

ON THE TREATMENT OF ADVANCED SLIPPING OF THE UPPER FEMORAL EPIPHYSIS

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Slipping of the upper femoral epiphysis is called severe or advanced in cases where the displacement of the femoral head exceeds one third of the diameter of the femoral neck or is greater than 1.5 cm. The slipping is called mild, when the displacement is less than this¹.

Though an exact distinction can hardly be made its practical purpose is to divide the patients into mild and severe cases.

Firstly the prognosis is different, as in cases with mild slipping necrosis of the femoral head practically never occurs when the patient is not treated, and it is seldom found after treatment, while on the other hand this complication is unfortunately quite common in cases with advanced slipping, both without and after different kinds of treatment.

Oram, in a material of 179 cases of slipped capital epiphysis collected from the Orthopaedic Hospital in Århus from 1936 to 1949, showed that among 77 hips with severe slipping, an avascular necrosis of the femoral head was found in 23 cases, i.e. more than 7 times more frequently observed than among 102 cases with only mild slipping, where it occurred in only 3 cases.

The second aspect which makes distinction between severe and mild cases desirable lies in the different measures of treatment to be taken.

There is no difference of opinion as to the treatment of cases with mild slipping as far as correction of the displacement is not considered

¹ The distance from the center of the femoral head to the axis of the femoral neck was measured in the Lauenstein projection as recommended by *Mathiesen*, instead of measuring the displacement along the margin of the neck, where continuous remodelling takes place, making it difficult to find the landmarks.

to be necessary, and the treatment should be directed only towards prevention of further slipping. This can be done successfully by internal fixation in situ, or by epiphyseodesis e.g. by drilling through the epiphyseal plate. The latter method has given satisfactory results in department I of the Orthopaedic Hospital, Copenhagen, as reported by *F. R. Mathiesen* in 1958.

If slipping, however, is already advanced when the treatment begins, the function is generally so greatly impaired by the adduction and external rotation contracture, by shortening of the limb, by diminuation of the range of motion of the joint, and by the limp, that correction of the deformity is desirable.

Several methods are available to obtain correction: closed reduction, open reduction, osteotomy or wedge osteotomy on the site of the deformity or distally to this, i.e. on the trochanteric or subtrochanteric region of the femur. It is very tempting to try closed reduction, particularly in cases with fracture-like symptoms in an early stage. Reduction to the anatomical position can be obtained under these circumstances, but the risk of an avascular necrosis of the femoral head is considerable. *Waldenström* puts it to ca. 20 per cent, *Watson Jones* to at least 25 per cent. *Jerre* found it in 10 cases out of 24 successful reductions, i.e. 41.7 per cent.

Open reduction and osteotomy on the site of the deformity was abandoned by most authors in favour of a wedge osteotomy to avoid injury by tension of the retinacular vessels during reposition. This is especially important in slowly developed slippings where secondary changes of bone apposition on the anterior and superior surfaces of the neck would also make an anatomical restoration, without removing a wedge, impossible.

The justifiability of this method of treatment was, however, eventually doubted, as avascular necrosis of the femoral head was often observed after this treatment.

In the Symposium of the British Orthopaedic Association on Slipped Upper Femoral Epiphysis in 1959 there was not a single defence of the wedge osteotomy, and compensatory trochanteric or subtrochanteric osteotomy was recommended in cases with advanced slipping, where nail fixation alone was impossible and the function had become impaired. *G. Wiberg* in 1959 evaluated the results of 84 wedge osteotomies, performed in 4 Swedish hospitals, and found 23 incidences of necrosis of the femoral head, i.e. 27 per cent. This leads him to advocate cautiousness in the use of this method.

In order to add to the clarification of this question, the wedge osteotomies performed in Department I of the Orthopaedic Hospital, Copenhagen, over a six year period from 1952 to 1958 were reviewed.

21 patients with advanced slipping were admitted, one of them having severe displacement in both hips. One case with fracture-like symptoms was treated with closed reduction and internal nail fixation. In one case no wedge was excised by the operation, as the reduction was performed after linear osteotomy. 20 hips of 19 patients were operated on with wedge osteotomy. One case was excluded in this series, as the patient was 26 years old when operated for slipping on the still open epiphyseal plate. She had marked endocrinological disturbances such as diabetes insipidus, amenorrhea, and was therefore not considered to be a typical case. The papers of another patient had been borrowed by the Invalidity Board and could not be obtained.

While the principles followed in the 18 wedge osteotomies in this series were uniform, as excision of the wedge followed cautious reduction and internal fixation, there were many differences in the details of the technique, as the operations were performed by 7 different surgeons. One operated on 7, one 5, the others 1 or 2 hips. This fact seems to be an advantage when evaluating the method, for the results are not absolutely dependent on the skill of one specially trained surgeon. The Smith Petersen approach was used in 9 cases, Gibson's in 6, Watson Jones' in 2 and Wagner-Donovan's in 1 case. A Smith Petersen nail was only used in 1 case, a lag screw in 4, Nyström's thin nails in 4 operations, while in the others two or three Kirschner wires were inserted to fix the reduced head on the neck. One of the surgeons preferred to take the wedge more distally, the others, however, on the site of the deformity, just beyond the epiphyseal plate. In one case there was no immobilization in cast, in two cases the cast was removed after three weeks, in 6 cases after 6 weeks, in 8 after 8 weeks, and in 1 after 12 weeks. In the postoperative period a Thomas' splint was worn in 4 cases. After the immobilization period all cases were given physical reeducation with active and passive exercises. No significant difference in the result was observed which might arise from one or other individual detail of technique as described above.

The youngest patient was 11 years and 6 months and the oldest 18 years old at the operation. There were 13 boys and 5 girls. The right hip was operated in 11 cases, the left in 7 cases. 2 patients had slipping in both hips. One of them was operated on both hips with wedge osteotomy, the other with drilling and then wedge osteotomy, as only one of

the hips showed advanced slipping. The rate of slipping varied from 18 to 40 mm., on an average 27.4 mm.

In this series only two of the cases had acute fracture-like symptoms, as in this country the acute traumatic cases are generally admitted in the regional surgical departments. All the other patients had a longer history with intermittent pain, mostly localized to the knee, and—or—a limp, lasting from 1 month till about a year. The observation time varied from 14 months till 7 years and 2 months, on an average 4 years and 1 month. In all cases the epiphysis was open at the time of operation. At the evaluation of the results, the radiological aspect was preferably taken into consideration, as the future fate of the joint is more dependent on this than on the actual clinical picture.

In some cases there was found a difference between the clinical and the radiological finding but always such that the clinical picture was better than the radiological one.

	very good	good	fair	bad
radiologically	6	5	4	3
clinically	8	6	2	2

In one third of the operated hips (6) the radiological aspect at the reexamination was very good. The position of the head was almost anatomical, and the only visible consequence of the preceding operation was a slight shortening of the femoral neck in some of the cases. All these and two other patients had nearly normal mobility of the joint, no limp, no complaints at all, and a shortening of less than 1 cm. On the other hand total failure occurred in 3 cases, the first one presenting an unusual complication among wedge osteotomies, not unimaginable, however, after an osteotomy in the trochanteric or subtrochanteric region, namely a pseudarthrosis.

The second and third failure was due to necrosis of the joint cartilage resulting in a considerable reduction of the mobility of the joint. This complication may, however, develop without any form of treatment, as *Jerre* has pointed out. He found this condition in two cases which had not received any form of treatment, and in two other cases after atraumatic interventions as immobilization in plaster of Paris for some weeks without previous reduction in one case, and after traction for 7 to 8 weeks in the other case. One of our failures also clearly showed radiological signs of narrowing of the joint space as well as a marked diffuse atrophy of the bones in the hip region even preopera-

tively. Besides these characteristic radiological signs of necrosis of the joint cartilage this patient had a nearly complete clinical ankylosis before the operation. The other patient with cartilage necrosis was reoperated one and a half years after the wedge osteotomy. At the reoperation the capsule was found adherent to the rather irregularly shaped and usurated cartilage. Capsulectomy, followed by several mobilizations under general anaesthesia and intraarticular compound-F administrations, could not prevent recurrence of stiffness. These complications could not with certainty be avoided by trochanteric or subtrochanteric osteotomy as these seem more to be a consequence of the pathological condition in itself than of the treatment. In cases where signs of these conditions are already found preoperatively, wedge osteotomy should be avoided.

The remaining 9 cases of the series were classed in two groups, one containing 5 hips in which the shortening of the femoral neck in the radiological picture was a little more marked resulting in a higher position of the top of the greater trochanter, or there were slight signs of of initial osteoarthritis, namely a light sclerosis in the acetabular roof. As already mentioned two of these cases had as perfect function as those classed in the best group, the others also having good mobility with an ability to flex the hip at least to a right angle. These patients, however, would occasionally notice a slight tenderness in the hip region after overcharging. In this group the gait was normal.

In the other group there were 4 hips. Here more marked signs of osteoarthritis were observed, e.g. moderate reduction of the height of the joint space, sclerosis in the acetabular roof, subchondral cysts, and moderate irregularities in the shape of the femoral head. Three of them, who had had a partial avascular necrosis, recovered, however, without significant deformation of the articular surface. The mobility was not bad in this group either, i.e. flexion to 90° in one case, to 110° in two, and to 120° in the fourth case.

When evaluating the justifiability of a method of treatment, the risks, of course, must firstly be taken into consideration, but the completeness of the successful results should not be neglected. Much may be gained with a successful wedge osteotomy. When considering the risks—avascular necrosis of the femoral head and necrosis of the joint cartilage—one must remember that these complications may also occur in the spontaneous course of the disease. In 13.6 per cent of untreated cases *Oram* found avascular necrosis, and as mentioned before, cartilage necrosis was observed in 4 out of 9 cases in *Jerre's* material,

without any or after very harmless and ineffective conservative measures. The results must finally be compared with those of trochanteric or subtrochanteric osteotomies, which have recently been recommended again by many surgeons as the method of choice in the treatment of advanced slipping of the upper femoral epiphysis. *G. Wiberg* calls for reviews of large series of patients treated with subtrochanteric osteotomies. This happened a short time ago when *Imhäuser* reported the results of 50 osteotomies, performed in the trochanteric region. He distinguishes between four types of displacement of the femoral epiphysis, dependent on the collodiaphyseal angle. When this is $155-160^{\circ}$, the epiphysis deviates in a lateral-behind-below direction, when 140° in a behind-below, when $120-125^{\circ}$ in a medial-behind-below and when 90° in a forward-below direction, as shown in special, so-called orthograde radiological pictures. 42 of the osteotomies were performed in cases with purely behind-below slippings. 30 of them were classed as very good, 7 as good, 2 as fair and 3 as bad, while the 8 osteotomies in lateral-behind-below slippings could not yet be finally evaluated. Among the bad results, one showed a necrosis of the femoral head, the second a cartilage necrosis, while the third case had not been precisely defined: "it was operated too early". The osteotomy should be postponed to a time when the epiphysis has already obtained at least a partial bony fixation on the neck. In cases where signs of capital or cartilage necrosis had developed during the preoperative treatment, operation was not performed, and the question is whether these cases would be those which after a wedge osteotomy on the site of the deformity would have had the worst results. The trochanteric ab- or adduction osteotomy combined with flexion and inward rotation of the distal fragment, is apt, as shown by *Imhäuser*, to improve the correlation of the joint surfaces to each other with restoration of the functional capacity of the hip joint, but nothing is known about the late consequences of the markedly changed position of the femoral neck and trochanters, which must be followed by change in the course of the short hip muscles and the ileopsoas.

Jerre cites *Lütken* who had collected the results of 12 subtrochanteric or transtrochanteric osteotomies: bad in 4 cases and poor in 2 cases. *Oram* in the Scandinavian, Anglo-American, German, and French literature from 1889 till 1950 found 60 cases with the following results: 28 good, 14 fair, 14 bad, and 4 unknown.

The wedge osteotomy does not represent an ideal treatment at all because of the rather high percentage of failures. All efforts should be

directed towards the prevention of at least the severe slipping by early diagnosis and treatment in the phase of moderate displacement, as emphasized by *Newman*. In cases of advanced slipping, however, the wedge osteotomy according to our experience has sufficient advantages not to be abandoned. After closure of the epiphysis, when there is no more danger of spontaneous necrosis of the femoral head, it would, however, not be wise to expose the patient to the risk of a necrosis by a wedge osteotomy on the site of the deformity.

SUMMARY

Wedge osteotomies in the treatment of advanced slipping of the upper femoral epiphysis were reviewed in order to elucidate more clearly whether this method of treatment is further justifiable, in spite of the increasing number of the reported bad results owing to necrosis of the epiphysis or the joint cartilage.

Out of 18 wedge osteotomies over a 6 year period one third had very good results, one sixth bad, and one half good (5) or fair (4) results. No total necrosis was observed in this series. Three partial necroses recovered and were classed as fair. Among the bad results one developed a pseudarthrosis, and two were due to cartilage necrosis.

It is emphasized that avascular necrosis of the femoral head and the joint cartilage may occur in the spontaneous course of the condition, too.

As no other treatment offers as perfect results as the good group of wedge osteotomies, this method of treatment according to our experience must not be abandoned.

RÉSUMÉ

Les ostéotomies en coin dans le traitement du glissement avancé de l'épiphyse fémorale supérieure ont été étudiées en vue d'établir plus clairement si cette méthode de traitement continue à être justifiée malgré le nombre des mauvais résultats rapportés en raison de la nécrose de l'épiphyse ou du cartilage de l'articulation.

Parmi 18 ostéotomies en coin pratiquées sur une période de six ans, on a constaté de très bons résultats chez un tiers des malades, de mauvais résultats chez un sixième, des résultats bons (5) ou relativement bons (4) dans la moitié des cas. Il n'a pas été observé de nécrose totale dans cette série d'observations. Trois nécroses partielles se sont guéries et ont été classées parmi les résultats relativement bons.

Parmi les cas où les résultats ont été mauvais, il s'est développé une pseudarthrose chez l'un et une nécrose du cartilage chez deux.

Il est souligné que la nécrose avasculaire de la tête fémorale et du cartilage de l'articulation peut également apparaître spontanément.

Etant donné qu'aucun autre traitement ne donne des résultats aussi parfaits que ceux du groupe des bons résultats, selon nous, cette méthode de traitement ne doit pas être abandonnée.

ZUSAMMENFASSUNG

Keilosteotomien als Behandlung von vorgeschrittenen Epiphysengleitungen der proximalen Femurepiphyse wurden nachuntersucht, um deutlicher klarzulegen ob diese Behandlungsmethode trotz der zunehmenden Zahl von, wegen Kopf- oder Gelenksknorpelnekrose, berichteten schlechten Ergebnisse, immer noch berechtigt ist.

Von 18 Keilosteotomien zeigte ein Drittel ein sehr gutes Ergebnis über einem Zeitraum von 6 Jahren, ein Sechstel ein schlechtes, und die Hälfte ein gutes (5) oder ziehmlich gutes (4) Ergebnis. Keine vollständige Nekrose wurde in dieser Serie beobachtet. Drei partielle Nekrosen erholten sich und wurden als ziehmlich gut bezeichnet. Von den schlechten Ergebnissen kam es in einem zur Pseudarthrosenbildung und zwei wurden durch Knorpelnekrose hervorgerufen.

Man hebt hervor, das ischämische Nekrosen des Femurkopfes und des Gelenksknorpels auch spontan im Verlaufe der Erkrankung auftreten können.

Da keine andere Behandlung so vollkommene Ergebnisse ergibt als die gute Gruppe von Keilosteotomien, sollte diese Behandlungsmethode gemäss unserer Erfahrung nicht verlassen werden.

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