Kinematics and Kinetics of Regenerative Rehabilitation

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Ortho Research Retreat



Charlottesville, VA

Quantify Regenerative Rehabilitation

- Regenerate Tissues, what constitutes success?
 - Grow tissue, insert without rejection
 - Muscle Function
 - Force production at tetanus
 - Ability to complete
 - 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



Baseline



1 Week Post

<u>Model</u>

- 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





<u>Next</u>

- 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









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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



Thank You