Appendix A: Post-Operative Knee Modalities

Focal Joint Cooling and Transcutaneous Nerve Stimulation

Altered afferent information (information coming from the knee back to the spinal cord) caused by knee joint injury or surgery causes a drastic reduction in quadricep activation. This reflexive inhibition, known as Arthrogenic Muscle Inhibition (AMI), leads to a reduction in motor neuron recruitment and availability. Focal joint cooling and Transcutaneous Nerve Stimulation (TENS) have been shown to reduce this inhibition by decreasing/interrupting inhibitory signals to the spinal cord and are thus thought to be disinhibitory modalities.[1]

When

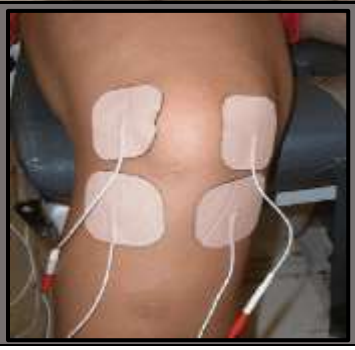
Cryotherapy and TENS temporarily reduce inhibition for approximately 45 minutes, which can improve motor unit recruitment to improve efficacy of traditional interventions.[2]

Cryotherapy should be applied *before* exercise for 20-30 min.
TENS can be performed *prior to or during* exercise for 20 min.

How

Cryotherapy: Apply locally to the knee using ice bags or sleeves. Ideally, care should be taken to not cool the quadriceps directly.

TENS: Applied with high-frequency settings (120-150 Hz) and applied directly to the knee joint.



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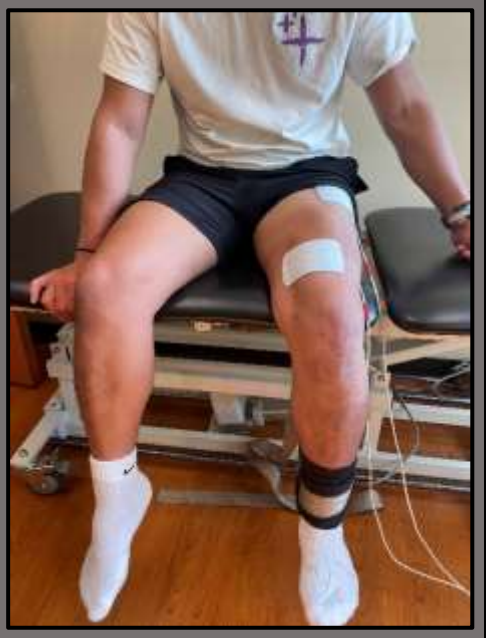
Appendix A: Post-Operative Knee Modalities

Neuromuscular Electrical Stimulation

Use of Neuromuscular Electrical Stimulation (NMES) is recommended following knee joint surgery due to its ability to overcome impaired voluntary muscle activation. High intensity NMES, in combination with traditional strength training, has abundant evidence for improving the restoration of quadricep strength after knee injuries.[1]

Setup	Electrodes: Proximal lateral quadriceps and medial distal quadriceps. Large (3"x5") electrodes improve both patient comfort as well as recruit a higher number of motor units and thus are highly recommended. Stimulation can be performed in a variety of positions, but to maximize motor recruitment should be performed *isometrically at 60-90 degrees of knee flexion.*	
Parameters	**Mode**: Biphasic OR "Russian Stimulation" **Pulse Width (Biphasic):** >400 microseconds **Frequency**: 50-75 pulses / second (Biphasic) OR 60-75 pulses/second (Russian). **On/Off:** 10s on, 30-50s off, 2 second ramp **Intensity:** M*aximum tolerated dosage. G*oal of achieving at least 50% MVIC. Intensity can be serially measured via isometric dynamometry if available.	

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Appendix A: Post-Operative Knee Modalities

Blood Flow Restriction Training

Blood Flow Restriction (BFR) has been shown to improve muscle hypertrophy and strength with low load resistance training. In short, vascular occlusion creates an ischemic and hypoxic environment which induces metabolic stress and greater motor unit recruitment due to peripheral fatigue. BFR has been demonstrated to be a useful tool in rehabilitation where traditional high-load resistance training is contraindicated due to pain, effusion, or specific biological tissue concerns.

Safety	Use of BFR does not appear to increase risk of adverse events compared to traditional exercise. However, care should be taken to ensure the patient has no personal or specific medical contraindications to BFR (see references).
Cuff Parameters	**Location:** Most proximal part of exercising limb **Pressure:** 60-80% of limb occlusion pression (LOP) **Type:** Static or dynamic (auto-regulated) cuff systems
Exercise Parameters	**Intensity:** 20-40% of 1-repetition Maximum (1RM) * **Sets**: 2-5 / exercise **Reps:** 45-75 total / exercise **Rest:** 30-60 seconds **Effort:** Should approach fatigue / near concentric failure **Most Common:** 1 set of 30 followed by 3 sets of 15 @20-40% 1RM *As obtaining a true 1RM may be contraindicated, an alternative option is to select a weight in which at least 20 repetitions, but no more than 40-50, can be performed in the first set

References

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