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STABLE FIXATION IN THE INTERTROCHANTERIC OSTEOTOMY

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McMurray (1935) described the intertrochanteric osteotomy as a method of treatment for osteoarthritis of the hip joint; and ever since, this operation has had a prominent place in this respect. As fixation after the osteotomy McMurray himself used a plaster spica for 4 or 5 months. In order to escape the prolonged immobilization in a plaster spica a variety of surgical appliances have later been designed, for example, by Kessel, Bosworth, Wainwright, Tupman, McKee, Nissen, and others.

A common feature of them all is, however, that the appliances have not been able to ensure a stable fixation. As a result the number of non-unions has as a rule been quite considerable, even in the hands of those authors using quite prolonged postoperative bedrest. Various authors report the non-union rate from 3 to 28 per cent (Table 1).

The poor fixation ability of the usual type of splines results from far too insufficient support medially, within the spongious substance

Table 1. Incidence of non-union

Authors	Operations	Non-union
King & Dooley (1962)	37	3 (8 %)
Ottolenghi & Frigerio (1962)	103	6 (6 %)
Crellin & Simurda (1965)	34	6 (17 %)
Rosborough & Stiles (1967)	108	14 (13 %)
Scott (1967)	100	11–20 (11–20 %)
Green (1967)	225	7 (3 %)
Rosendahl & Ernst (1967)	60	17 (28 %)
Tillberg (1967)	97	6 (6 %)
Lucht & Tarp (1967)	57	5 (9 %)

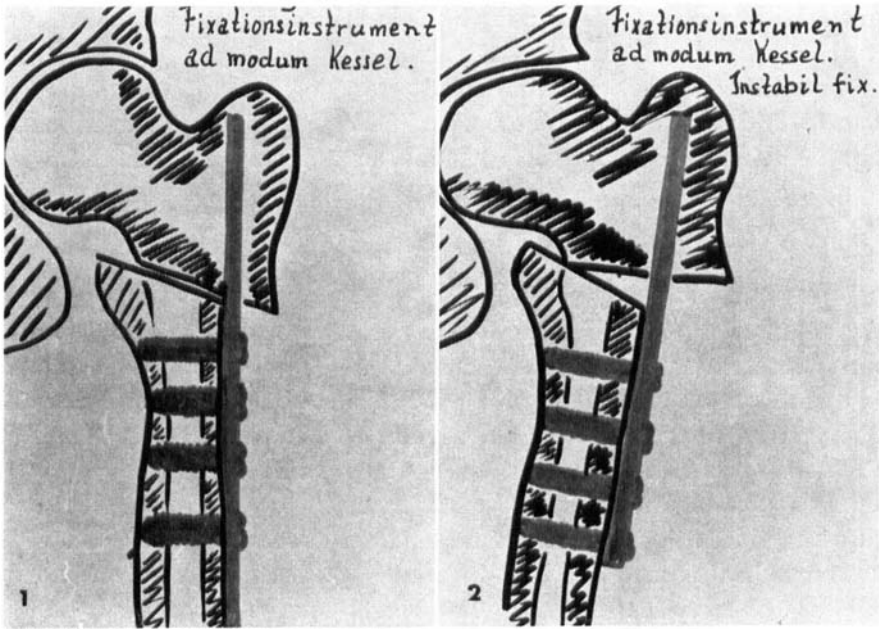

Figure 1. Intertrochanteric osteotomy fixed with a Kessel spline.
Figure 2. Varus deformity due to unstable fixation with a Kessel spline.

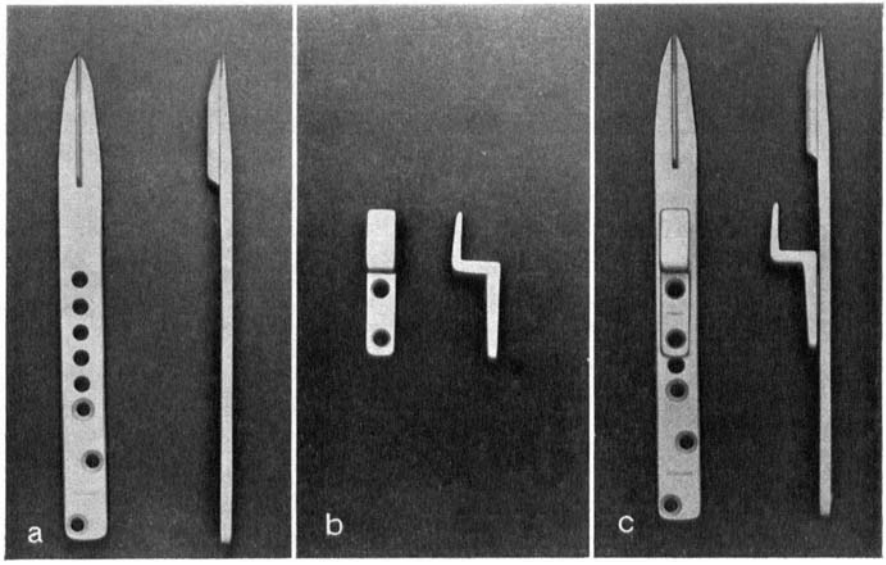

Figure 3. The authors' appliance. a. The spline seen in front and from the side. b. The hook. c. The hook applied to the spline.

in the proximal fragment, giving rise to varus deformity and instability in the osteotomy (Figures 1 and 2).

In order to ensure a better fixation one of the authors (T. Jerre) has together with Elof Törnros, engineer with Stille-Werner, Stockholm, designed the appliance demonstrated in Figure 3. Initially the appliance was made of stainless steel, nowadays of vitallium.

TECHNIQUE

An oblique osteotomy is done in the usual way immediately above the lesser trochanter. The distal fragment is displaced medially. The spline is hammered up into the proximal fragment, until the tip of the spline has perforated the cortex of the greater trochanter. When hammering the spline upwards, one must, by counterpressure on the lateral cortex of the proximal fragment, prevent it from tilting into varus, and it is also very essential that the spline is placed as far laterally as possible.

The hooks are delivered in 6 different sizes as far as the intermediate part is concerned, 10–15 mm. The biggest one is now placed on the spline, so that the two holes in the hook correspond exactly to two holes in the spline. Finer adjustment of the spline is now achieved by gently hammering it upwards into the proximal fragment so that the distance between the lower edge of the proximal fragment and the intermediate part of the hook is 3 mm (Figure 4). If this distance is too great, the hook has too poor a grip on the proximal fragment. If the distance is too small, compression in the osteotomy by weight-bearing is hindered, a compression that is highly desirable for stability and union.

It may very occasionally happen, for example, when the skeleton is very big and/or the osteotomy too oblique, that the spline must be hammered so far up into the proximal fragment before the tip perforates the cortex of the greater trochanter that the hook cannot be fixed to the spline in such way that a distance of 3 mm is obtained. In this case one quite simply removes, either by saw or with chisel, enough of the lateral lower edge of the cortex of the proximal fragment that the distance to the intermediate part of the hook is the desirable 3 mm.

The osteotomy is now adjusted to get the best possible contact between the osteotomy surfaces, with the spline lying close to the cortex of the femur. The spline is fastened by 2 or 3 screws to the femur.

A correct size hook now must be found. Here one always starts with

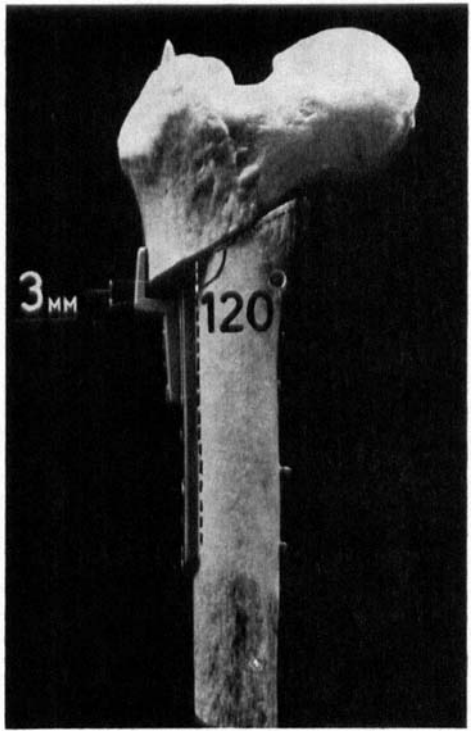

Figure 4. Skeletal preparation with the appliance.

the biggest hook (15 mm) and proceeds to hooks in diminishing order. The first hook that cannot by finger pressure be applied close to the spline is chosen as the correct one. There is thus to be left a minimal interval between the spline and the hook when the hook is pressed hard with the fingers against the spline. The hook is fixed by 2 screws through holes in the spline, and should perforate both the lateral and the medial cortex of the femur. The screws are tightened so that the above-mentioned interval between the hook and the spline disappears, and the hook lies close to the spline.

With this appliance the osteotomy should be made quite oblique: the authors' aim is an angle of about 120° (Figure 4). This is because in this oblique osteotomy the weight-bearing forces will produce a tendency for the lower fragment to displace along the osteotomy line upwards and medially, but this is effectively prevented by the hook. If the osteotomy is too horizontal, the weight-bearing forces will tend to produce varus tilting in the osteotomy, which the hook cannot effectively prevent. If the tilting is pronounced, one risks that the hook loses its grip on the lateral cortex of the proximal fragment altogether.

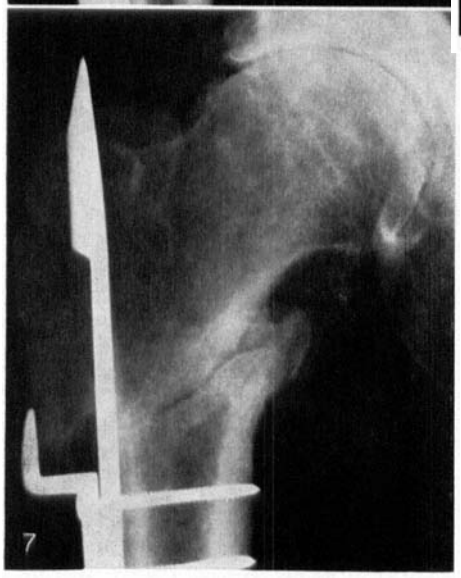

Figure 5. Typical case 3 days post-operatively.

Figure 6. Typical case 4 months post-operatively.

Figure 7. Typical case 9 months post-operatively.

Two days after the operation the patient is allowed to sit up in a chair. After one more day the patient is encouraged to start walking with 50 per cent weight-bearing on the operated leg, with support of two elbow crutches, and continues in this manner until radiological evidence of union is satisfactory. The patients have as a rule been kept in the hospital for 2–4 weeks after operation for walking exercises.

Since April 1966, 61 hips have been operated by the method de-

scribed above. In this material there are only cases of advanced osteoarthritis of the hip joint, and no operations on early cases as suggested by Nissen (1963) have been done. In the beginning of April 1968, 34 patients had a follow-up period of at least 6 months (Table 2). The age distribution is shown in Table 3.

Table 2. Sex-distribution and frequency of right, left, and bilateral cases

	Right	Left	Bilateral	No. of patients	No. of hips
♂	9	6	3	18	21
♀	8	8	0	16	16
Total	17	14	3	34	37

Table 3. Age distribution

< 40	40–49	50–59	60–69	> 70
2	2	8	20	2

Complications. Two patients died, both 11 days after operation, one of uraemia, the other of massive pulmonary embolism. In both cases the osteotomy was unchanged and quite stable.

In one case (No. 14) the spline bent at the level of the osteotomy, resulting in varus tilting in the osteotomy (Figure 8). This spline belonged to an earlier series of thinner splines made of stainless steel. The tilting occurred during a period of walking exercises in a very obese patient between the fourth and the fourteenth postoperative days. A progressing adduction-contracture developed and 2 months after operation this was about 20° with functional leg-shortening of about 10 cm. Reoperation was performed, a new spline introduced in the canal of the old spline. This spline has not been stably fixed in the old canal, and continued X-ray controls have demonstrated absorptions around the spline in the proximal fragment, showing that it is loose. The union of the osteotomy has therefore not progressed normally, and the osteotomy line has not yet at 13 months after re-operation been obliterated. The unsatisfactory result in this case has its full explanation in the fact that the first spline bent and the new spline

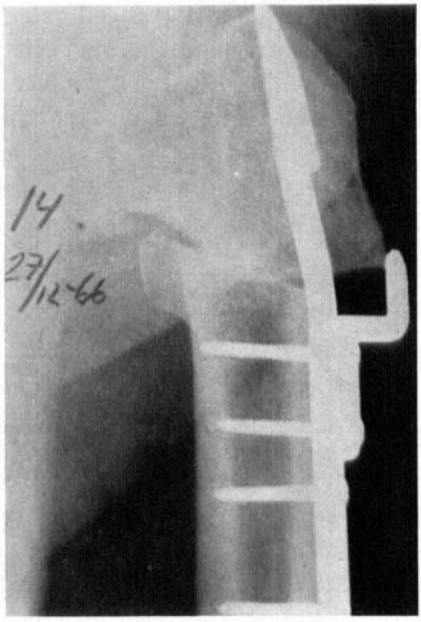

Figure 8. Case No. 14. The spline has bent.

was not stably fixated in the old canal. This was the only case in the entire series in which a spline bent, and in this case a stainless steel spline of a thinner type had been used. This complication should surely not be feared now, with the use of vitallium splines, which are double the strength of the stainless steel ones.

In one case (No. 15) the fixation of the osteotomy became unstable, resulting in varus tilting, because of wrong surgical technique. The osteotomy has been made almost horizontal (Figure 9). The spline should have been hammered further up into the proximal fragment, so that the distance between the lower femoral cortex of the proximal fragment and the intermediate part of the hook was only 3 mm, and not as in this case 11 mm. On the original X-rays one can see a small space between the hook and the femoral cortex, proving that in this case a hook with too large an intermediate part has been selected. These three errors combined made the appliance unable to prevent the varus tilting so often observed with previously used osteotomy splines (Figure 10). Because of the unstable fixation, the union in this case has not progressed normally and the osteotomy line is still, 15 months after the operation, not completely obliterated. Signs of non-union are, however, not present and sound union is expected to take place gradually.

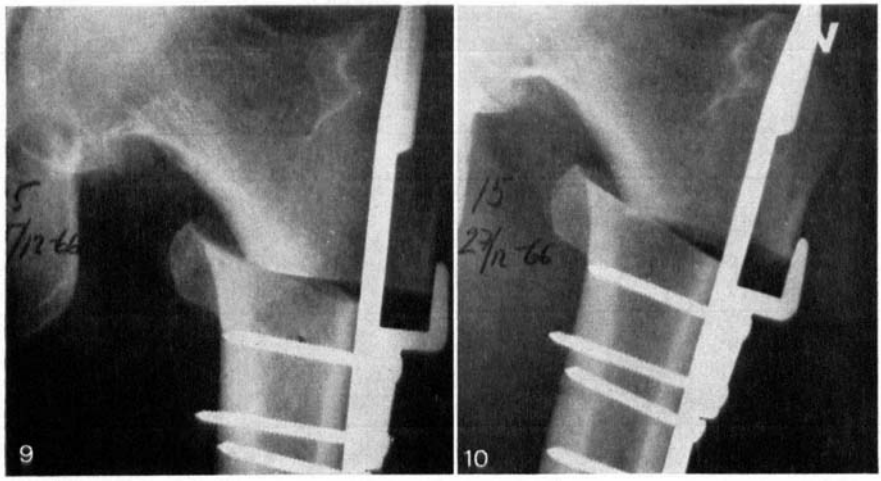

Figure 9. Case No. 15. The osteotomy too horizontal. Too large an interval between the lower edge of the proximal fragment and the intermediate part of the hook. The intermediate part of the hook is too big.

Figure 10. Case No. 15. Because of the faults mentioned, the fixation has been unstable and varus deformity has developed.

Only in one case did a slight superficial wound infection occur; this disappeared quickly without consequences.

Postoperative thrombosis in the operated leg occurred in 8 cases.

Of the 34 patients with at least a 6-months' follow-up period, 2 have died. The remaining 32 have been examined in the months of February–April 1968, clinically and radiologically, all by the authors personally. Three of these cases are bilateral, and the number of operated hip joints on follow-up examination is therefore 35.

The presence of pain at rest and on weight-bearing before and after operation is shown in Table 4. Complete freedom of symptoms regarding pain at rest has been obtained in 89 per cent and in 80 per cent for pain on weight-bearing, and an improvement, which the patients have in all cases reported as important, in 11, respectively 20 per cent. Within the short time of observation in this small material a 100 per cent improvement has been obtained for both pain at rest and pain on weight-bearing, a very good result indeed compared with previous authors. Adam & Spence (1958) report an improvement of pain in 81 per cent; Robins & Piggot (1960) in 92 per cent; Hirsch (1961) in about 80 per cent; Nicoll & Holden (1961) in 88 per cent; Ottolenghi &

Table 4. Pain at rest and on weight-bearing

		Pain at rest	Pain on weight-bearing
Preoperatively		33 (94 %)	34 (97 %)
At follow-up	None	31 (89 %)	28 (80 %)
	Decreased	4 (11 %)	7 (20 %)
	Unchanged	0	0
	Increased	0	0

Table 5. Pre- and postoperative mobility

	Extension – flexion	Abduction – adduction	Internal rotation – external rotation
Increased	13 (37 %)	9 (26 %)	9 (26 %)
Unchanged	21 (60 %)	26 (74 %)	23 (66 %)
Decreased	1 (3 %)	0	3 (8 %)
Average preoperative mobility	84°	21°	13°
Average postoperative mobility	97°	30°	19°

Frigerio (1962) in 94 per cent; Howe et al. (1963) in 97 per cent; and Lucht & Tarp (1967) in 95 per cent.

The range of movement before and after operation is shown in Table 5. Our investigation shows, in accordance with the majority of previous authors (Nicoll & Holden 1961, King & Dooley 1962, Ottolenghi & Frigerio 1962, Bucht & Tarp 1967, and others), in some cases improvement, in some cases no change, and in other cases deterioration as regards range of movements in various planes.

At follow-up, 15 patients walk without limp. Ten patients have slight limp, and 4 a moderate one. Four quite newly operated patients, all with only 6-months' period of observation, still walk with the support of 2 elbow crutches on our instructions. Permanent limp cannot as yet be judged for these 4 cases, nor case No. 14 or No. 15 (see above) who also still use one or two elbow crutches in accordance with our instructions.

Fourteen patients do not use a stick; 12 patients use one stick for

outdoor use; 3 patients use one stick, both outdoors and indoors; and 6 patients (see above) one or two elbow crutches on our instructions.

Seventeen patients have no measurable leg-shortening. In 18 cases a leg-shortening has been registered on the operated leg, which in 11 cases amounts to 1 cm, in 3 cases to 1.5 cm, and in 4 cases to 2 cm.

Of the 28 patients who at operation were under 67 years old, 17 have returned to their previous work (2 farmworkers, 7 factory workers, one butcher, one manageress of a nursery, and 6 housewives).

Of those who have not yet returned to their previous work is one bilateral case (farmer) followed-up for 17, respectively 7, months; cases Nos. 14 and 15 (see above), and 7 patients followed-up for only 6 months.

Preoperatively all the cases have presented radiological signs of osteoarthritis in the hip joint, these have, of course, been of varying degree, but in all cases these osteoarthritic changes have been advanced, and in some cases very advanced.

Callus has been radiologically observed within 2 months after operation in 15 cases, between 2–3 months postoperatively in 16 cases, and between 3–4 months in 4 cases.

In the authors' opinion it is impossible to decide the earliest time when an osteotomy can be regarded as united. Not until the osteotomy line is completely obliterated has one an absolutely safe proof of union.

In the material now presented, a complete obliteration of the osteotomy line has been observed radiologically within 6 months in 12 cases, within 9 months in another 12 cases, and within 12 months in yet another 3 cases. In 4 cases the osteotomy line can still be observed 6 months after operation, in one case 10 months after operation, and in one 13 months after operation. None of these cases presents any signs of non-union whatsoever; all show progressing union. In case No. 14 and case No. 15 the osteotomy lines are not yet obliterated 13 and 15 months, respectively, after the operation.

It is very often seen on X-rays that the joint space increases after an intertrochanteric osteotomy. Previously many authors explained this as a shift of the position in the acetabulum of the head after the osteotomy. Almost all agree now that this is the correct explanation for some cases but that there is in addition often a real improvement of the osteoarthritic changes in the hip joint that is shown by from time to time increasing joint space, decreasing size of the cysts typical for osteoarthritis, and/or decreasing amount of subchondral sclerosis.

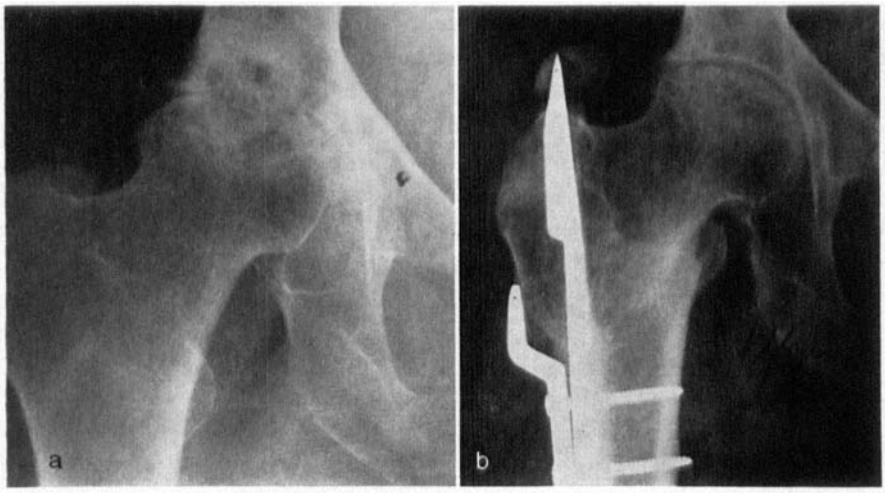

Figure 11. a. Preoperative X-ray. b. X-ray 17 months postoperatively shows a considerably increased joint space, and regression of both cysts and subchondral sclerosis.

In 15 cases in this material it has been possible to demonstrate a continuing increase in joint space, which in 9 cases has been accompanied by decreasing of the cysts and of subchondral sclerosis. In 3 cases, without increase in joint space, disappearance of osteoarthritis cysts has been seen which has been so marked that we have judged this as a safe sign of improvement of the osteoarthritis in the hip joint. Radiologically we have therefore in 18 cases altogether found regression of the osteoarthritis changes. In the short time of observation, we have not found deterioration of the osteoarthritis changes in any case.

CONCLUSIONS

The results obtained by the authors with this vitallium surgical appliance in cases of osteoarthritis of the hip joint must be regarded as very good in comparison to previously published series.

It is the authors' opinion that because of the stable fixation given by the presented appliance, the following has been gained:

1. The postoperative recumbency can be shortened very considerably.
2. Because of the shortened recumbency, primary complications above all, deep vein thrombosis and embolism should be expected to decrease in number.

3. Time in hospital can be shortened very considerably.
4. The very frequent non-unions in previous publications might with this appliance, and with correct surgical technique, be completely eliminated, and the final results improved in comparison with those obtained with previous appliances.

Since the authors designed and started to use the above-described appliance, Wainwright-Hammond, Osborne-Ball, Harris, and the AO group in Switzerland have reported other appliances for providing stable fixation and compression of the osteotomy. The compression gained with these appliances, which, quite correctly, great importance is attached to, can without doubt be gained as effectively and, further, continuously through weight-bearing with our appliance.

The appliance is available from AB Stille-Werner, Stockholm.

SUMMARY

The authors describe a new fixation appliance for intertrochanteric osteotomy. This appliance gives a stable fixation with compression through weight-bearing. It has been used with good results in 61 intertrochanteric osteotomies; and 37 cases with an observation period of at least 6 months are reported here.

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