INTERTROCHANTERIC OSTEOTOMY FOR OSTEOARTHRITIS OF THE HIP

A RADIOLOGICAL ASSESSMENT OF NON-COMPRESSIVE AND COMPRESSIVE METHODS

SVEN S. OLSSON, IAN F. GOLDIE and LARS K. H. IRSTAM, GOTHENBURG, SWEDEN

From the Departments of Orthopaedic Surgery II and Radiology II, University of Gothenburg

A radiological review of two groups of intertrochanteric osteotomies of the femur for primary osteoarthritis of the hip has been made. Each group originally consisted of forty-one hips. In one group a Wainwright straight V-spline without compression had been used for fixation, and in the other group an AO angled plate with compression. The time for bony union was equal in the two groups but the incidence of non-union was lower in the AO group. Regression of cysts and of bone sclerosis was more frequent in the Wainwright group, possibly as a consequence of the greater medial displacement and varus angulation.

With the advent of total replacement in the treatment of osteoarthritis of the hip and with the excellent results reported of this procedure, other methods of treatment run the risk of being abandoned. From further experience of total replacement it has proved appropriate, however, that the operation should be limited to the older age groups with osteoarthritis and to younger patients afflicted with rheumatoid arthritis (Coventry 1973).

Intertrochanteric osteotomy yields such good results in osteoarthritis that in many cases it can be resorted to with confidence (McMurray 1935; Adam and Spence 1958; Pauwels 1963; Nissen 1963; Harris and Kirwan 1964; Hirsch and Goldie 1968; Coventry 1969; Gudmundsson 1970; Salenius, Langenskiöld and Österman 1971; Appel and Friberg 1972). It has been said (Detenbeck, Coventry and Kelly 1972) that the key to success lies in the precise pre-operative evaluation according to the method of Pauwels (1963) and in the use of compression for internal fixation. This is relevant to the problem of union, which was apt to fail before compression methods were employed. According to Holst-Nielsen, Schousbo and Sørensen (1972), quoting Jerre and Tilling (1969), there was a non-union rate of 9-5 per cent in 827 osteotomies although different osteosynthesis materials had been used. The former reported on their technique with the MacLaughlin instrument used in compression. Of 186 cases, 153 united in three months and thirty-two united in four to seven; in a single case union was not obtained until revision was performed.

In previous papers we have described in detail the results in a series of 102 patients with the osteotomy internally fixed without compression (Hirsch and Goldie 1968, 1969; Hirsch, Goldie and Ryba 1972; Goldie, Andersson and Olsson 1973). The incidence of pseudarthrosis was 13 per cent.

In order to improve the internal fixation the AO compression method has been used since 1967 over a period of five and a half years. We have therefore found it of interest to detect any difference in the rate of union for the two methods. The times of healing, namely the times taken for bone trabeculae to fill the whole osteotomy gap, have been estimated and compared.

A comparison between the two methods has also been made with regard to the fate of osteoarthritic cysts and sclerosis, both in the femoral head and in the acetabulum. A number of previous radiological studies have shown that after osteotomy cysts may decrease and sclerosis become less.

MATERIAL

The material consisted of two groups of patients, one operated on according to the original Wainwright procedure without compression and the other by the AO compression technique. All the cases selected were classified as primary coxarthrosis and the ages at operation were comparable.

Wainwright group—There were forty-one osteotomies in thirty-seven patients, but because of missing radiographs nine operations in eight patients were excluded, leaving thirty-two osteotomies in twenty-nine patients for survey. Seventeen were women and twelve men; two women and one man had bilateral operations. The mean age was fifty-nine years, with a range of forty-one to sixty-eight years.

AO group—There were forty-one osteotomies in thirty-six patients. One hip was excluded because of missing radiographs, leaving forty hips in thirty-five patients, twenty-seven women and eight men. Four women and one man had bilateral operations. The mean age was fifty-nine years, with a range of forty-three to sixty-nine years.
Within each group the operative technique was relatively uniform. In the Wainwright group medial displacement of the femoral shaft ranged from 15 to 30 millimetres and varus angulation from 5 to 20 degrees (Figs. 1 and 2). Post-operative mobilisation commenced after an average of eighteen days in bed, after which walking with crutches and no weight-bearing was carried on for about fifteen days. Walking aids were as a rule discarded after five months.

In the AO group as a rule only slight medial displacement had been made, less than 10 millimetres in most cases (Fig. 3), and significant angulation, either varus or valgus, in only six of the forty osteotomies. This group stayed in bed for two or three days and walked with crutches without weight-bearing for two months.

RESULTS

Time of healing—In each case the time of healing was registered as the interval from the operation to the date at which the radiograph revealed osseous trabeculae filling the osteotomy gap. It soon became apparent that the time between each radiological examination varied considerably. In only half the cases was this interval four months or less; the mean time of healing was then found to be 5.8 months in the Wainwright group and 5.4 months in the AO group. If we consider all cases which healed without revision, the mean time of healing was eight months in the Wainwright group and nine months in the AO group. Figures 4 and 5 indicate the respective percentages of osteotomies that had united at various times up to twelve months.

Non-union—In the Wainwright group there were five cases of non-union and in the AO group one. All six patients were subjected to further operation.

Joint space—A possible increase of joint space following osteotomy has not been looked for as it has previously been demonstrated that an increase cannot be regarded as a sign of regression of the osteoarthritic process (Robins and Piggot 1960). In our opinion, when narrowing of the joint space is used as an index of an osteoarthritic process the patient should be examined weight-bearing. In the present series no such procedure has been carried out.
Osteophytes—The presence of osteophytes was recorded; no remarkable variations were seen.

Cysts and sclerosis—Radiographs at the time of operation have been compared with those taken two years later with regard to the number of cysts and density of sclerosis (Figs. 6 to 8). The time of two years was selected as Nissen (1960, 1963, 1966) has ascertained that nearly all the regression of the osteoarthritic changes occurs during the first year after osteotomy. The changes in the presence of cysts and sclerosis have roughly kept the same pace.

For the Wainwright group the mean time interval was twenty-eight months (five months to eight years; only three cases over four years); for the AO group it was twenty months (two months to four years).

The difference in observation time between the two groups depended on the difficulty in obtaining films acceptable for comparison. During our study, however, we noted that signs of regression of osteoarthritic changes became apparent after two to three months and became maximal at six to twelve months. The difference in observation time between the two groups is therefore of no consequence.

The results are seen in Tables I and II, where the changes in the femoral head and in the acetabulum have been recorded separately.

### DISCUSSION

In the two series compared the incidence of non-union was higher in the Wainwright than in the AO group. This is not surprising as the fixation no doubt is considerably better when compression is used. Experimental evidence has shown that the compression induced at a site of osteotomy is maintained for about two months, with a very slow decline in the compressive forces (Perren et al. 1969). The early mobilisation of the patients has not jeopardised the stabilisation of the osteotomy and the rate of union has been almost completely uncompromised.

From a technical point of view there is another difference between the two series. Medial displacement of the femoral shaft was much less in the AO group, giving a larger area of contact in the line of osteotomy. The stability is partly dependent on this.

The use of compression has not influenced the time of osseous healing. Apparently the biological sequence of events is not affected by compression or by the lack of it.

In the two series presented there was a difference in the influence of the osteotomy on cysts and sclerosis. As for the Wainwright group the results very much resembled those reported in other series (Osborne and Fahrm 1950; Duthie and Howe 1963; Gudmundsson 1970; Morscher

---

**TABLE I**

<table>
<thead>
<tr>
<th>Regression</th>
<th>Femoral head</th>
<th>Acetabulum</th>
<th>Femoral head and acetabulum</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 (68 per cent)</td>
<td>18 (58 per cent)</td>
<td>15 (48 per cent)</td>
<td></td>
</tr>
<tr>
<td>No change</td>
<td>6 (19 per cent)</td>
<td>10 (32 per cent)</td>
<td></td>
</tr>
<tr>
<td>Progression</td>
<td>4 (13 per cent)</td>
<td>3 (10 per cent)</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE II**

<table>
<thead>
<tr>
<th>Regression</th>
<th>Femoral head</th>
<th>Acetabulum</th>
<th>Femoral head and acetabulum</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 (34 per cent)</td>
<td>11 (32 per cent)</td>
<td>9 (26 per cent)</td>
<td></td>
</tr>
<tr>
<td>No change</td>
<td>16 (46 per cent)</td>
<td>19 (54 per cent)</td>
<td></td>
</tr>
<tr>
<td>Progression</td>
<td>7 (20 per cent)</td>
<td>5 (14 per cent)</td>
<td></td>
</tr>
</tbody>
</table>
In the AO group the results were not as satisfactory, and to explain the difference both haemodynamic and biomechanical factors have to be considered. In osteoarthritis of the hip there is an arterial hyperaemia (Trueta and Harrison 1953; Mériel, Ruffé and Fournié 1955). There is impaired venous return which contributes to expansion of the sinusoids (Hulth 1958; Phillips, Bulmer, Hoyle and Davies 1967). Dilated veins and abnormal pathways for venous drainage have been demonstrated at phlebography (Phillips 1966). After osteotomy Phillips et al. (1967) could show by phlebography that a normal pattern of venous flow was restored. In osteoarthritic hip joints Arnoldi, Linderholm and Müssbachler (1972) have demonstrated an increased intramedullary pressure in the head and neck and a venous engorgement with dilated veins carrying the blood distally into the femoral shaft. Indications were found by these authors that the aching pain at rest typical of severe osteoarthritis is caused by intramedullary hypertension. An immediate fall of intramedullary pressure after osteotomy was demonstrated by Arnoldi, Lemperg and Linderholm in 1971.

No long-term pressure measurements after intertrochanteric osteotomy have so far been done. There are indications, however, that after union of an osteotomy of the tibia for osteoarthritis of the knee the intrasosseous pressure remains low.

The events which bring about a reversal of the osteoarthritic processes are not known, but both changes in the internal environment of the bone and structural adaptation to altered mechanical stresses may be involved (Pauwels 1960; Nissen 1966; Brookes, Richards and Singh 1970). Nissen pointed out that some change of alignment is necessary to induce arrest and regression of the disorder, and also noted that in some cases of slowly increasing varus angulation because of non-union of the osteotomy remarkable regression occurred.

In the present series the Wainwright osteotomies were made with more medial displacement and angulation than the AO osteotomies, but less stability of fixation. It cannot be excluded that the intensity and duration of the vascular and haemodynamic events after osteotomy may be influenced by the amount and character of the displacement and by the method of fixation. From a biomechanical aspect, a more rigorous and radical rebuilding of trabecular bone according to Wolff’s Law may be induced when the change of position is considerable than when it is minimal.

### TABLE III

<table>
<thead>
<tr>
<th></th>
<th>&quot;Displaced&quot;</th>
<th>&quot;Non-displaced&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>9 (41 per cent)</td>
<td>14 (29 per cent)</td>
</tr>
<tr>
<td>No change</td>
<td>12 (54 per cent)</td>
<td>23 (48 per cent)</td>
</tr>
<tr>
<td>Progression</td>
<td>1 (5 per cent)</td>
<td>11 (23 per cent)</td>
</tr>
</tbody>
</table>

*"Displaced" implies medial displacement of the femoral shaft by more than 10 millimetres, or varus or valgus more than 5 degrees. The femoral head and the acetabulum have been assessed separately, giving seventy observations.

In Table III the AO group is divided into two sub-groups with regard to the degree of change of position at the osteotomy site. Radiological signs of regression of osteoarthritic changes were more prominent in the sub-group with the greater change. Table III should be compared to Table I (Wainwright material) where the results are still better and all the osteotomies were much more displaced.
REFERENCES


Coventry, M. B. (1973) Personal communication.


