# Cyclocentric Ergometer: A new concept in exercise

David A. Brown, PT, PhD

Assistant Professor

Department of Physical Therapy and Human Movement Sciences and Physical Medicine and Rehabilitation

Feinberg School of Medicine, Northwestern University

Chicago, IL

Consultant to Biodex Medical Systems, Inc

# Biodex Cyclocentric™ Semi-Recumbent Cycle

- Designed as a
  - Graded weight-bearing and limb-loading exercise within a functional locomotor context

# What is cyclocentric exercise?

- Limb loaded cycling through 100% of the pedal cycle
  - Feels like riding a bike standing up
- Forces muscles of both extremities to be firing either concentrically or eccentrically throughout 100% of the pedal cycle

## Origins

**1996 : TiltCycle**

- VA Rehabilitation Research and Development Center, Palo Alto, California
  - Modified ergometer fixed to a tilt table that allows patients to pedal in a variety of inclinations from supine to upright. Resistance based on gravity
    - Pre-ambulation strengthening and assessment

**1998: Biodex licensed the technology**

Biodex decided to develop the concept using a semi-recumbent ergometer as the platform

# Development

- First generation Semi Recumbent Cyclocentric Ergometer
  - 1998 : Biodex built a prototype to do comparative research of cyclocentric cycle with traditional therapies.

## Clinical Advantages of using a Cycle Ergometer platform

- Stable and comfortable postural support
- Basic associated technologies are readily available
- Constrained trajectory
- Workload regulation
- Speed regulation
- Limb-loading capability
- Tractable biomechanical analyses

- There are scientific rationale for using a cycle ergometer as an evaluation and intervention tool for locomotor disability post-stroke.
- There is clinical evidence to support cycle ergometry as an evaluation & intervention tool to restore functional locomotion post-stroke

## Evolved into first commercial version (under revision)

- Patented tension cord system
- Step through design
- Use as a cyclocentric or traditional semi-recumbent ergometer

# Method

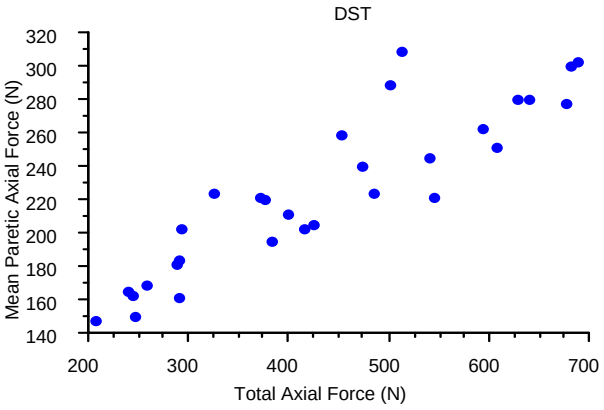
- By allowing a seat that is “spring” loaded in the forward direction to glide forward and backward during pedaling.
- During the actual pedaling the cyclist is challenged to match the set tension with opposing muscle groups.
- When accomplished the seat will remain in the neutral position

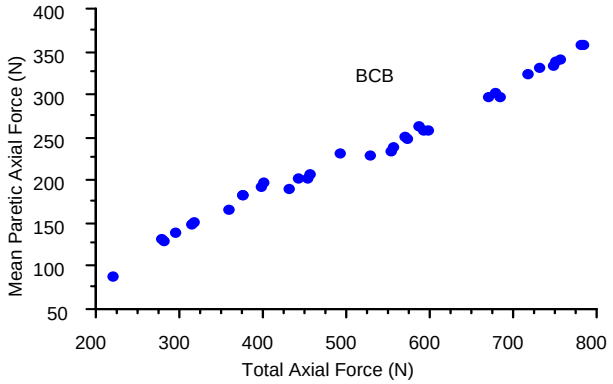
# Biomechanical and Neurological Effects

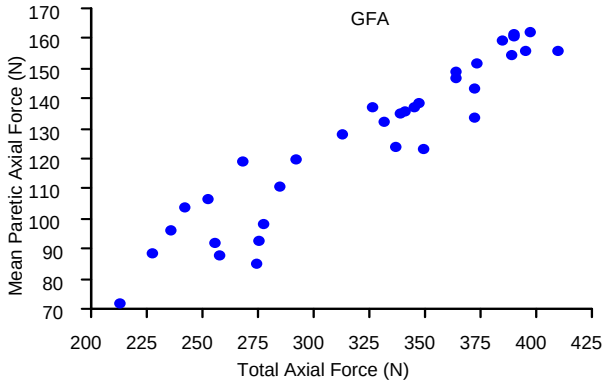
- Biomechanics
  - Graded force with equal loading of both legs
  - Consecutive concentric/eccentric activation of the extensors and flexors
- Neurological Control
  - Enhanced Proprioception
  - Enhanced repetition and practice

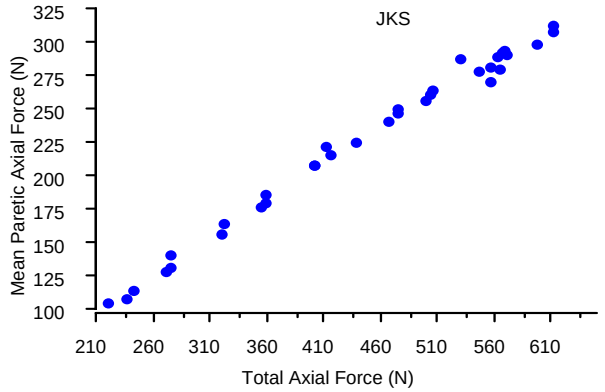
# Graded, equal limb loading - axial forces

- Increase load of bungee cords- paretic leg generates increased forces.
- If you want to strengthen the paretic leg increase the cord level until they cannot support the load.
- This is not possible on regular bicycle.



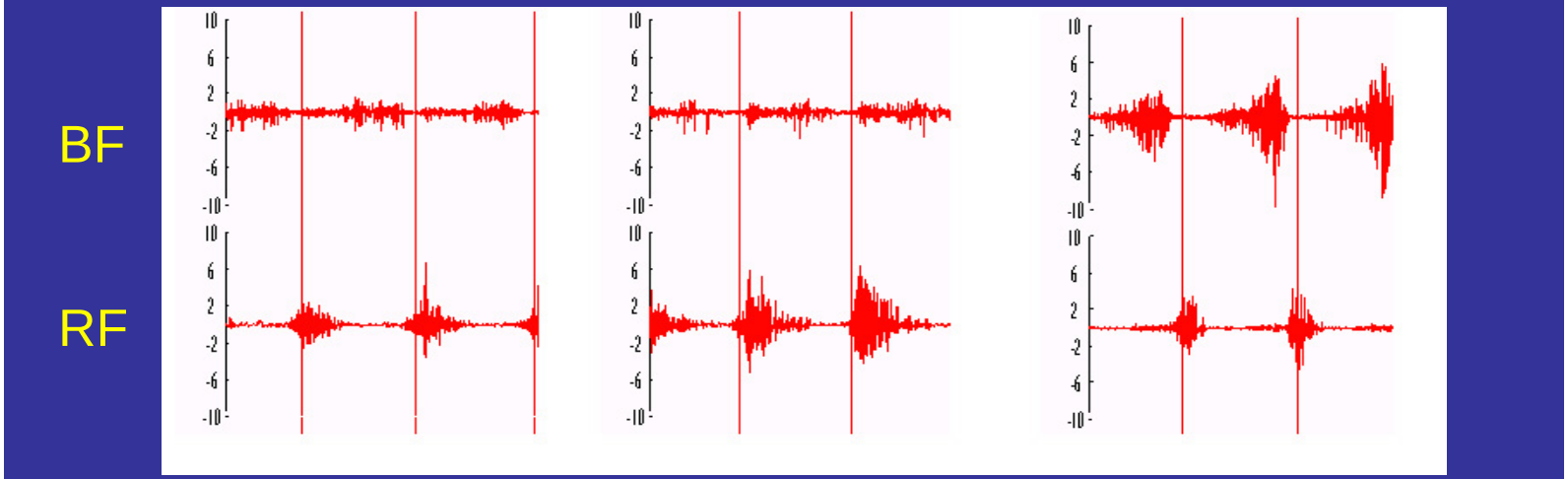



## What is happening with the muscles?

Muscles of the lower extremity are “on” either concentrically or eccentrically at all times.

BF = biceps femoris = flexors = HS  RF = rectus femoris = extensors = Quads

**Consecutive concentric/eccentric activation of extensors or flexors**



# What is happening at the joint

- The joint is stabilized as a result of increased proprioception and the co-contraction between the Quads (RF) and the Hamstrings (BF)

# What are the biomechanical and neurological benefits

- Improvement in Bi-lateral symmetry in terms of muscular force production and timing
- Enhanced neurological control
- Increase joint stability
- Concentration on strength, power, speed and timing – all functional necessities

# Therapeutic benefits

- Task is totally driven by user
- Fine control of load progression
- Positional feedback available
- Specificity of training in terms of:
  - Phasic versus tonic muscle activation
  - Strength versus endurance
- Carry over to functional walking

# Current Clinical Research


Foundation for Physical Therapy

- PTClinResNet  $1.5M 3 yr clinical study to access effects of strength-training exercise designed for muscle performance and movement skills in people with physical disabilities

# STEPS

## Strength Training Efficacy Post-Stroke

- **USC, Rancho Los Amigos, Northwestern**

Lead Investigator: Dave Brown, PhD PT

The STEPS project will determine if functional outcomes, primarily gait speed, are improved with: strength training as an adjunct to body weight supported treadmill training; locomotor-based strength training compared with muscle specific strength training; and locomotor-based strength training compared with body weight supported treadmill training. Biodex Cyclocentric Ergometer is an integral training device

# PEDALS

## Pediatric endurance development and limb strengthening

- **Southwest Missouri, UCLA**

Lead Investigator: Eileen Fowler, PhD PT

Children with Cerebral Palsy can use cycling as an activity that not only allows them to participate in family and social activities, it is a means of providing mobility and independence. Dr. Fowler and her team of investigators will be analyzing the outcomes of the cycling intervention using the Biodex Cyclocentric cycle on strength, cardiorespiratory endurance during walking, gross motor functional performance, perception of change in activities of daily living, sport, and play activities, health related quality of life and measures of gait performance

# What is the preferred protocol?

- **Overview**
  - 10 training sessions (approximately 20 minutes of exercise)
  - 10 sets per session
  - Each set consisted of 20 possible revolutions
- **Intensity setting**
  - Initial load determined through limb loading test
    - start with 20# - if 5 successful, then more; if not, then less
  - 12-15 successful revolutions, then setting unchanged
  - 16-20 successful revolutions, then increase load by 10#
  - 0-11 successful revolutions, then decrease load by 10#

# In Summary

Cyclocentric exercise is ideal to promote

- Graded equal loading of lower extremities
- Phasic versus tonic activity
- Joint stabilization
  - Co-contraction
  - Increase proprioception
  - Extensor versus flexor activity
- Consecutive concentric/eccentric contractions
- Strength vs endurance
- Suitable for pre-, co-, and post gait training

# Thank you



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**Biodex Medical Systems, Inc.**

20 Ramsay Road, Shirley, New York, 11967-0702

Tel: 800-224-6339 *(In NY Call 631-924-9000)*, Fax: 631-924-9338

Email: sales@biodex.com, www.biodex.com