THE INFLUENCE OF PREGNANCY ON THE DEVELOPMENT OF DEGENERATIVE SPONDYLOLISTHESIS

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Degenerative spondylolisthesis is most common at the L4/L5 level and in women. There are several possible reasons for its predilection at this site, but there is no satisfactory explanation for the predominance in women. We considered that pregnancy was a possible influence.

We reviewed the records and radiographs of 949 women and 120 men aged 50 years and over who had attended a spinal surgeon for low back pain over a five-year period. We found that women who had borne children had a significantly higher incidence of degenerative spondylolisthesis than nulliparous women (28% v 16.7%; p = 0.043). The men had a 7.5% incidence, significantly less than nulliparous women (p = 0.031). Our results suggest that pregnancy is an important factor in the aetiology of degenerative spondylolisthesis.

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Spondylolisthesis with a forward slip of one vertebra on the next with no break in the neural arch was described by Macnab (1950). Newman and Stone (1963) pointed out that there were various causes for slipping with an intact arch and first used the term 'degenerative spondylolisthesis'.

Degenerative changes within the facet joints are partly responsible for allowing forward slip (Spengler 1987), but Farfan (1980) has shown that there is also a rotatory component. The condition is four times more common in women than in men, and six times more common at L4/L5 than at L3/L4, which is the next most affected level. It is rarely diagnosed before 40 years of age (Rosenberg 1975). The reasons advanced for its location at the L4/L5 level include the more sagittal orientation of the L4/L5 facet joints in relation to the coronal placement of the L5/S1 joints (Grobler et al 1993) and the stability of the fifth lumbar vertebra which is provided by large transverse processes supported by strong ligaments and muscle attachments (Fitzgerald and Newman 1976). Another factor may be that a hypermobile L4/L5 level is associated with a low-lying iliac crest; Farfan (1980) considers that in this group of patients there is more rotational and sheer stress at this level.

No explanation has been provided for the four times greater incidence in women, but we gained the clinical impression that it was seen less often in nulliparous women and therefore decided to investigate the possible association with pregnancy.

PATIENTS AND METHODS

We made a random selection from our database of female patients with low back pain who attended a spinal surgeon's practice from 1990 to 1995. Each had completed a questionnaire which included information on the number of children which they had borne. Their plain radiographs of the lumbosacral spine were examined by the senior author (RDF) for evidence of degenerative spondylolisthesis. The level and the percentage slip (5% to 25%) were recorded. Patients with an isthmic spondylolysis and those who had had previous lumbar surgery were excluded. A control group of radiographs of 120 men with low back pain, in the same age range, was also assessed. Statistical analysis used the chi-squared test.

RESULTS

Of the 949 women assessed, 96 were nulliparous and 853 had one or more children. The men in the control group also had back pain and were well matched for age (Table I). The levels affected by degenerative spondylolisthesis are

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Age</th>
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<tbody>
<tr>
<td>Nulliparous</td>
<td>96</td>
<td>61.2 ± 6.4</td>
</tr>
<tr>
<td>Parous</td>
<td>853</td>
<td>63.1 ± 5.1</td>
</tr>
<tr>
<td>Men</td>
<td>120</td>
<td>64.1 ± 5.8</td>
</tr>
</tbody>
</table>

Table I. The number and mean (± std) age in years of the patient groups

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shown in Table II. The highest incidence was the 28% in parous women which compared with 16.7% in nulliparous women ($p = 0.043$). The 7.5% incidence in men was only half of that of nulliparous women ($p = 0.031$).

The number of pregnancies in parous women is shown in Figure 1, with the percentage incidence of degenerative spondylolisthesis for each number (Fig. 2). This shows a trend towards an increasing incidence with a greater number of pregnancies, but the difference did not reach statistical significance ($p = 0.08$).

**DISCUSSION**

Our study can be criticised because the patients were preselected by significant low back symptoms which required referral to a spine surgeon. Despite this we believe that the groups probably represent the general population fairly accurately. This is supported by our results for the relative incidence in men and women and at different lumbar levels; these are virtually identical to other published figures. The relatively large numbers which were involved in the study may also help to offset any bias.

Our results indicate that the increased incidence of degenerative spondylolisthesis in women with back pain cannot be entirely attributed to pregnancy since nulliparous women showed twice the incidence of that in men, but there was a significant increase in relation to parity. This trend did not reach statistical significance because of the relatively low numbers of women with large families.

There are many physiological changes during pregnancy, and relaxation of the pelvic and other joints is an essential and normal feature (Abramsom, Roberts and Wilson 1934). This change correlates with the levels of the hormone relaxin (Zarrow, Holmstrom and Salhanick 1955). It has been shown that parous women have significantly greater laxity than nulliparous women but after the first pregnancy laxity did not change with the number of pregnancies (Cagliari, Bird and Wright 1982). The action of relaxin is not fully understood, but it appears to increase the tissue level of collagenase (Mazouijian and Bryant-Greenwood 1978).

<table>
<thead>
<tr>
<th>Level</th>
<th>Nulliparous</th>
<th>Parous</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number (n = 96)</td>
<td>Per cent</td>
<td>Number (n = 853)</td>
</tr>
<tr>
<td>L5/S1</td>
<td>1</td>
<td>1.1</td>
<td>23</td>
</tr>
<tr>
<td>L4/L5</td>
<td>13</td>
<td>13.5</td>
<td>182</td>
</tr>
<tr>
<td>L3/L4</td>
<td>2</td>
<td>2.1</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>16.7*†</td>
<td>239</td>
</tr>
</tbody>
</table>

* difference: $p = 0.043$
† difference: $p = 0.031$
There is some evidence that the generalised effect on joint relaxation may have long-term effects, persisting for years after delivery in some women (Saugstad 1991). Joint laxity and instability are recognised as a feature of degenerative spondylolisthesis (Postacchini and Perugia 1991), and it is possible that relaxin affects the collagen of the facet joint capsules which limit rotation of the spinal motion segment (Gunzburg et al 1992). Relaxin may also affect the collagen of the annulus, again reducing the stability of the motion segment. The greater joint laxity in women than in men (Harris and Joseph 1949; Beighton, Solomon and Soskolne 1973) may be a factor in the difference in the incidence of degenerative spondylolisthesis between nulliparous women and men.

During pregnancy, the large flexion moment on the lower back is reported to be equivalent to the loads imposed on the spine of a non-pregnant woman with her trunk flexed forwards by 22° (Ostgaard et al 1993). This increase in loading of the lumbar spine may influence the development of degenerative spondylolisthesis. Rosenberg (1975) has shown that patients with an increased lordosis have a higher incidence of degenerative spondylolisthesis. It is often assumed that there is an increase in lumbar lordosis during pregnancy, but this is a misconception. Ostgaard et al (1993) have shown that carrying a child is accommodated by extension of the hips and that the lumbar lordosis does not change during pregnancy. These postural changes are therefore unlikely to account for the increased incidence of degenerative spondylolisthesis in multiparous women.

A third, and possibly the most important factor, is the effect of pregnancy in reducing the tone of the abdominal muscles (Omatsu 1957). We were unable to find any reports regarding the strength and tone of these muscles after delivery, but the senior author (RDF) has noted during anterior surgery on the lumbar spine that in multiparous women rectus abdominis is often widely separated with associated wasting of the abdominal musculature. Poor muscular tone may be a contributing factor in joint hypermobility (Beimborn and Morrissey 1988). Weak muscles may allow an increase in sheer forces on the L4/L5 joints, and lead to the rotatory deformity seen in degenerative spondylolisthesis. In support of this, it is interesting that flexion exercises to strengthen the abdominal muscles give better results than extension exercises in the conservative management of spondylolisthesis (Sinaki et al 1989).

Low back pain is common in pregnancy with a reported prevalence of 81% (Kristiansson, Svärdssudd and Schoultz 1996), but we have found no reports of specific conditions of the spine which are influenced by pregnancy. It has been suggested that scoliosis may accelerate during pregnancy, but this view is controversial. Berman, Cohen and Schwentker (1982) reported that scoliotic curves deteriorated during pregnancy in three of the eight patients who were observed. By contrast, Betz et al (1987) found no evidence that pregnancy affected the progression of scoliosis in a larger study of 355 patients.

Isthmic spondylolysis with or without slip is not affected by pregnancy (Saraste 1986), but this is not surprising because of the distinct differences: it occurs most commonly at the L5/S1 level, is more frequent in men than in women and develops in young patients (Roche and Rowe 1951).

The pathogenesis is also different; the cause appears to be the repetitive flexion-extension activity of athletes and gymnasts (Letts et al 1986).

Conclusion. The incidence of degenerative spondylolisthesis in patients with low back pain is almost twice as high in parous as in nulliparous women. The reasons are not clear, but there is a need for further research on the changes in the abdominal muscles and in the ligaments and joint capsules of the spine after parturition. This may have important implications for the development of effective methods of prevention.

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REFERENCES


