Kinematics and Kinetics of Regenerative Rehabilitation

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Quantify Regenerative Rehabilitation

• Regenerate Tissues, what constitutes success?
  – Grow tissue, insert without rejection
  – Muscle - Function
    • Force production at tetanus
    • Ability to complete task
    • Quality of function
Movement Analysis

- How do interventions effect human movement
  - Clinical
    - Pre post surgery
    - Efficacy of interventions
Quantifying the Impact of TA VML injuries on Rat Gait

• Function assessment of pathologic gait due to VML

• Develop method for motion analysis on rats, Models

• Quantify changes in rat kinematics and kinetics
  – Initial effect of VML
  – Effect of regenerative intervention
  – Temporal recovery rate

• Test Rehab strategies
Model

- Developed in OpenSim environment
- Based on model developed by Johnson (JOB 41(3) 2008)
- Kinematics and Kinetics
- Qualitative differences
Kinematics

- Typical Results Normal
- Average of multiple sessions, over 12 weeks
Kinematics

- Consistent with typical kinematics of drop foot
  - Hip
    - Decreased Flexion, ROM
    - Increased Abduction
    - Increased External Rot
  - Knee
    - Decreased peak flexion
  - Ankle
    - Increased Plantar pre-swing
    - Decreased Dorsi in swing
- Largest differences at push-off to heel strike
Kinematics

- Similar results with extended Time
- Trend toward baseline at 12 week post surgery
- Pre/Post able to quantify differences in rat kinematics
- Quantify recovery post
• Instrument walkway to measure GRF, develop kinetic model

• Track changes in Gait with increased recovery time

• Repair VML with regenerated material

• Quantify VML size on loss of function vs max force

• Investigate injury size, shape with function
Assistive Devices in Rehab

Work

Support
Assistive Devices in Rehab
Moving Forward

Combination of Motion Analysis and computational modeling together offer powerful tools to help measure out success and develop best standard of care to expedite and maximize recovery.
Identifying Optimal Design Criteria for Muscle Tissue Regeneration
Computational Modeling as a Tool for Assessing Muscle Tissue Engineering Strategies

A

B
Intact LD
Injured LD
Passively/Actively Repaired LD

C
Insertion to humerus
Origin from spine

Native LD Tissue
Regenerated Tissue
Thank You