EARLY MOTOR SIGNS OF DISORDERED DEVELOPMENT IN INFANTS AND TODDLERS AT RISK FOR ASD

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Presenters
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PRESENTATION OBJECTIVES

• Overview of ASD History and current Diagnostic perspectives
• Current theories of causes of ASD with emphasis on motor pathways
• Past and current motor differences cited in literature
• Detailed discussion of postural differences, Object Manipulation and visual tracking differences
• Current assessments used for ASD Including Motor Assessments
• Need for a screening tool to capture the motor differences see in ASD
• Development of Clinical Reasoning/Screening Tool
• Results from Small pilot study
• Moving Forward…..
ASD HISTORY – BEGINNING OF THE PUZZLE

• Bleuler – Cold Mother
• Leo Kanner (45,46,47)
• Hans Asperger (47)
• Rimland 1960’s (46,45,47)
• DSM-IV (ASD DD, PDDNOS, Aspersers)
• DSM-V Current (33)
Current ASD Diagnosis

DSM-V
Focus on Social and Communication deficits-
sensory disturbances and repetitive behaviors

Motor differences are associated symptom-
odd gait, clumsiness, abnormal motor signs
(33)
AUTISM EARLY SIGNS PROPOSED CAUSES

• Autism Spectrum Disorder - prevalence 1 in 59 children (25,27)
• Brain based disorder, evident in prenatal development (2)
• Differences in connectivity
  • Cerebellum - Movement Timing/Rhythms
  • Limbic Areas - Premotor Cortex - Basal Ganglia
  • White Matter
  • Frontal to Posterior (1,2,3,4,5 & 6)
PROPOSED CAUSES OF ASD

Autism is a Neurodevelopmental Disorder with a very Heterogenous Presentation (7)

( Diagram and content adapted from Bhat et al., 2014)
EXPRESSION OF ASD

- Core Features Evolve over-time & may have different phases (30,35,42)
- Intermittent phenotypes of ASD possible (33,43)
- Differences in attentional and sensory systems seen in imaging and connectivity studies (35)
MOTOR DIFFERENCES ASD

DSM-V – Includes motor differences as associated features (33)

• Recent research pointing to movement differences in ASD being major sign vs minor associated symptom (9,12,14,29,30,34)
MOTOR DIFFERENCES RELATED TO SOCIAL BEHAVIOR

• Cerebellum
  • ASD
  • Modulation of reward circuits and social Behavior (36,37, 24)

Moderate Correlations
  Gross Motor and social Skills
  Core Stability subtest and Social Skills
  Tasks tested were ball skills ( ASD vs TD) (33,44)
CEREBELLUM & ASD ? –LINK TO MOTOR AND SOCIAL DIFFERENCES

- ASD Less activation in cerebellum
- This decreased Activation in the cerebellum may manifest as less input for unconscious movements (36,37,6)
- More Activation Seen in Frontal Areas of the Cortex – i.e. increased activity of conscious movements (36,37,24,6)
- ? Does this mean individuals with ASD have more difficulties unconscious movements and have to “think” about movements we execute unconsciously? (36,37,24,6)
MOVEMENT ANALYSIS EXAMPLE

Report in Spectrum Research news by Nicolette Aeliadt

Side by Side comparison showed difference in kinematics of gait,

* Differences seen in velocity of step and length and width of set (38,39,40,41,44)

Gait Analysis Example – High Functioning ASD-ADHD- TD-Aspergers, Low Functioning ASD
MOTOR DIFFERENCES – RELATIONSHIP TO SOCIAL & COMMUNICATION SKILLS

• Motor ability (crawling and walking) related to social skills and later communication skills in those with ASD (29,7,14,12,40,41050)

• Early motor delays were more common in high risk group vs low risk group (29,41,51)

• Communication delays shown later in 67-73% of high risk infants (44,51)

• Overall- early motor delays may be predictive of later communication delays in children at risk for ASD - (at least for one phenotype) (44,41,3,42)
FURTHER EVIDENCE
MOTOR FUNCTIONING ASD

- Gait Analysis
- EEG Findings—May predict ASD pattern
- Study using Moto Sensors to record Movement R. Wilson
  CART UCLA
  - (41,39,46,47,50)
• Standard motor measures have limitations when looking for quality or more subtle differences in child with ASD (34,41,51,52)

• There is a need for Quantitative measure to compare (EEG, Movement Sensors, Etc.) (41,52)

• Current ASD assessments and Screening tool focus mostly on social and communication features of ASD (10)
CLINICAL REASONING TOOL CATEGORIES BASED ON MOTOR SIGNS IN LITERATURE

- Gross and Fine Motor Coordination Differences
- Differences in Praxis During Sequential Tasks
- Difficulty in Simultaneous coordination between two sides of the Body
- Postural Control Deficits – Pull-to-Sit Study
- Deficits in Social motor coordination (Social Synchrony)
- Object Manipulation Differences
- Visual Attention tracking Differences) faces- Habituation to Objects
- (7,8,9,12,13,14,26,15,17,20,21,22,23)
EVIDENCE-BASED CATEGORIES OF CLINICAL REASONING TOOL

• Visual Tracking-Face/Object
• Object Manipulation
• Postural Items- Focus on Symmetry, Coordination, Balance, Righting Rx, Task
OBJECT MANIPULATION

- More Mouthing
- Less manipulation Strategies
- Doing only one play strategy with a toy
- Looking at toy only or using it not for its intended purpose
- Less finer coordination
- Poor bilateral skills
  - (20,21,22,23,29,7)

Comparison – Twins TD and ASD
POSTURAL REACTIONS/DYNAMIC WEIGHT SHIFT

- ASD relies more on proprioceptive input than visual feedback (21,53)
- Motor Planning difficulties (14,34)
- Object control difficulties (20,21,22)
- Unusual postures during walking
  - (7,8,9,12,13,20,21,23,26,29)

Typical Object Control – (https://youtu.be/ydCOCPgNe_8)
VISUAL DIFFERENCES

- Differences in visual attention
- Differences in Visual Tracking
- Pay attention to Less to Faces more to objects
- Reduced Habitation
- Social Anxiety
  - (15,16,17,18,19)
CLINICAL REASONING TOOL ITEM DEVELOPMENT

- Items were developed based on references to current motor and ASD assessments
- Items were evaluated for understanding/wording by 2 participating therapists/practice expert
- Item wording and structure based on Bayley/Peabody/tasks in research articles (i.e., Object manipulation ball item)
- Age Categories – 6-9 mo., 9-12 mo., 12-18 mo., 18-24 mo.
- Three therapists used the tool with infants on their caseload (parent permission)
- Final Sample 2 TD Infants -6 At Risk Infants-all premature –Twins, Triplets, Single
METHODS

• Design
  • Multiple single case study

• Sample
  • Convenience through agency known to investigator
    • Typically developing infants
    • Infants at high risk for atypical development
Early Motor Signs of Disordered Development
Clinical Reasoning Tool

Demographic Information
Client Name:
Client's Chronological age:
Client's Corrected age:
Therapists Initials/Place of Employment
(to please put C for Coprimus or B for Bloomingtree)
Pertinent Medical Issues:
  * Follow administration instructions for each item.
  * Illustrations to clarify are next to instructions.
  * Scoring is on the back of each card with clarifying illustrations. Indicate the proper response + or - by circling it or X it. Write any comments on the page near the scoring.
  * The last page provides a checklist of incidental observations you may observe/ask parent about if time allows. There is also more space for comments if you choose to add more information.
  * After completing one item move on to the next card and do the next item until all six are completed.
  * Follow Age guidelines at the top of the cards for scoring. There are different instructions & scoring for each age category. Follow the infant's corrected age to determine the correct category to use. If the infant you are working with is significantly involved you can score according to developmental age but please note that clearly on scoring card.
  * This is a tool meant for information gathering so there is no specific order or time limit.
  * If a child scores 0 on more than 2 out of the 6 items they are at higher risk for Disordered Development and should be targeted for more intensive bouts of motor services with outcomes centered within the skill areas of missed items.
• Postural Items Showed Greatest Difference in Performance between the two groups
• Small Sample
• Other items may also be indicative given a larger sample and/or a change of criteria to be more sensitive
## OUTCOMES BY CASE

<table>
<thead>
<tr>
<th>Corrected Age</th>
<th>Medical DX</th>
<th>Development/Corrected Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 mo 30 days (actual)</td>
<td>None Typical</td>
<td>6/6 X 100 = 100%</td>
</tr>
<tr>
<td>8 mo 22 days (actual)</td>
<td>None Typical</td>
<td>6/6 X 100 = 100%</td>
</tr>
<tr>
<td>14.5 mo.</td>
<td>Premature - Twin</td>
<td>4/6 X 100 = 67% (failed item 3, 5)</td>
</tr>
<tr>
<td>14.5 mo.</td>
<td>Premature Twin also cleft lip and G-Tube</td>
<td>4/6 X 100 = 67% (failed item 3, 4)</td>
</tr>
<tr>
<td>1 yr 1 mo 18 days</td>
<td>Premature Triplet</td>
<td>3/6 X 100 = 50% (failed item 4, 5, 6)</td>
</tr>
<tr>
<td>1 yr 1 mo 18 days</td>
<td>Premature Triplet</td>
<td>3/6 X 100 = 50% (failed item 3, 4, 5)</td>
</tr>
<tr>
<td>1 yr 1 mo 18 days</td>
<td>Premature Triplet</td>
<td>3/6 X 100 = 50% (failed item 4, 5, 6)</td>
</tr>
<tr>
<td>19 months</td>
<td>Born 28 weeks 1lb 10 oz.</td>
<td>5/6 X 100 = 83% (failed item 4)</td>
</tr>
</tbody>
</table>

**12-18 month items**

In supported stance, 3-pulling apart pop-beads : 4-throwing ball forward : 5-reaching with trunk rotation
6-standing with some support
REFLECTION AND FUTURE DIRECTIONS

• CRTDD Development for ASD difficult due to hererogeneity of ASD
• Qualitative Information About Posture will be Focus Moving Forward
• Age Category Challenge
• Information used in Parent Pamphlet
• Expand use to broad Early Intervention Team
• Tool use Refinement-Expansion?
QUESTIONS??????

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• 41. Webinar – The importance of Motor Function and physical Activity in Autism Spectrum Disorder-In this webinar, Rujuta Bhatt Wilson, M.D. and Shafali Spurling Jeste, M.D., discuss an overview of what we know about motor function and impairments -https://youtu.be/nJIVChOpVhk


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• 54. Learn the Signs Act Early CDC Milestone tracker –WWW.CDC.Gov <a href="https://www.cdc.gov/ncbddd/actearly/milestones-app.html" title="CDCs Milestone tracker app"> CDCs Milestone tracker app </a>