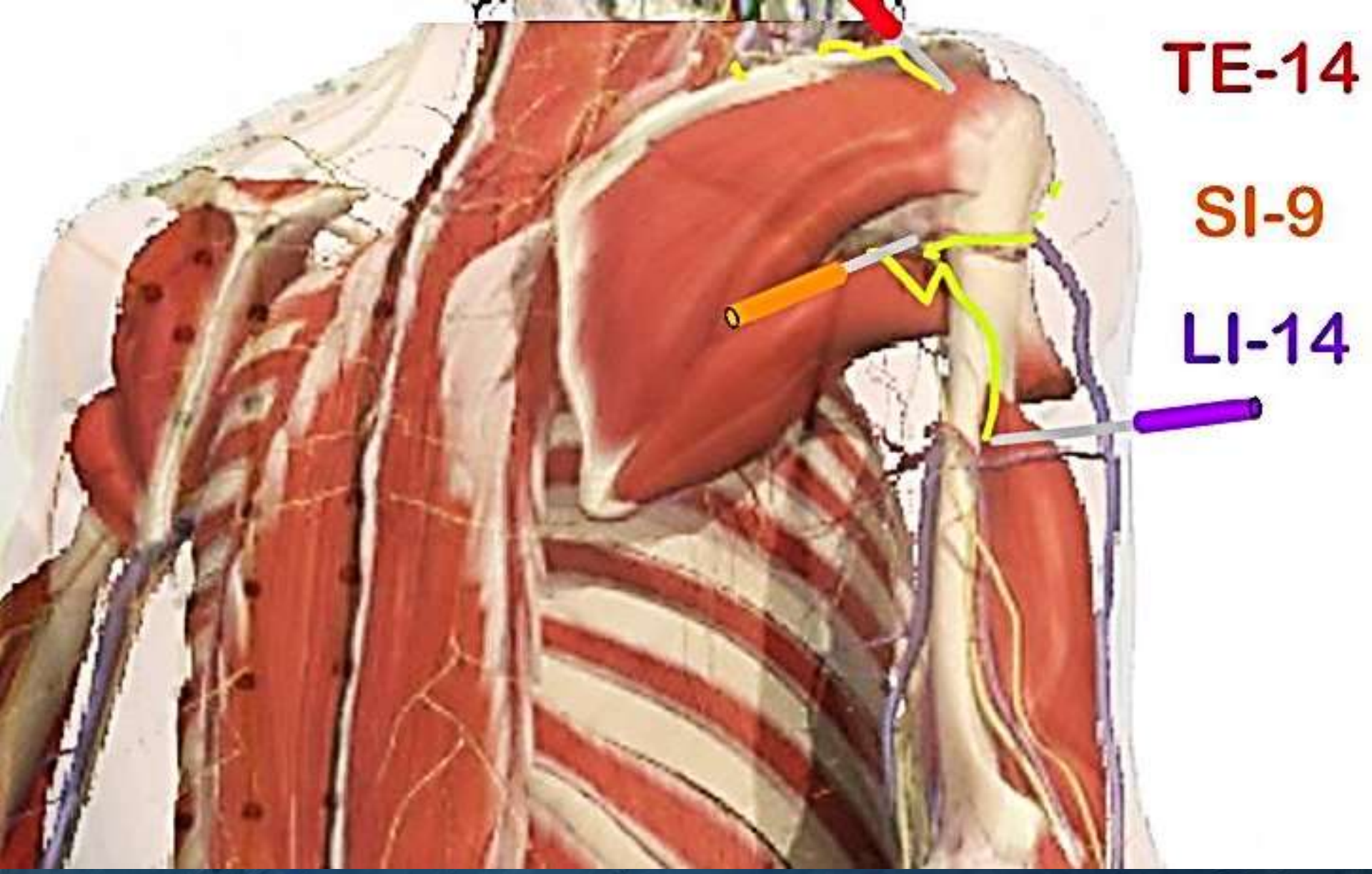


Shoulder Acupoint Selections

SI-9
SI-11
SI-12
TE-14




SUPRASCAPULAR
SI-12
SUPRASP.
SI-10
SUPERIOR BRANCH OF AXILLARY
MINOR
INFRASPINATUS
SI-11
SI-9
INFERIOR BRANCH OF AXILLARY
DELTOID
CUTANEOUS BRANCHES
TERES
TERES MAJOR
TRICEPS
NERVE TO TERES MINOR
RADIAL



Relationship of axillary nerve and supraclavicular nerve to teres major and deltoid muscles

Shoulder Acupoint Selections

Muscle Trigger Point	Corresponding Acupoint	Nerve Influenced
anterior deltoid	Jubi	axillary branch of lateral pectoral +/- axillary
anterior deltoid	LI-15	supraclavicular
lateral deltoid	LI-14	axillary
posterior deltoid	TE-14	supraclavicular
posterior deltoid, teres major	SI-9	axillary
supraspinatus	SI-12	suprascapular
infraspinatus	SI-11	suprascapular

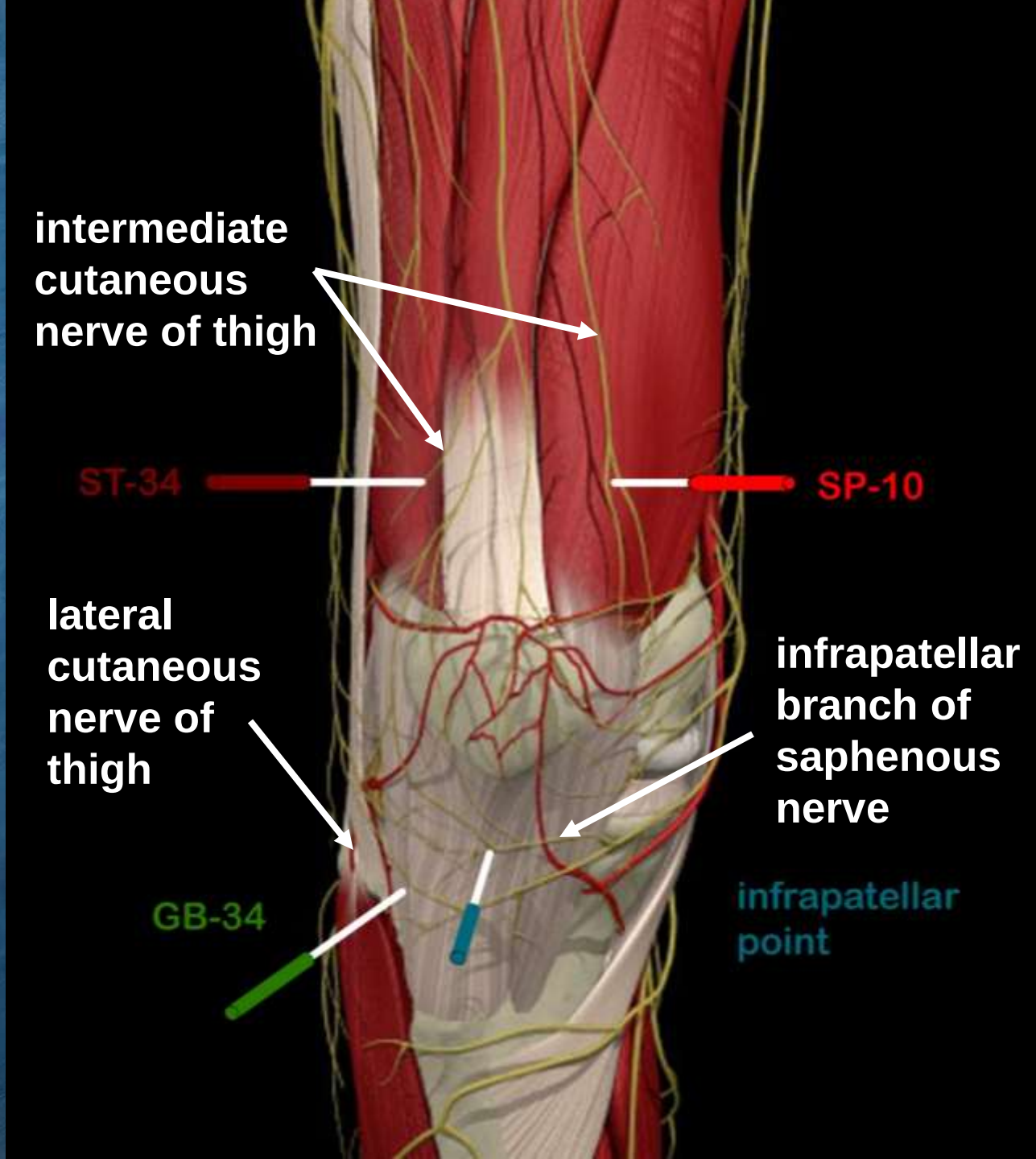
Shoulder Acupoint Indications

Acupoint	Actions	Indications
Jubi	"raise arm"	
LI-14	Meeting point of Large Intestine with Small Intestine & Bladder channels	shoulder pain, arm pain
LI-15	Meeting point of Large Intestine with Small Intestine & Triple Energizer channels	shoulder pain, arm pain
TE-14	Meeting point of Triple Energizer channel with Yang linking vessel	shoulder pain, shoulder joint soft tissue diseases
SI-9	"true shoulder", activates the Small Intestine channel, alleviates pain, benefits the shoulder	shoulder or scapular pain, shoulder disorders
SI-12	Meeting point of Small Intestine channel with Large Intestine, Triple Energizer, and Gallbladder channels	benefits the shoulder and scapula
SI-11	"celestial gathering", activates the channel, moves qi, relieves pain	shoulder or scapular pain

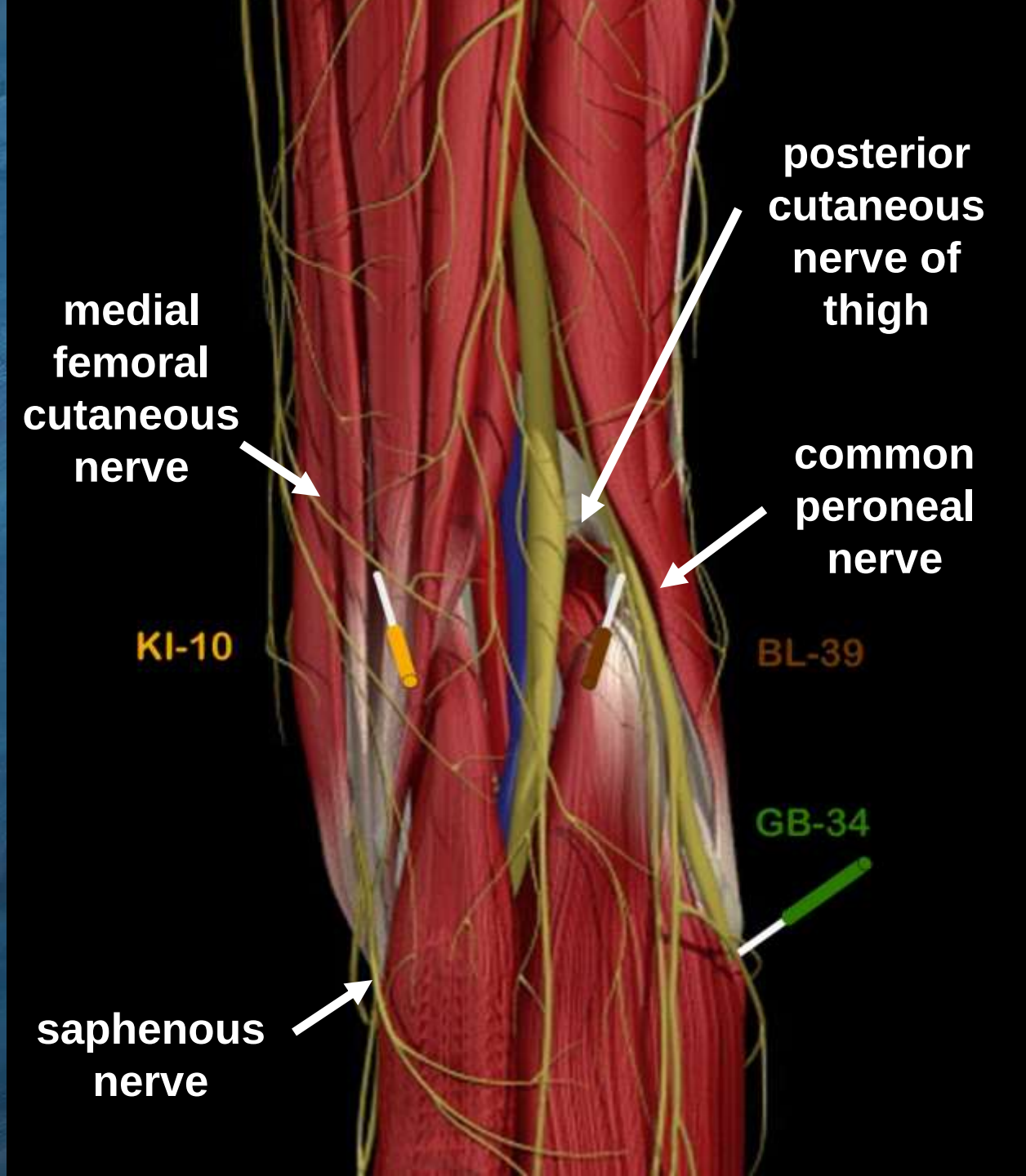
Treat the Nerves Innervating the Joints

- Knee
  - femoral nerve → superior knee + medial retinacular nerve → medial knee structures
  - sciatic nerve → posterior knee + lateral retinacular nerve → lateral knee structures
  - saphenous (medial) and peroneal (lateral) nerve branches → inferior knee structures

Knee Acupoint Selections- Anterior



Knee Acupoint Selections-Posterior



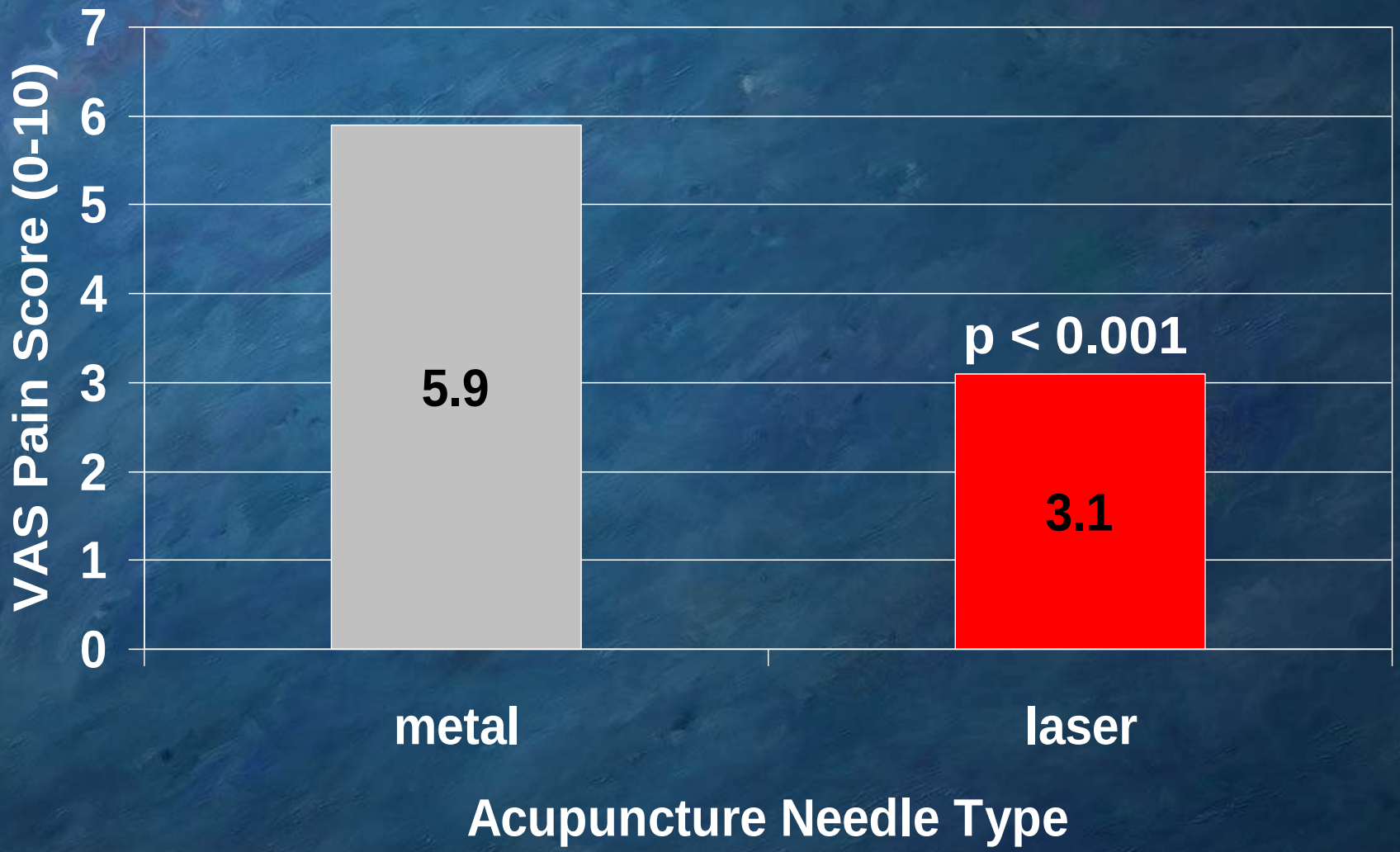
Knee Point Selections

Muscle Trigger Point	Corresponding Acupoint	Nerve Affected
vastus medialis	SP-10	femoral nerve, medial retinacular nerve
medial gastrocnemius	KI-10	saphenous nerve
vastus lateralis	ST-34	lateral femoral cutaneous nerve
lateral gastrocnemius	BL-39	common peroneal nerve, lateral retinacular nerve
peroneus longus	GB-34	common peroneal nerve
n/a	infrapatellar point	branch of saphenous nerve

Knee Point Selections

Acupoint	Actions	Indications
SP-10	“sea of blood”, dispels stasis	medial thigh pain
KI-10	He sea point on Kidney channel, activates channel, alleviates pain	knee disorders, medial thigh pain
ST-34	Xi cleft point on Stomach channel, activates the channel, alleviates pain	knee disorders
BL-39	Lower He sea point on Triple Energizer channel, activates channel, relieves pain	leg muscle cramp or paralysis
GB-34	Hui point for tendons and muscles, He sea point on Gallbladder channel, activates channel, relieves pain, benefits the joints	leg pain, knee disorders

Results: Knee & Shoulder Arthritis



Overall Results

- laser treatment preferred by 90% of subjects with knee & shoulder arthritis pain compared to treatment with metal needles
- no complications from the laser treatments
- treatment response lasted 5-21 days (mean >17 days)

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