We treated 98 consecutive patients with Perthes’ disease by a unilateral brace in external rotation, flexion and abduction and a further consecutive 110 by a bilateral cast with the hips in internal rotation and abduction.

During treatment in the unilateral brace, six (6.1%) hips on the opposite side developed evidence of Perthes’ disease and one developed this after the brace had been removed. In children managed in bilateral casts, no contralateral Perthes’ disease was seen. Adequate containment of the femoral head may prevent subsequent changes in the opposite hip.

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The incidence of bilateral Perthes’ disease has been reported to vary between 6.3% and 17.2%. Containment of the femoral head within the acetabulum has been the main principle of treatment since Eyre-Brook first described the concept. Various methods of containment have been suggested, including bilateral bracing and the use of a unilateral orthosis. The effect of these treatments on the opposite hip has not been studied in detail. We have assessed this in two centres, one of which used unilateral orthoses and the other bilateral containment.

PATIENTS AND METHODS

The Shiga Medical Centre for Children and Kobe City General Hospital are near each other in west central Japan. We have reviewed children with Perthes’ disease from these hospitals and assessed their radiographs over a period of at least two years.

Kobe City General Hospital (KCGH). Between 1971 and 1991, 125 patients with Perthes’ disease were treated at Kobe City General Hospital (Table I). Of these, five were treated by the Scottish Rite abduction brace, four were over nine years of age and required surgical intervention because the initial radiographs showed severe involvement, three (one with bilateral disease) were in the healed phase of the disease when first examined and three were less than five years old at the time of onset and were merely observed carefully.

The remaining 110 patients (five with bilateral disease) were treated by a modification of the Petrie abduction cast developed by Tamura. This has two removable metal crossbars and holds both hips in 45° of abduction and 15° of internal rotation, with 10° of flexion in the knees and 20° plantar flexion at the ankles to relax the gastrocnemii (Fig. 2). The patients can stand and move about using bilateral crutches. This device provides good containment, removal...
of the crossbars allows passive exercises which are routinely performed twice daily for both hips.

At both centres all children were followed up both clinically and by radiography every three months. The orthosis or cast was discarded when reossification was seen in the anterolateral region of the head of the femur and acceptable congruity with the acetabulum confirmed.

Bilateral involvement was classified into three groups as follows:
1) patients in whom the contralateral hip was already involved at initial examination;
2) those whose opposite normal hip became involved between the application and removal of the orthosis or cast; and
3) those in whom the opposite hip developed Perthes’ disease after removal of the cast or brace.

The time of initial involvement was determined by the onset of continuous pain in the hip or limping and the interval between the involvement of both sides was recorded. The incidence of bilateral involvement in each group was compared with each other and with other results reported in the literature.

RESULTS

Of the children treated in a unilateral SPOC brace, 11 (11.2%) had bilateral involvement (Table II), of whom four (4.1%) were already affected on both sides when first
examined (group I). In six patients (6.1%) the contralateral normal hip subsequently became involved during treatment (group 2), after an average time of 15 months (11 to 23). The average period of use of the brace until this was found was seven months (1 to 11).

A six-year-old boy with a history of pain in the right hip for two months was treated by the brace for 12 months. He developed involvement of the opposite hip nine months after the brace had been removed (group 3). The average interval until bilateral involvement in the seven children in groups 2 and 3 was 16 months (11 to 23).

Of those treated by a modified abduction cast five (4.5%) had bilateral involvement at the initial examination, but no other child in this group later developed an abnormality of the contralateral side.

Statistical analysis. There was no significant difference in the distribution of background factors in the patients treated consecutively (Table I), although the duration of immobilisation in the unilateral SPOC brace (13.5 ± 3.9 months; range 5 to 25) was significantly longer than that in the modified abduction cast (9.9 ± 3.3 months; range 4 to 25; p < 0.01). Analysis of the time of onset of bilateral involvement is shown in Table II. The frequency of bilateral involvement did not differ significantly in the two methods of treatment in group-1 patients but did so in group 2 (p = 0.0098 < 0.05).

The incidence of bilateral involvement throughout the course of the disease was compared with that reported in the last 30 years (Table III). In our patients treated in the modified abduction cast it was significantly lower than in all reported results except for those of Kemp and Bolders and Kelly et al who described an incidence of 10% and 6.3%, respectively.

Although Harrison and Blakemore did not describe their method of treatment, 13.1% of their patients had bilateral disease with 9.1% detected before treatment. The latter figure corresponds to that of our series from Shiga, but is significantly different from that of the group treated at Kobe.

### Table II: Patients treated consecutively at each centre divided according to bilateral involvement by the stage of the treatment, by number and percentage

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of patients</th>
<th>Bilateral frequency (%)</th>
<th>Onset of bilaterality (%)</th>
<th>Comparison of bilateral frequency?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1</td>
<td>Group 2</td>
<td>Group 3</td>
<td>Group 1</td>
</tr>
<tr>
<td>Shiga</td>
<td>98</td>
<td>4 (4.1%)</td>
<td>6 (6.2%)</td>
<td>1 (1.0%)</td>
</tr>
<tr>
<td>Kobe</td>
<td>110</td>
<td>5 (4.5%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* see test
† not significant (p > 0.05; chi-squared and Fisher’s exact probability test)
‡ p < 0.05 (Fisher’s exact probability test)

### Table III: Frequency of bilateral Legg-Perthes’ disease according to the literature

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number of patients</th>
<th>Gender (M:F)</th>
<th>Mean age (yr)</th>
<th>Treatment</th>
<th>Bilateral frequency (%)</th>
<th>Onset of bilaterality (%)</th>
<th>Comparison of bilateral frequency?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kemp</td>
<td>220</td>
<td>-</td>
<td>-</td>
<td>Abduction cast</td>
<td>10.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Petrie and Blemes</td>
<td>60</td>
<td>49:11</td>
<td>7</td>
<td>Abduction cast</td>
<td>13.3</td>
<td>13.3</td>
<td>0</td>
</tr>
<tr>
<td>Fisher</td>
<td>188</td>
<td>153:35</td>
<td>6</td>
<td>Newington brace</td>
<td>13.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Brotherton and McKibbin</td>
<td>87</td>
<td>-</td>
<td>6</td>
<td>Bed rest and broomstick</td>
<td>17.2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wynn-Davies and Gormley</td>
<td>310</td>
<td>-</td>
<td>246:64</td>
<td>-</td>
<td>13.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Harrison and Blakemore</td>
<td>176</td>
<td>-</td>
<td>13.1</td>
<td>-</td>
<td>9.1</td>
<td>4.0</td>
<td>(group 2+3)</td>
</tr>
<tr>
<td>Kelly et al</td>
<td>96</td>
<td>-</td>
<td>6.3</td>
<td>Harness or sling and crutches</td>
<td>6.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bowen et al</td>
<td>411</td>
<td>337:74</td>
<td>6.3</td>
<td>Various</td>
<td>16.8</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* see text
† chi-squared test for independence
‡ compared with all of the cases treated consecutively
¶ compared with all of the cases
§ 411 patients, 445 hips; 193 hips by non-containment methods and 252 by containment therapy; 68 needed operations (30 innominate osteotomy, 34 varus osteotomy, 4 both)
Kobe by the abduction cast (p = 0.028). The results reported by Petrie and Bitenc showed that, overall, 13.3% of their patients had bilateral changes, but none developed Perthes’ disease on the opposite side when treated by the Petrie-type cast.

**DISCUSSION**

In 1971 Petrie and Bitenc considered that the unaffected femoral head never developed Perthes’ disease in children treated by the abduction method. There is no previous detailed statistical analysis of this problem, but we were able to compare the effect of different positions of the unaffected hips during treatment. None of our patients progressed to bilateral involvement after the application of the modified abduction cast. This suggests that the occurrence of Perthes’ disease may not be related to weight-bearing but to the distribution of weight on the femoral head in various positions of the hip.

An increase in the intracapsular pressure in Perthes’ disease has been thought to produce deficiency in the circulation in the femoral head. Eckerwall et al.13 and Wingstrand et al.14 suggested that effusion and the position of the hip could cause a critical situation. Vetter and Lubsen showed that elevation of the intra-articular pressure in the hip could be achieved by internal rotation with a mean pressure of 7.7 kPa in extension and neutral rotation and 36.5 kPa in extension and internal rotation. The results of continuous elevation of the intra-articular pressure by internal rotation are not known, but our patients who were subjected to an increase in pressure in the abduction cast showed a lower incidence of Perthes’ changes.

The anterolateral region of the femoral head is always involved in Perthes’ disease. From observation of spontaneously hypertensive rats, in which the clinical course resembled Perthes’ disease, Iwasaki et al.16,17 showed that the clinical course of continuous elevation of the intra-articular pressure by internal rotation is not known, but our patients who were subjected to an increase in pressure in the abduction cast showed a lower incidence of Perthes’ changes. The anterolateral region of the femoral head is always involved in Perthes’ disease. From observation of spontaneously hypertensive rats, in which the clinical course resembled Perthes’ disease, Iwasaki et al.16 showed that the clinical course of continuous elevation of the intra-articular pressure by internal rotation is not known, but our patients who were subjected to an increase in pressure in the abduction cast showed a lower incidence of Perthes’ changes.

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**REFERENCES**