IDENTIFYING PREDICTORS OF FALLS IN THE NEUROLOGICAL POPULATION POST INPATIENT REHABILITATION: OT'S ROLE IN IDENTIFYING FALL RISK

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REVIEW OF WHAT HAS BEEN STUDIED WITH FALL PREVENTION INTERVENTIONS WITH:

* COMMUNITY DWELLING OLDER ADULTS,
* HOSPITALIZED OLDER PEOPLE
* PEOPLE AFTER STROKE
Group and home-based exercise programs, usually containing some balance and strength training exercises, effectively reduced falls, as did Tai Chi.

Multifactorial interventions integrating assessment with individualized intervention, usually involving a multidisciplinary team, are effective in reducing rate of falls but not risk of falling.
Overall, vitamin D did not reduce rate of falls or risk of falling, but may do so in people with lower vitamin D levels before treatment.

Home safety assessment and modification interventions were effective in reducing rate of falls and risk of falling. These interventions were more effective in people at higher risk of falling, including those with severe visual impairment. Home safety interventions appear to be more effective when delivered by an occupational therapist.
An intervention to treat vision problems resulted in a significant *increase in the rate of falls*

- Pacemakers reduced rate of falls in people with carotid sinus hypersensitivity

- Gradual withdrawal of psychotropic medication reduced rate of falls
Despite the large number of trials (60 RCTs) there is limited evidence to support any one intervention.

Vitamin D reduced the number of falls, probably because residents have low Vitamin D level.

PT reduced the number of people falling in the hospital as did interventions targeting multiple risk factors.
10 studies and 1004 participants

- Investigated exercises, medication, and the provision of single lens (distance) glass instead of multi-focal glasses
- No evidence that exercises or single lens glasses reduced number of falls.
- There was evidence (2 studies) that Vitamin D in women reduced number of falls.
Recent (2014) study of 24 community-dwelling older women.

- Decreased executive function (measure by TMT) was associated with worse performance on functional measures of balance. Specifically, independently associated with decreased performance on TUG-cog and Fullerton Advanced Balance Scale.4

- Tests Included: Berg Balance, TUG, TUG-cog, SBT, SBT-cog, FAB, mFES, MMSE & MoCA (global cog), TMT (EF)
One Study of community dwelling older adults considered executive function (TMT), speed of processing (DSS Test) and psychomotor speed (Digit Symbol Copy Test) were all significantly related to recurrent falls. However better psychomotor speed was found to be an independent predictor of falls.\(^5\)
A large prospective cohort study (n=583) of community dwelling older adults without neurological deficits: TMT (B-A) was found to be a strong independent predictor of decline and mortality.\textsuperscript{6}
RIC DAY REHABILITATION POPULATION

- Stroke, Brain Injury, Spinal Cord Injury, MS, Cancer, Parkinson’s Disease, Other Neurological

- Most Patient’s have undergone Inpatient Rehabilitation and are now living at home with family.

- Patients are:
  - developing insight
  - Gaining experience with new disability
  - Identifying emerging abilities
Occurrence of Falls in Day Rehab
- Interdisciplinary approach to capture objective data on cognition in general, executive function, balance, and dual task.

- Goal is keep patients safe in therapy, at home, and in the community
TRAIL MAKING TEST (TMT)  A & B

- Developed by the US Army in 1944 as a measure of intelligence.
- Tests mild cognitive impairments.
- Measure of Executive Function: visuospatial, visual-motor tracking, sustained attention, alternating attention.

A copy of the measure
Pencil or pen
Stopwatch
TRAIL MAKING A

- 25 circles numbered from 1-25 randomly distributed over a page of letter size paper. The participant is required to connect the circles with a pencil as quickly as possible in numerical sequence beginning with the number 1.
TRAIL MAKING B

- Consists of 25 circles numbered 1-13 and lettered A-L, randomly distributed over a page of paper. The participant is required to connect the circles with a pencil as quickly as possible, alternating between numbers and letters in ascending sequence (i.e. 1, A, 2, B, 3, C...)
Alternative versions of the TMT

- Color Trails (D'Elia et al., 1996)
- Comprehensive Trail Making Test (Reynolds, 2002)
- Delis-Kaplan Executive Function Scale (D-KEFS) - includes subtests modeled after the TMT
- Oral TMT - an alternative for patients with motor deficits or visual impairments (Ricker & Axelrod, 1994).
- Symbol Trail Making Test - (Barncord & Wanlass, 2001)

From: http://strokengine.ca/
**TRAIL MAKING TEST (A & B )**

- 5 minutes is typically allowed for Part B. Participants who are unable to complete Part B within 5 minutes are given a score of 300 or 301 seconds.

**Ranges and Cut-Off Scores**

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Brain-damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMT- A</td>
<td>1-39 secs</td>
<td>40 or more secs</td>
</tr>
<tr>
<td>TMT – B</td>
<td>1-91</td>
<td>92 or more seconds</td>
</tr>
</tbody>
</table>

Adapted from Reitan (1958) as cited in Matarazzo, Wiens, Matarazzo & Goldstein (1974).
TMT: NORMS ADJUSTED FOR AGE & EDUCATION
A study of 83 community-dwelling people with MS the TMT time (B minus A to remove the motor speed element) was studied along with a series of measures of other deficits and found to be associated with frequent falls. In this study FM coordination (9 hole peg test) was significantly and independently discriminated between fallers and non-fallers.\textsuperscript{5}
The MoCA was designed as a rapid screening instrument for the detection of mild cognitive impairment.

It was developed in response to the poor sensitivity of the Mini-Mental State Examination (MMSE) in distinguishing clients with mild cognitive impairment from normal elderly clients (Nasreddine et al., 2005).

Thus, the MoCA is intended for clients with memory complaints who score within the normal range on the MMSE.
MoCA

MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

VISUOSPATIAL / EXECUTIVE

Copy cube

Draw CLOCK (Ten past eleven)
(3 points)

POUNTS

NAMING

MEMORY
Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.

FACE VELVET CHURCH DAISY RED

1st trial

2nd trial

ATTENTION
Read list of digits (1 digit/sec.). Subject has to repeat them in the forward order

Subject has to repeat them in the backward order

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥2 errors

BA C M N A J K L B A F K D E A A A J A M O F A A B

LANGUAGE
Repeat: I only know that John is the one to help today.
The cat always hid under the couch when dogs were in the room.

Fluency / Name maximum number of words in one minute that begin with the letter F

ABSTRACTION
Similarity between e.g. banana - orange = fruit

DELAYED RECALL
Has to recall words with no cue

OPTIONAL

Category cue

Multiple choice cue

ORIENTATION

POINTS

Date

Month

Year

Day

Place

City

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www.mocatest.org

Administered by:

TOTAL

ADD 1 point if ≤12 yr edu

POINTS

ADMINISTRATION

Version 7.1

Examiner

December 20, 2019

Score: 26

Add 1 point if ≤12 yr edu
One study suggests that cognitive and physical functions affect the risk of falls in patients with chronic hemiparetic stroke. The results of all outcome measures, including 6MWT, 10MWT, BBS, DGI (Dynamic Gait Index, MoCA, & TUG test, were significantly better in the nonfaller group than that in the faller group.

The MoCA was significantly correlated with the 6MWT, BBS, DGI, and the TUG test in the fallers group.

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MoCA & Falls Evidence

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The aim in one study was to identify cognitive tests for predicting falls in PD patients without postural instability.

The MoCA was found to be a predictor but the MMSE was not.\(^9\)
PHYSICAL THERAPY TESTS & MEASURES

- **Gait Speed**
  - 10 Meter Walk Test
  - Sustained Gait Speed – 6 minute Walk Test

- **Functional Mobility**
  - Timed Up and Go
  - Timed Up and Go with Dual Cognitive Task or Dual Motor Task

- **Other Measures Considered** –
  - BERG Balance Test
  - Functional Gait Assessment
• Fritz & Lusardi (2009) consider Gait Speed the “6th Vital Sign”
  ▪ Found gait speed to be useful to determine:
    ▪ Functional Status
    ▪ Need for rehabilitation
    ▪ Appropriate discharge location
• Factors contributing to Gait Speed
  ▪ Individual health status
  ▪ Motor Control
  ▪ Muscular Strength
  ▪ Musculoskeletal condition
  ▪ Cardiac Status
  ▪ Sensory and perceptual function
  ▪ Habitual activity level
  ▪ Cognitive Status
  ▪ Motivation
  ▪ Mental health
• Gait Speed as measured on the 10 Meter Walk Test
Red Flag - Gait Speed ≤0.6m/s

Figure 1. A collection of walking speed times that are linked to dependence, hospitalization, rehabilitation needs, discharge locations, and ambulation category.
Yellow Flag .6 m/s to 1.0 m/s
GAIT SPEED

Green Flag
≥ 1.0 m/s

Figure 1. A collection of walking speed times that are linked to dependence, hospitalization, rehabilitation needs, discharge locations, and ambulation category.
GAIT SPEED AND AGE

**Figure 2.** Self selected walking speed categorized by gender and age (6-12 and teens, 20s-50s, & 60s-80s).
GAIT SPEED AND DEMENTIA

- Those with a slower walking speed were found to be 1.5 times more likely to develop dementia over the age of 65 compared with those who were more speedy
  - Less than 1.0 m/s (Verghese)
- People with a stronger grip had a 42 per cent lower risk of stroke or a mini-stroke – known as a transient ischemic attack (TIA) – over the age of 65, although the risk was not cut at younger ages.
- Read more: http://www.dailymail.co.uk/health/article-2101736/Dementia-Fast-walking-speed-strong-grip-middle-age-help-predict-risk.html#ixzz3GdIllo7m Follow us: @MailOnline on Twitter | DailyMail on Facebook
Prior to Initiation of our pilot program fall risk was established on admission and reviewed every 2 weeks with input from PT, OT, and SP

- Objective data has historically been based on balance tests completed by PTs
- Fall history
- Clinical judgment from PTs, OTs, SPs
SUSTAINED GAIT SPEED/ 6 MIN WALK TEST

- Used to predict exercise tolerance w/ COPD
- Used to predict hospital READMISSION – If less than 200 meters/650 feet
- Determinant for level of Assistance with ADL’s
6 MINUTE WALK TEST

- Validated in Patient Populations of:
  - Alzheimer's Disease
  - Children
  - Fibromyalgia
  - Geriatrics
  - Heart failure
  - Multiple sclerosis
  - Parkinson’s Disease
  - Pulmonary disease
  - Osteoarthritis
  - Spinal cord injury
  - Stroke

- Patient’s ability to ambulate with or without an assistive device is measured over a 6 minute period – measured for distance and speed.

- Modified versions allow for physical assistance to be provided by the evaluating therapist

- Rest breaks are allowed
6 MINUTE WALK TEST

- Normative Data

<table>
<thead>
<tr>
<th>Population</th>
<th>Mean ± SD (m)</th>
<th>Range (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Cord Injury</td>
<td>205 ± 120</td>
<td>23-475</td>
</tr>
<tr>
<td>Chronic CVA</td>
<td>202 ± 88</td>
<td>N/A</td>
</tr>
<tr>
<td>Traumatic Brain Injury</td>
<td>403 ± 105</td>
<td>155-660</td>
</tr>
<tr>
<td>Lower-Limb Amputee (K0-K1)</td>
<td>50 ± 30</td>
<td>4-96</td>
</tr>
<tr>
<td>Lower-Limb Amputee (K2)</td>
<td>190 ± 111</td>
<td>16-480</td>
</tr>
<tr>
<td>Lower-Limb Amputee (K3)</td>
<td>299 ± 102</td>
<td>48-475</td>
</tr>
<tr>
<td>Lower-Limb Amputee (K4)</td>
<td>419 ± 86</td>
<td>264-624</td>
</tr>
<tr>
<td>Healthy Elderly Adults</td>
<td>417 ± 95</td>
<td>N/A</td>
</tr>
</tbody>
</table>
6 MINUTE WALK TEST

- Minimal Detectable Change:
  - Ranges from 33 meters (112 feet) to 84 meters (269 feet)
- Minimal Clinically Important Difference - Distance
  - 50 meters (164 feet) to 60 meters (196 feet)
- Minimally Clinically Important Difference – Speed
  - .11 m/s over the 6 minutes period
6 MINUTE WALK TEST

- Considerations:
  - Time and distance to complete ADL’s
  - Time and distance that patient can safely sustain the activity
  - Comparison to the 10 Meter Walk Test – is there a variance between the gait speed placing the patient at risk for an adverse health event – or a fall?
  - Consider MS – Exacerbations
  - Consider Energy Expenditure after ADL’s such as bathing
  - Consider mental fatigue on ability to complete motor task safely over time
The ‘timed up and go’ test (TUG) [1] is a simple, quick and widely used clinical performance-based measure of lower extremity function, mobility and fall risk. The TUG has been validated in:

- Community Dwelling elderly populations
- Parkinson’s disease (both ‘off’ and ‘on’ medication),
- Amyotrophic lateral sclerosis
- Stroke
- Orthopedic disturbances
- Spinal Cord Injury

Has been shown to be sensitive to a variety of therapeutic interventions. Has been shown to be predictive of fall risk.

**Test procedure.** Subjects are asked to stand up from a standard chair (seat height between 44 and 47 cm), walk a distance of 3 m (marked on the floor) at a comfortable pace, turn, walk back and sit down. Subjects are permitted to use routine walking aids and are instructed not to use their arms to stand up. No physical assistance is given. The time to complete the task is measured with a stopwatch.

In the Dual-TUG (Cognitive), individuals were asked to complete the test while counting backward by threes from a randomly selected number between 20 and 100.

In the Dual-TUG (Manual) it has been suggested that the client must walk holding a cup filled with water (Shumway-Cook et al, 2000, Hofheinz and Schusterschitz, 2010).
### Normative Data

<table>
<thead>
<tr>
<th>Population</th>
<th>Mean ± SD (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic CVA (Ng et al)</td>
<td>22.6 ± 8.6</td>
</tr>
<tr>
<td>Chronic CVA (de Wit et al)**</td>
<td>29.2 ± 12.9</td>
</tr>
<tr>
<td>Chronic CVA w/ AFO **</td>
<td>25.6 ± 11.7</td>
</tr>
<tr>
<td>Spinal Cord Injury+</td>
<td>36.0 ± 27.0</td>
</tr>
<tr>
<td>Transtibial Amputation (Shoppen et al)^*</td>
<td>23.1 ± 23.0</td>
</tr>
<tr>
<td>Transfemoral Amputation (Shoppen et al)^*</td>
<td>28.3 ± 12.2</td>
</tr>
<tr>
<td>Lower-Limb Amputee (Miller et al)^*</td>
<td>19.3 ± 15.1</td>
</tr>
<tr>
<td>Healthy Elderly Adults*</td>
<td>9.1 ± 1.6</td>
</tr>
</tbody>
</table>
DUAL TASK TUG

<table>
<thead>
<tr>
<th></th>
<th>Healthy Older</th>
<th>PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUG Baseline</td>
<td>9.85 (1.44)</td>
<td>16.4 (3.8)</td>
</tr>
<tr>
<td>TUG Low</td>
<td>10.77 (2.11)</td>
<td>16.5 (3.6)</td>
</tr>
<tr>
<td>TUG High</td>
<td>11.58 (2.63)</td>
<td>21.5 (7.9)</td>
</tr>
</tbody>
</table>

- Time to complete (seconds) by group and task (mean/SD):
- TUG low: low cognitive demand
- TUG high: high cognitive demand
- Maranhao-Filho et al (2011)
  - Positive predictive Value of 71% for falls in older adults undergoing TUG-Cog versus 42% for those undergoing TUG basic
- Shumway-Cook et al, 2000; \( n = 30 \); 15 fallers and 15 non-fallers; mean age of fallers = 86.2 (6.4) years; mean age of non-fallers = 78.4 (5.8)
  - High specificity (93.3%) for predicting non-fallers
  - High sensitivity (80%) in positive prediction of falls
Considerations:
- Individuals are asked to perform subtraction. Language and educational levels should be considered when applying this test.
- Shumway-Cook et al, 2000 found that the TUG, TUG (Manual) and TUG (Cognitive) were all comparable in determining the likelihood of falls in older adults. Therefore, the addition of a dual-task did not increase the sensitivity of the TUG in predicting the likelihood for falls in that study.
- The effect on the reliability of the TUG (Cognitive) has not been studied in individuals with cognitive impairments. However, Rockwood et al reports poor test-retest reliability of the TUG in individuals with cognitive impairments.
- In PD, changes in gait under dual task conditions are proportional to the complexity of the secondary task performed. (Campbell et al 2003)
- TUG-Cog is simple to administer and interpret at the bedside. In the elderly, it greatly enhances measurement of the risk of falling. It should become part of the routine neurological examination.
The TUG appears to be an appropriate tool for clinical assessment of functional mobility even in healthy older adults:

- does not suffer from ceiling effect limitations
- is normally distributed
- is apparently related to executive function.
- The BBT and the DGI do not share these beneficial properties. Perhaps the transferring and turning components of the TUG help to convert this relatively simple motor task into a more complex measure that also depends on cognitive resources.
Literature has been focused on falls in acute hospitalizations and among those with chronic disability. (reference)

Filling the gap
- Developing insight
- Experience with disability
- Emerging abilities

Identifying the need for an interdisciplinary approach to reduce fall risk
After establishing Fall Risk in our clinic: Yes or No

- A level of assist with mobility and supervision is established.

Levels of Assist:

- **Handoff:** Must always be under the responsibility of a staff member. Red bracelet worn by therapist or aid and handed off to next person as the patient’s day progresses. These are patients who are confused, lack orientation, and awareness of disability.

- **Physical assistance:** Needs assist to propel wheelchair or walk within the clinic.
Levels of assist (continued)

- Close Supervision: Needs someone close enough to correct balance to prevent fall or needs direction due to decreased vision or topographical orientation.

- Visual Supervision: Needs to be watched to ensure they get to the correct place or in the case of unexpected environmental challenge.

- Independent: Able to get from place to place within the clinic without supervision.
Pilot program has been established to test the effectiveness of a multi-disciplinary approach that uses objective data on:

- Balance
- Gait Speed
- Dual Tasking
- Global Cognitive Function
- Executive Function and visual scanning

In addition to clinical judgment and falls history
IDENTIFYING FALL RISK

- Severity of fall risk
  - High
  - Moderate
  - Low

- Roles: OT, PT, SLP
  - Outcome measures
    - OT: Trail Making Test
    - PT: TUG, Dual TUG, 10 Meter Walk, 6 Min Walk
    - SLP: MoCA
FEASIBILITY

- Outcome measures completed within 2\textsuperscript{nd} day of admission
  - 2\textsuperscript{nd} day eval
- Staff training and Implementation
  - Documentation
- Exclusion criteria
  - Language deficits
  - Vision deficits
  - Cognitive deficits
  - Safety
INTERVENTIONS

Goals:
- Increase awareness of Fall Risk
- Identify Fall Prevention as a priority
- Establish goal to prevent falls in the clinic and at home
**INTERVENTIONS: OT FALL PREVENTION GROUP**

- Introduction to the reason for the group and activities
- Fall Self Awareness Survey
- Discussion
- Red, Yellow, Green Light Activity
- Discussion
- Functional Activity involving problem solving, safety strategies
- Generation of individual fall prevention strategies
- Wrap Up.
- Communication with PT, and pt’s primary therapists
Check Your Risk for Falling (CDC)

- Yes (2)  No (0)  I have fallen in the past year
- Yes (2)  No (0)  I use a cane or walker
- Yes (1)  No (0)  Sometimes I feel unsteady when I am walking
- Yes (1)  No (0)  I steady myself by holding onto furniture when walking at home
- Yes (1)  No (0)  I am worried about falling
- Yes (1)  No (0)  I need to push with my hands to stand from a chair
Check your Risk for Falling (CDC). Continued

- Yes (1)  No (0)  I have some trouble stepping up onto a curb
- Yes (1)  No (0)  I often have to rush to the toilet
- Yes (1)  No (0)  I have lost some feeling in my feet
- Yes (1)  No (0)  I take medication that sometimes makes me feel light-headed or tired
- Yes (1)  No (0)  I often feel sad or depression

Total:  4 or more points = increased fall risk


REFERENCES FOR PT MEASURES