THE SPINAL CANAL IN SYMPTOMATIC LUMBAR DISC LESIONS

R. W. PORTER, CATHERINE S. HIBBERT, MARGARET WICKS

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The oblique sagittal diameter of the lumbar spinal canal was measured by diagnostic ultrasound in seventy-three patients with symptomatic disc lesions, and compared with measurements from 200 asymptomatic subjects. Results suggest that the available space in the spinal canal is highly significant in the symptomatology of disc lesions, and in the patient’s response to treatment.

Following the description by Mixter and Barr (1934) of the syndrome of ruptured lumbar intervertebral disc, clinicians have shown more interest in the size of the lesion than in the available space in the spinal canal. It is increasingly recognised, however, that a disc protrusion or herniation can compromise an already narrow canal (Williams 1975; Choudhury and Taylor 1977; McCulloch 1977; Verbiest 1977). The relative importance of the size of the spinal canal in the symptomatology of the acute lumbar disc lesion has not been established because of difficulty in obtaining accurate measurement. Ultrasound measurement of the oblique sagittal diameter of the lumbar canal can now provide the opportunity to assess the significance of canal diameter in the presence of disc symptoms.

METHOD

The oblique sagittal diameter of the lumbar spinal canal was measured by ultrasound in patients with symptomatic disc lesions. They had to satisfy three or more of the criteria described by McCulloch (1977): unilateral leg pain in a typical sciatic root distribution, including discomfort below the knee; specific neurological symptoms incriminating a single nerve; limitation of straight leg raising by at least 50 per cent of normal; at least two neurological changes of muscle wasting, muscle weakness, sensory change, or hyporeflexia; and myelographic evidence of disc protrusion.

Measurements were obtained from seventy-three patients with a mean age of thirty-nine years (plus or minus eleven years). Forty-six were men and twenty-seven women. Twenty-eight patients settled with bed rest at home. Of the forty-five admitted for inpatient traction, twenty-one failed to improve and were treated surgically. The measurements were compared with those of 200 asymptomatic subjects, 100 mining recruits between fifteen and eighteen years old, and 100 nursing cadets of the same age.

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RESULTS
The measurements of the spinal canals of the 200 asymptomatic subjects are shown diagrammatically in Figure 1, with mean values, and tenth and ninetieth percentiles for miners and nurses at each lumbar level. The size of the canal at the fifth lumbar level was not related to the findings at operation. Nine patients with sequestrated discs had mean diameters of 1.28 centimetres compared with 1.27 centimetres for nine patients with disc protrusions (Table II).

Table I. Mean spinal canal measurements in centimetres

<table>
<thead>
<tr>
<th></th>
<th>200 asymptomatic subjects</th>
<th>73 symptomatic disc lesions</th>
<th>28 discs settled at home</th>
<th>24 discs settled with inpatient traction</th>
<th>21 discs treated surgically</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>1.68</td>
<td>1.57</td>
<td>1.60</td>
<td>1.52</td>
<td>1.58</td>
</tr>
<tr>
<td>L2</td>
<td>1.64</td>
<td>1.52</td>
<td>1.56</td>
<td>1.47</td>
<td>1.52</td>
</tr>
<tr>
<td>L3</td>
<td>1.60</td>
<td>1.42</td>
<td>1.45</td>
<td>1.41</td>
<td>1.42</td>
</tr>
<tr>
<td>L4</td>
<td>1.57</td>
<td>1.35</td>
<td>1.38</td>
<td>1.32</td>
<td>1.33</td>
</tr>
<tr>
<td>L5</td>
<td>1.57</td>
<td>1.34</td>
<td>1.37</td>
<td>1.35</td>
<td>1.27</td>
</tr>
</tbody>
</table>

The mean values for the seventy-three patients with disc lesions are compared with the asymptomatic subjects in Figure 2, and the measurements at the fifth lumbar level are compared with the percentiles of the asymptomatic subjects in Figure 3. Fifty-five per cent were below the fifth percentile, and 68 per cent were below the tenth percentile.

There was a relationship between the size of the canal and the response to treatment. Twenty-eight

DISCUSSION
The available space in the spinal canal is highly significant in the symptomatology of disc lesions. The fact that 55 per cent of patients with disabling disc symptoms had canal measurements below the fifth percentile of asymptomatic subjects suggests that many patients with wider canals escape root involvement in the presence of disc prolapse. It is the patients with measurements less than 1.4 centimetres at the fourth and fifth lumbar levels who are at risk. The probability of failure to respond to treatment is also related to the size of the canal. The narrowest canals were recorded in the patients who required surgical treatment.

Table II. Mean spinal canal measurements in centimetres

<table>
<thead>
<tr>
<th></th>
<th>9 sequestrated discs</th>
<th>9 disc protrusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>1.62</td>
<td>1.60</td>
</tr>
<tr>
<td>L2</td>
<td>1.55</td>
<td>1.54</td>
</tr>
<tr>
<td>L3</td>
<td>1.45</td>
<td>1.41</td>
</tr>
<tr>
<td>L4</td>
<td>1.41</td>
<td>1.27</td>
</tr>
<tr>
<td>L5</td>
<td>1.28</td>
<td>1.27</td>
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</tbody>
</table>

Lumbar nerve roots will be most vulnerable to compression in a narrow canal of trefoil shape. Eisenstein (1977) recorded the trefoil shape at the fifth lumbar level in 15 per cent of spines he examined, and concluded that this was a developmental variant rather than the result of degenerative change. The pattern of measurement throughout the lumbar spine suggests that many of the canals we have measured in patients with disc symptoms are narrow canals of trefoil shape (Fig. 4). The mean oblique measurement recorded by ultrasound decreased throughout the lumbar spine in

Fig. 3
Measurements from seventy-three patients with disc symptoms compared with percentiles of 200 asymptomatic subjects.
operation. We had anticipated that the canals would be wider in patients with herniations than in those with smaller disc protrusions, but this was not confirmed in this small series.

The high incidence of narrowing in the presence of disc symptoms is probably not generally recognised, and may account for some of the poor results of operation. It is difficult to appreciate the dimensions of the spinal canal when it is examined through the usual limited exposure. Naylor (1974) records a continuation of some symptoms in 62 per cent of patients after operations for disc prolapse, and Gurdjian et al. (1961) in 71 per cent. Verbiest (1977) explored and measured the canal at several levels with a "Stenosimeter". He reported surgical failures due to unrecognised stenosis in the presence of disc protrusions.

Measurement of the spinal canal before operation offers a more rational approach to surgical treatment. In the presence of a 1.1 centimetre canal and a small protrusion, it would be unreasonable to enucleate the disc through a fenestration and risk subsequent stenotic symptoms. Decompression would be a more reasonable procedure and might perhaps be necessary at more than one level. The larger sequestration in a wider canal can readily be treated by excision of the disc alone.

The risk of developing disabling symptoms from disc protrusion is inversely related to the size of the spinal canal. It is now possible in adolescence to identify subjects at risk and to offer vocational counselling and the benefits of ergonomics to this selected group. It would be economically relevant, and offer hope of reducing a major cause of morbidity in adults.

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REFERENCES