Abstract

Background: Premature infants with normal cranial ultrasounds remain at risk for later motor delays, which go undetected in early infancy.

• Of the 12.16% of children with developmental delay, only half will be identified by the time they enter kindergarten.

• The Test of Infant Motor Performance (TIMP) is the current gold standard infant motor assessment, but rarely used by pediatrics during well-child visits due to lack of time and special training required.

• A short, standardized screening test administered to infants in the first months of life would target early intervention to those most at risk.

• In our previous work, Rasch partial credit model was used to analyze and select 10 TIMP items with strongest correlation to motor ability at 12 months. Now we compare the performance of our scoring of these 10 items, comprising a novel screening tool, the Specific Test of Infant Motor Performance (STEP) (Figure 1).

Specific aims: Evaluate the robustness of a new, shorter, screening assessment (STEP) through factor analysis of 10 motor items, and test the STEP against current validated infant motor skills assessments and outcome measures of development.

Design: A secondary analysis of an existing cohort of 22 premature infants (24-35 weeks gestation), with video recorded motor tests at 12 weeks and 12 months corrected gestational age (CGA). (Table 1)

Methods

Measures of Outcome: The STEP score from existing video recordings of TIMP at 12 weeks CGA.

• Test of Infant Motor Performance (TIMP) at term and 12 weeks CGA.

Bayley III Scales of Infant and Toddler Development (Bayley III) at 12 months CGA, Bayley subscale scores, and Bayley average (BvA) score.

• MRI: Siemens 3T: Single voxel [15 x 15 x 15 mm] in basal ganglia (BG) and frontal lobe white matter (WM) [with PRESS sequence 128x128, TR=2000ms, TE 30ms, 270ms].

Data Analysis: Pearson’s correlation coefficient was used to relate TIMP, Bayley and STEP scores, and Bayley IV: Motor Outcomes, using EFA scores, was performed to prevent redundancy in item construction from 9 items for the EFA analysis.

Results

Sensitivity and specificity of EFA STEP scores were evaluated using predictive outcome versus actual outcomes. A drop-one-prediction evaluation was used to assess external validity.

1. Item (with arm) was unreliable to be scored by viewing ultrasound. Since the order that items were scored is randomized, 9 items were constructed from 9 items for the EFA analysis.

2. A pair of relationships exists between STEP items that evaluate head, arm, and leg movements.

3. STEP items related to head movements are likely influencing the overall score (Table 2).

Table 2. Lateont constructs of STEP using Exploratory Factor Analysis (EFA)

<table>
<thead>
<tr>
<th>Head Control</th>
<th>Upper Body</th>
<th>Lower Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull to sit</td>
<td>0.89540</td>
<td>0.25616</td>
</tr>
<tr>
<td>Prone extension</td>
<td>0.86965</td>
<td>-0.15936</td>
</tr>
<tr>
<td>Supine with no vision</td>
<td>0.58410</td>
<td>0.20399</td>
</tr>
<tr>
<td>Supine with vision</td>
<td>0.91933</td>
<td>-0.05863</td>
</tr>
<tr>
<td>Standing</td>
<td>0.81915</td>
<td>-0.43411</td>
</tr>
<tr>
<td>Supine heel kick</td>
<td>0.80238</td>
<td>0.09899</td>
</tr>
<tr>
<td>Grasp</td>
<td>0.32403</td>
<td>0.72577</td>
</tr>
<tr>
<td>Kicking</td>
<td>0.35813</td>
<td>0.48327</td>
</tr>
<tr>
<td>Rolling with leg</td>
<td>0.47593</td>
<td>0.11573</td>
</tr>
</tbody>
</table>

% variance explained 66% 20% 12%

The STEP is quick and easy to administer and score and requires minimal training of healthcare professionals.

The 10-item STEP at 12 weeks showed a much stronger correlation than the concurrent Guttman timp (Bayley) at 12 months.

Early motor skills about to appear and evidence of subtle brain injury. Preliminary analysis of the STEP scores showed correlations to key biomarkers.

The STEP demonstrated good psychometric properties and predictive abilities for infant developmental outcomes at the Bayley 12 month assessment.

The motor items of STEP were grouped into three meaningful latent constructs which show a pattern of relationships between motor movements which are predictive of neurodevelopment. Early head movements, patterns of standing, kicking, and visual responses may be sensitive to discriminate differences between typical and at-risk infants interact with people and objects in their environment.

Discussion

Though our numbers are small, the strength of the associations are encouraging and provide strong pilot data and proof of concept for potential validity of the STEP assessment.

This is a preliminary analysis of the psychometric properties of the STEP Validation of the STEP as a clinically useful infant motor assessment requires further analysis.

Future work: currently enrolling and testing infants using a revised STEP for adequate subject to variable ratio needed to complete a more thorough factor analysis of the psychometric properties of the STEP.

References


