GAIT SYMMETRY IN CHILDREN WITH AUTISM

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INTRODUCTION

Autism is a developmental disorder that is typically characterized by impaired social interactions and communication, and restricted, repetitive, and stereotyped patterns of behaviour [1]. Autism is often associated with movement impairments including motor asymmetry [2,3]. Most studies examining gait asymmetry in autism have focused on infants and toddlers and have tended to use subjective methods of evaluating movement. No previous studies have examined gait symmetry in older children with autism using objective motion capture systems. The purpose of this study was to quantify gait symmetry in children with autism versus age-matched controls.

METHODS

Fourteen children (n=14) aged 5 to 9 years with Autism Spectrum Disorder were recruited to participate in the study (mean age = 5.9 yrs; mean height = 120.06 cm; mean weight = 28.67 kg). Children diagnosed with Asperger’s or Otherwise-Non Specified Disorder were excluded from the study. Previously published control data was used for data comparisons (Chester et al., 2006) and consisted of twenty-two (n=22) children aged 5-9 years (mean age = 6.2 yrs; mean height = 119.42 cm; mean weight = 28.66 kg). Ethical approval for this study was obtained from the University of New Brunswick Research Ethics Board. An eight camera Vicon MCam motion capture system (Oxford Metrics Group Ltd., UK) tracked the three-dimensional trajectories of reflective markers placed on the subjects’ skin at a sampling frequency of 60Hz. Twenty reflective markers were placed directly on the skin of each participant in accordance with Davis et al. (1991). Children were then encouraged to perform at least 20 trials, if possible.

Data was exported from the Vicon software to Matlab (Mathworks Inc.) for processing. The temporal-spatial variables computed in this study were 1) cadence (steps/min), 2) stride length (m), 3) swing time (s), 4) stance time (s), 5) double stance time (s), and 6) swing/stance ratio. For each temporal-spatial measure (TS), six measures of symmetry were computed.

1) Symmetry Ratio (ratio): ratio = TSright/TSleft

2) Symmetry Index Average (SIavg):

3) Symmetry Index Left (SIleft):

4) Symmetry Index Right (SIright):

5) Symmetry Angle (SA):

6) Gait Asymmetry (GA):

$$GA = |100 \times \ln(TS_{right}/TS_{left})|$$

Significant ($P<0.05$) differences in mean temporal-spatial parameters and mean symmetry indices between the control and autism groups were tested using a MANOVA. All statistical tests were performed using SPSS (SPSS Inc).

RESULTS

Descriptive data for the six temporal-spatial measures for the autism and control group are provided in Table 1. No significant differences in mean walking velocity were observed between groups. No significant differences ($P>0.05$) in mean temporal-spatial data or mean symmetry indices were found between the autism group and the age-matched controls.

DISCUSSION & CONCLUSIONS

No previous studies have examined gait symmetry using motion capture in older children with autism. While studies of movement in infants and toddlers have revealed asymmetries, this study found no significant differences in temporal-spatial data or symmetry indices between the autism group and the age-matched controls. Future work should use larger sample sizes to validate the findings in the present study. Additional studies should also focus on different biomechanical inputs to the gait symmetry indices, including kinematics and kinetics. A greater awareness of movement deviations could be beneficial for treatment planning in children with autism.

REFERENCES


Table 1: Descriptive data for the six temporal-spatial measures for the autism and control group

<table>
<thead>
<tr>
<th>Group</th>
<th>Cadence (steps/min)</th>
<th>Velocity (m/s)</th>
<th>Stride Length (m)</th>
<th>Swing Time (s)</th>
<th>Stance Time (s)</th>
<th>Double Stance Time (s)</th>
<th>Swing/Stance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>129.11</td>
<td>101.82</td>
<td>0.95</td>
<td>0.38</td>
<td>0.57</td>
<td>0.19</td>
<td>0.68</td>
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<tr>
<td>Autism</td>
<td>134.27</td>
<td>99.89</td>
<td>0.90</td>
<td>0.36</td>
<td>0.56</td>
<td>0.20</td>
<td>0.65</td>
</tr>
</tbody>
</table>