Accuracy of Motor Assessment in the Diagnosis of FASD

March 8, 2019
Danielle Johnston, Occupational Therapist (OT)
Erin Branton, Physical Therapist (PT)

No relationship with commercial interests to disclose
Diagnostic Clinic

- Pediatric Specialty Clinic, Camrose, Alberta, Canada

- FASD diagnostic clinic
  - Additional diagnoses
  - Recommendations

- Multi-disciplinary
Research Team

- Danielle Johnston, OT
- Erin Branton, PT
- Leah Rasmuson, OT
- Sylvia Schell, PT
- Doug Gross, Mentor (PT, PhD)
- Lesley Pritchard-Wiart, Mentor (PT, PhD)
To qualify for an FASD diagnosis:

- Confirmation of prenatal alcohol exposure (PAE)

- Evidence of pervasive brain dysfunction defined by severe impairment (2 SD or more below the mean) in 3 or more neurodevelopmental domains

Cook et al (2015)
# Canadian Guideline

## Neurodevelopmental domains:

<table>
<thead>
<tr>
<th>Domain</th>
<th>Related Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>Neuro-anatomy</td>
</tr>
<tr>
<td>Memory</td>
<td>Academic achievement</td>
</tr>
<tr>
<td>Language</td>
<td>Cognition</td>
</tr>
<tr>
<td>Attention</td>
<td>Executive function</td>
</tr>
<tr>
<td>Affect regulation</td>
<td>Adaptive behavior, social skills or social communication</td>
</tr>
</tbody>
</table>

Cook et al (2015)
OT and PT Role

- Fine, gross and visual motor skill evaluation
- Physical and neurological exam
- Impact on function
- Recommendations
Motor Domain

2015 Canadian guideline:

- recommends using either total motor scores or multiple subtest scores of motor assessments

Cook et al (2015)
Background
Background Literature

Recent literature indicates:

• Fine and gross motor scores should be considered separately

• Use of subtest scores in motor evaluation

• Complex motor skills more likely to be impaired than basic
<table>
<thead>
<tr>
<th>Guideline</th>
<th>Diagnostic terms</th>
<th>Cut-off score to indicate a severe impairment</th>
<th>Total scores or subtests</th>
<th>Evidence of pervasive brain dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Guideline (Cook et al. 2016)</td>
<td>FASD with Sentinel Facial Features, FASD without Sentinel Facial Features</td>
<td>-2SD</td>
<td>Composite score or multiple subtest scores</td>
<td>Severe impairment in 3 or more of 10 neurodevelopment domains</td>
</tr>
<tr>
<td>Australian Guide (Bower &amp; Elliot, 2016)</td>
<td>FASD with 3 Sentinel Facial Features, FASD with &lt;3 Sentinel Facial Features</td>
<td>-2SD</td>
<td>Composite score or 1 or more major subdomain scores</td>
<td>Severe impairment in at least 3 neurodevelopmental domains</td>
</tr>
<tr>
<td>University of Washington 4 Digit Code (Astley &amp; Clarren, 2004)</td>
<td>FAS, Partial FAS, ARND</td>
<td>-2SD</td>
<td>Not specified</td>
<td>Severe dysfunction in 3 or more domains of function</td>
</tr>
<tr>
<td>Updated Clinical Guidelines (Hoyme et al. 2016)</td>
<td>FAS, Partial FAS, ARND, ARBD</td>
<td>-1.5SD</td>
<td>Not specified</td>
<td>Impairment in at least 1 neurodevelopmental domain</td>
</tr>
<tr>
<td>CDC Diagnostic Guidelines (Bertrand et al 2004)</td>
<td>FAS</td>
<td>-1SD</td>
<td>Not specified</td>
<td>Deficit in 3 or more functional domains</td>
</tr>
</tbody>
</table>
Study Objectives

1. Determine the diagnostic accuracy of motor assessment tools and subtests listed in the Canadian guideline

2. Determine if a severe motor impairment can be more accurately identified by using multiple subtest scores or total motor scores

3. Investigate which cut-off is most accurate in identifying a motor domain impairment
Methods
Study Design

• Cross-sectional diagnostic study
• File review of 134 files from 2010 – 2017

• Data collected:
  o Motor assessment scores
  o FASD diagnosis or not
  o Demographics
Motor Assessment Data Collected

Movement Assessment Battery for Children, 2nd Edition (MABC-2)

- Total score
- Subtest scores
  - Manual Dexterity
  - Aiming and Catching
  - Balance

(Henderson et al 2007)
Motor Assessment Data Collected

Bruininks-Oseretsky Test of Motor Proficiency, 2\textsuperscript{nd} Edition short form (BOT-2-SF)

(Bruininks & Bruininks 2015)
Motor Assessment Data Collected

Developmental Test of Visual-Motor Integration, 6th Edition (Beery VMI)

- Visual Motor Integration
- Motor Coordination

(Beery & Beery, 2010)
Other Data Collected

- Functional activities
  - Activities of daily living (ADL)
- Printing speed
- Levels of alcohol exposure
- Scores in other areas (SLP, Psych, etc.)
Data was collected from all files of children and youth assessed for FASD between 2010-2017 at the Pediatric Specialty Clinic in Camrose, AB (n=134)

Files reviewed for inclusion and exclusion criteria

Included (n=63)
- Confirmation of prenatal alcohol exposure
- Data from all 3 motor assessments (BOT-2 SF, MABC-2 and Beery VMI-6)
- No other genetic or neurological diagnosis
- Children 6-17 years at the time of assessment
- English speaking

Excluded (n=71)
- 5 did not have confirmation of prenatal alcohol exposure
- 58 did not have data on all 3 motor assessments
- 4 had a neurological/genetic diagnosis
- 4 were outside of the age range
- 0 were not English speaking
## Data Analysis

<table>
<thead>
<tr>
<th></th>
<th>FASD diagnosis</th>
<th>No FASD diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe motor impairment</td>
<td>True +</td>
<td>False +</td>
</tr>
<tr>
<td>No severe motor impairment</td>
<td>False -</td>
<td>True -</td>
</tr>
</tbody>
</table>
Results
Prevalence of Severe Motor Impairment at -2SD

- Fine Motor: 51% Fetal Alcohol Spectrum Disorder, 5% Prenatal Alcohol Exposure, without Fetal Alcohol Spectrum Disorder
- Gross Motor: 37% Fetal Alcohol Spectrum Disorder, 25% Prenatal Alcohol Exposure, without Fetal Alcohol Spectrum Disorder
- Total Motor: 30% Fetal Alcohol Spectrum Disorder, 5% Prenatal Alcohol Exposure, without Fetal Alcohol Spectrum Disorder

Johnston et al (under review)
Functional Difficulties

Johnston et al (under review)
Accuracy of Motor Assessment

• Sensitivity/specificity values greater than 0.65 are clinically useful (Portney & Watkins, 2009)

• BOT-2-SF sensitivity was extremely low (0.02)

• Beery VMI sensitivity was higher (0.16)

• MABC-2 total motor score was statistically more sensitive than the BOT-2-SF (0.30 vs. 0.02, p <0.01)

Johnston et al (under review)
Total vs. Subtests

- MABC-2 total motor score was more accurate than any combination of subtest scores at -2SD

- Beery MC, as a single subtest, was the most sensitive (0.38) at -2SD

Johnston et al (under review)
Cut-off Scores: Optimal Accuracy Balance

- Total motor score:
  - 2\textsuperscript{nd} percentile using MABC-2 total motor (0.3/0.95)

- Multiple subtests:
  - 5\textsuperscript{th} percentile using MABC-2 MD and Beery MC (0.40/1.00)

- Single subtests:
  - 5\textsuperscript{th} percentile using Beery MC (0.68/0.90)
  - 9\textsuperscript{th} percentile using Beery MC (0.75/0.84)

Johnston et al (under review)
Discussion
Prevalence of a severe motor impairment in children with FASD:

- BOT-2SF identified 2%
- BOT-2 Complete Form identified 9.5% (Lucas et al., 2016)
- Beery VMI identified 16%
- MABC-2 total motor score identified 30%
Subtests and Cut-offs

• Support for use of Beery MC subtest in FASD assessment
  – Highest sensitivity
  – Similar findings in other research (Doney et. al, 2017)

• Use of single subtests becomes more accurate than use of total motor scores as the cut-off percentile is increased
Implications and Conclusions
Implications

Camrose Pediatric Specialty Clinic has:

• Discontinued use of the BOT-2 SF
• Continued to use the MABC-2 and Beery VMI (including Beery MC)
• Continue to assess the impact of motor deficits on daily function
Conclusions

1. BOT-2 SF is not an appropriate assessment tool when diagnosing FASD

2. MABC-2 total score is the most accurate using current Canadian Guideline criteria and it’s use should be considered by FASD clinics

3. Accuracies improved with the use of single subtests combined with less conservative cut-off scores

4. Motor skills should routinely be assessed during FASD diagnosis
Future Considerations

Further investigation is warranted on the following topics:

1. Accuracies of motor assessment tools in FASD diagnosis
2. Single subtest scores as evidence of severe motor impairment
3. Optimal clinical cut off score to indicate a severe motor impairment
4. An Activity of Daily Living (ADL) measure or questionnaire that is tailored for children with potential FASD
Acknowledgements

Funding for this project was generously provided by the

Alberta Health Services Research Challenge and

AHS Children’s Rehabilitation Services
Questions
References


