



SomaTx Design Inc.

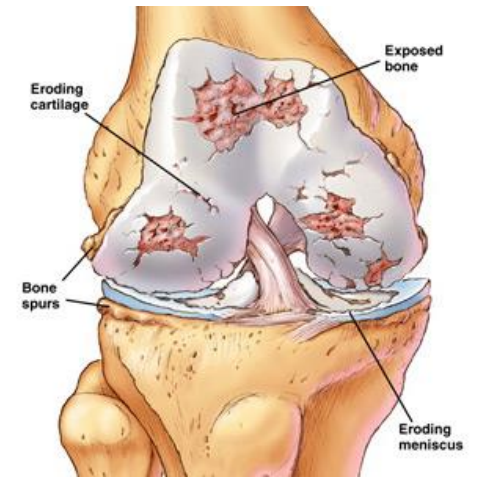
Need/Potential Market



- **Arthritis** → leading cause of disability among older adults in the US
 - Osteoarthritis (OA) is the most common form of arthritis
- Osteoarthritis affects approximately 27 million individuals in the US.
- Knee OA affects nearly 40% of US adults over the age of 60 and 80% of all adults suffer from symptoms by 75.
- OA is a disease of the entire joint involving the cartilage, joint lining, and underlying bone. Breakdown of these tissues leads to pain and joint stiffness.
- Approximately 50% of ACL reconstructed patients develop rapidly progressive OA 10–15 years after injury.
- **ACL injury**- 200K Americans suffer from ACL injuries each year.

OA Cure/Intervention?

- Currently no cure for OA
- **Pharmaceuticals** for pain management are available but *do not address* underlying causes of the disease and have numerous side effects.
- **Non-Pharmaceutical options:**
 - Reduced muscle function- observed in individuals with knee OA and knee injury.
 - Restoration of muscle function offers a potential target to mitigate the risk for developing OA.
 - Restoring ambulatory muscle function in patients has been met with limited success with conventional methods such as exercise and physical therapy.



<http://hip-knee.com/en/knee/knee-disease/knee-osteoarthritis>

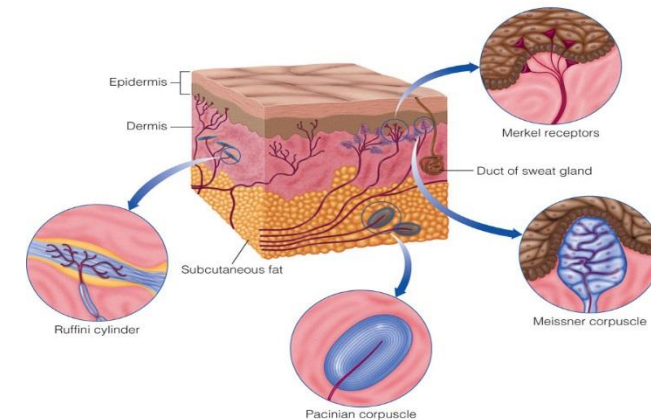
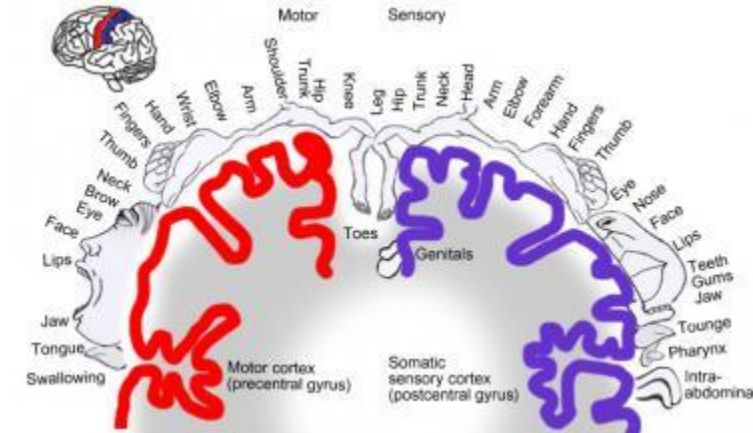
There remains a need to mitigate the risk of developing OA using new approaches to restore normal patterns of muscle activation during ambulation.

Underlying Scientific Principles

Novel Approach to Restore Muscle Function

Somatosensory System

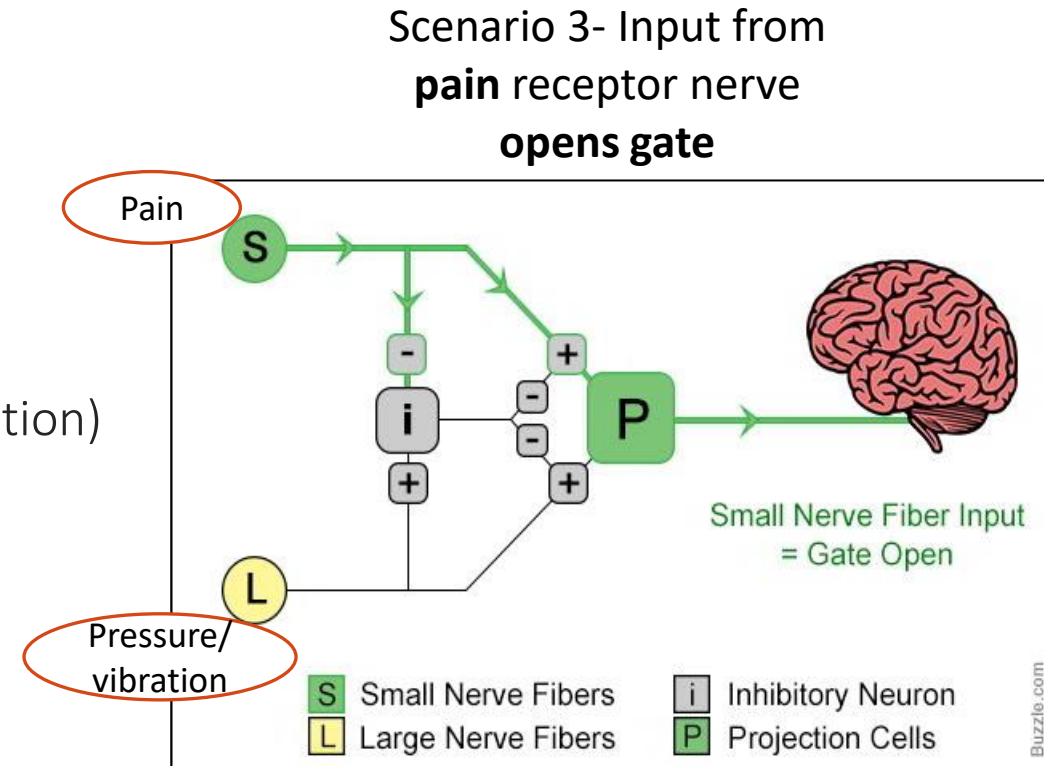
- The cross modal plasticity of the somatosensory system with common sensory pathways including pain, pressure and vibration offers a novel opportunity to enhance quadriceps function during walking.
- The proposed intervention is designed to activate the mechanoreceptors of the somatosensory system to respond to a mechanical stimulus causing a functional response.
- Common sensory pathways- over stimulation in one mode of the system can gate response in other modalities.



Gate Control Theory: Pain and Sensory Pathways

Pain Relief through neural mechanism

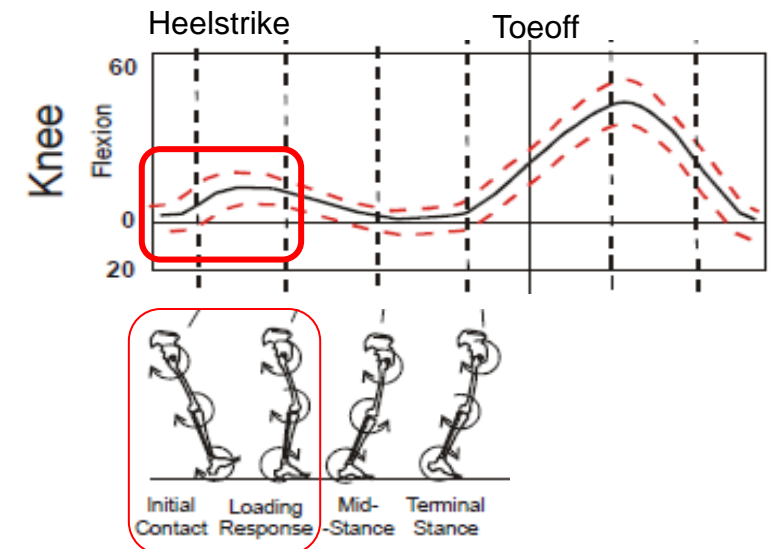
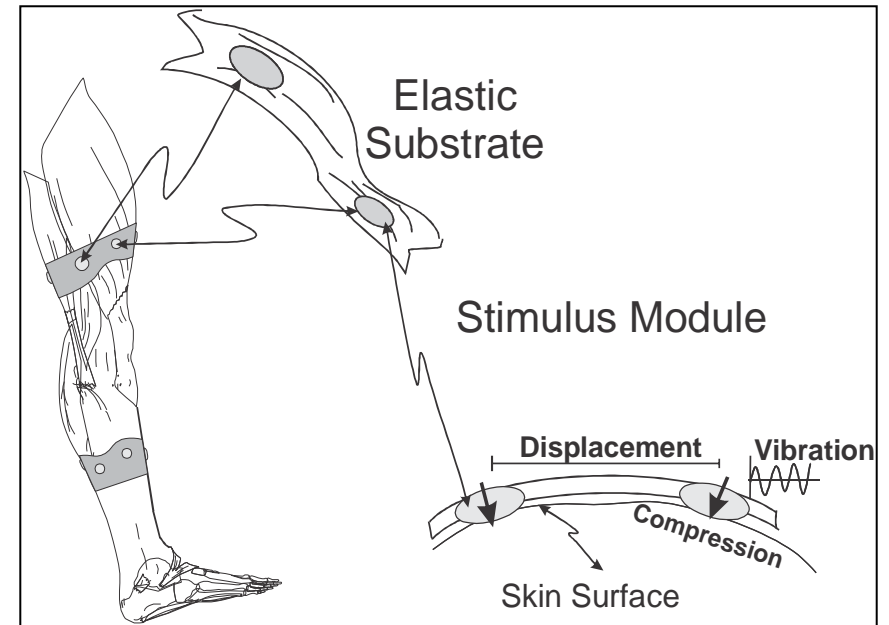
- Interaction between pain receptors and mechanoreceptors.
 - Nerve fibers:
 - Large fibers- sensory neural pathways (touch, pressure, vibration)
 - Small fibers- pain pathways
- Both types carry information from site to the spinal cord.



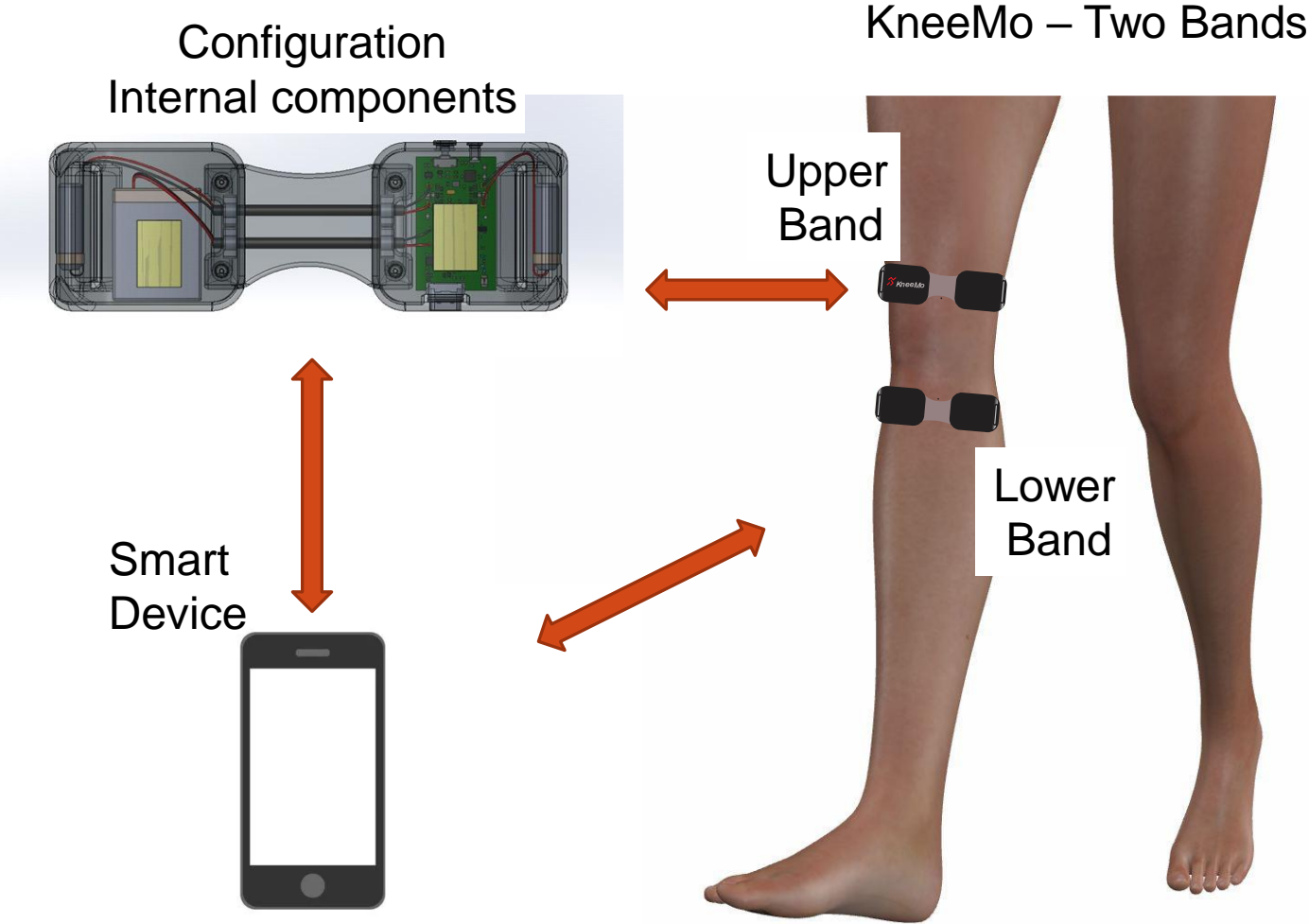
→ Over-stimulation in one mode of the system (**vibration**) can gate response in other modalities (pain)

KneeMo

- An inexpensive wearable device that can be worn daily and offer an alternative to current treatments for deficient muscle activation.
- Can be used independently and/or as an addition to physical therapy.
- The intervention consisted of 2 elastic straps with strategically placed stimulus modules.
- Straps are applied tightly around the lower-thigh and the upper-shank applying static pressure
- Stimulus modules apply active vibration to the surface of the skin and are equipped with IMUs, ensuring that the intermittent stimulus is applied from heel strike to mid-stance.

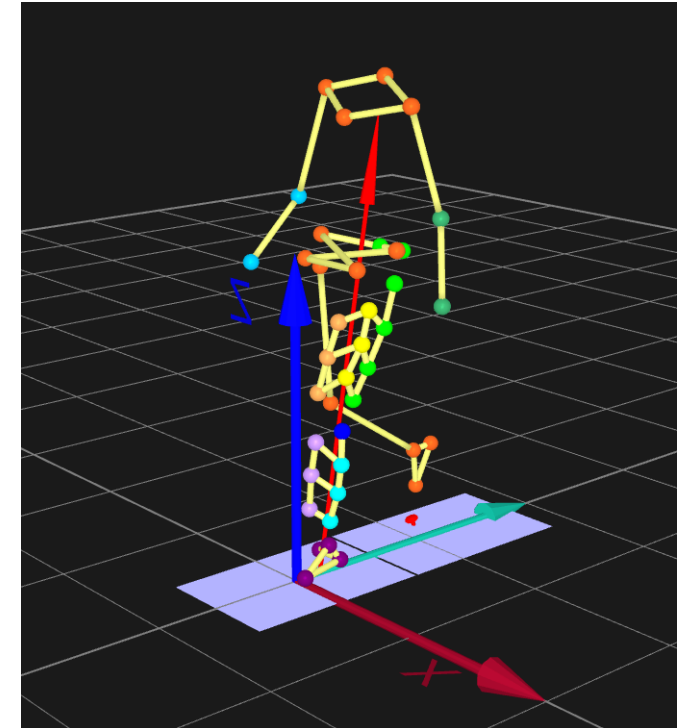
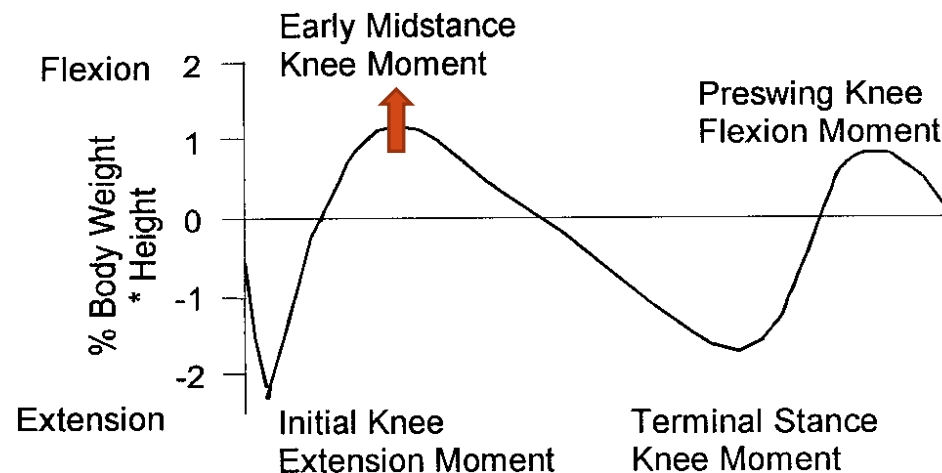


KneeMo



Proof of Concept Testing- Confirm Design Principle

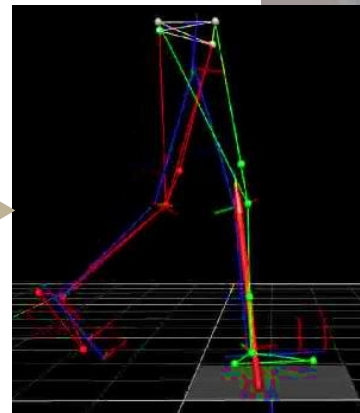
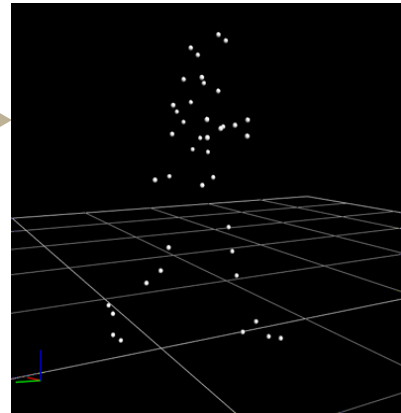
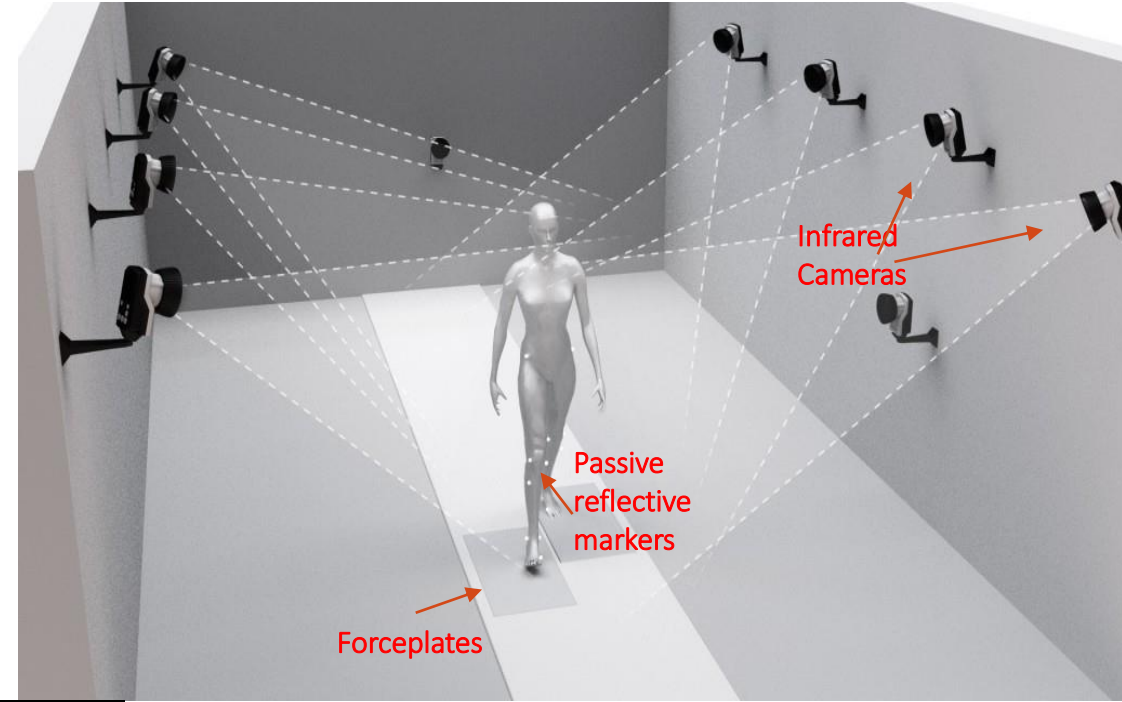
- Effects on gait
 - Single test session to determine immediate effects of initial prototype on muscle function (via knee flexion moments)
 - Knee Flexion Moment \rightarrow Moment about the knee that tends to flex the knee joint
 - \uparrow Knee Flexion Moment \rightarrow \uparrow Quadriceps use



Motion Capture Analysis

Gait Laboratory

- A 3D optoelectronic system and multi component force plate are used to capture gait kinematics (joint angles) and kinetics (joint forces and moments).

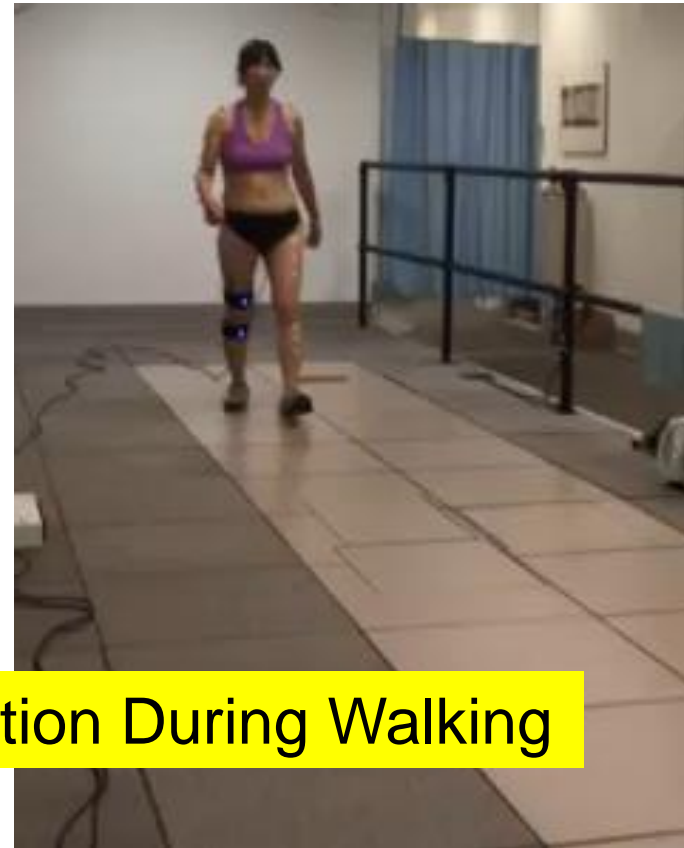


Results- walking videos (fast walking)



Control

KFM= 2.083 %Bw*Ht

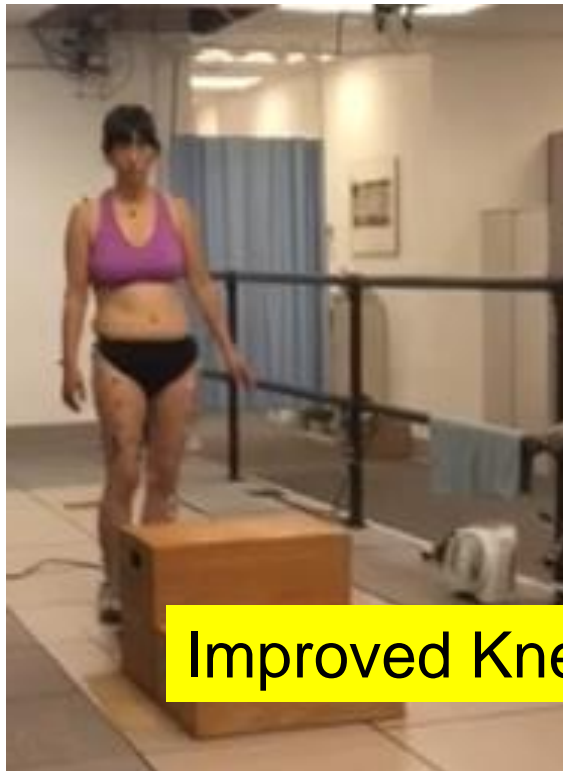


With KneeMo

KFM= 2.899 %Bw*Ht

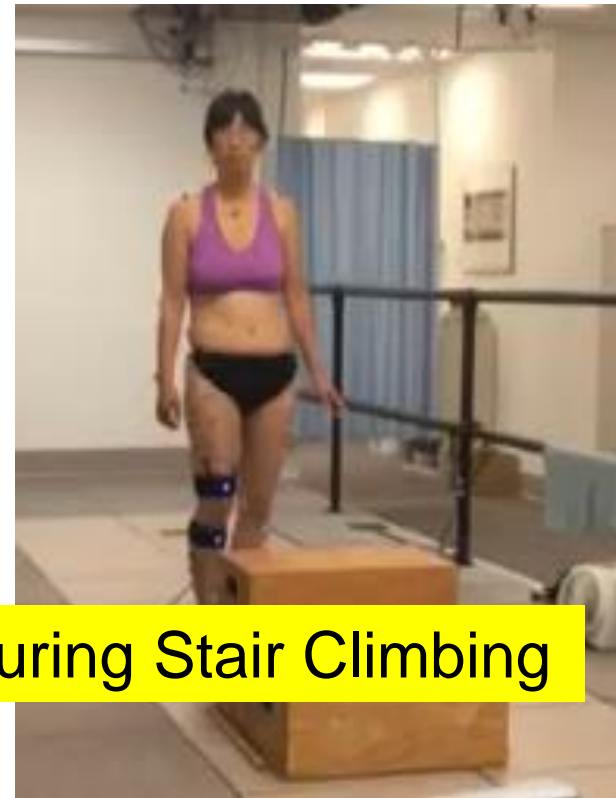
Improved Knee Function During Walking

Results- stair ascent videos



Normal Control

KFM= 2.984 %Bw*Ht



With KneeMo

KFM= 4.575 %Bw*Ht

Improved Knee Function During Stair Climbing

The efficacy of KneeMo[®] was proven in a registered clinical trial^{1,2,3}.

- ¹AG Fischer, JC Erhart-Hledik, JL Asay, CR Chu, TP Andriacchi, Utilizing the somatosensory system via vibratory stimulation to mitigate knee pain during walking: Randomized clinical trial Gait & Posture 80, 37-43, 2020.

- ²AG Fischer, JC Erhart-Hledik, JL Asay, CR Chu, TP Andriacchi, Activating the somatosensory system enhances knee flexion and quadriceps activity during gait and stair climbing, Osteoarthritis and Cartilage 27, S63-S64, 2019.

- ³AG Fischer, JC Erhart-Hledik, JL Asay, CR Chu, TP Andriacchi, Utilizing the somatosensory system via vibratory stimulation to mitigate knee pain during walking: Randomized clinical trial Gait & Posture 80, 37-43, 2020.

THANK YOU!