The Clinical Issue
• Cerebral palsy (CP) is the most common cause of physical disability in childhood.1
• Children with CP have motor problems2 that stem from weakness, impaired control3,4, and spasticity5.
• Walking is a primary goal for many children with cerebral palsy (CP) and their families.
• Mechanisms to improve gait and reduce the need for mobility aids are paramount.

The Shortcomings
FES: FES does not reliably produce patterns of swing phase activity that approximate healthy gait6,7.
RGT: RGT can promote passive movement during stepping. Muscle activation timing in RGT can differ from healthy, unrestricted patterns, and may be due to restriction of movement to the sagittal plane7,8.

The Question
• The combination of FES and PBWSTT mitigates their isolated disadvantages.
• RGT provides very precise and biomechanically correct position control.
• FES ensures the “active” nature of the intervention and appropriate timing of muscle activation.
• Can they be combined?

The College Try
• Design: multiple single-subject study design
Sample: volunteer sample of 3 children with spastic diparetic CP (2 males, 1 female, 9-11 years of age; Gross Motor Function Classification System III)
• Treatment period: included 6 sessions of combined FES/RGT over the course of 3 weeks.
• Intervention: 30 minute RGT sessions with concurrent multichannel, patterned FES (of rectus femoris, gastrocnemius and tibialis anterior).
• Assessment: 1 week prior to onset of intervention, at the end of the treatment period, and 2-4 weeks after completing the intervention. Outcome measures included:
  a) Gross Motor Function Measure 66-15
  b) myometry (medial hamstrings, quadriceps)
  c) Observational Gait Scale.
  d) Patient, family, and therapist perceptions of the treatment approach were surveyed.

The Thumbs Up
• Strategic, patterned multi-channel FES can be simultaneously delivered during RGT.
• Participants, therapists and families globally endorsed this intervention and their experience with it.
• Pending technical improvements and this successful pilot bolster ongoing efforts to explore the efficacy of this innovative approach to gait rehabilitation.

Down:
• Using a beta multichannel FES stimulation system was challenging (e.g., software malfunction, absence of pattern feedback, connectivity issues, difficulty with electrodes).

The Results
Participants:
• all completed the assessments and intervention.
• reported tolerable treatment periods.
• Acclimatization to multichannel FES sometimes required adjustments for participant comfort.
Caregivers:
• reported very high satisfaction with the care that their child received, and did not criticize the study approach or believe that their child was exposed to unnecessary risk.

Therapists:
• reported that the combination of therapies was not difficult to learn and that they gained comfort with setting manipulation to optimize gait.

The Future
• Use of these gait training modalities has the potential to produce significant recovery in mobility, function, and participation.
• The Cerebral Palsy International Research Fund has supported our efforts to establish optimal application and synchronization of FES and RGT.
• 3/8 participants have now completed the single subject research design with a multiple n-of-1 approach.
• Data from ongoing work will be sufficient to permit reliable sample size calculations for future clinical trials.

References