INTERTROCHANTERIC OSTEOTOMY FOR OSTEOARTHRITIS

A LONG-TERM FOLLOW-UP

H. WEISL

From the Prince of Wales Orthopaedic Hospital, Cardiff

The results of 757 intertrochanteric osteotomies for osteoarthritis of the hip carried out between 1958 and 1970 were reviewed. After osteotomy the joint space in two thirds of the hips was increased and a similar proportion experienced relief of pain lasting at least five years. However, the effect of the osteotomy declined after some ten years; only a quarter of the hips had a lasting "good result" as defined in this investigation.

The best results were obtained in active patients under 70 years of age with unilateral hip disease in which a fair range of movement had been preserved despite some shortening and where the radiographs showed loss of joint space with a break in Shenton's line. In this study a displaced osteotomy fixed with a spline emerged as the most successful surgical technique.

Ten years ago, femoral osteotomy was the most frequently performed operation for osteoarthritis of the hip; now it has been virtually abandoned. Some pathologists and surgeons have even suggested that intertrochanteric osteotomy has no appreciable effect on osteoarthritis and does not alter the natural history of the condition. Others consider that intertrochanteric osteotomy may have a place in the treatment of the younger patient and in the earlier stages of osteoarthritis (Harris and Kirwan 1964).

It was thought that an extensive retrospective survey of intertrochanteric osteotomies might answer some of the questions implicit in these views. It was therefore decided to review all the intertrochanteric osteotomies performed for the relief of osteoarthritis at the Prince of Wales Orthopaedic Hospital, Cardiff, between 1958 and 1970.

MATERIAL AND METHOD

The patients were reviewed between 1972 and 1974 and were examined clinically and radiographically. Those who failed to attend for examination were sent a questionnaire. The results in those patients who failed to attend for review and in those who had died were assessed from the notes, questionnaires and radiographs. All the results were analysed by a computer.

During the period under review 757 intertrochanteric osteotomies were carried out; in 689 of these internal fixation was used. Of the 757, 535 attended for assessment, 83 were dead (including six deaths in hospital or within one month of the operation) and 139 failed to attend for review. The number of osteotomies carried out in each of the years under review is shown in Figure 1.

The results were graded into three groups—good,

fair and bad. A result was considered good if the patient was satisfied with the operation and if the pain in the hip had been relieved for at least three years. Pain in the scar or backache were not thought to mar a good result. After a good result the patient was expected to do some form of work and to walk a fair distance, if necessary with the aid of a stick; he was not expected to have any further operation except perhaps removal of the implant, an injection or a manipulation. Bad results were those where the pain recurred within a year of the operation, when the patient was unable to work, was confined to the house or to a wheelchair, or if a further major operation on the hip was required. The remaining results were labelled fair.

RESULTS

Of the patients who attended for review (Table I) a quarter had good results and about half had bad results. The results in those who attended for the review were

Table I. Results of all operations 1958–1970

	Number of operations	Results (per cent)		
		Good	Fair	Bad
Reviewed	535	25	27	48
Did not attend	222	5	63	32
All operations	757	19	38	43

significantly better than in those who failed to attend—an observation similar to that made by Shepherd in 1960. When the results of the attenders and the non-attenders were combined then the proportion of

H. Weisl, MD, MChOrth, FRCS, 10 Greenlawns, Cardiff CF2 6AW, Wales.

good results was only one fifth of all the osteotomies. There was no significant difference in outcome between men and women, nor between patients under 60 years of age and those aged 60 to 70. However, osteotomy declined in effectiveness when performed on patients over 70 years of age; this conflicts with the findings of an extensive review by Schmied and Kaufman (1971). The effectiveness of osteotomy also declines with the length of time since the operation (Fig 1); the hips reviewed within ten years of operation (after 1962) had better results than those in which the interval was longer.

secondary arthritis; this does not agree with the findings of Hooper (1971) and Schmied and Kaufman (1971) who reported worse results in primary chronic polyarthritis, protrusio acetabuli, Paget's disease and avascular necrosis.

Personal details. Patients who were working—particularly those still capable of heavy manual work—responded better to osteotomy with internal fixation than those who were totally disabled by their pain or those who had retired. Similarly, those able to walk out of doors did better than those who were confined to the

Fig. 1

The number of intertrochanteric osteotomies performed each year, the percentage that were fixed by splines and the percentage of good results obtained.

In nearly half the hips (49 per cent) relief from pain was experienced immediately after the operation; in another 21 per cent relief occurred within a year of the operation. In two thirds of the osteotomies the relief from pain lasted for over five years. In nine per cent of patients pain recurred after three years, in nine per cent after one year, and in nine per cent within a year of the operation. Nine per cent of osteotomies were not followed by any relief of pain. These results are almost as good as those reported from Oxford by Hooper (1971) in a much smaller series fixed with Müller-Harris plates and with a much shorter follow-up.

Factors influencing results

Aetiology. The results of osteotomy were better when only one hip was affected (unilateral, good results 23 per cent; bilateral, good results 15 per cent; χ^2 (2 df)=11.38, $P<0.01$); this agrees with Shepherd's findings (1960). The response to osteotomy in primary osteoarthritis was not significantly different from that in hips with

house or to a wheelchair, and fit patients did better than those with significant cardiovascular disease. This applied equally whether the patients were under or over 70 years of age. It was perhaps this clinical observation that active, walking patients responded better to osteotomy that may have led Harris and Kirwan (1964) and Morscher (1971) to explore the suggestion that early cases might do better than advanced ones. The results which follow, however, show that patients who were able to walk and work despite their osteoarthritis did so not because their disease was at a particularly early stage but probably because they were better motivated.

Clinical data. The site of the pain and its duration before operation made little difference to the result. Hips with more than half an inch of true shortening (Table II) did significantly better than the rest of the hips. The finding that hips with abduction deformity responded badly to osteotomy was not statistically significant; however, it is of some interest when related to the observation

Table II. Results related to deformity before operation

Deformity	Percentage in each grade		
	Good	Fair	Bad
No deformity	20	27	53
Flexion deformity	18	38	44
Adduction deformity	22	36	42
Abduction deformity	11	39	50
Shortening more than 0.5 inch	29	28	43

χ^2 (2 df)=9.32, $P<0.01$

regarding shortening, since osteoarthritic hips with abduction deformities are unlikely to have true shortening. Mobile hips tended to respond better to osteotomy than hips with very restricted movements, but the difference did not reach statistically significant levels.

Radiographic appearances. Hips with a break in Shenton's line responded significantly better to osteotomy than those where Shenton's line remained intact (line intact, good 17.4 per cent; line broken, good 25.9 per cent; χ^2 (2 df)=5.81, $0.05>P>0.10$). This observation accords with the findings that hips with true shortening have better results. The presence and position of osteophytes and cysts did not affect the outcome, neither did the shape of the femoral head, not even segmental collapse. There was a trend to improved results with decreasing joint space, but this did not reach statistically significant levels; this does not quite agree with the findings of Hooper (1971) who found better results in cases where some cartilage space persisted.

The technique of osteotomy. Table III shows the results of the various techniques of osteotomy. Osteotomies which were immobilised in plaster did not do as well as

Table III. Results of various techniques

Technique	Number of cases	Percentage in each grade		
		Good	Fair	Bad
Osteotomy with plaster fixation	68	13	44	43
Spline without compression	217	25	37	38
Spline with psoas tenotomy	108	26	35	39
Spline with compression	10	30	30	40
Pin and plate	90	14	39	47
Müller-Harris plate	164	14	34	52
HJR plate*	76	16	43	41
HJR undisplaced	24	13	42	45

χ^2 (4 df)=16.1, $P<0.01$

*The HJR plate was designed by Mr Harold J. Richards in the late 1950s; its shape resembled the later Müller-Harris plate but it was not designed to achieve compression.

some of the osteotomies with internal fixation. However, this comparison incorporates a bias against plaster, since spica fixation had been favoured early in the series thus allowing an "unfairly" long period in which relapse might occur. For the remaining cases internal fixation had been preferred and plaster was used only when it proved impossible to fix the osteotomised femur in any other way. Because of this bias the results presented here (unless otherwise stated) are those following internal fixation. Table III also shows that osteotomies fixed by splines fared considerably better than those fixed by pins and plates. This conflicts with the opinion of Rosborough and Stiles (1967), who considered that variable angle nail-plates were the best method of internal fixation.

Complications. The complications encountered in this series and the effect of the complications on the end result are set out in Table IV. Fracture of the neck of the

Table IV. The effect of complications on the results of osteotomy; only those in which internal fixation was used are considered

Complications	Number of cases	Percentage in each grade		
		Good	Fair	Bad
No complications	521	20	38	42
Fracture neck of femur	10	0	50	50
Sepsis	26	15	38	47
Non-union	36	3	3	94
Sciatic nerve lesion	9	22	56	22
Fracture of implant	33	33	28	39
Other complications	50	26	38	36

femur as a complication of osteotomy is only of historical interest; this complication was eliminated by the introduction of the power saw for dividing the bone. Like non-union of the osteotomy it had a catastrophic effect on the result of operation. In this series there were 36 cases of non-union (5.2 per cent): in undisplaced osteotomies the incidence was 2.1 per cent, in those displaced less than half a diameter 5.2 per cent and in those displaced over half a diameter 6.7 per cent. This fits in neatly with the views of Scott (1967) who showed that displacement of the osteotomy was an important cause of non-union.

All methods of internal fixation were almost equally liable to be followed by non-union. The Müller-Harris plate did not eliminate non-union although, in this retrospective survey, it could not be ascertained whether it had been correctly inserted with compression; it was the only implant which did not fracture with the stress of use.

Obviously most complications affected the results of the operation adversely; the only exception was fracture of the implant, after which the osteotomy

usually collapsed into a varus position. The outcome of osteotomies with this complication was better than average and it is tempting to speculate that the abducted position of the proximal fragment favoured healing of the osteoarthritis.

Under the heading of "other complications" are included deep vein thrombosis, pulmonary embolism, pneumonia and coronary thrombosis; the total incidence was eight per cent when the osteotomies were held by internal fixation but was doubled when the osteotomies were immobilised in plaster.

Aftercare. When the osteotomies had been fixed with a spline, the operated limb was supported by Hamilton Russell traction or by a below-knee plaster cast with an antirotation bar, usually for about six weeks; in the small group of cases where support was discontinued earlier there was a significant increase in the proportion of bad results. When the osteotomies had been fixed by a pin and plate, the patients rested in bed or were immobilised on some form of traction for four weeks; in this group the duration of immobilisation did not affect the outcome of the operation. After the period of immobilisation patients were allowed up on crutches which were replaced by sticks once there was radiological evidence of union.

At review the patients were asked to estimate how long they had been incapacitated after the operation. Return to normal daily living was slow; only a third had achieved independence within six months of the operation, and a quarter took over a year to resume normal activities. Once full recovery after osteotomy with internal fixation had been achieved, 40 per cent of patients were able to walk any distance, some requiring one stick; but 10 per cent remained house-bound and one per cent were chair-bound. Almost half (48 per cent) were able to return to housework and about a quarter returned to paid employment (heavy manual work, two per cent; light manual work, 14 per cent; and clerical work, seven per cent).

Anatomy of the osteotomy. True intertrochanteric osteotomies (just above the lesser trochanter) did significantly better than those at other levels (Table V). Green (1967) stated that more proximal osteotomies had a higher incidence of non-union than intertrochanteric osteotomy, but this was not an important factor in the better result achieved by osteotomies at the "correct" level.

Displaced osteotomies had somewhat better results (Table VI) than undisplaced osteotomies, and there was a consistent trend towards an improved result with increasing displacement; similar good results in displaced osteotomies were recorded in the earlier work of Osborne and Fahrni (1950).

The changes in the angle between the neck and the shaft were found by measuring, on the radiographs before and after operation, the angle between two lines, one tangential to the femoral head and the top of the

Table V. Results related to the level of osteotomy

Level of osteotomy	Number of cases	Percentage in each grade		
		Good	Fair	Bad
Subcapital	10	0	20	80
Intertrochanteric	470	22	36	42
Through lesser trochanter	179	15	40	45
Subtrochanteric	12	0	8	92

Table VI. Results related to the amount of displacement of the femoral shaft.

Displacement	Number of cases	Percentage in each grade		
		Good	Fair	Bad
Undisplaced	95	18	34	48
Less than half the diameter	343	18	36	46
More than half the diameter	225	20	40	40
More than one diameter	3	100	—	—

χ^2 (4 df) = 3.30, not significant

greater trochanter, the other running through the mid-points of the femoral shaft (Fig. 2). The results were somewhat better in osteotomies with varus angulation, but this trend did not quite reach statistically significant levels (Table VII). These findings are similar to those of

Fig. 2

Method of measuring the neck-shaft angle.

Harris and Kirwan (1964), and of Nissen (1971) and Detenbeck, Coventry and Kelly (1972), but conflict with those who support valgus osteotomy (Wardle 1955; DePalma, Rothman and Klemek 1970). All these authors based their views on much smaller numbers than

in this present series, and did not subject their results to statistical analysis. After operation many of our osteotomies tended to lapse into varus, a finding which Green (1967) and Ferguson (1971) had also noted.

Changes in joint space after operation. Increase in the joint space after intertrochanteric osteotomy has been a subject of controversy. In this series the joint space between the most proximal part of the femoral head and the acetabular roof was measured on the films taken before and after operation (Table VIII). Surprisingly, the joint space appeared to increase immediately after operation in about one third of hips, probably because of mechanical factors. In another third the joint space increased during the subsequent 18 months, as Wardle (1955), Coventry (1969), Scheck (1970) and DePalma *et al.* (1970) had noted; this late restoration of joint

space must be due to an increased thickness of material covering the articular surfaces and indicates that osteotomy is followed by a biological reaction. The hips in which this reaction occurred had better results than any other group. Whether very early or late, increase in joint space was associated with better results; the greater the increase in joint space the greater was the proportion of good results. There was also a highly significant association between the change in joint space and displacement; in general, the greater the displacement the wider the joint space.

CONCLUSION

This investigation shows that in two-thirds of hips affected by osteoarthritis, whether primary or secondary, intertrochanteric osteotomy with internal fixation led to the relief of pain for at least five years and produced an increase in the thickness of the covering of the articular surfaces. However, the long-term results were less satisfactory; only a quarter of the hips had lasting good results. The clinical impression is that the results of intertrochanteric osteotomy were unpredictable and compared unfavourably with the results of total hip replacement.

The best response to osteotomy was found where the disease was unilateral, where the hip had retained at least 70 degrees of flexion, where there was some shortening, and where the radiographs showed some loss of joint space with a break in Shenton's line. These are hips with moderately advanced osteoarthritis; this study offers no support for the suggestion that osteotomy is particularly advantageous in the earliest stages of osteoarthritis.

The most effective operative technique involved division of the femur just above the lesser trochanter followed by displacement and internal fixation with a spline. This technique produced the greatest increase in joint space, but carried a higher risk of non-union than an undisplaced osteotomy and was not easily converted to total hip replacement.

Our results show that osteotomy is less effective in patients aged over 70 years; in them, total hip replacement is clearly better. In the younger patient, however, particularly when there has been mechanical failure of a total hip replacement, the question will arise whether he might not have been better served by an osteotomy initially, followed later by hip replacement. Unfortunately, the answer to this question is beyond the scope of this investigation.

Table VII. Results related to the change in neck-shaft angle after osteotomy

Neck-shaft angle	Number of cases	Percentage in each grade		
		Good	Fair	Bad
Into valgus by more than 5 degrees	131	16	36	48
Unchanged	236	19	35	46
Into varus by more than 5 degrees	245	24	33	43

χ^2 (4 df) = 3.33, not significant

Table VIII. Results related to changes in the joint space after osteotomy

Joint space	Number of cases	Percentage in each grade		
		Good	Fair	Bad
Increased immediately	204	21	34	45
Increased later	200	27	35	38
Increase over 2 millimetres	32	44	28	28
Increase 1-2 millimetres	208	22	36	42
Increase less than 1 millimetre	167	22	35	43
Unchanged	224	13	36	51
Reduced	12	0	50	50

χ^2 (6 df) = 16.32, $P \sim 0.01$

The author is indebted to his colleagues at the Prince of Wales Orthopaedic Hospital, Cardiff, for permission to study their patients. The cost of this research was originally borne by the Joint Clinical Research Committee of the Welsh Hospital Board and the Board of Governors of the United Cardiff Hospitals and subsequently by a grant from the Welsh Scheme for the Development of Health and Social Research; the author would like to thank Mrs M. D. V. Hart for the extensive administrative, clerical and secretarial work in connection with this review and Messrs Moulding, Morris and Page of the staff of the Computer Services Department, Welsh Health Technical Services Organisation, who prepared the data and carried out the computer work. The statistical analysis was undertaken by Mr Peter M. Sweetnam of the MRC Epidemiology Unit (South Wales).

REFERENCES

- Coventry MB. Osteotomy of the hip for degenerative arthritis. *Mayo Clin Proc* 1969;**44**:505-14.
- DePalma AF, Rothman RH, Klemek JS. Osteotomy of the proximal femur in degenerative arthritis. *Clin Orthop* 1970;**73**:109-15.
- Detenbeck LC, Coventry MB, Kelly PJ. Intertrochanteric osteotomy for degenerative arthritis of the hip. *Clin Orthop* 1972;**86**:73-8.
- Ferguson AB Jr. The pathology of degenerative arthritis of the hip and the use of osteotomy in its treatment. *Clin Orthop* 1971;**77**:84-97.
- Green JP. Union of intertrochanteric osteotomies. *J Bone Joint Surg [Br]* 1967;**49-B**:488-94.
- Harris NH, Klrwan E. The results of osteotomy for early primary osteoarthritis of the hip. *J Bone Joint Surg [Br]* 1964;**46-B**:477-87.
- Hooper JC. Intertrochanteric osteotomy of the femur for osteoarthritis using compression fixation. *Med J Aust* 1971;**2**:22-5.
- Morscher E. Multizentrische Nachuntersuchung von 2251 Intertrochanteren Osteotomien bei Coxarthrose. In: Morscher E, ed. *Die Intertrochantere Osteotomie bei Coxarthrose*. Bern, Stuttgart, Vienna: Hans Huber, 1971.
- Nissen KI. The rationale of early osteotomy for idiopathic coxarthrosis (epichondro-osteoarthritis of the hip). *Clin Orthop* 1971;**77**:98-104.
- Osborne GV, Fahrni WH. Oblique displacement osteotomy for osteoarthritis of the hip joint. *J Bone Joint Surg [Br]* 1950;**32-B**:148-60.
- Rosborough D, Stiles PJ. Non-union after intertrochanteric osteotomy with internal fixation for osteoarthritis of the hip. *J Bone Joint Surg [Br]* 1967;**49-B**:462-74.
- Scheck M. Roentgenographic changes of the hip joint following extra-articular operations for degenerative arthritis. *J Bone Joint Surg [Am]* 1970;**52-A**:99-104.
- Schmied HR, Kaufman L. Indikationen und Kontraindikationen zur Intertrochanteren Osteotomie in Bezug auf Ätiologie und Schweregrad der Coxarthrose. In: Morscher E, ed. *Die Intertrochantere Osteotomie bei Coxarthrose*. Bern, Stuttgart, Vienna: Hans Huber, 1971.
- Shepherd MM. A further review of the results of operations on the hip joint. *J Bone Joint Surg [Br]* 1960;**42-B**:177-204.
- Scott PJ. Non-union of oblique displacement intertrochanteric osteotomy for osteoarthritis of the hip. *J Bone Joint Surg [Br]* 1967;**49-B**:475-87.
- Wardle EN. Displacement osteotomy of the upper end of the femur. *J Bone Joint Surg [Br]* 1955;**37-B**:568-575.