

**The Place for Regenerative  
Medicine in Lifecare Plans**

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**Disclosures**

Nothing to disclose

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Physical Medicine and Rehabilitation  
Board Certifications: PM&R, Brain Injury Medicine  
Private Practice  
Forensic work 10 years  
Teach Interventional Regenerative Ortho. Med.  
Trained with Dr. Pascual Leon Non-inv. Brain Stim.

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**Physiatry**

Focus on Quality of Life and Functional Independence

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**Regenerative Medicine**

NIH: "Regenerative medicine is the process of creating living, functional tissues to repair or replace tissue...lost due to age, disease, damage, or congenital defects. This field holds the promise of regenerating damaged tissues...by stimulating previously irreparable organs to heal themselves...."

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**Regenerative Medicine**

Nature: "Regenerative medicine is the branch of medicine that develops methods to regrow, repair or replace damaged or diseased cells, organs or tissues."

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**S** Two tools I use clinically

Prolotherapy (prolo) Platelet Rich Plasma (PRP)

Repetitive Transcranial Magnetic Stimulation (rTMS)

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**S** History

Hippocrates  
Cauterize unstable joints






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**S** History

"Prolotherapy"






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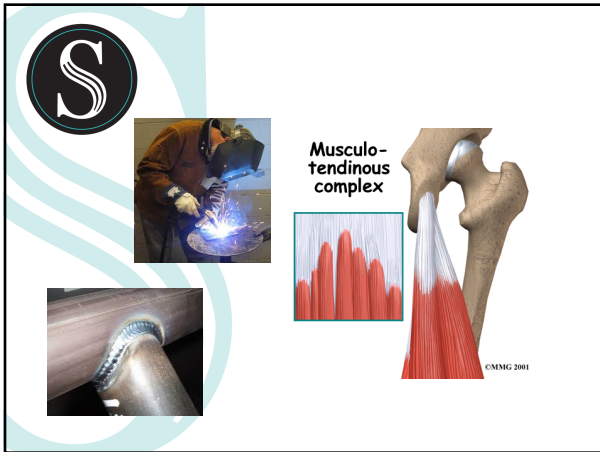
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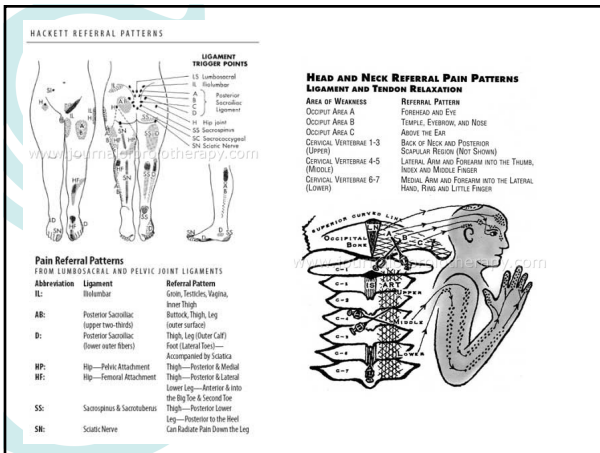
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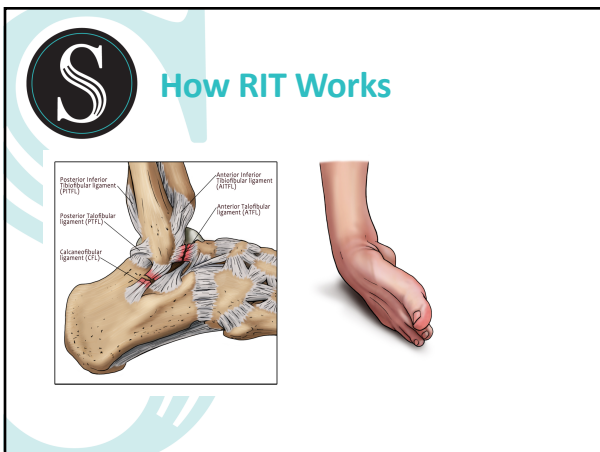
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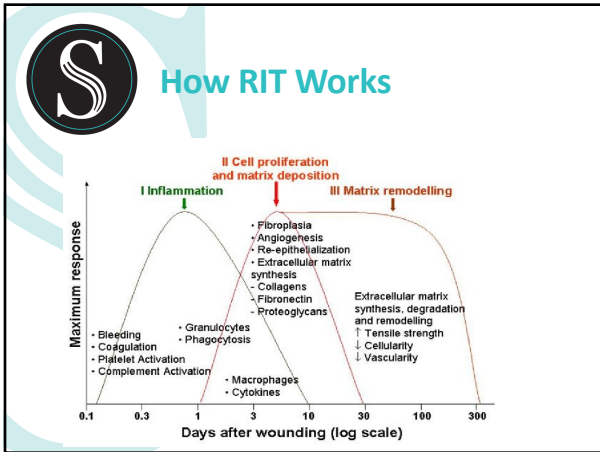
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<u>Prolotherapy</u>	<u>Platelet Rich Plasma</u>
-15-25% Dextrose/Lido	-60 cc autologous blood
-Historically phenol or other solutions	-Processed in centrifuge
	-5cc 1,000,000 platelets/dl

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**S** **How RIT Works**

- Careful history and physical examination
- Discomfort during injection
- 24-72 hours increased "soreness"
- Limit sports for a few days
- No anti-inflammatories



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**S** **What Can RIT Treat?**

Neck pain	Elbow pain
Mid-back pain	TMJ pain
Low back pain	Head ache pain
Hip pain	Whiplash
Knee pain	"All the ills that flesh is heir to.." (Shakespeare)
Foot pain	NOT REALLY
Shoulder pain	

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**S** **Risk vs Benefit**

Risks  
 Usual risks for injections (bleeding, infection, etc...)  
 Documented adverse events are VERY rare in RIT

Benefits  
 Well tolerated  
 Good safety record  
 Great addition to conservative care options  
 No deleterious effects if surgery needed later  
 Utilizes the body's own healing responses (DNA as guide)

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**S Strengths and Weaknesses**

Pros  
 Safe  
 Well-tolerated  
 May be alternative to surgery

Cons  
 First days after injections can be painful (PRP++)  
 Cannot use NSAID's  
 Smokers do not respond as well  
 Not covered by insurance  
 Requires multiple injections




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**S Is RIT/IROM "Experimental"?**

U.S. Preventative Service Task Force Basic Classification of Evidence

- Level I: Well designed RCT (s) with clinical and statistically significant evidence.
- Level II: Well designed: II-1 Controlled trials without randomization. Controlled treatment comparison studies. II-2 Cohort (delayed Rx) studies from more than one center. II-3 Uncontrolled trial with dramatic result. Uncontrolled trial with blindable objective outcome measure.
- Level III. Substantially flawed RCTs or other controlled studies. Single well designed cohort or case control study.

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**S U.S. Preventative Services Taskforce Recommendations for When Doctors Should Discuss a Treatment.**

- Good evidence Benefit > Risk  
 Level I evidence and minimal risk
- Fair evidence Benefit > Risk  
 Level II evidence and minimal risk

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**S**

Although Further Research is Needed, Prolotherapy is NOT Experimental

- It is taught as an acceptable method procedure by one or more approved post graduate programs for the healing arts
- It is based upon sufficient learned publications supporting the safety and efficacy? (Level II or higher in multiple areas)

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**S**

- Dextrose Prolotherapy has 4 areas of level I evidence (Knee OA, OSD, Finger OA, and Lateral Epicondylitis), and 5 additional areas of level II evidence (SI joint pain, Low Back Pain, Achilles Tendinitis, Groin Pain, and ACL laxity).

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**Anterior-medial Knee**

- Medial Coronal ligaments
- MCL
- Pes anserine insertion
- ACL
- Medial Patellar ligaments
- Patellar tendon origin / insertion




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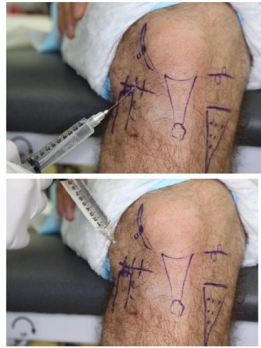
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## Coronal ligaments

- Located superficial to the meniscus and originate and insert along the joint line
- May help stabilize small or degenerative meniscal tears



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## Anterior-lateral Knee

- Gerdy's tubercle
- LCL
- Fibular head ligaments
- Lateral coronal ligaments
- Lateral Patellar ligaments



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## Pes Ansurine Bursa

- Laxity / pain often accompanies knee OA
- Tender to inject
- Large upside down delta shape
- Insertion of semimembranous, semitendinous and gracilis tendons



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### Gerdy's tubricle

- Insertion of ITB
- Inserts in this entire vicinity
- In ITB syndrome, pain at area of tendonopathy in the ITB where it crosses over the lateral femoral condyle



The image contains two parts. On the left is an anatomical diagram of the knee joint showing the iliotibial band (ITB) crossing over the lateral femoral condyle. A yellow arrow points to this specific area. On the right is a clinical photograph of a person's knee with purple ink markings and a yellow arrow pointing to the same anatomical location.

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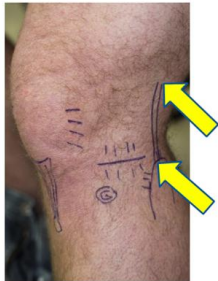
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### Lateral Collateral Ligament

- Origin at lateral femoral condyle
- Insertion onto posterior proximal fibular head
- Inject origin and insertion and points along the ligament



A clinical photograph of a knee joint with purple ink markings. Two yellow arrows point to the origin of the lateral collateral ligament on the lateral femoral condyle and its insertion on the posterior proximal fibular head.

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### Patellar tendon

- Tendonopathy tears more pronounced at the tendon origin and proximal tendon
- Osgood-Slaughters affected at insertion



The image contains three parts. At the top right is an anatomical diagram of the patellar tendon. Below it are two clinical photographs. The one on the left shows a person's knee with purple ink markings and a red arrow pointing to the proximal tendon. The one on the right shows a person's knee with purple ink markings and a yellow arrow pointing to the distal tendon near the tibial tuberosity.

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**S** **Transcranial Magnetic Stimulation (TMS)**

Focal electromagnetic impulse produces weak electric currents in neural tissue by electromagnetic induction.

Causes acute and (in some cases) longer lasting physiologic effects.

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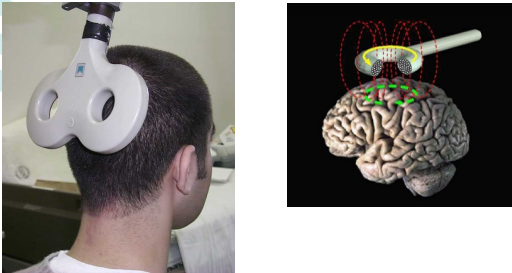
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**S** **TMS**



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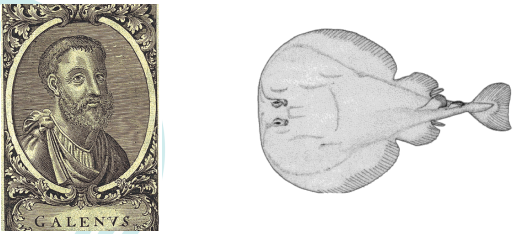
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**S** **Ancient History**

Claudius Galen and the Torpedo Ray



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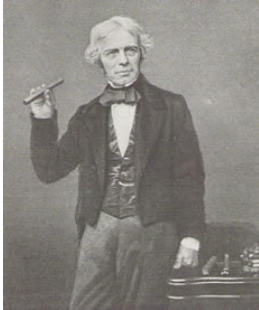
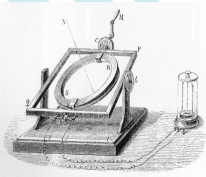
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**S** TMS Physics 101

Farraday and electromagnetic induction



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**S** TMS Physics 101 a la 1896  
(Kids, don't try this at home!)



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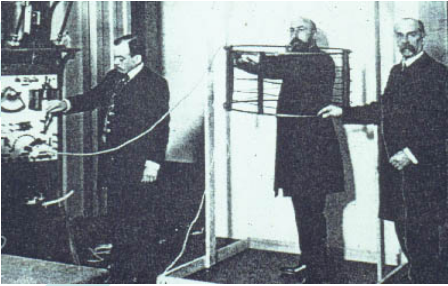
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**S** TMS Physics 101



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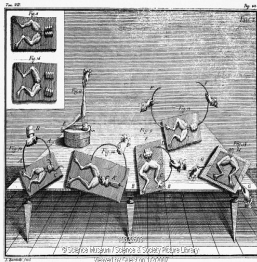
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**S Physiology 101**

- Kolin et al. (1959)  
Sciatic n. with electromag.
- Bickford (1965)  
Peripheral n. stim with electromagnet
- Barker (1985)  
Peripheral n. stim, then ADM stim via motor cortex



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**S How TMS works**

Electric current → magnetic field → electric field → depolarization of neurons via electromagnetic induction

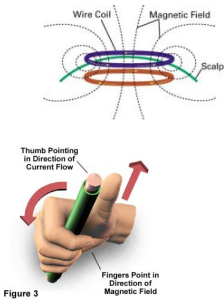


Figure 3

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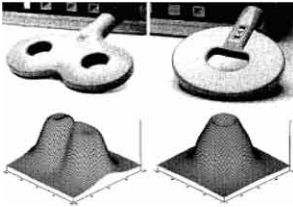
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**S How TMS works**

Coil placed on the head or over a peripheral nerve



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**S** **How TMS works**

Coil is placed over primary motor cortex  
Monitoring with surface EMG, sub-threshold levels are normally used.

The diagram shows two lateral views of the human brain. The left view is labeled 'sensor. Cortex' and includes areas like 'Gehirn', 'Kleinhirn', 'Lippchen', 'Zunge', 'Nachen', and 'Langeweile'. The right view is labeled 'motor. Cortex' and includes areas like 'Lippchen', 'Nachen', 'Zunge', and 'Langeweile'.

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**S** **TMS Variables**

- Single pulse vs. paired pulse vs. rTMS
- Coils
- Intensity, duration, frequency

The first photograph shows a person wearing a blue TMS coil on their head. The second photograph shows a person using a TMS coil on their hand.

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**S**

Affected hemisphere  
• Decreased excitability

Unaffected hemisphere  
• Increased excitability

Solution 1: increase activity in the lesioned hemisphere

Solution 2: decrease activity in the healthy hemisphere

Options:

- Excitatory high-frequency rTMS
- Anodal tDCS

Options:

- Inhibitory low-frequency 1 Hz rTMS
- Cathodal tDCS

Increased transcallosal inhibition

The diagram shows a cross-section of the brain with a dashed vertical line separating the 'Affected hemisphere' (left) and 'Unaffected hemisphere' (right). A blue arrow points down from the affected hemisphere, and a red arrow points up from the unaffected hemisphere. A yellow arrow points from the unaffected hemisphere to the affected hemisphere, labeled 'Increased transcallosal inhibition'. Two colored spheres (blue and red) are shown on the brain's surface.

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**S** Risks Associated with TMS

- Seizures
- Neuropsych variables
- Contraindications



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**S** Uses for TMS and tDCS

Central Neuromodulation=> BALANCE!

- Neurology
- Psychiatry
- Pain
- Neurorehabilitation



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**S**

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