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## INTERTROCHANTERIC OSTEOTOMY OF THE FEMUR WITH AO-TECHNIQUE FOR OSTEOARTHRITIS OF THE HIP JOINT

*A Clinical Follow-up Study Five Years after Surgery*

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Over the last few years the dominating position of total arthroplasties has been substantiated in the surgical treatment of osteoarthritis of the hip. Although most reports so far have dealt with primary results, information is now appearing concerning the reliability of these results over a longer period of time, giving a clearer picture of the advantages and disadvantages of total hip replacement. Charnley & Cupic (1973) report 9.6 per cent of total failures after nine to ten years' follow-up time and Chapchal et al. (1973) recommend a lower age limit of 60 to 65 years for total hip arthroplasty. The question then arises of how to treat patients in younger age groups with hip osteoarthritis causing pain and functional impairment. Charnley (1970) recommends expectation whereas others, e.g. Huggler (1971) and Detenbeck et al. (1972), advocate intertrochanteric osteotomy of the femur in these cases.

It has been shown that intertrochanteric osteotomy will bring about relief or abolition of pain in over 80 per cent of the cases (Hirsch & Goldie 1968, Gudmundsson 1970, Morscher 1971, Hansen et al. 1973) and an arrest or reversal of the osteoarthritic process may be expected in a majority of cases as shown radiologically (Osborne & Fahrni 1950, Duthie & Howe 1963, Hirsch et al. 1972). With this background it was considered essential to evaluate the clinical results of the operations performed after introduction of the AO-technique at our clinic in August 1966, and to present them with special consideration of the results of total hip replacement as well as the natural history of osteoarthritis of the hip.

## MATERIAL

The follow-up study covers the intertrochanteric femur osteotomies, performed with the AO-technique, in cases of primary and secondary osteoarthritis of the hip joint at the Department of Orthopaedic Surgery, University of Gothenburg, from August 1966 through 1968. During the end of the period the first two total hip replacements were performed at this clinic. Except for arthrodesis, which was reserved for particularly selected cases, no other operative methods were in use. The indications for osteotomy were essentially identical with those reported in an earlier material (Hirsch & Goldie 1968), with spontaneous pain as the main criterium for surgical intervention.

The number of patients amounted to 110, representing 115 osteotomies; 28 of the osteotomies had to be excluded from the follow-up study for various reasons. Eleven patients, representing 11 hips, were dead, in no case from a cause associated with the operation. Eleven hips had been re-operated with total hip replacement and should be considered in the following as failures. In addition, six patients, all operated on one side only, had to be excluded for various reasons. Two patients could not be examined because of old age and general weakness, two could not be traced, one had emigrated and one refused to appear for examination. In the re-operated cases, the records reveal that the patients have had a period of generally one to three years of relative or total relief from pain following osteotomy. As regards four of the remaining patients, information could be obtained from nursing staff and relatives. Two patients were completely free of pain in their operated hips, one was partially relieved but had pain during activity and one had pain at rest. 87 operated hips in 84 patients remained for follow-up. 30 were men and 54 women, five of whom were bilaterally osteotomized during the period. Two of the bilateral cases had been re-operated on one side with total hip replacement. 47 of the osteotomies were on the right side and 40 on the left. The age of the patients at operation ranged from 38 years and 9 months to 80 years and 10 months with a mean age of 59.7 years, the age distribution being shown in Table 1.

*Table 1. Age at operation.*

| Age (years): | 40 or less | 41-50 | 51-60 | 61-70 | 71-80 |
|--------------|------------|-------|-------|-------|-------|
| No. of hips  | 2          | 12    | 35    | 30    | 8     |

73 hips were classified as primary osteoarthritis and 14 as secondary to dysplasia (seven hips), Perthes' disease (three hips), congenital luxation, treated conservatively in childhood (three hips) and epiphyseolysis (one hip). In three cases operations had been done on the same hip before; Voss' operation, acetabuloplasty and transposition of the greater trochanter in one case each.

In the absence of a uniform pre-operative assessment of the patients' conditions, close questioning during the follow-up has completed and confirmed the information available from the patients' records to give a general picture of the pre-operative symptoms constituting the indication for the operations.

### *Pain*

In 65 cases the patients had spontaneous pain which with few exceptions was characterized as "severe" and had lasted for at least half a year. Pain usually disturbed sleep and greatly reduced physical activity. 21 patients had severe pain that appeared during walking and other activities but as a rule was relieved or disappeared during rest. The duration of these symptoms was in three cases between a half and one year and in 18 cases two years or more. Only in one case was pain insignificant, stiffness and weakness being stated as the main symptoms.

### *Range of movement*

The range of movement in the hip joint and the radiological state were not determining factors in selecting patients for operation. The wide margin of error and variations between different examiners in measuring hip joint movement precludes any reliable comparison in this respect between pre-operative data and those obtained at the follow-up examination. The majority of patients stated a slight or moderate improvement of the range of movement after the operation. In no case had it been normal before operation and in a considerable number of the cases restriction of movement was so great that with the principles of today it would have made the patients candidates for total hip replacement rather than osteotomy.

### *Radiology*

Radiological changes varied from slight narrowing of the joint space to advanced deterioration with deformation of caput and acetabulum. Most hips showed a radiologically advanced osteoarthritis with marked narrowing or complete obliteration of the joint space and with sclerosis and cysts in caput and acetabulum.

### *Walking*

To facilitate the assessment of walking, Charnley (1972) divided his material into three categories, "A" denoting unilateral hip involvement and absence of other disabilities interfering with walking, "B" bilateral hip involvement and "C" presence of some other factor contributing to the impaired function of walking. In the present series 36 patients belonged to category "A", 34 to category "B", and 14 to category "C". Of the 34 bilateral cases 19 had had both hips operated on at the time of the follow-up examination. Osteotomy on the opposite hip had been done in six cases before and in six cases after the period under discussion. Five patients had had bilateral osteotomies during the period and two of these had later been re-operated on one side with total hip replacement. The remaining two patients had been operated on the opposite side with total hip replacement and arthrodesis, respectively, as primary interventions.

### *Operative technique*

At the 87 operations included in this study different types of AO-angulated plates have been used, the angle varying from 90° to 120°. In all plates the difference in level between the vertical leg and the base of the upper leg was 10 mm, thus confining the medial displacement of the femoral shaft to 10 mm provided

the plate was optimally placed. Medial displacement only was carried out in 36 cases and a wedge was removed in 51 cases to achieve angulation in the case of contracture or to provide maximal congruity between the cut surfaces. In 46 cases the base of the wedge was directed medially and in five cases laterally or anteriorly. The height of the base varied from a few millimetres to  $1\frac{3}{4}$  cm, in most cases it was about  $\frac{1}{2}$  cm. In six cases, because of adduction contractures, a tenotomy of the ileopsoas tendon was also done. Compression of the osteotomy using the AO-compression device was consistently carried out. Permanent suction drainage was always used for one to two days postoperatively. In one case the internal fixation was supplemented with a plaster cast for six weeks and the patient was confined to bed for three months. All other patients were mobilized after an average of five days in bed and walked with the aid of two crutches without weightbearing for two to three months.

#### *Time of healing and rate of pseudarthrosis*

Radiological signs of healing were established and full weightbearing was allowed in all cases except four after an interval from the time of operation ranging from three to seven months. In two of these four cases, spontaneous healing took place after nine months and two years, respectively, and in the other two cases pseudarthrosis developed, requiring re-operation. Union was ultimately achieved after one year and four months in one case and two years and nine months in the other.

#### *Early complications*

Complications during the early postoperative course were diagnosed in ten patients. Four cases of crural thrombosis and two cases of suspected pulmonary embolism were treated for a few weeks with anticoagulants and no residual symptoms appeared. Two superficial infections healed after antibiotic treatment for two weeks. One case of deep infection occurred and was not cured until the fixation instrument was removed eight months after the osteotomy. Union of the osteotomy took place at the normal time. In one case an adduction contracture developed postoperatively and was treated with adductor tenotomy four months after the osteotomy with a satisfactory and permanent result.

#### *Removal of fixation instruments*

In addition to the two pseudarthroses, the fixation instruments have been removed in 25 cases, owing to infection in one case and local pain or tenderness in the rest. The time interval from the osteotomy to the removal varied between six months and five years with an average of two years.

### METHOD OF INVESTIGATION

The follow-up examination took place from August through December in 1973. The follow-up times varied between four years and eleven months and seven years and two months, the mean follow-up time being five years and eight months. The questioning and examination were based upon the numerical rating system for

*Table 2. Assessment of pain at follow-up 5 years after intertrochanteric osteotomy with the AO-technique in 87 hips, compared with an earlier series of intertrochanteric osteotomies (Goldie et al. 1973) and to one of total hip replacements (Patterson & Selby Brown 1972).*

| Pain                                                                                   | Points | Present series |      | Goldie et al.<br>1973* | Patterson &<br>Selby Brown<br>1972† |
|----------------------------------------------------------------------------------------|--------|----------------|------|------------------------|-------------------------------------|
|                                                                                        |        | No. of<br>hips | %    | %                      | %                                   |
| Severe, spontaneous                                                                    | 1      | 7              | 8.0  | 16                     | 2.7                                 |
| Severe on attempting to walk.                                                          |        |                |      |                        |                                     |
| Prevents all activity                                                                  | 2      | 4              | 4.6  | 2                      | 5.5                                 |
| Tolerable, permitting limited activity.                                                | 3      | 12             | 13.8 | 15                     | 13.3                                |
| Only after some activity.                                                              |        |                |      |                        |                                     |
| Disappears quickly with rest.                                                          | 4      | 24             | 27.6 | 15                     | 21.5                                |
| Slight or intermittent. Pain on starting to walk but getting less with normal activity | 5      | 16             | 18.4 | 5                      | 28.0                                |
| No pain                                                                                | 6      | 24             | 27.6 | 47                     | 29.0                                |
| Mean value, points                                                                     |        | 4.3            |      | 4.3                    | 4.5                                 |

\* Intertrochanteric osteotomies, 81 cases.

† McKee-Farrar total hip replacements, 368 cases.  
(Decimals of original are rounded off).

assessment of results after hip joint surgery described by Merle d'Aubigné & Postel in 1954 and modified by Charnley in 1972. The examiner had not been engaged in the operation or after-treatment of any of the patients.

## RESULTS

In Tables 2-4 the results with reference to pain, range of movement and ability to walk are presented, together with corresponding data from a follow-up examination of 81 osteotomies made before the AO-technique came into use (Goldie et al. 1973) and from a representative material of total replacements, including 368 operations with the McKee-Farrar technique (Patterson & Selby Brown 1972). The mean observation times in these series were 8.7 and 1.4 years, respectively, and both have been assessed according to the same rating system as the present series, thus providing a condition necessary for comparing the results (Andersson 1972).

In the present series all patients who stated spontaneous or more or less continuous pain have been rated as Grade 1, considering the

*Table 3. Assessment of total range of movement at follow-up 5 years after intertrochanteric osteotomy with the AO-technique in 87 hips, compared with an earlier series of intertrochanteric osteotomies (Goldie et al. 1973) and to one of total hip replacements (Patterson & Selby Brown 1972).*

| Range of movement, degrees | Points | Present series         |    |              |    | Goldie et al. 1973† | Patterson & Selby Brown 1972§ |
|----------------------------|--------|------------------------|----|--------------|----|---------------------|-------------------------------|
|                            |        | Opposite hip Cat. A+C* |    | Operated hip |    |                     |                               |
|                            |        | No.                    | %  | No.          | %  | %                   | %                             |
| 0- 30                      | 1      | —                      | —  | 8            | 9  | 7.5                 | 1.6                           |
| 31- 60                     | 2      | —                      | —  | 12           | 14 | 16                  | 1.9                           |
| 61-10                      | 3      | —                      | —  | 18           | 21 | 32                  | 7.3                           |
| 101-160                    | 4      | 4                      | 8  | 41           | 47 | 33                  | 56.3                          |
| 161-210                    | 5      | 27                     | 54 | 8            | 9  | 7.5                 | 27.7                          |
| 211-260                    | 6      | 19                     | 38 | —            | —  | 4                   | 5.2                           |

\* Category "A" = unilateral hip disease. Category "C" = unilateral hip disease plus other disorder impairing walking.

† Intertrochanteric osteotomies, 81 cases.

§ McKee-Farrar total hip replacements, 368 cases.  
(Decimals of original are rounded off).

*Table 4. Assessment of ability to walk at follow-up 5 years after intertrochanteric osteotomy with the AO-technique in 87 hips, compared with an earlier series of intertrochanteric osteotomies (Goldie et al. 1973) and to one of total hip replacements (Patterson & Selby Brown 1972).*

| Ability to walk                                                                                   | Points | Present series |    |         |    | Goldie et al.<br>1973† | Patterson &<br>Selby Brown<br>1972§ |
|---------------------------------------------------------------------------------------------------|--------|----------------|----|---------|----|------------------------|-------------------------------------|
|                                                                                                   |        | Total          |    | Cat. A* |    |                        |                                     |
|                                                                                                   |        | No.            | %  | No.     | %  | %                      | %                                   |
| Bedridden or few yards.                                                                           |        |                |    |         |    |                        |                                     |
| Two sticks or crutches.                                                                           | 1      | —              | —  | —       | —  | 1                      | 3.5                                 |
| Time and distance very limited                                                                    |        |                |    |         |    |                        |                                     |
| With or without stick.                                                                            | 2      | 24             | 28 | 3       | 8  | 20                     | 24.0                                |
| Limited with one stick (less than 1 hour). Difficult without a stick. Able to stand long periods. | 3      | 12             | 14 | 4       | 11 | 26                     | 27.0                                |
| Long distances with one stick.                                                                    |        |                |    |         |    |                        |                                     |
| Limited without a stick.                                                                          | 4      | 21             | 24 | 11      | 31 | 22                     | 22.3                                |
| No stick but a limp.                                                                              | 5      | 14             | 16 | 9       | 25 | 23.5                   | 20.4                                |
| Normal                                                                                            | 6      | 16             | 18 | 9       | 25 | 7.5                    | 3.0                                 |
| Mean value, points                                                                                |        | 3.8            |    | 4.5     |    | 3.7                    | 3.4                                 |

\* Unilateral hip disease.

† and § See notes under Table 3.

*Table 5. Use of stick at follow-up 5 years after intertrochanteric osteotomy with the AO-technique in 84 patients.*

| Use of stick       | Number of patients |             | Percentage |             |
|--------------------|--------------------|-------------|------------|-------------|
|                    | Total              | Category A* | Total      | Category A* |
| Two sticks always  | 6                  | 1           | 7.1        | 2.8         |
| One stick always   | 12                 | 2           | 14.3       | 5.6         |
| One stick outdoors | 36                 | 15          | 42.9       | 41.6        |
| No stick           | 30                 | 18          | 35.7       | 50.0        |

\* Unilateral hip disease.

term "spontaneous" rather than "severe". Four of the seven Grade 1 patients claimed that pain was less pronounced than before operation and all could perform light household work or a comparable activity. Only one patient stated that pain was worse than before operation.

The range of movement represents the sum of degrees of movement in all three standard directions. For comparison the range of movement in the opposite hip is also accounted for, excluding cases with bilateral hip joint affection. The average range of movement in the operated hips was 93°. Anchylosis was found in two hips.

In Tables 4 and 5, showing walking capacity and use of walking aids, category "A" has been accounted for separately in addition to the total material.

Table 6 shows the patients' own overall evaluation of the results of the operation.

In Table 7 eight old-age pensioners are excluded. Six months' absence from work caused by the actual disease has been chosen as a limit after which the inability to work cannot be regarded as tem-

*Table 6. Patients' own overall evaluation at follow-up 5 years after intertrochanteric osteotomy with the AO-technique in 87 hips, compared with an earlier series of intertrochanteric osteotomies (Goldie et al. 1973).*

| Patients' evaluation                     | Present series |    | Goldie et al. 1973* |    |
|------------------------------------------|----------------|----|---------------------|----|
|                                          | No. of hips    | %  | No. of hips         | %  |
| Worthwhile                               | 73             | 84 | 68                  | 84 |
| Not worthwhile (10)<br>and undecided (4) | 14             | 16 | 13                  | 16 |

\* Intertrochanteric osteotomies.

*Table 7. Working capacity of 76 patients before operation and at follow-up 5 years after intertrochanteric osteotomy with the AO-technique. Eight old-age pensioners excluded from total series.*

| Before operation                                                | No. of patients | Not at work | Changed to lighter work | Returned to same work | At follow-up |              |         |           |
|-----------------------------------------------------------------|-----------------|-------------|-------------------------|-----------------------|--------------|--------------|---------|-----------|
|                                                                 |                 |             |                         |                       | Heavy        | Light mobile | Sitting | Household |
| At work or on sick list less than 6 months                      | 53              | 15          | 3                       | 35                    | 1            | 9            | 3       | 25        |
| On sick list more than 6 months or receiving disability pension | 23              | 19          | 2                       | 2                     | 1            | —            | —       | 3         |

*Table 8. Presence of hip joint contractures at follow-up 5 years after intertrochanteric osteotomy with AO-technique in 87 hips, compared with non-surgically treated osteoarthritis in 91 hips (Danielsson 1964).*

| Contractures (Degrees) | Present series, percentage |          |           | Danielsson (1964), percentage |          |           |
|------------------------|----------------------------|----------|-----------|-------------------------------|----------|-----------|
|                        | Flexion                    | Rotation | Adduction | Flexion                       | Rotation | Adduction |
| 0                      | 66.7                       | 77.0     | 97.7      | 27.0                          | 62.6     | 78.0      |
| 1-15                   | 28.7                       | 18.4     | 2.3       | 28.4                          | 13.0     | 16.3      |
| 16-30                  | 4.6                        | 4.6      | —         | 33.3                          | 19.5     | 5.7       |
| 31-45                  | —                          | —        | —         | 8.9                           | 4.1      | —         |
| 46-50                  | —                          | —        | —         | 2.4                           | 0.8      | —         |

porary, considering the nature of disease. Six patients under the heading "Not at work" had returned to work after operation for periods of at least two years but had retired at the time of follow-up, four of them for reasons other than hip joint affection.

In Table 8 the presence of contractures in the present series is accounted for together with the corresponding data from a material of non-surgically treated patients with osteoarthritis of the hip presented by Danielsson (1964).

Trendelenburg's sign was negative in 47 cases and positive or questionable in 40.

A shortening of the leg was found on the operated side in 49 of the 65 patients who had not been subjected to operation on the opposite

hip. In nine cases the leg length discrepancy amounted to 3 cm or more (maximally 5 cm), the average discrepancy being 1.2 cm.

#### DISCUSSION

When comparing the present material with others, the eleven cases that have been re-operated with total hip replacement should be taken into account as failures. On the other hand there is strong support for the assumption that the results will not deteriorate further with the passing of time (Goldie et al. 1973). Two points concerning the material deserve special attention. For the first, the operations were performed with today's osteotomy technique but with yesterday's indications for osteotomy, as the selection of patients made possible with the introduction of total arthroplasty was not possible during the period under discussion. For the second, obviously not less than three fourths of the cases in the material would have been classified pre-operatively as Grade 1 with regard to pain using the same principles for assessment as in the follow-up. This remarkably high figure can be explained by a generally restrictive attitude to surgical treatment of hip osteoarthritis in our clinic during the period under discussion, with the preference being for a conservative regimen in cases without severe spontaneous pain. The results in the present series, expressed in general terms such as "patients' own overall evaluation", are on a level with other reports of results after osteotomy. The number of totally pain-free patients, however, is remarkably small. A comparison with the report by Goldie et al. (1973) (Table 2) of an earlier operated series might give an indication of how to explain this, the only fundamental difference between the two materials being the operative techniques employed. The earlier material was operated with a technique involving a considerable medial displacement of the femoral shaft and often also a marked displacement in varus. The fixation instruments achieved a relatively incomplete stability and secondary dislocation often accentuated the varus angulation. In the present series the medial displacement in most cases has been less than 1 cm and only slight or moderate angulations have been made. The stability of the fixation has prevented secondary dislocation.

The significance of displacement and angulation in the osteotomy has been discussed by several authors. Adam & Spence (1958), Lucht & Tarp (1967) and Appel & Friberg (1973) found no evidence that the amount of medial displacement of the femoral shaft would influence

the result. Nissen (1963) noted that some change of alignment in the osteotomy appears to be essential for its effect. Harris & Kirwan (1964) found indications that a varus osteotomy would stimulate healing of the osteoarthritic process more effectively than an osteotomy without angulation or with valgus angulation. Vasey (1971) in a radiologic study including 2159 intertrochanteric osteotomies also found regression of osteoarthritic changes in a higher percentage of cases after varus osteotomies than after valgus or medially displaced osteotomies. The importance of improving joint congruity by angulation in the osteotomy with the guidance of pre-operative radiographs in different positions of abduction and adduction in the hip joint is stressed by many authors, e.g. Pauwels (1961), Blount (1964), Knodt (1964), DePalma et al. 1970), Detenbeck et al. (1972) and Grundhöfer (1973).

When comparing, in the present series, the group of 46 hips in which a varus angulation was made by removal of a wedge, with the 36 hips in which only medial displacement was made, it is found that in the former group 35 per cent and in the latter group only 19 per cent are totally pain-free. The differences within the other grades of pain, however, are not clear-cut.

To evaluate the benefit of operation, one must be able to answer the question as to what course the disease would have taken without surgical intervention. The natural history of coxarthrosis, however, has not been sufficiently studied to allow a definite answer. Danielsson (1964), studying the course of 91 non-operated cases for a ten-year period, found that two thirds reported a decrease of pain. 15 per cent of the hips were ankylosed, compared with 2 out of 87 in the present material. As indicated by Table 8, the reduction in pain in the non-operated cases was attained at the cost of a relatively large loss with regard to movement. Pearson & Riddell (1962), following the course of primary coxarthrosis in 400 patients for periods of from 4 to 15 years, found only seven hips that became painless during the period. The average time from onset of pain to almost complete loss of movement in the hip was 8 years. Regarded against this background, the results of intertrochanteric osteotomy are certainly encouraging.

#### SUMMARY

87 intertrochanteric osteotomies out of a total material of 115, performed from 1966 through 1968 with the AO-technique, have been

examined with an average observation time of five years and eight months.

Subjectively satisfactory relief of pain or total absence of pain was found in 84 per cent. The total range of movement exceeded 100° in 56 per cent. One third of the patients never used walking aids and 18 per cent walked without a limp. In two cases pseudarthrosis had developed; both healed after re-operation.

The methods of assessment employed facilitate comparisons of the results with those of other methods of surgical treatment of coxarthrosis. It appears justifiable to regard intertrochanteric osteotomy as a valuable method for surgical treatment of coxarthrosis, especially in the cases where limitation of movement is not disabling.

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