

Modifications to BWSTT for a Child with Spastic Quadriplegia and Multiple Concurrent Disabilities: A Case Report

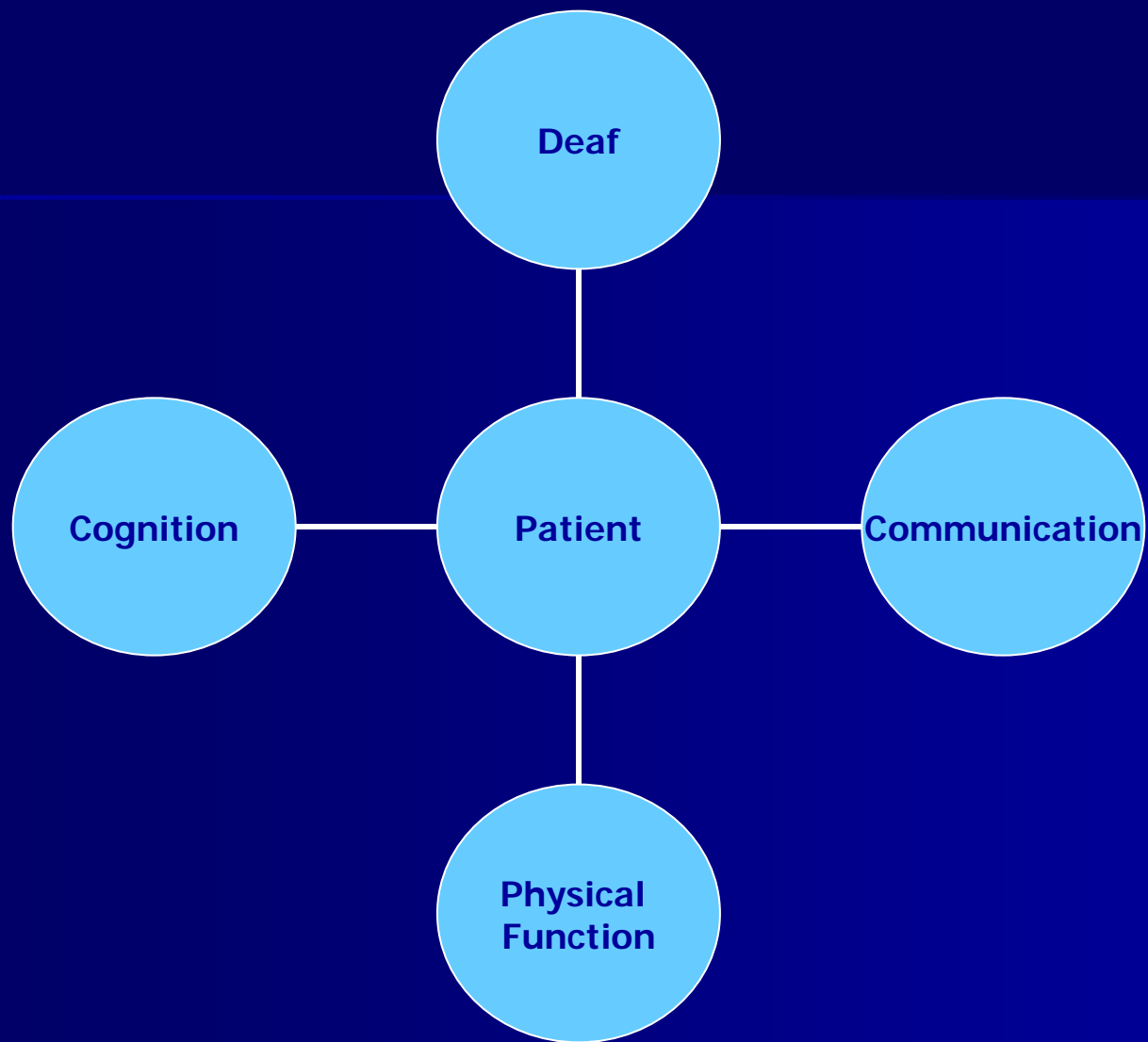
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Introduction: Background

Cerebral Palsy

- static encephalopathy resulting from lesions to the brain during fetal development/birth
(Sankar 2005)
- prevalence of 400,000 (Paul 2007)
- Significant health care costs for children with developmental disabilities
 - Cerebral palsy: \$11.5 billion/yr
 - (Centers for Disease Control & Prevention 2003)



Introduction: Review of Literature

- Hearing impairments:
 - 12% children with cerebral palsy (Sankar 2005)
 - Sign language, hearing aids, cochlear implants
 - Nonverbal communication behaviors:
 - facial expressions, eye contact, head and body movements (Roter 2006)
 - Increased chance of learning disabilities & cognitive impairments (Schum 2004, Soukup 2007)

Introduction: Review of Literature

- Mental impairments:
 - 30%-60% of children with cerebral palsy
(Koman 2004 , Sankar 2005)
 - Learning disabilities, activity limitations associated with degree of cerebral involvement
 - Cognitive impairments more common in spastic quadriplegia than spastic hemiplegia (Sankar 2005, Koman 2004)

Introduction: Review of Literature

- Children with multiple disabilities:
 - Benefit from therapy aimed at meaningful gross motor tasks (Brown 1998)
 - Implications for physical therapists
 - Modify goals, treatment approach, expectations (Benassi 1973)
 - Modeling, prompting, unique modifiers/motivation techniques (Lieu 2007)

Introduction: Review of Literature

- BWSTT for children with cerebral palsy
- Possible benefits:
 - ↑ stride length & self-selected walking speed
 - ↓ time in double support
 - ↑ GMFM score
 - ↑ subjective report of gait
 - (Begnoche 2007, Cherng 2007, Day 2004, Dodd 2007, Phillips 2007, Provost 2007, Schindl 2000)

Introduction: Clinical Problem

- Children with cerebral palsy present with:
 - Multiple gait impairments (Berger 1982 , Cherng 2007, Norlin 1986, Thompson 2001)
 - Other impairments: hearing, communication, cognition
- Children with multiple disabilities require modifications to interventions
- Little research about BWSTT for children with multiple concurrent disabilities

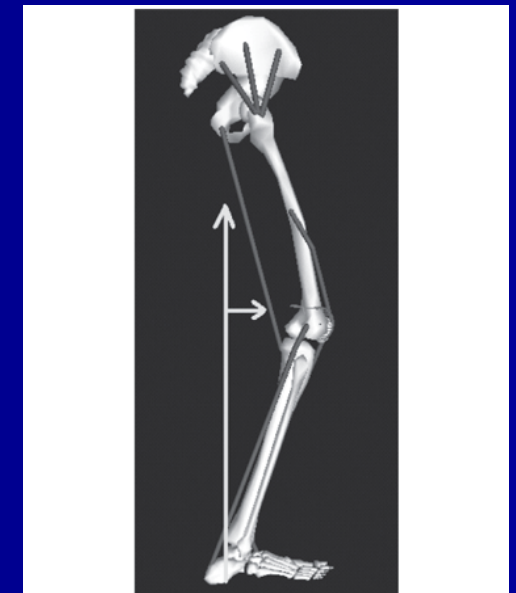


Figure 1 - Crouch Gait: increase knee flexion during stance phase and the external flexion moment

Introduction: Purposes

- Describe the characteristics of a deaf, non-verbal 11 y.o. girl with spastic quadriplegia, low level of physical & cognitive function necessitating modifications to the use of BWSTT
- Describe modifications to treatment required to use BWSTT to increase functional mobility for this patient

Case Description: Medical and Social History

- 11-year-old female: cerebral palsy, spastic quadriplegia, deaf, nonverbal
- Born 34 wks by C-section
- Hearing impairment from birth
- Communication: facial expressions, vocalizations
- Cognition: special education class (SH/SDC)
- Social Hx: Family support variable

Case Description: Function

- **Chief Complaint:** dependence in transfers, limited weight bearing in bilateral lower extremities
- **Mobility:** bunny hopping, dependent in wheelchair, Mulholland Walkabout, carried
- Hypertonicity
- ↓ lower extremity ROM
- Parents signed HIPAA and informed consent documentation

Case Description: Exam

Functional Mobility

- Modified use of Functional Independence Measure (FIM)
- FIM evaluates independence in motor tasks such as transfers, ambulation, wheelchair mobility, and stairs
- 7-point scoring scale: from Dependent (0) to Independent (7)
- **Sit to Stand transfer: Max Assist (1)**
- **Stand pivot transfer: Mod Assist (2) for bearing weight**
- **Ambulate with manual assist x 20 steps: Mod Assist (2)**

Psychometrics: mean interrater reliability: 0.95 (Ottenbacher 1996)

Case Description: Exam

Popliteal Angle (contractures)

- Measures hamstring flexibility, which affects standing posture, ambulation (ten Berge 2007)
- Measured in supine, hip flex to 90
- **-45° R; -40° L**
- Psychometrics: Intrarater reliability between sessions: (ICC) 0.771; same session: (ICC) 0.929 (ten Berge 2007)

Case Description: Exam

Tone

- ↑ resistance to externally-imposed movement
- Performed passive movement and graded Minimal, Moderate, Severe
- trunk tone-hypotonia
- ↑ flexor tone R>L in elbow, wrist, hip, knee, ankle:
 - Right : Severe
 - Left : Moderate
- (Clopton 2005)

Case Description: Exam

Gross Motor Function Measure-88 (GMFM)

- 5 subsections: Lying & Rolling, Sitting, Crawling & Kneeling, Standing, Walking/Running/Jumping
- Scoring:
 - Subsection score; total gross motor score
 - Scale: 0 (no movement), 1 (<10%), 2 (partial completion), 3 (completed)
- **Initial: 42.85/100**
- Psychometrics:
 - interrater reliability (ICC=0.77; 0.90) (Nordmark 1997; Russell 1993)
 - intrarater reliability (ICC = 0.7740; 0.90) (Nordmark 1997; Russell 1993)

Case Description: Exam

Observational Gait Analysis (OGA)

- careful observation of a patient's gait by an observer systematically assessing the motion at each joint (hip, knee, ankle) and recording observations (Gronley and Perry 1984)

Initial Contact	Mid-stance	Terminal Stance
<ul style="list-style-type: none">•At forefoot•Hip IR, Add•Increased Knee flexion	<ul style="list-style-type: none">•Loading on forefoot•Excessive hip & knee flexion	<ul style="list-style-type: none">•Pushoff on forefoot•Excessive hip & knee flexion

Psychometrics: intra-rater reliability varied from $r = .32-.97$ (Krebs 1985)

Case Description: Exam

Gross Motor Function Classification System

- classifies children with cerebral palsy based on their motor patterns and limitations (Wood 2000)
- 5 Levels:
 - I: high function-walk, run, jump independently
 - V: low function-dependent for mobility, or power mobility w/adaptations
- **GMFCS Level IV**
 - Ambulate short distances with a walker
 - wheeled mobility at home/school/community
- Psychometrics: interrater reliability ($K=0.84$) (Bodkin 2003)

Case Description: Evaluation

- Diagnosis
 - 11 year old female presenting with:
 - ↓ Independence in transfers & ambulation
 - Hypertonicity
 - ↓ lower extremity ROM
 - Limited ability to access environment
 - Consistent with spastic quadriplegia and concurrent hearing impairment and cognitive and communication deficits

Case Description: Plan of Care

- PT: 2x/wk (60 min) x 6 months
- PT visits: 10 sessions, 60 min/session, over 8 weeks
- Home Exercise Program
 - 2 hr/day progressive knee extension soft casts
 - standing activities with knee immobilizers



Case Description: Traditional Goals

Impairment/Functional Limitation	PT Goal	Time Frame
Limited popliteal angles	↑ by 10 deg each leg	8 weeks
Ambulate Mod Assist x 20 steps	x 50 feet	8 weeks
Mod Assist for stand pivot transfer	Min Assist	6 months

- Goals of Patient's Family: ↑ participation in transfers
- Prognosis: Fair

Case Description: Modified Goals

Impairment/Functional Limitation	PT Goal	Time Frame
Decreased participation in stepping	Initiate stepping x 5 minutes	8 weeks
Inconsistent weight bearing in both legs	Experience consistent weight bearing for 10 minutes	8 weeks

Intervention: BWSTT

BWS Lite Gait System



Harness suspension system

Manual facilitation

Treadmill

<http://www.litegait.com/images/WATM18.JPG>

Intervention: Description of BWSTT Sessions

- 7 sessions total
- Setup:
 - ~40% unweighting
 - .5 mph
- **Duration of BWSTT: 6-18 minutes**
- Last 2 sessions:
 - Over ground ambulation with Lite Gait: played “kick” the ball with 2 PT’s present

Intervention: Modifications to BWSTT Requirements

BWSTT Reqs	Impairment	Modification	Rationale
Active participant	Deaf	Mirrors, facial expressions, clapping	Use her method of interaction to ↑ tolerance (Lieu 2007)
	Perseveration on moving treadmill	Aladdin Video	Modify visual field, redirect attention (Benassi 1973)

Intervention: Modifications to BWSTT Requirements

BWSTT Reqs	Impairment	Modification	Rationale
Simple Commands	Deaf, ↓ communication ↓ cognition	Manual guidance, then freedom to initiate	Demo, modeling
Repetition	↓ initiation of movement	Intermittent manual guidance	Consistent weight bearing experience

Intervention: Modifications to BWSTT Techniques

Factor	Modification
Perseveration	Aladdin Video
Decreased Stepping & Decreased Participation	↑ visual and tactile feedback for stepping
	Over ground with Lite Gait, “kicking” ball with 2 PT’s

Outcomes: Traditional Measurements

* Performance varied throughout sessions

	Initial	Final
R Popliteal Angle	-45	-60 (at 2/8 wks)
L Popliteal Angle	-40	-55
GMFM	42.85	43.10
Sit-Stand	Max Assist	*Max Assist
Stand Pivot Transfer	Mod Assist	*Max Assist
Ambulation with assist x 20 steps	Mod Assist	*10 steps Mod Assist
OGA		unchanged

Outcomes: Modifications for Perseveration

Modification	Before Modification	After Modification
Aladdin Video	Manual guidance x 2	Manual guidance x 1 + bungee cord
		↓ resistance to manual guidance
Aladdin Video	↓ self-initiated stepping (2-4 steps)	Variable ↑ self-initiated stepping: (1-8 steps)

Outcomes:

Modifications for Self-Initiated Stepping

Modification	Before Modification	After Modification
↑ visual and tactile feedback for stepping	0 steps	Variable stepping amount
Over ground with Lite Gait, “kicking” ball w/2 PT’s	8 steps max	Up to 8 minutes of self-initiated stepping

Outcomes: Modifications for Participation

Modification	Before Modification	After Modification
Aladdin Video	decreased stepping	Variable stepping; no linear progress
Over ground ambulation with Lite Gait "kicking" ball w/2 PT's	↓ perseveration due to video, not consistently effective	↑ facial expressions of enjoyment: smiles, laughter
		↑ duration (8') of stepping without distraction

Discussion: Expected vs. Observed Outcomes

- Objective Measurements:
 - No improvements
 - With this patient, needed to change expectations and outcome measures to assess effectiveness of treatment

Discussion: Benefits of Treatment

- Consistent weight bearing experience for up to 18 minutes
- New upright mobility experience
- Active attempt to modify treatment specifically to meet her needs
- Identified motivating factors for this patient:
 - ↑ socialization
 - ↑ visual/tactile feedback from therapists

Discussion: Modifications

- Perseveration-Aladdin
 - Focused attention, modified visual field (Martin 1973, Benassi 1973)
- Decreased self-initiated stepping-over ground ambulation play
 - To increase participation, need to find appropriate reinforcers for activity (Benassi 1973, Martin 1973, Kolderie 1971)
 - Patient-centered → more active participant
 - Working on goals important to patient with limited physical & cognitive abilities more successful (Brown 1998)

Discussion: Clinical Relevance

- Attempt to modify intervention to see if improvement could be made in this complex child
- Important to:
 - Evaluate modifiers to ↑ participation
 - Determine appropriate interventions

Discussion: Limitations of Methods

- Length of time to make modifications
- Inconsistent Measuring
 - Popliteal angle (contractures)
 - Stand pivot transfer

Discussion: Future Work

- Further case reporting on patients with cerebral palsy with multiple concurrent disabilities
 - Aid in evaluation of these children
 - Generate ideas of modifications to interventions
 - Stimulate discussion about appropriate expectations for this population

Conclusion

- Child with spastic quadriplegia who presents with multiple concurrent disabilities presents a complex clinical picture
- Need to modify goals, interventions, and expectations to meet the needs of each child
 - Discover what motivates the child
- Importance of:
 - Evaluating effectiveness of intervention
 - Making modifications to address factors limiting success
 - Reassessing intervention

Thank you!

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