REHABILITATION ROBOTICS

Team Science
Designing the Future

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What is a Robot?

A device that automatically performs complicated often repetitive tasks; a mechanism guided by automatic controls.
In 2031, 100% of rehabilitation publications will use a robot.
Types of Robots

- Prosthetic Limbs
- Mobility Units
- Powered Orthotics
- Environmental Control/Manipulation Units
- Therapy Assist Devices
- Brain Computer Interface
Rehabilitation Robotics Cluster Hire

HUMAN

MECHANGERONICS
(Mechanical Engineering)

BIOMECHANICS
(Kinesiology)

mechanical transfer

MACHINE

HUMAN-COMPUTER
INTERFACES
(Biomedical Engineering)

electrical transfer

CLINICAL RESEARCH
(Physical Medicine & Rehabilitation)
Clinician helps define clinical need for better orthotic

Mechatronics designs the components for a new orthotic that works with feedback

Bioengineer develops ways to improve feedback mechanisms to provide data to orthotic

Kinesiologist gives input on design based on biomechanical principles, and tests biomechanic output

Clinician evaluates changes in function with new device

...and everyone give input at every phase of the project
Lokomat Training for Ambulation

- Weight supported Treadmill
- Single therapist
- Variation of program based on child’s own abilities
- Varies weightbearing
Lokomat Results

- Improved Gait speed
- Increased endurance
- Higher scores on GMFM D and E
- Correlated with amount of training
- Some maintenance over time
- Some adverse effects
  - Muscle soreness, skin abrasion in up to 30%
- Greater effect for GMFCS I-II
Improved Kinematics (Patritti et al)

- Decreased double support phase
- Improved stride length
- Decreased ankle dorsiflexion in stance (decreased crouch)
Spasticity

- Lokomat measures muscle stiffness
  - Calculates torque at different movement speeds
- Tone reduction noted after single training session
  - Not measured over time
Upper Extremity Robotic Therapy

- Emphasizes repetition
- Children enjoy sessions, highly motivated
- Targeted movements with robotic assistance
- Provides visual feedback
- Offers games during breaks
CP study

- 12 subjects
- Improved QUEST
  - Dissoc. Movements
  - Wt Bearing
  - Total
- Fugl-Meyer score improved
- MAS went down
- Positive results 1 month r/u
Benefits patients with lower MACS level, ROM

Less therapist intensive

For both, less involved patients have better outcome

Current protocol seemed best combined with outside RX
Cyberdyne
MIT
Argo Medical Technologies
Tibion
Berkeley Bionics
U Michigan

The Exoskeletons Are Here

Raytheon
U Illinois
Laval U
Honda
Honda
The Robotic Orthosis Lokomat

Institute of Automatic Control ETHZ
+ University Clinic Balgrist
+ Hocoma GmbH
Powered Orthoses
Direct Brain Interface

- EEG signals control system
- Works computer
- Can control W/C, ECU
- Currently slow, trying to improve scanning and speed
Robotic Power Mobility

- Crash avoidance
- Route Planning/Path Guidance
- Direct Brain Interface
Feeding robot

- Consistent presentation of food
- Feeding did not go as well as with hand feeding.
What can they do?

- As well as we do now
  - Consistency
  - Dependability
  - Cost Effective
- Better than we do now
  - Adding to quality of life
  - Improving therapy effectiveness
  - Making rehabilitation more available