Gait analysis in ankylosing spondylitis

L Zebouni, P S Helliwell, A Howe, V Wright

Abstract
A study was conducted to compare the gait pattern of 12 patients with ankylosing spondylitis with axial disease only with that of 11 healthy controls using a telemeterised electrogoniometer gait analysis system. The reproducibility of the gait variables was found to be acceptable. Angles for movement at the hip and knee were less in patients with ankylosing spondylitis, but hip/knee angle ratios did not differ between the two groups. The stride length was shorter in the patients with ankylosing spondylitis. These findings are due to the increased rigidity of the spine, which results in decreased shock absorption and consequently a more cautious gait pattern in the absence of clinically and radiologically detectable peripheral joint disease.


In a previous study of the effect of vibration on the spondylitic spine we noted the abnormal gait of patients with ankylosing spondylitis in that they 'walked gingerly'. It was therefore decided to examine the gait of such patients qualitatively and quantitatively and to compare it with normal control subjects using apparatus previously designed in this department for gait analysis. This type of investigation has proved useful in patients with Paget's disease, where patients had a slower gait with decreased cadence compared with controls. The findings were similar to those obtained in a study by Murray et al., in which patients with unilateral hip disease (osteoarthritis or avascular necrosis) had a gait pattern similar to those with Paget's disease.

Table 1 Coefficients of variation for hip and knee angles in control subjects

<table>
<thead>
<tr>
<th>Angle measured</th>
<th>Coefficient of variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right hip range</td>
<td>5.8</td>
</tr>
<tr>
<td>Left hip range</td>
<td>7.8</td>
</tr>
<tr>
<td>Right hip flexion</td>
<td>8.0</td>
</tr>
<tr>
<td>Left hip flexion</td>
<td>9.9</td>
</tr>
<tr>
<td>Right knee range</td>
<td>6.5</td>
</tr>
<tr>
<td>Left knee range</td>
<td>7.1</td>
</tr>
<tr>
<td>Right knee flexion</td>
<td>9.1</td>
</tr>
<tr>
<td>Left knee flexion</td>
<td>10.6</td>
</tr>
</tbody>
</table>

Patients and methods
Eight men and four women with ankylosing spondylitis, diagnosed using the New York criteria and aged between 30 and 35 years, were tested. Patients with clinically or radiologically detectable disease of the hip were excluded. An age matched control group of nine men and two women was also studied. The MIE gait analysis system was used, which measures hip and knee angles by electrogoniometers attached to the hips and knees. Contact time, stride length, and stride frequency were also recorded. The readings were relayed by a transmitter attached to a belt into a data analysis system which gave a digital and graphic display of the readings at each gait cycle. A minimum of two strides was used to calculate the mean of the data. Reproducibility studies were carried out using three stride lengths. This method of gait analysis needs the minimum of training, is easy to operate, and is practical to use in a general ward. The procedure took 50-60 minutes. At the end of the procedure the patient was disconnected from the measuring apparatus and timed while walking a short distance to calculate the stride length. The data were obtained during level walking.

STATISTICAL METHODS
The UNISTAT III package was used to calculate the mean, median, standard deviation, and significance (two tailed probability) using the Mann-Whitney U test.

Results
The median age for the control subjects was 39-5 years (range 26-60 years) and for the patients 46-5 years (28-70 years). The median duration of ankylosing spondylitis was 14 years (range 6-47 years). The coefficients of variation for the angular measurements were acceptable (table 1). The figure shows an example of a Grieve diagram relating hip and knee angles. The hip and knee angles during walking were less in the patients with ankylosing spondylitis than in normal subjects, and this was more clearly seen in the right hip than the left.

Table 2 Mean (SD) of hip and knee angles in degrees during walking in control subjects and patients with ankylosing spondylitis

<table>
<thead>
<tr>
<th>Study group</th>
<th>Right hip and knee</th>
<th>Left hip and knee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hip range</td>
<td>Knee range</td>
</tr>
<tr>
<td>Ankylosing spondylitis</td>
<td>30-2 (8-7)</td>
<td>39-9 (9-2)</td>
</tr>
<tr>
<td>Controls</td>
<td>35-5 (5-5)</td>
<td>49 (9-9)</td>
</tr>
<tr>
<td>p Value</td>
<td>0.5</td>
<td>0.05</td>
</tr>
</tbody>
</table>
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Example of Studv group spondylitis. Note: the Controls spondylitis length in Ankylosingspondylitis 3 Table groups, showing determined there rather variables The movement of frequency did (table 2). When the knee/hip angle ratios were determined there was no difference between the groups, showing that the smaller angles of movement of each joint accounted for the differences, rather than one being reduced at the expense of the other. The cycle time and frequency did not differ between the groups, but table 3 shows that the stride length was significantly (p<0.05) shorter in the patients with ankylosing spondylitis.

Discussion

The variables measured by this method of gait analysis had acceptable coefficients of variation, though some of the variation was greater for patients with ankylosing spondylitis than for control subjects. A possible source of variation between the subjects is a change in gait with age. Our subjects were reasonably well matched for age so any such differences are likely to be minimal.

The decreased angle of flexion at the knee and hip in the patients with ankylosing spondylitis and the shorter stride length, with the same frequency, explains the description of 'walking gingerly'. As patients with clinical and radiographic changes in the hips were excluded from the study, this gait is likely to be due to spinal changes. Patients did not report any pain during the procedure, so the changes are more likely to be due to spinal stiffness. Evidence suggests that a rigid spine may cause problems with balance and weight distribution due to the enhanced transmissibility of vibration. Patients with ankylosing spondylitis tend to avoid jarring and hence walk more cautiously as they feel the vibrations more prominently. These patients have a reduced ground reaction force when corrected for weight.

There are few objective functional measurements in ankylosing spondylitis. Gait analysis would be interesting to study on a longitudinal basis to determine the effects of both physical and drug treatment. It would also be of interest to evaluate the natural progression of the disease.

We are grateful to our bioengineering colleagues for their help, and to Mrs B Dibb and Mrs M Turner for secretarial help.

5 Grieve D W. A device called polgon for the measurement of the orientation of parts of the body in relation to fixed external axis. J Physiol (Lond) 1969; 201: 70.
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