Don't Just Sit There: Evidence-Based Sitting Balance Examination & Intervention

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Disclosure Statement

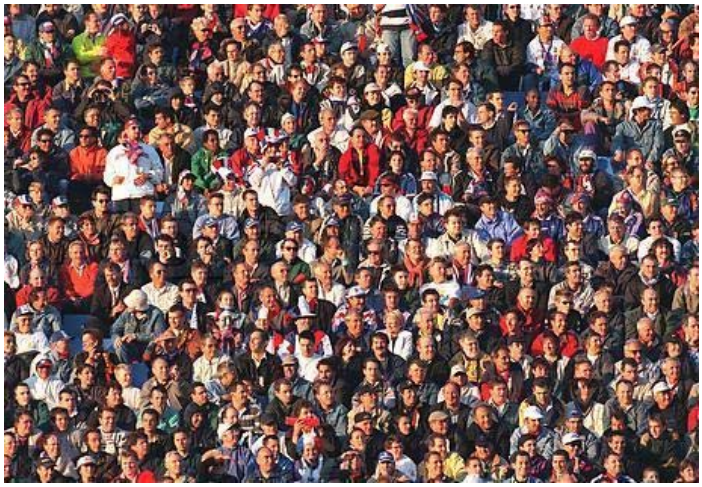
- Dr. Gorman is the creator of the FIST. She has no conflict of interest to report.
- Ms. Harro is an interprofessional team member for development and testing of the PocketPT . She has no conflict of interest to report.
- Dr. Platko has no conflict of interest to report.

Session Objectives

At the completion of this course, you will be able to:

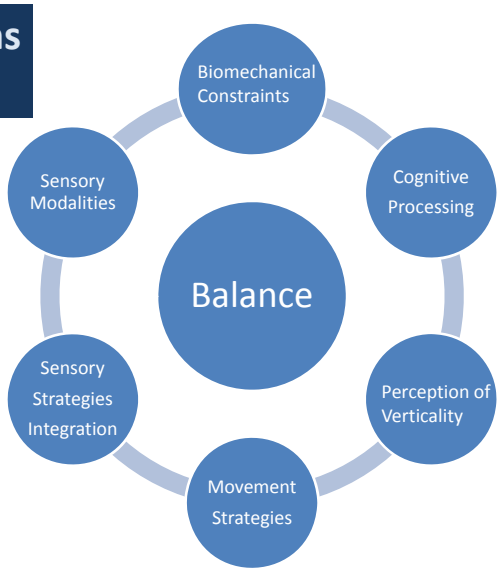
1. Apply theoretical models of postural control and function in sitting to patient cases.
2. Select from reliable and valid measures of sitting balance at both the impairment and activity level of the International Classification of Functioning, Disability, and Health model.
3. Utilize results from sitting balance measures to develop intervention strategies specific to postural control problems in sitting.
4. Using current evidence, relate sitting balance dysfunction to patient prognosis in select patient populations.

Who's here today?



Balance Models Applied to Sitting

Systems Model

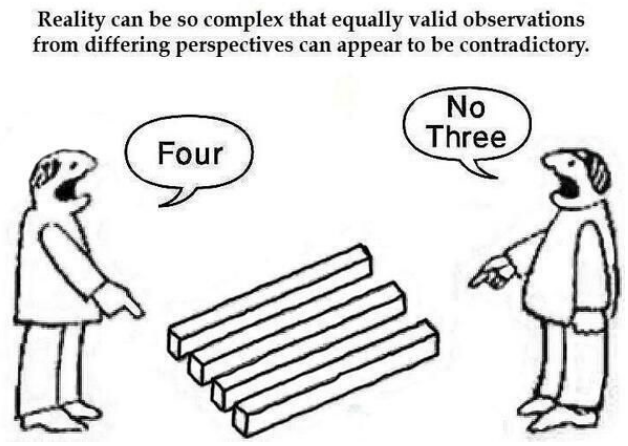


Key Constructs of Balance Control

- Voluntary Postural Control
  - Midline Stability
  - Limits of Stability
- Anticipatory Postural Control
  - Proactive Postural Strategies
  - Feedforward Control
- Reactive Postural Control
  - Automatic Postural Adjustments
  - Feedback Control

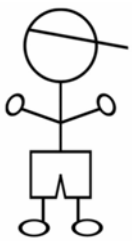
"…many scientists believe that concepts important for stance postural control will be shown to be equally valid for postural control in sitting."

(Shumway-Cook, 2011, p 192)



Comparison to Standing Balance

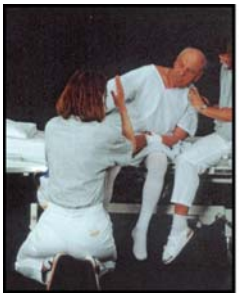
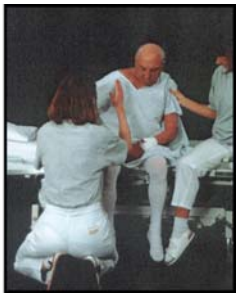
CONSTRUCT	STANDING	SITTING
Postural control	Static, proactive, reactive	Static, proactive, reactive
Stable trunk for limb motion	To allow for gait	To allow for **standing** & gait
Direction of control	Anterior/posterior	**Lateral** & anterior/posterior
Base of support	Feet	Feet, **thighs, buttocks**
Somatosensory input	Feet	Feet, **thighs, buttocks**
LE contribution	Multiple degrees of freedom	**Less** degrees of freedom



Postural Control Deficits in Sitting
Common Neurologic Impairments

- Abnormal postural alignment for stable BOS
- Impaired perception of midline & orientation in space
- Poor postural stability, dynamic stabilization
- Reduced & delayed anticipatory strategies
- Slowed & limited range of voluntary weight-shifts, poor LOS control
- Poor limb control without stable trunk posture
- Delayed or absent automatic postural reactions

Clinical Populations w/Sitting Balance Impairment

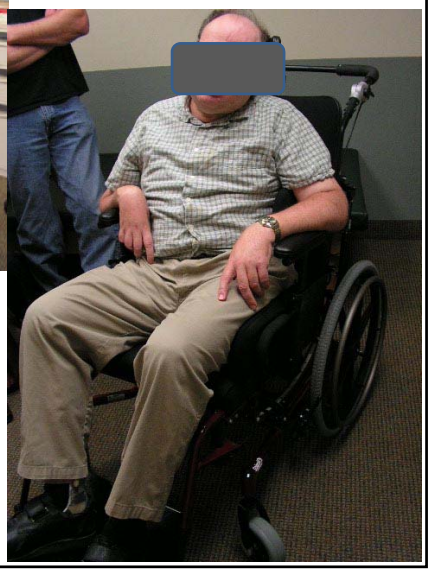




Acute Stroke
Early Sitting Balance Recovery

Stroke Help Series: Teaching Independence-A Therapeutic Approach to Stroke Rehabilitation
International Clinical Educators, Inc.

Patient with TBI:
Impaired Sitting Balance

Aging with TBI
Decline in Sitting Stability



Sitting Balance & Function

- Sitting balance at admission predicted both BBS & FIM (Feld 2001, Katz-Leurer 2008, Gorman 2014)
- Trunk Impairment Scale & PASS predicted FIM scores (DiMonaco 2010)
- FIM score improvement predicted by sitting balance s/p CVA (Carod-Artal 2007)
- Sitting balance predictive of depressive s/s & ADL outcomes s/p CVA (Hama 2007)
- Poor prognosis for independence for persons with limited sitting balance after acute CVA (Tyson 2007)
- Dual task challenges disrupted sitting balance after acute CVA (Harley 2006)

Sitting Balance & Locomotor Outcomes

- Mobility Outcomes
  - Mobility at 1 yr s/p CVA predicted in part by sitting balance (van de Port 2006)
- Walking
  - Balance (sit & stand) strongest predictor of recovery of walking (Tyson 2007)
  - Sitting balance at 2 wk s/p CVA predicted walking ability at 6 mo (Feigin 1996)
  - s/p CVA TIS score was highly related to walking ability (Verheyden 2006)

Sitting Balance & Discharge Disposition

- Trunk Impairment Scale & PASS predicted DC destination (DiMonaco 2010)
- Sitting balance 1 of 4 predictors of DC to home s/p CVA (Frank 2010)
- Sitting balance 1 of 5 predictors of DC to home s/p CVA (Meijer 2005)
- Function In Sitting Test at admission predicted home DC from IPR (Gorman in press)

Sitting Balance & TBI Prognosis

- Functional Independence
  - Recovery of sitting balance predictive of functional recovery up to 5 years after BI (Black 2000)
  - Dynamic sitting balance deficits related to functional limitations 1 yr s/p TBI (Duong 2004)
- Productive activity (Brown 2005)
  - Sitting balance predicted recovery 1 yr s/p BI
- TBI severity (Greenwald 2001)
  - Single global sitting balance rating at IPR admission associated with
    - Initial GCS
    - Acute care LOS & medical complications
    - Length of PTA

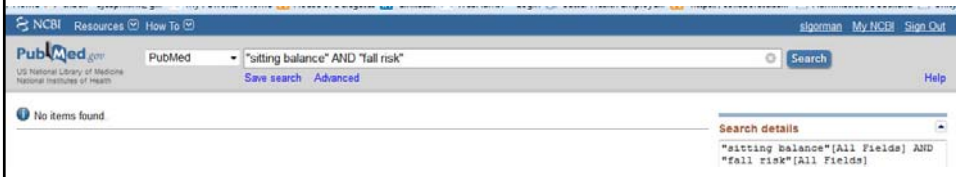
Sitting Balance & SCI

- Complexity of the functional task matters
  - MAS sit balance items + Sitting Balance Score had good reliability but little to mod validity compared to FIM (Jorgensen 2011)
  - Functional reach in sitting correlated with dressing (LB>UB) but not transfers or w/c propulsion (Jaskirat 2008)
- Functional balance ≠ normal balance
  - Paraplegia showed decreased static sitting & LOS compared to normal controls (Serra-Año 2013)
  - Sitting & standing balance not highly correlated (Forrest 2012)
- Sitting balance tasks can differentiate high (C6-T7) vs. low (T8-L2) level of SCI & acute vs. chronic SCI (Boswell-Ruys 2009)

Sitting Balance & Fall Risk

- Medio-lateral sway & rate of rise (sit to stand) related to falls
  - CVA w/fall ↑ med-lat sway & ↓ rate of rise compared to CVA w/o fall & controls (Cheng 1998)
  - Fear of falling ↑ med-lat sway during sit-to-walk (Aberg 2010)
- Sitting down task associated with falls in LTC 12% of all recorded falls (Robinovitch 2013)

Gap in the literature!



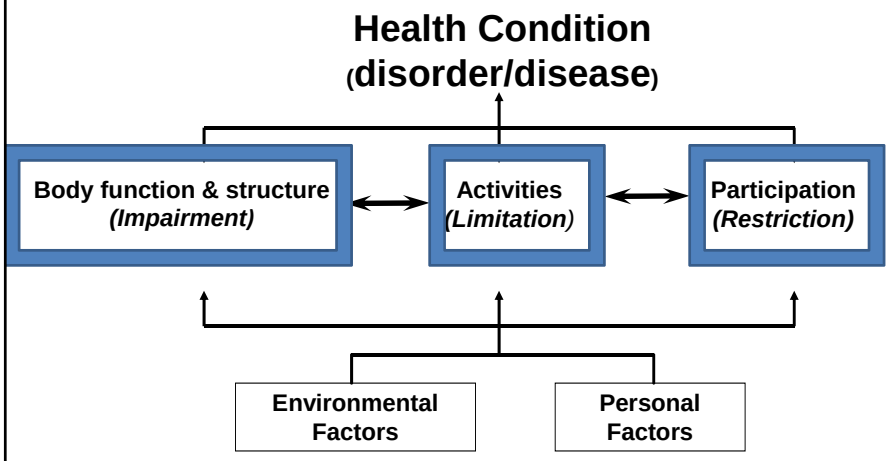
Clinical Examination: Sitting Balance

- Importance of sensitive outcome measures
  - Diagnose sitting balance deficits
    - Possibly fall risk
  - Provide baseline measure of sitting function
  - Serve as prognostic indicator for functional outcomes
  - Guide interventions to remediate balance deficits
  - Document recovery or decline in sitting function
  - Assess effectiveness of targeted interventions

Psychometric Properties of Measures

- Reliability
  - Inter- & Intra-rater reliability
  - Test / Re-test reliability
  - Minimal Detectable Change
- Responsiveness
  - To recovery of function
  - To decline in function
  - Clinically meaningful change
- Validity
  - Content validity
  - Concurrent validity
  - Discriminative validity
  - Predictive validity
- Sensitivity
  - To detect fall risk
  - To detect functionally relevant change

ICF Model



Clinical Examination
Sitting Balance Tests/Measures

Body Structure & Function (Impairment)
- Postural Alignment
- Trunk Impairment Scale
- Trunk Control Test
- Clinical Scale for Contraversive Pushing
- Multidirectional Functional Reach test

Activities
- Function in Sitting Test
- Sitting Balance Scale
- Ottawa Sitting Scale

Postural Stability & Alignment

- **ICF level: Body Structure/Function**
  - Anatomical alignment
- Photographic records
  - Frontal & Sagittal planes
- Videographic records
  - Stability & dynamic tas
- Objective measure
  - Head alignment
  - Spinal alignment

Constraints on Photo/Video

- Photo release
- Method to attach to EHR
- Department vs. personal device
- Dealing with the original
- Infection control

- Know policies & procedures!

Trunk Impairment Scale

Verheyden 2007

- **ICF level**: **Body Structure/Function**
  - Trunk control impairments in sitting
- TIS Examines
  - Static sitting balance
  - Isolated trunk movements
    - Shortening & elongation of trunk
    - Rotation of upper trunk on fixed lower trunk
    - Rotation of lower trunk on fixed upper trunk
- Key Limitation
  - Does not evaluate functional tasks in sitting

Trunk Impairment Scale

Item

Static sitting balance
1 Keep sitting balance
2 Keep sitting balance with legs crossed
3 Keep sitting balance whle crossing legs

Dynamic sitting balance
1 Touch seat with right elbow (task achieved or not)
2 Touch seat with right elbow (trunk movement)
3 Touch seat with right elbow (compensation strategies)
4 Touch seat with left elbow (task achieved or not)
5 Touch seat with left elbow (trunk movement)
6 Touch seat with left elbow (compensation strategies)
7 Lift right side of pelvis from seat (task achieved or not)
8 Lift right side of pelvis from seat (compensation strategies)
9 Lift left side of pelvis from seat (task achieved or not)
10 Lift left side of pelvis from seat (compensation strategies)

Coordination
1 Rotate shoulder girdle 6 times
2 Rotate shoulder girdle 6 times within 6 seconds
3 Rotate pelvic girdle 6 times
4 Rotate pelvic girdle 6 times within 6 seconds

Trunk Impairment Scale

Verheyden 2004, 2006, 2007, 2010

- Excellent Reliability in subacute stroke
  - Inter-rater (ICC= .99)
  - Test / Re-test (ICC=.96)
- Excellent internal consistency
  - Cronbach alpha =.89
- Good concurrent validity with
  - Trunk Control Test (r= 0.83)
  - Barthel Index (r= 0.86)
  - PASS (r= 0.84)
- Lack of ceiling effect

Trunk Control Test

Collin 1990

- **ICF level: Body Structure/Function**
  - Trunk motor control impairments
- TCT Examines
  - Rolling (both sides)
  - Transfer supine to sitting
  - Static sitting (unsupported, w/out feet on floor)
- Key Limitation
  - Only 1 item specific to sitting balance
  - Does not evaluate functional tasks in sitting

Trunk Control Test

ITEMS

- Roll to weak side
- Roll to strong side
- Sitting up from lying down
- Balance in sitting position
  - On side of bed
  - Feet not on floor
  - Not using arms

SCORING

- 0 = Unable to do on own
- 12 = Able to do but only with non-muscular help (i.e., using arms to pull, using bed rail)
- 25= Normal

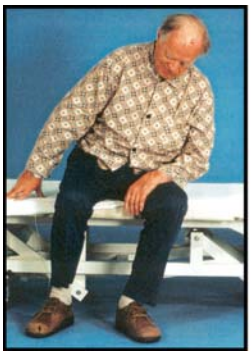
Trunk Control Test

Collin 1990

- Predictive Validity
  - TCT added to FIM at admission improved prediction of DC FIM more than admission FIM alone (RR .66 to .75)
- Quick, impairment-based test
- Test limitations

Pusher Syndrome: Diagnostic Criteria

a) Spontaneous Body Posture
b) Abduction/Extension of Non-paretic Extremities
c) Resistance to Passive Correction



Karnath HO, Broetz D. Understanding and treating "pusher syndrome." *Phys Ther*. 2003; 83: 1119-1125.

Clinical Scale for Contraversive Pushing

Babyar 2009

- **ICF level: Body Structure/Function**
  - Body posture under different conditions
- Contraversive Pushing Scale examines
  - Both in sitting & standing
    - Spontaneous body posture
    - Abduction & extension of non-paretic limbs
    - Resistance to passive correction
  - Key Limitation
    - Does not evaluate PS during dynamic/functional activities

Clinical Scale for Contraversive Pushing

Clinical Scale for Contraversive Pushing		
	Sitting	Standing
Spontaneous body posture	.75	1.0
Sum total (max=2)	1.75	
Abduction and extension of non-paretic extremities	1.0	1.0
Sum total (max=2)	2.0	
Resistance to passive correction	1.0	1.0
Sum total (max=2)	2.0	
Total Score	**5.75/6.0**	

Sample Scoring Sheet from patient with Acute Stroke with Pusher Syndrome

Clinical Scale for Contraversive Pushing

Babyar 2009

- Test Psychometrics
  - Excellent inter-rater reliability (ICC =.92)
  - Good concurrent validity with Barthel Index (r=.66)
  - Adequate sensitivity (64.7%) and specificity (100%) to detect PS based on diagnostic criteria
- Stronger test psychometrics than
  - Burke Lateropulsion Scale
  - Modified Scale for Contraversive Pushing

Multidirectional Functional Reach Test

Newton 2001

- **ICF level: Body Function/Structure**
  - Weight shift with UE reach in multiple directions
- MDFR Test Examines
  - Can be adapted to sitting
  - Ability to maintain balance while weight-shifting and reaching
    - All directions (anterior *, posterior, right, left)
  - Key Limitation
    - Measures only a single construct
    - Clinically challenging for reliable test administration

Multidirectional Functional Reach Test

Newton 2001, Lynch 1998

- Reliability in SCI
  - Test / Retest (ICC=.85-.94)
- Concurrent validity with
  - BBS (r=.48), but best in forward direction
  - TUG (r=-.44)
- Prone to measurement errors
- Not comprehensive for sitting function

Clinical Examination
Sitting Balance Tests/Measures

Body Structure & Function (Impairment)
- Postural Alignment
- Trunk Impairment Scale
- Trunk Control Test
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- Multidirectional Functional Reach test

Activities
- Function in Sitting Test
- Sitting Balance Scale
- Ottawa Sitting Scale

Function In Sitting Test

Gorman 2010

- **ICF level: Activity**
  - Performance-based test of functional tasks
- FIST Examines
  - Static Sitting
    - Static, eyes closed, turn head, lift foot
  - Dynamic Sitting
    - Forward reach, lateral reach, item off floor, item from behind
  - Reactive Sitting
    - Nudges in anterior, lateral, posterior
- Key Limitation
  - Limited to sitting

Function In Sitting Test

FUNCTION IN SITTING TEST (FIST) RESULTS

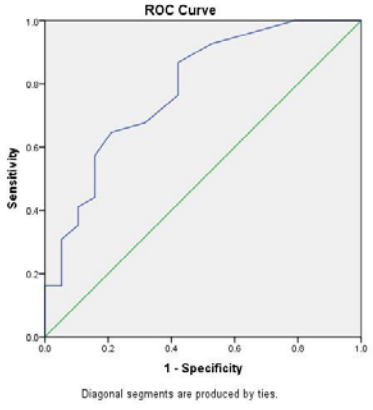
FIST Test Item ½ femur on surface; hips & knees flexed to 90° X Used step/stool for positioning & foot support		Date: 10/21/09	Date: 10/25/09	Date:
Randomly administered	**Anterior Nudge**: superior sternum	3	4	
	Posterior Nudge: between scapular spines	3	4	
	Lateral Nudge: to dominant side at acromion	2	3	
Static sitting: 30 seconds		4	4	
Sitting, shake 'no': left and right		3	3	
Sitting, eyes closed: 30 seconds		2	4	
Sitting, lift foot: dominant side, lift foot 1 inch twice		2	2	
Pick up object from behind: object at midline, hands breadth posterior		1 (min)	2	
Forward reach: use dominant arm, must complete full motion		2	2	
Lateral reach: use dominant arm, lift opposite ischial tuberosity		1 (mod)	1 (min)	
Pick up object from floor: from between feet		1 (mod)	1 (min)	
Posterior scooting: move backwards 2 inches		1 (mod)	1 (mod)	
Anterior scooting: move forward 2 inches		1 (mod)	1 (min)	
Lateral scooting: move to dominant side 2 inches		1 (max)	1 (mod)	
TOTAL		27 / 56	33 / 56	/ 56
Administered by:		SGorman PT	SGorman PT	

Scoring Key:
4 = Independent (completes task independently & successfully)
3 = Verbal cues/increased time (completes task independently & successfully and only needs more time/cues)
2 = Upper extremity support (must use UE for support or assistance to complete successfully)
1 = Needs assistance (unable to complete w/o physical assist; **document level: min, mod, max**)
0 = Dependent (requires complete physical assist; unable to complete successfully even w/physical assist)

Function In Sitting Test

Gorman 2014

- Prospective, multicenter study
  - 4 inpatient rehab centers across US
  - N=125 participants
  - Variety of dx (CVA & TBI most common)
- Relationship of FIST at admission & d/c
  - FIM (both motor & total)
  - BBS
- Responsiveness of FIST
- MCID of FIST



Function In Sitting Test

Gorman 2010, 2013, 2014

- Excellent Reliability
  - Inter- & Intra- rater (ICC=.99)
  - Test / Re-test (ICC=.97)
- Excellent internal consistency
  - Cronbach alpha = .98
- Excellent/good concurrent validity
  - mRS (r=-.76)
  - BBS (r=.85)
  - FIM (r=.71)
- Responsiveness
  - ES = .83
  - SRM = 1.04
  - MCD = 5.5 points
  - MCID = 6.5 points
- Predicative validity
  - DC to home
- No floor effect, but ceiling affect by DC in IPR
- Free online training
  - www.samuelmerritt.edu/fist

Sitting Balance Scale

Medley 2011

- **ICF level: Activity**
  - Ability to maintain sitting w/ and w/o displacements
- Sitting Balance Scale Examines
  - Static sitting balance (3 items)
  - Sitting balance w/trunk displacement (6 items)
  - Sitting balance w/UE displacement (2 items)
- Key Limitations
  - Unknown responsiveness or concurrent validity

Sitting Balance Scale

- Sit unsupported (60 s)
- Sit unsupported, eyes closed (30 s)
- Sit w/arms as levers (90° shld flex w/2lb cuff wt)
- Forward reach
- Pick up object from floor
- Alternate foot touch (3-3.5 inch ht)
- Lateral reach
- Turn to look over both shoulders
- Lateral bend to elbow
- Sit to stand
- Pick up object from floor

Scoring: ordinal scale (0-4) for each individual item

Sitting Balance Scale

Medley 2011, Thompson 2013

- Good to Excellent Reliability
  - Intra-rater (ICC=.96-.99)
  - Inter-rater (ICC=.87)
- Good Internal Consistency
  - Cronbach alpha = .76
- Moderate concurrent validity
  - TIS (r=.60 to .92, varied by setting)
  - Ambulatory status (r=.67)
- Equipment required & 2 items require bilateral LEs
- 1 study sample included persons w/o sitting balance dysfunction

Ottawa Sitting Scale

Thornton 2010

- **ICF level: Activity**
  - Movement within & outside BOS in sitting
- Ottawa Sitting Scale Examines
  - Static sitting
  - Weight shifts of small & longer distance
  - Lift hips
  - Walk hips forward & back
- Key Limitations
  - Lack of validity studies

Ottawa Sitting Scale

- Items
  - Maintain static sitting position
  - Moves short distance (12 cm)
    - Anterior, right, left
  - Moves longer distance (25 cm)
    - Anterior, right, left
  - Trunk rotation ability
  - Sitting on 1 hip
  - Walking on hips
    - Forward & back
- 6 items scored twice
  - Feet supported
  - Feet unsupported
- Scoring
  - 0-4 point ordinal scale
  - Different scale for each item

Ottawa Sitting Scale

Thornton 2010

- Excellent Reliability
  - Intra-rater (ICC=.99)
  - Inter-rater (ICC=.96-.98)
- Ceiling effect noted
  - Corresponded to BBS scores of ~10
- Lack of validity studies
  - Compared to BBS & PFMP, no analysis
- Lack of studies on responsiveness of test

Other Activity-level Measures (with limitations)

- Global Rating Scales (N, G, F, P)
  - Subjective
  - Poor operational definitions that vary
- Kansas Sitting Balance Scale (Kluding 2006)
  - Single study, limited research
  - Limited test psychometrics
- Berg Balance Scale (Berg 1995)
  - Single item "static sitting x 30 seconds"

Other Activity-level Measures (with limitations)

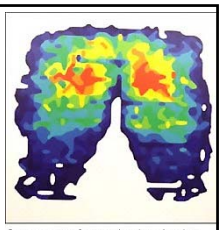
- Motor Assessment Scale (Carr 1985)
  - Single item "balanced sitting"
- Postural Assessment Scale (PASS) (Benaim 1999)
  - Static sitting & supine ←→ sit transfers
- Stroke Impairment Assessment Set (Liu 2002)
  - Trunk subsection: 2 items (verticality & abd MMT)
- Brunel Balance Assessment (Tyson 2004)
  - 3 items (static, arm lift, forward reach)

Participation-level Measures (with limitations)

- Activities-specific Balance Confidence Scale (Botner 2005)
  - No sitting items, all items in standing
- Falls Efficacy Scale (Delbaere 2010)
  - No sitting items, sit to stand only
- Stroke Impact Scale (Guidetti 2014)
  - 1 sitting item: sitting without losing balance

GAP → Participation level measures relevant to sitting function

Emerging Technologies



Pressure map of a seated patient showing high pressures (orange areas) over the ischial tuberosities.

- Force platform systems
- Pressure mat sensors devices
- Accelerometers & movement sensors
- Videographic movement analysis (eg. Dartfish)

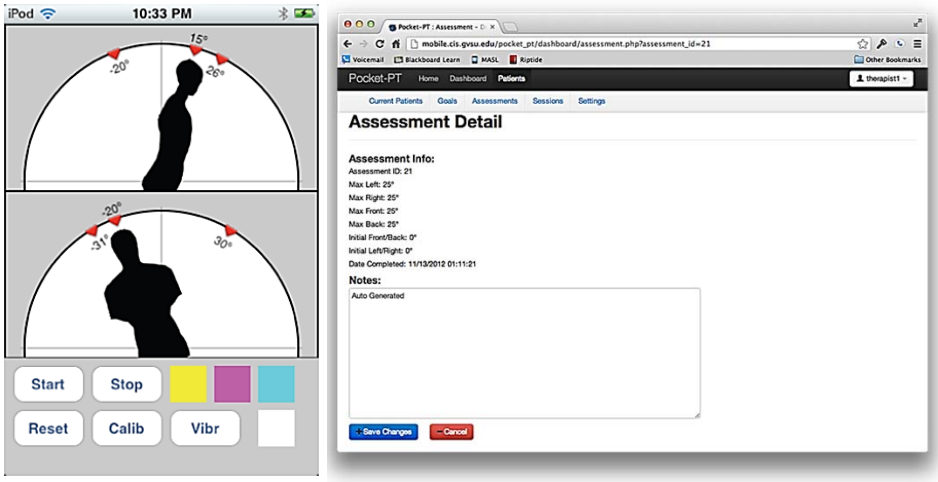
- Clinical utility?
- Affordability
- Portability?

Emerging Quantitative Measures

- PocketPT™ Trunk Movement Battery

Movement Sensor Assessment Technology

PocketPT Trunk Movement Battery

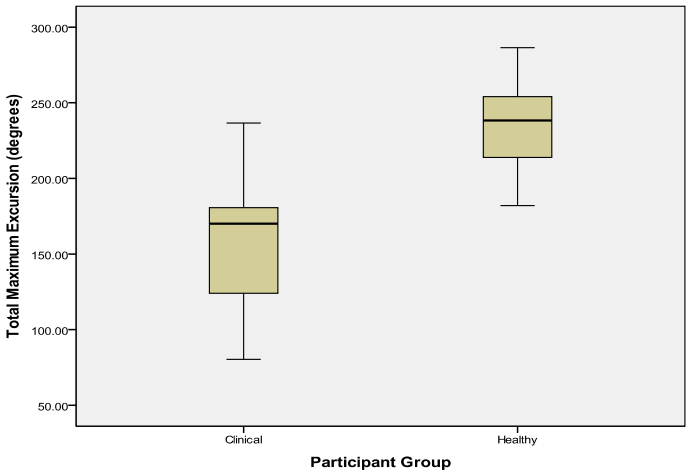


Trunk Movement Battery

Beel-Bates 2011, Englesma 2014

- Assessment component of PocketPT™
  - Quantitative Limits of Stability test
    - Anterior, Posterior, Lateral maximal trunk lean
    - Initial position, maximal COM excursion & average movement velocity
  - Excellent to Moderate Reliability (adults w/BI)
    - Intra-rater Reliability (ICC=.70-.91)
    - Inter-rater Reliability (ICC=.75-.99)
  - Good to excellent concurrent validity (adults w/BI)
    - FIST, Multidirectional FRT, global rating scale
  - Excellent discriminative validity

Total Maximum Excursion



Designing Interventions to Promote Recovery of Sitting Function

Examination Findings ➔ Guide Directed Interventions

- **Clinical decision-making**
  - What balance components need remediation?
    - Voluntary, Proactive, Reactive, Sensory or Motor Strategies
  - What are the activity limitations? What functional tasks are inefficient or ineffective?
    - Task demands, transitional movements, dual tasks
  - What environmental conditions are challenging or pose fall risk?
    - With/without trunk support, UE support, feet on ground
    - Surface conditions, base of support, visual context

Examination Findings ➔ Guide Directed Interventions

- **Clinical Decision-making**
  - What are the primary system impairments contributing to sitting balance deficits?
    - Trunk weakness, dynamic trunk control
    - LE weakness affecting stable BOS
    - Impaired perception of vertical/midline
    - Sensory or Perceptual deficits
    - Musculoskeletal limitations
    - Abnormal tone/alignment issues
    - Impaired postural strategies; motor control issues
    - Attention/cognition

Treatment Principles
Promote Neuroplasticity

- Apply motor learning concepts to facilitate recovery of sitting balance skills
- Apply task-specific training concepts
- Practice meaningful tasks, saliency
- Practice in functionally relevant environments
- Build in repetition & intensity of practice
- Learning from errors
  - YES! Errors = loss of balance so CNS learns

Task Oriented Balance Training

- Practice balance skills in context of specific task goals vs. "balance exercises"
  - Embed balance demands into task design
  - Be explicit regarding task goal & FB on success
- Encourage active problem-solving and motor learning
  - Promote self-evaluation of task demands
  - Highlight critical aspects of environment
  - Encourage patient to evaluate their performance
- Address underlying impairments affecting balance in the context of TO balance training

Balance Training Interventions
Application of Ecological Model

Customized Interventions for Balance Training

Task Demands ➲ Forced use of PC system

Reaching Tasks	• Single UE or both UEs • Load or unloaded • Distance, speed, timing demands
Trunk Movement	• Limits of Stability demands • Segmental trunk motions/rotation • Transitional movement demands
Dual Task Demands	• Balance + motor demands • Balance + cognitive demands • Environmental distraction/ attn.

Customized Interventions for Balance Training

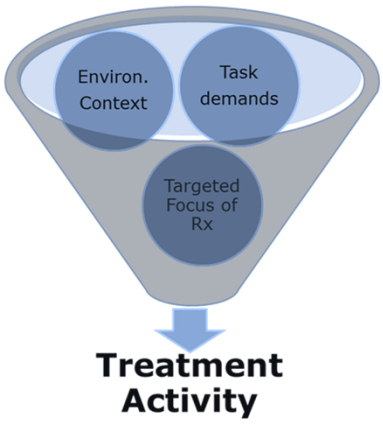
Environmental Conditions ➲Progressive challenge

Support Surface	• Stable/unstable/moving • Level/unlevel, surface area support • Bed, w/c, mat table, couch
Level of External Support	• Thigh and feet support • Back/trunk support & support location • UE support & location of support
External Environment	• Lighting conditions, eyes open/closed • Attention demands • Cognitive processing load

Targeted Balance Treatment Design

What aspects of balance is Rx focus?

- Postural stability & Voluntary postural control
- Proactive postural control
- Reactive postural control
- Effective motor strategies
- Functional task demands



Progression Activities

Sitting: Voluntary Postural Control

- Address postural alignment & create stable BOS
- Retrain midline for static and dynamic tasks
  - Use of external cues, internal recalibration
- Expand limits of stability (perceptual workspace)
  - A/P, Lateral, Functional rotational planes
- Embed task demands that require ↑ LOS
- Challenge stability on moving base of support
  - Exercise ball, equilibrium board, dynadisc
  - Environmental feedback re: stable center

Sitting: Proactive Balance Strategies

- Practice self-generated movements
  - Initially in midline with min. displacement of COM
  - Progress to increasing dynamic COM excursion
- Progress demands for UE, LE, & trunk motions
  - Add amplitude, speed, load, timing demands
  - Reaching, leaning, lifting, hitting, kicking, turning
- Practice transitional movements
  - Sit/sidelying, scooting, sit to standing, s/p transfers

Sitting: Reactive Balance Strategies

Promote timely & effective postural responses to perturbations or any loss of balance

- Manual perturbations
  - First in midline, then during dynamic tasks
  - Progress from expected to unexpected
- Challenge in unstable/moving surface conditions
  - Inclines, foam, balance board, ball
  - Progress from midline to dynamic tasks
- Safe practice at edge of LOS where fall risk zone
  - Working on safe recovery from loss of balance

What is the Evidence for Sitting Balance Interventions?

- Task Specific Training (Dean et al 2007)
  - Sitting reaching training beyond arms length
  - Varied distance, direction, thigh support, loads
  - RCT demonstrated significantly improved reach distance, paretic LE loading, & speed of reach
  - No carry over to walking function
- Early Intensive Forced Use (Tang et al 2014)
  - Comparison of early sitting, standing, walking task training with contemporary "Bobath approach"
  - Patients with severe motor deficits post-stroke
  - Significantly higher STREAM and Berg scores at 4 & 8 wk in Early Task-specific training group

What is the Evidence for Sitting Balance Interventions?

- Mental Practice added to Task Specific Training
  - Combining physical with mental practice primes system for motor strategy, enhances limb loading during STS task (Malouin 2009)
  - Mental imagery of sit to stand and reach tasks resulted in task-specific increases in speed (Guttman 2012)
  - Combining visual image with mental & physical practice of sitting trunk lean task (anterior and lateral) enhanced loading on paretic side (Saito 2013)
  - Patient's ability to use motor imagery varies; evaluate with published measures
  - Use of external imagery vs. internal imagery (kinesthetic feel of movement) in training
  - Weak levels of evidence of MP in sitting balance recovery

What is the Evidence for Sitting Balance Interventions?

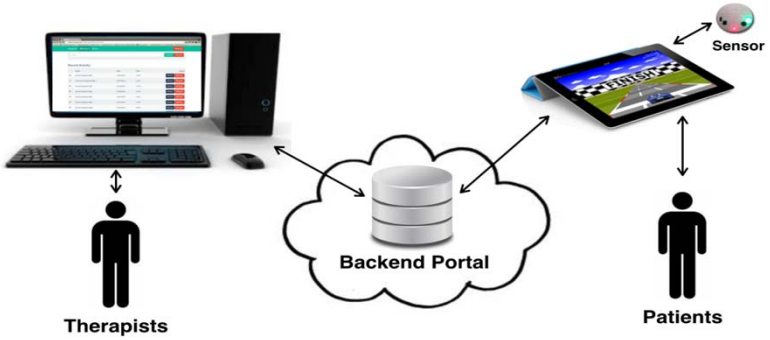
- Efficacy of trunk exercises (Verheyden et al 2009)
  - Rx: selective trunk exercises in supine and sitting (CVA)
    - Dosing- 4 x week for 5 weeks vs control group "conventional" PT/OT
  - RCT Findings: Significant gains only in dynamic balance subscale of Trunk Impairment Scale (TIS) for exercise group
  - No differences in functional outcomes
- Trunk exercises effect on balance & function (Saeys 2012)
  - Additional 16 hrs (8 wks) of trunk exercise in acute CVA
  - Focus of exercises: strength, coordination, selective motion
  - Significant higher gains in TIS for exercise group
  - Carryover to higher Berg and DGI scores in exercise group

Use of Emerging Technology in Balance Interventions

- Augmented visual BFB enhances sitting symmetry (Mudie et al 2002)
  - Balance performance monitor, carryover to function?
- Video-gaming effect on dynamic sitting balance
  - Sony Play Station II EyeToy (s/p stroke) (Rand 2008)
  - Case Series x 3 (SCI and TBI) (Betker 2007)
  - Advantages: motivational, increased practice time
  - Limitations of commercial video-gaming technology
    - High level of task demands and complexity
    - Limited ability for therapist to customize training for patient

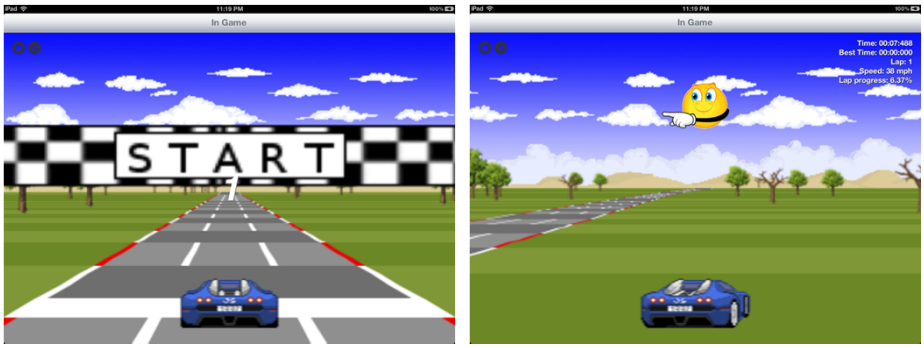
Pocket PT™ Technology

Englesma et al 2014

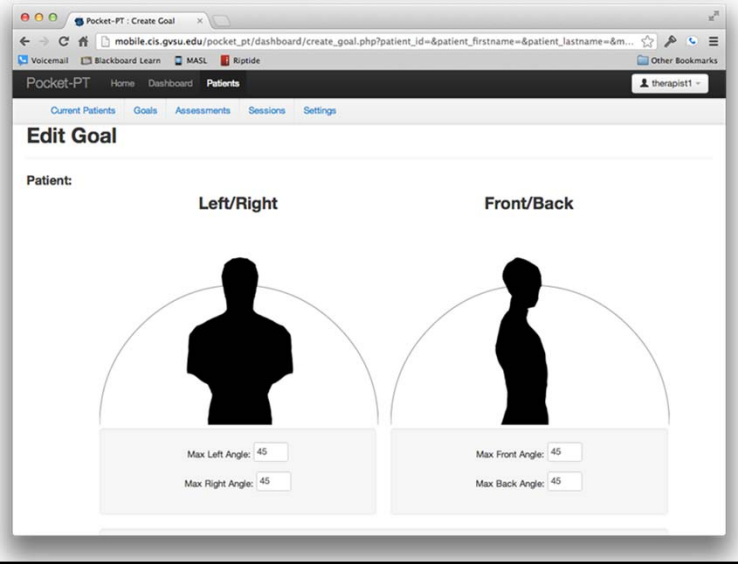


- 3d Sensor transmits data to ipad, wireless technology
- PocketPT app interprets & stores test results for each patient on backend dashboard portal for PT online access
- PocketPT is a personalized, therapeutic gaming platform for retraining dynamic balance
- Assessment findings drive PT-directed game parameters and goals

PocketPT
Interactive Gaming System for Balance Retraining



Pocket PT
PT-Directed Goals Set for Trunk Motion



Putting It All Together

Cases

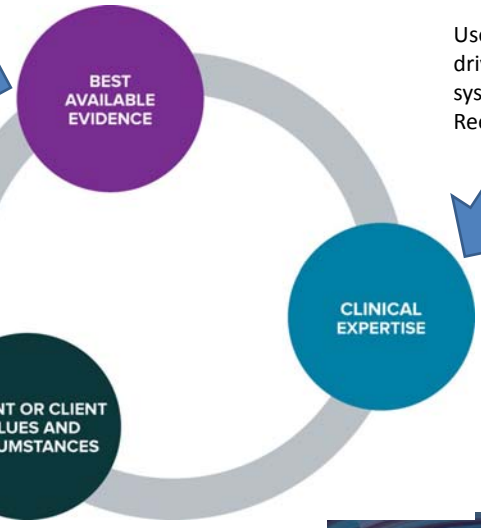
- Case #1:
  - Patient with acute stroke
- Case #2:
  - ICU patient pneumonia who developed critical illness polyneuropathy
- Case #3:
  - Patient with TBI

Take Home: Summary Points

Selection of right measure for right patient at right time

Use measurement to drive interventions systematically; Reexamine periodically

Selection of both measure & intervention for tasks, environment, needs



GUIDE TO PHYSICAL THERAPIST PRACTICE

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