UPPER FEMORAL OSTEOTOMY IN THE TREATMENT OF PARALYTIC SUBLUXATION OF THE HIP DUE TO POLIOMYELITIS*

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Blundell Jones[1] incriminated coxa valga as the main cause of paralytic hip luxation, occasioned by weak hip abductors opposed to strong adductors and developing over several years in those contracting poliomyelitis under the age of 2 years. Somerville[2] suggested that the determining factor was what he termed the 'effective valgus', whether resulting from coxa valga due to muscle imbalance, from an adduction contracture as in the cases reported by Watson Jones[3] or from pelvic obliquity, and maintained that the nearer the angle between the femoral neck and the horizontal plane of the pelvis approaches 90°, the more unstable the hip becomes.

Despite this better understanding of the mechanism of luxation, its management still presents problems. Blundell Jones, who originally[1] recommended varus osteotomy to restore a femoral neck-shaft angle of about 120°, later[4] advised an angle of 105° in those under 5 years of age in view of some recurrences of valgus and luxation in this group. While suspecting that the recurrent valgus was due to persistent muscle imbalance and recognizing the value of iliopsoas transfer in preventing redislocation in myelomeningocele, he felt that this muscle was rarely sufficiently spared to justify its transfer in poliomyelitis. Blundell Jones[4] reported 6 redislocations following 24 varus osteotomies, which compares favourably with the 11 failures in 13 osteotomies reported by Parsons and Seddon.[5] Furthermore, of 9 acetabuloplasties and 2 Salter pelvic osteotomies in their series, 6 of the 8 adequately followed up have already failed. They conclude that correction of the bony deformity must be supplemented by rectification of the muscle imbalance that produced it. Mustard[6] reports favourably on the effect of iliopsoas transfer on hip stability, but gives no specific results in luxation due to poliomyelitis.

The present paper analyses the results of upper femoral osteotomy in a small series of cases of paralytic subluxation of the hip, with a view to assessing its value and elucidating the causes of recurrence.

MATERIAL

All cases of osteotomy of the hip performed at this hospital between 1 January 1958 and 1 January 1966 for the relief of paralytic luxation of the hip due, with one exception, to poliomyelitis have been reviewed. Two patients lost to follow-up and one patient who died early from a lung abscess have been excluded. Dislocations due to myelomeningocele or cerebral palsy have not been included here, as it is felt that in these conditions accessory factors are active. The details of the 12 cases reviewed are shown in Table I. Nine patients were Coloured, 2 were White and there was 1 Bantu. Six were male and 6 female. Poliomyelitis was causative in 11 cases and an intraspinal, lipomatous, mesodermal defect in one; and, of the poliomyelitis cases, 2 incurred their disease in the first year of life, 2 between 1 and 2 years, 3 at 2 years and 4 at 3 years of age. All cases were more or less freely ambulant with or without supportive appliances from an early stage.

Causative Factors

In only two cases, cases 4 and 7, did pelvic obliquity appear to be a major causative factor and in one further case, case 11, a contributory factor. In all cases there was an imbalance of varying degree between weak hip abductors and stronger adductors and flexors, and in most between stronger external than internal rotators. As a crude estimate of hip valgus and/or anteversion, radiographs were taken in the supine position with legs flexed over the end of the table and in various degrees of hip rotation. The film that showed the neck-shaft angle at its most acute position was taken as the approximate measure of this angle, and the degree of internal rotation at which this film was taken as an index of the anteversion.

By this rough standard, the neck-shaft angle fell between 130° and 140° in 10 cases, was 150° in one and unrecorded in one. Shands and Steele[7] estimated the average neck-shaft angle as 145° at the age of one and 138° at 2 years, decreasing to 132° at 16 years, so that the majority of the cases in this series fall within normal limits, whereas Blundell Jones reported significant coxa valga as the outstanding factor in his series. Perhaps the discrepancy can be explained by the fact that all the cases in this series were freely ambulant from an early stage, whereas some of his patients were unable to walk,

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TABLE I. SUMMARY OF CASES

Case	*Sex*	*Race*	*Age at onset of paralysis*	*Muscle charting**	*Age and degree of luxation*	*Diff. in length of affected limb*	*Pelvic obliquity*	*Neck-shaft angle*	*Ante-version*	*Performance*	*Age at operation*	*Type of osteotomy*	*Result of operation*	*Subsequent operations*	*Final result and age at follow-up*
1	F	White	3 yrs	GM4 F4 Ab3 Ad4+ IR4 ER4+	Sub-luxation severe at 11 years	Nil	Nil	135°	60°	Ambulant. Below knee irons and stick	11 yrs	35° varus, 35° derotation	Slight residual sub-luxation, but hip stable	Nil	Satisfactory at 15 yrs
2	M	White	3 yrs	GM3 F4 Ab2 Ad4 IR3+ER3+	Sub-luxation severe at 6 years	2 in. short	Nil	140°	45°	Ambulant with caliper	7 yrs	25° varus, 90° derotation	At 14 yrs gross recurrence	40° varus osteotomy at 15 yrs	Very shallow acetabulum and moderate residual sub-luxation at 18 yrs
3	F	Coloured	1 yr 4 mths	GM3 F4 Ab2 Ad4 IR2+ER4	Sub-luxation severe at 3½ years	1 in. short	Nil	—	—	Ambulant No appliances	3 yrs 9 mths	20° varus, 60° derotation	At 6 years slight recurrent sub-luxation	35° varus osteotomy at 6 yrs	Gross recurrent sub-luxation at 11¼ yrs. Further varus derotation osteotomy
4	F	Coloured	5 mths	GM4+F4+ Ab3+Ad5 IR4+ER4	Sub-luxation severe at 3 years	Nil	Moderate unfavourable	135°	45°	Ambulant. Below knee iron on affected, caliper on unaffected side, and crutches	3 yrs	20° varus, 30° derotation	Moderate recurrence at 5½ yrs	30° varus, 60° derotation at 5½ yrs	Gross recurrence at 12. Further 45° varus 45° derotation osteotomy
5	M	Coloured	Birth (mesodermal malformation)	GM.O F4 Ab2 Ad4	Sub-luxation severe at 6 years	1½ in. short	Nil	130°	55°	Ambulant. No appliances	6 yrs	35° varus, 60° derotation	Satisfactory	Nil	Satisfactory congruity at 11 yrs
6	M	Coloured	2 yrs	GM3-F4 Ab3 Ad4 IR3+ER3+	Sub-luxation severe at 5½ years	1 in. short	Nil	130°	60°	Ambulant. Below knee irons	5½ yrs	70° derotation	Severe recurrence at 7 yrs	35° varus osteotomy at 7 yrs	Moderate recurrent sub-luxation at 11 yrs
7	F	Coloured	6 mths	GM2 F3 Ab3 Ad3+ IR1 ER3	Sub-luxation moderate at 5 yrs	½ in. short	Moderate unfavourable	140°	45°	Ambulant. Caliper and pelvic band on unaffected side	5 yrs	35° varus, 35° derotation	Satisfactory	Nil	Satisfactory congruity at 12 yrs
8	F	Coloured	3 yrs	GM2 F4 Ab1 Ad5 IR4 ER3	Sub-luxation very severe at 4 yrs	Nil	Nil	140°	45°	Ambulant. Bilateral calipers	4½ yrs	25° varus and derotation	Moderate recurrence at 9 yrs	30° varus, 30° derotation osteotomy	Too early to assess final result
9	F	Coloured	3 yrs	GM3+F4 Ab2+Ad4+ IR2+ER3+	Sub-luxation severe at 4 yrs	1½ in. short	Nil	135°	60°	Ambulant. Below knee irons	4 yrs	35° varus, 60° derotation	Satisfactory	Nil	Satisfactory congruity at 11 yrs
10	M	Coloured	1½ yrs	GM2+F4+ Ab2 Ad4+ IR3 ER3+	Sub-luxation severe at 15 yrs	2¼ in. short	Nil	140°	60°	Ambulant. No appliances	15 yrs	40° varus, 60° derotation	Satisfactory	Nil	Satisfactory congruity at 22 yrs
11	M	Coloured	2 yrs	GM4 F4+ Ab2 Ad4+ IR4 ER4	Sub-luxation moderate at 10 yrs	1½ in. longer	Moderate unfavourable	150°	—	Ambulant. Caliper with pelvic band on unaffected side	12 yrs	45° varus	Satisfactory	Nil	Satisfactory congruity at 16 yrs
12	M	Bantu	2 yrs	GM1+F2+ Ab2 Ad3	Sub-luxation moderate at 10 yrs	Nil	Nil	135°	45°	Ambulant	10½ yrs	20° varus, 30° derotation	Satisfactory	Nil	Satisfactory congruity at 13 yrs

*Muscle charting: GM = gluteus maximus; F = hip flexors; Ab = hip abductors; Ad = hip adductors; IR = internal rotators; ER = external rotators

and Phelps[5] has clearly shown that early weight-bearing is effective in preventing the development of coxa valga.

In this series the degree of anteversion was approximately 45° in 5 cases, between 50° and 60° in 5 and unrecorded in 2. Shands and Steele[7] give the average anteversion as 39° from 3 months to one year of age and 31° at the end of the second year, decreasing to 16° at the age of 16 years. Excessive anteversion was thus a feature of this series.

A further feature occasionally noted has been a relatively vertical pelvic side wall and malorientated acetabulum, apparently associated with weak hip abductors vis-à-vis a strong iliopsoas (Fig. 1). However, as Somerville emphasizes, it is the effective valgus that is significant, and,

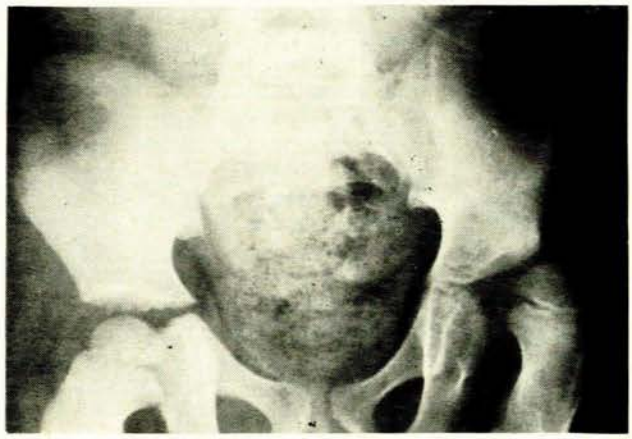

Fig. 1. Case 2. Vertical pelvic side wall.

although in this series excessive anteversion seems to have been more conspicuous than coxa valga, in every case an X-ray study in the supine position with limbs in the neutral position has shown a marked 'effective valgus' associated with the subluxation, and there can be little doubt that in most cases this 'effective valgus' is exaggerated by the Trendelenburg dip occasioned by weak abductors during ambulation, and in some cases by weight-bearing with the limb in external rotation.

On the other hand, factors militating against luxation even in the presence of the appropriate pattern of muscle imbalance and severe coxa valga were noted to be an abduction contracture of the hip, and favourable pelvic obliquity or significant shortening of the affected limb which tended to throw the weight-bearing line more directly over the hip and feet. A patient with a left-sided congenital dislocation of the hip developed poliomyelitis in her first year of life. Prolonged frame treatment resulted in an abduction contracture of the right hip and, despite the appropriate pattern of muscle imbalance and an extreme coxa valga, no luxation resulted (Fig. 2). Case 7 also illustrated how pelvic obliquity, a causative factor in the subluxation of the left hip, militated against luxation of the even more valgus right hip.

TREATMENT AND RESULTS

All cases reviewed here have been treated by a varus and/or derotation osteotomy of the upper femur. Either a medially based wedge of bone has been removed or the osteotomy has been of the lateral open-wedge type with fixation by means of a bent plate. The Blundell Jones blade-plate was not used. Initially, osteotomy was often not carried out as soon as subluxation became apparent, but delayed so long as apparent adequacy of the acetabulum would permit, as it was then felt that the younger the child, the more susceptible it would be to the deforming growth influence of continued muscle imbalance and so to relapse. In earlier cases the varus and derotation conferred were of such degree as pre-operative, recumbent radiographs in abduction and internal rotation suggested were indicated to procure congruity. Latterly, since it has been appreciated that congruity both in recumbency and during weight-bearing is essential to freedom from recurrence, we

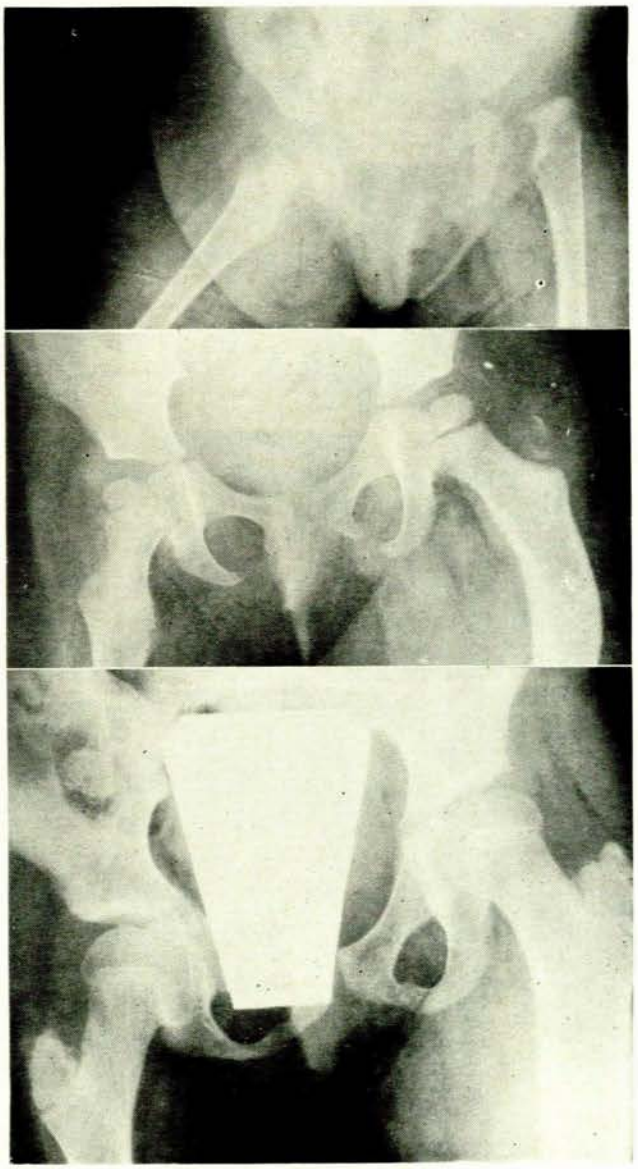

Fig. 2. Case illustrating left congenital hip dislocation (*top*), gross right coxa valga due to poliomyelitis (*middle*), but absence of luxation due to abduction contracture of the right hip (*below*).

have aimed at a considerably greater degree of varus.

In 6 of the 12 cases stable, congruous reduction was maintained (in one case 5 years, in 3 cases 7 years, in one 4 years and in one 3 years after operation). Ages at operation were respectively 6, 5, 4, 15, 12 and 10½ years, and the intervals between the paralytic disease and operation were 6, 4½, 1, 13, 10 and 8½ years. In one further case operated upon at the age of 11 years—8½ years after she had contracted poliomyelitis—the subluxation was, perhaps, due to an imperfect operative technique, never fully corrected, yet the hip did not deteriorate but developed fairly stably, despite some residual subluxation. Fig. 3 illustrates some of these 7 satisfactory results.

In the 5 cases in which recurrence of subluxation occurred, ages at first operation were 7, 3¾, 3, 5½ and 4½ years, and the intervals between the poliomyelitis attack and the first osteotomy were 4, 2½, 2½, 3½ and 1½ years. In all 5 a second upper femoral osteotomy was carried out, and further relapse has occurred in 4 of these, it being as yet too early to assess the result in the fifth. In two patients, cases 3 and 4, subjected to a third osteotomy, the ultimate result cannot yet be assessed.

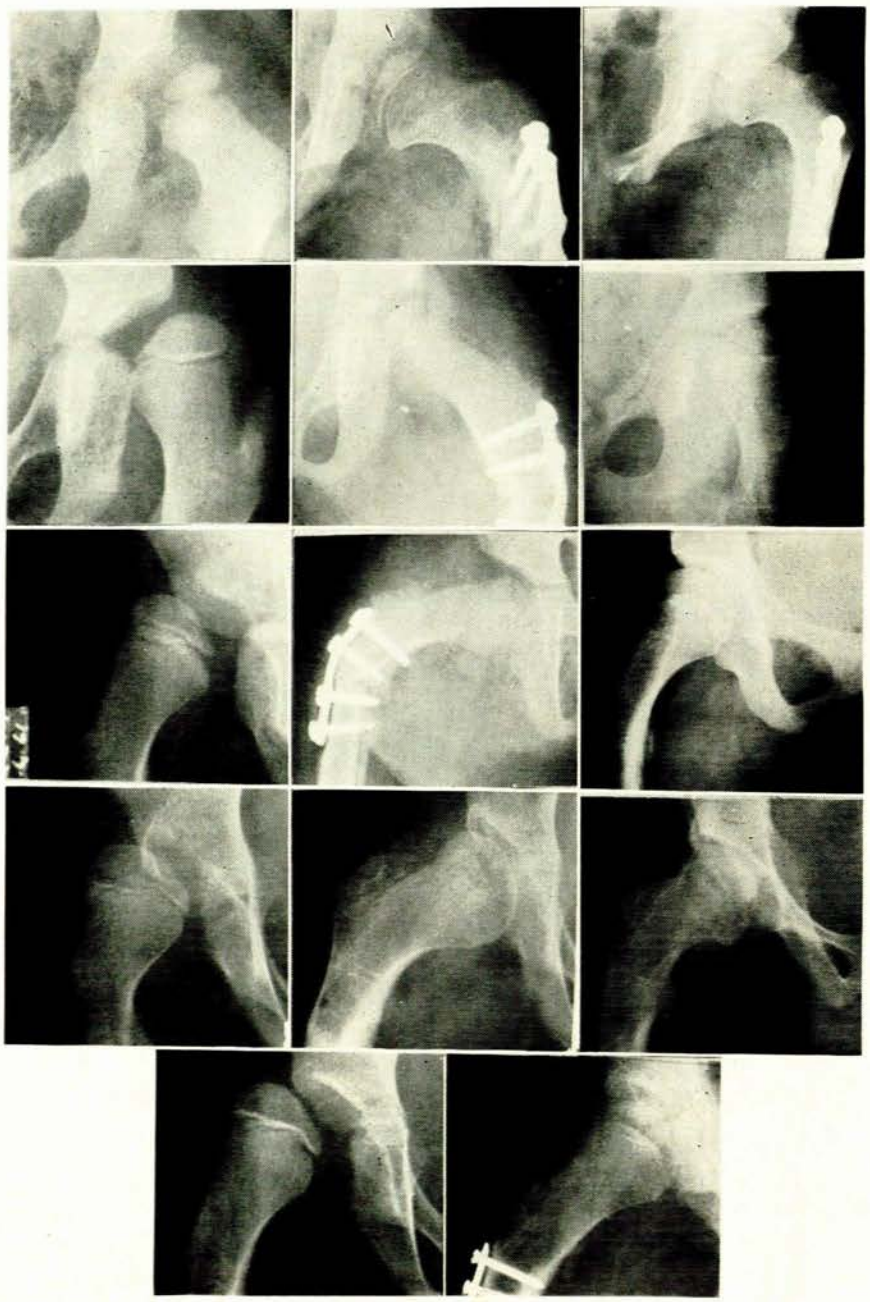

Fig. 3. Top to bottom: cases 5, 7, 9, 10 and 12. Left to right: pre-operative, postoperative and follow-up respectively at 5, 7, 7, 7 and 2½ years.

DISCUSSION

While Parsons and Seddon,[5] with 11 recurrences following 13 operations, appear to take an unduly pessimistic view of the value of upper femoral osteotomy in the treatment of paralytic hip luxation, there is no doubt that relapse does occur in a proportion of cases, particularly, as Blundell Jones[4] points out, in those operated upon under the age of 5 years. The younger the child, the more susceptible it is to deforming growth factors. Further, the younger age at operation would imply a shorter interval between the paralytic illness and the appearance of significant luxation and, therefore, relatively severe causative factors. The cause of recurrence is not at once clear. To allow that muscle imbalance, however severe, is incompetent to initiate hip luxation in a child acquiring poliomyelitis over the age of 2 or 3 years, and yet to attribute to persistence of imbalance recurrences at an appreciably later age following surgical correction of the bony deformity, is scarcely logical.

On the other hand, it is accepted that a subluxed hip in a young child, whether the luxation be congenital or paralytic and whether the muscles be normal or imbalanced, will deteriorate progressively unless congruous reduction, both in recumbency and during weight-bearing, can be maintained at all times. This, then, must be the aim of any upper femoral osteotomy. In some of the failures in this series, even the supine postoperative X-ray did not show complete congruity and relapse was thus inevitable.

In case 6, because internal rotation appeared to produce congruous reduction, a derotation osteotomy alone was performed (Fig. 4), but the postoperative X-ray does not show complete congruity, and, when relapse occurred, a further varus osteotomy was

performed, unfortunately followed by a second relapse. In other cases, although the supine X-ray may indicate complete restoration of congruity following osteotomy, a postoperative weight-bearing X-ray with the added factor of a Trendelenburg dip might have shown the femoral head still resting against the somewhat shelving outer part of the acetabular roof, again suggesting inevitable deterioration and recurrence.

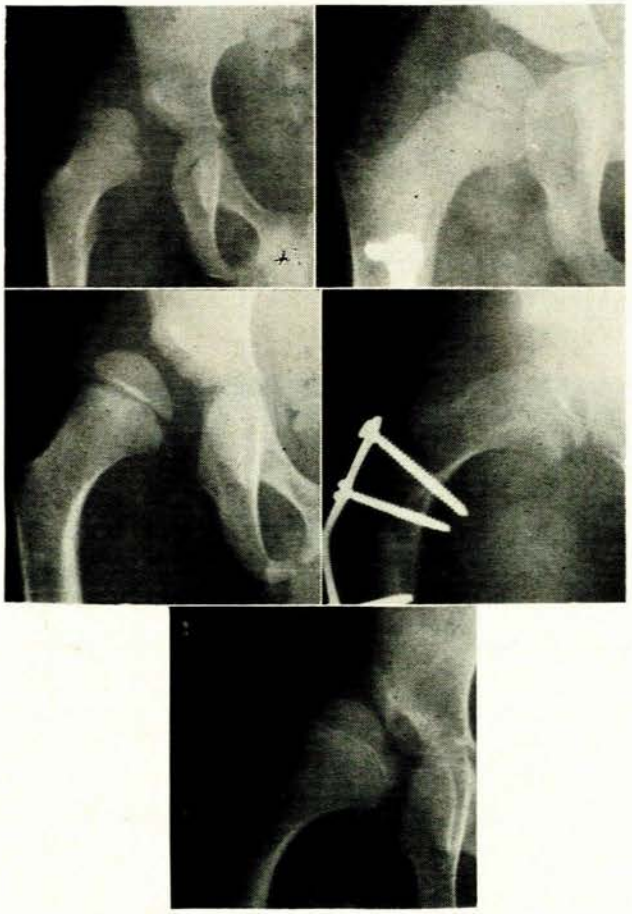

Fig. 4. Case 6. *Top left*: Pre-operative. *Top right*: Following derotation osteotomy. *Middle left*: Relapse 1½ years after operation. *Middle right*: Following varus osteotomy. *Bottom*: Further relapse 4 years after second operation.

Occasionally, as in case 3 (Fig. 5), however, congruity may appear better in the weight-bearing than in the supine film, if favourable pelvic obliquity or appreciable shortening of the limb enforces weight-bearing in abduction. It is suggested then that the best safeguard against recurrence of luxation is an upper femoral osteotomy adequate to ensure congruity under all circumstances, as evidenced by postoperative X-rays both supine and weight-bearing. If the condition is not diagnosed until the acetabulum is grossly inadequate, the femoral osteotomy may have to be reinforced by a Salter pelvic osteotomy. Nevertheless, just as relapse may follow an inadequate osteotomy, with an initially fair acetabulum as in case 2 (Fig. 6), so congruous reduction with freedom from relapse may

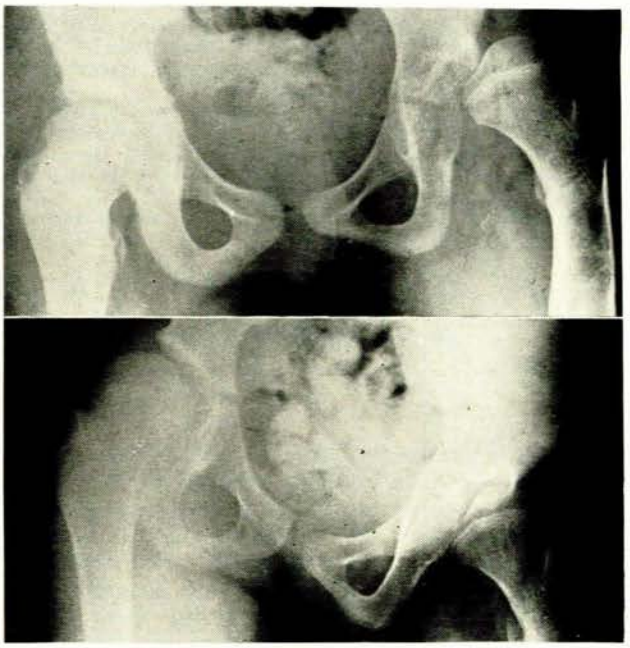

Fig. 5. Case 3. Illustrates relapse following operation, but, owing to favourable pelvic obliquity, congruity is better in the weight-bearing radiograph (*bottom*) than in the supine film (*top*).

reward an adequate femoral osteotomy in the presence of a relatively poor acetabulum as in cases 5 and 10 (Fig. 3). It is felt that transfer of a weakened iliopsoas will in fact play little useful part in the prevention of recurrence.

A further point that emerges is that in older children—in my experience those over 12 or even 10 years of age—despite failure to procure complete correction and congruity and/or a very shelving acetabulum, the hip, instead of deteriorating further with subsequent relapse, may endeavour to make the best of a bad job and to acquire what stability it can by buttressing of the acetabular roof.

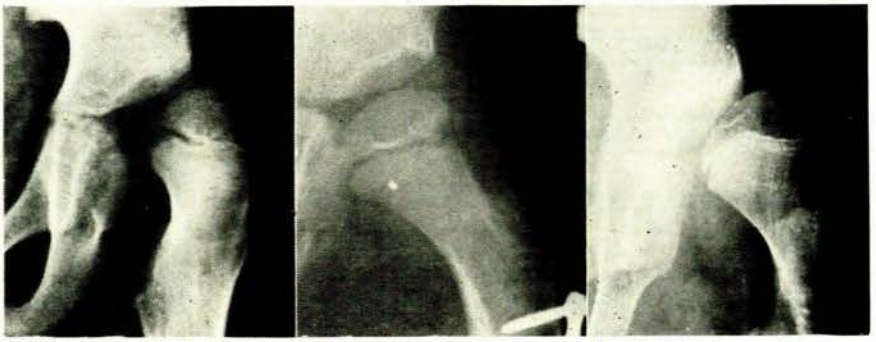

Fig. 6. Case 2. *Left*: Pre-operative. *Middle*: Postoperative. *Right*: Later relapse despite initially good acetabulum.

SUMMARY AND CONCLUSIONS

Twelve cases subjected to upper femoral osteotomy for paralytic luxation of the hip are analysed. It is suggested that the cause of recurrence in a proportion of the younger cases is inadequacy of the osteotomy to ensure congruous reduction, particularly during weight-bearing, rather than persistence of muscle imbalance.

It is concluded that upper femoral osteotomy is at present the most satisfactory procedure for the correction of paralytic luxation, but that it must procure adequate varus to ensure complete congruity under all circumstances, as evidenced by a postoperative, weight-bearing radiograph.

In some younger patients with grossly shelving acetabula, it may be necessary to supplement the femoral osteotomy by a Salter pelvic osteotomy, but iliopsoas transfer is unlikely *per se* to reduce the recurrence rate and probably has little place in the management of the condition.

In patients in whom the luxation develops slowly and who present for treatment at a relatively later age, recurrence is less likely; and bone modelling seems to take the form of adaptation to the less than perfect relationships, rather than deterioration and relapse.

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