

WEDGE OSTEOTOMY IN SLIPPED FEMORAL EPIPHYSIS¹

With special reference to technique

By

M. FOSS HAUGE

Watson-Jones, dealing with cervical osteotomy in epiphysiolysis capitis femoris: "It is by no means an easy operation."

INTRODUCTION

The problems associated with slipping of the upper femoral epiphysis are mainly limited to cases with advanced slipping. Nevertheless, these problems are of great importance because the future function of the hip affected is completely dependent on successful treatment. Which treatment is the best? This question has occupied the majority of orthopedic surgeons and has been the subject of discussion in a number of journals, as in this one (*Friberg, Hierton, Jerre, Waldenström, Wiberg* and others).

The majority recommend a wedge osteotomy on the border of the collum femoris and the epiphysis and fix the caput to the rest of the collum with the aid of a nail or screw through the trochanter. Attempts at closed reduction by traction and manipulation are emphatically rejected. It is *only* possible to attempt this with completely *fresh* slipping, but failure often results even in these cases.

However, open reduction with wedge osteotomy is no ideal treatment either, for the following reasons:

- (1) In a certain percentage, sometimes in a large percentage, disturbances of nutrition of the caput femoris occur.

¹ Read as a paper in a somewhat altered form in the Norwegian Orthopedic Association 25/10/56.

- (2) The operation is difficult and the result depends to a great extent on mastery of technique.

The object of this article is to illustrate a number of problems concerning the last point: operative technique. The question of open versus closed reduction will not be discussed in this connexion.

In Martina Hansens Hospital we have admitted patients at certain intervals with slipped epiphysis of the upper end of the femur. All grades of slipping have been observed from the slightest to the most pronounced. In those cases where we thought that open reduction was indicated, then wedge osteotomy, we found that Watson-Jones' words could be fully underlined: "It is by no means an easy operation".

In 1955-56 an accumulation of these cases occurred in our department. We operated on six patients with advanced slipping at short intervals and so had fresh in our minds the difficulties and subtleties of each previous operation. It is these technical difficulties which we believe ourselves justified in reporting in greater detail.

THE SERIES

The six cases which are to be discussed, have been selected with this publication in mind and thus form a lesser group of the total number of patients treated at Martina Hansens Hospital for epiphysiolysis capitis femoris. They were admitted to the hospital, with short intervals separating each, in 1955-56. All had advanced slipping and all were operated on shortly after admittance.

There were five girls and one boy, a numerical relationship between boys and girls which is most unusual. It is probably merely chance and no significance can be attributed to this on account of the small number in question. Four of them (three girls and one boy) were much overweight; average weight 55.25 kg, average height 149 cm. The other two had normal weight in relation to their height. Four of the patients showed immediately a clinical picture of dystrophia adiposo-genitalis. They were examined by an internist who could not find any definite grounds for this condition in any of them.

OPERATIVE TECHNIQUE AND CASE HISTORY

We commence with a proximal incision on the lateral aspect of the thigh, detach a small area of periosteum below the trochanter major and introduce a guiding probe in the direction of the joint head through the collum. The position of the guide is then checked by X-rays.

After this the hip joint is opened by a Smith-Petersen incision. We detach the m. sartorius and m. rectus femoris from the anterior, superior and inferior iliac spine. We have never seen discomfort arising from this, provided that the muscles are efficiently attached to their origins at the end of the operation. For us the decisive point is to obtain as good a view of the forward part of the joint capsule as possible. The further detachment of muscles is as usual (the m. tensor fasciae latae and the forward part of the m. gluteus medius and minimus are held laterally as a collected bundle of muscles, and the m. iliopsoas is held medially). As a rule we divide the joint capsule by a T shaped incision near the limbus edge. In many cases we have seen that the condition of the synovial membrane is not completely physiological. It is often *irregular, rough, partly thickened* and its surrounding folds are not as sharply marked as in a completely normal hip.

It has been asserted that the periosteum on the anterior aspect of the collum femoris must be spared and lesion avoided. Sometimes this is successful, at other times it is impossible, because the *periosteum is completely joined to the inner side of the joint capsule*.

In order to obtain the best view of the site for the osteotomy we place the leg in an extreme position of outward rotation and, as a rule, *adduction* (very seldom *abduction*, as advocated by Hierton). The osteotomy is undertaken by first chiselling through the collum femoris just distally of the epiphysis plate, and here we made an error with the patient which is reported in the following:

Case 1. A girl-aged 14 (M.B.) was admitted on 20/5/55 with advanced epiphysiolysis capitis femoris on the right side (see Fig. 1). After brief preoperative physiotherapy we performed a wedge osteotomy as described above. As we employed the osteotome to chisel in just below the epiphysis, we did not have sufficient view or certain exposure to the lower margin of the caput on the posterior aspect of the joint. Consequently, we performed the osteotomy a little too straight with the result that *a section of the caput dorsally was left hanging on the collum*. This was confirmed by later X-rays of the patient (see Fig. 2).

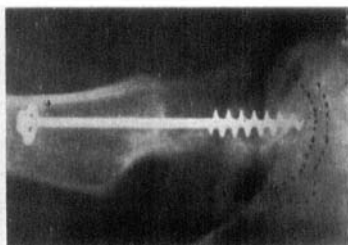
Even with a good view and approach to the hip joint from the front, the lower margin of the caput femoris on the dorsal side *can never be seen*. Afterward we consistently took an X-ray when the osteotome had entered the collum a little way in order to judge the direction, *before* we proceeded further inside. With a little practice one can manage in a number of cases without the X-ray check, because the index finger can be taken behind along the caput-collum border on its medial aspect

*Fig. 1.*

Case 1. Advanced slipped epiphysis in the upper end of right femur.
Left hip normal.

*Fig. 2 a.*

Case 2. A part of the caput at the rear
is left hanging on the collum femoris.

*Fig. 2 b.*

Same as Fig. 2 a, taken three months
later.

and thus feel out the direction of the instrument. In other cases there is so little room that one cannot succeed in putting a finger round.

When we have detached the caput from the collum, we chiselled out a section of the collum with its largest base upward laterally and a little forward. It has often been claimed (*Hiertonn* and others) that the periosteum must not be detached on the *posterior aspect* of the collum or be injured, so that the later nutrition of the joint head may not be harmed. Firstly, this can be very difficult to avoid, secondly it is not certain that the theoretical grounds are good, insofar as a number of studies of the blood supply to the joint head (*Trueta, Judet, Hulth*) indicate that a large part of the nutrition comes along the *lateral side* of the collum. If a wedge resection is to be performed as described above on the border of the caput and the collum, one cannot avoid breaking the blood supply on the lateral side of the collum.

On the basis of this argument we have in all cases (except one) completely removed the head from the neck, since we have thought that a *new* blood supply must be established, to the head from the

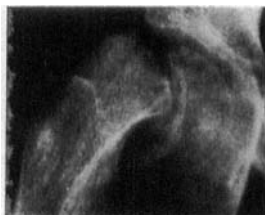


Fig. 3.

Case 2. Advanced slipped epiphysis in the upper end of the right femur.

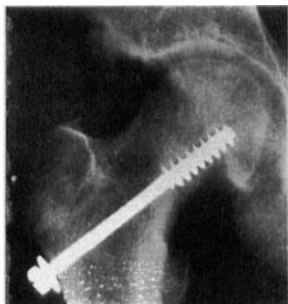


Fig. 4.

Same case as in Fig. 3, one year after wedge osteotomy. Frontal plane.



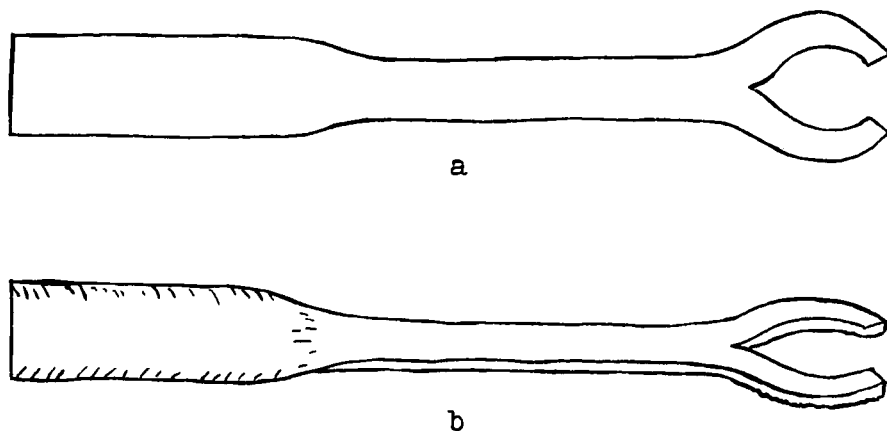
Fig. 5.

Same as fig. 4. Lauenstein's position.

neck, and this could only be achieved by intimate adjustment and good immobilisation of the resection surfaces. Moreover, the collum femoris can be more easily manipulated in relation to the caput and placed in the desired position. It has been commonly thought that when the connection of the joint head to the neck has been completely removed, the head dances about and cannot be guided and particularly it can be difficult to fix it to the collum. We met this problem in the next patient we operated on:

Case 2. A girl 12 years old (S.M.S.) was admitted on 17/6/55 (see Fig. 3) and operated on one week later by the method stated. We made a great effort to fix the collum to the caput femoris in a good position, because the head "danced about", and had to be satisfied with a not entirely successful position. X-rays one year later (see Fig. 4) show an ideal position from the frontal plane but a picture in Lauenstein's position (see Fig. 5) shows that the slipping backward of the caput in relation to the collum has not improved. On the other hand no necrosis of the caput has occurred either in this case or in the previous one.

After this we prepared a small instrument (see Fig. 6) which we place against the resection surfaces of the caput, and we can then manipulate the caput and put it accurately into whatever position we wish.

*Fig. 6.*

Instrument which easily holds the caput femoris in place: (a) seen from above, (b) seen partly from the side.

The next step in the operation is the fixation. We use a screw for this, preferably a wing screw. We have periodically used nails, but find that a screw is more suitable, as it fixes better.

A joiner prefers a screw to a spike to hold two pieces of wood together. On the other hand the nail has other advantages (see later).

Now we take the guiding probe further and can see directly if it passes the centre of the lower resection surface. Possibly we change the position of the guide until it is correct. Afterwards the neck is reduced in relation to the head (in the customary way: inward rotation and slight abduction of the lower extremity) and the neck can be placed in the centre of the first resection surface guided by the naked eye. We have often desired screws with holes centrally along their length, but we cannot persuade anyone to make these. Therefore, we must guide the screws in through the trochanter mass relying on judgment when the guide is removed, but as a rule this has proceeded without difficulty.

The choice of the screw type is very important. The screws should be narrow (of small diameter) at the point, like the majority of screws made of stainless steel. It always proves rather troublesome to insert the screw into the caput femoris, partly because it must pass the epiphysis plate. The vitallium screws are just as wide in front as behind and are much more difficult to get into the joint head to get a solid hold in the cancellous bone with the screw threads.

If the attachment to the joint head is satisfactory and the position

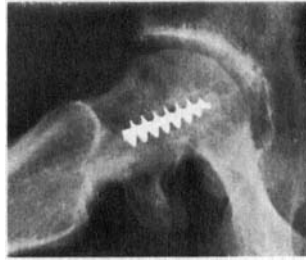


Fig. 7.

The screw broke on attempts at extraction. Note the part of the caput at the rear left hanging on the collum femoris.

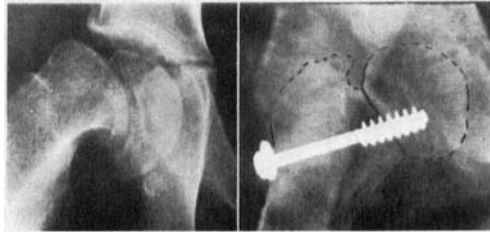


Fig. 8.

Before and after wedge resection. "Ideal" position and adjustment.

good, it can be seen that exact adjustment will succeed by further screwing. After this the wound is closed in the normal way. As stated we are especially careful with the attachment of the m. rectus femoris and m. sartorius.

Post-operatively we have sometimes put the patient in plaster (long hip plaster) with the lower extremity slightly abducted and rotated inward. In other cases we have merely put a plaster round the foot with a wood plate under the heel section to keep the leg in slight inward rotation for two to three weeks. Probably both procedures have no decisive significance on the result. Passive physiotherapy is begun immediately after the intervention, active physiotherapy in the course of one week or two.

We follow up the patients with regular X-ray checks and do not allow weight-bearing until $\frac{3}{4}$ to 1 year after the operation.

Before this the patient must have walked on crutches for three months.

We like to remove the screw one or two years after the operation. This was done with the first patient discussed here. It happened, however, that the screw was rather firmly in place. It could be withdrawn

relatively easily for about 1 cm. From then onwards it was much more difficult and after further attempts the screw broke (see Fig. 7). Stainless steel screws undoubtedly possess the drawback that *they have not proved strong enough*. The screw must make new screw threads in the bone in order to come out and cannot bear this strain. We have, therefore, abandoned stainless steel and now employ vitallium screws in spite of the drawback in the shape of the threads which they, in our opinion, possess (see above). There is another point about the shape of the screw to which attention should be given. If the screw has threads along the greater part of its length the screw threads will grip both the caput femoris and the adjoining part of the collum femoris. Even if the contact between the resection surfaces is primarily good, the screw will act as a barrier from the time bone resorption commences. It prevents the muscle tone maintaining contact between the resection surfaces. A diastasis easily arises and the result may be a complete failure, as in our next patient:

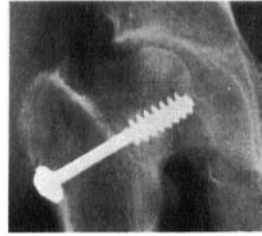
Case 3. A girl aged 10 (B. S.) was admitted 21/9/55 with severe slipped epiphysis. She was operated on in the customary way on 4/10/55. The operative course was satisfactory, and the X-ray result some days later indicated a very successful resection (see Fig. 8). We started the usual passive and active physiotherapy and the mobility of the hip became comparatively good. A new X-ray check after two months was similarly satisfactory but a check after four months showed a severe diastasis between the caput femoris and the stump of collum femoris (see Fig. 9). The screw undoubtedly held the resection surfaces apart and the resorption of the collum femoris in this case was larger than normal. (Nutritional disturbances?) We had to operate on the patient again. The screw was partly removed without destroying the hold of the caput femoris, the resection surfaces were chiselled clean again, and we packed cancellous bone between them from the patient. Then it was screwed together again and as with the first operation the contact seemed to us to be very good, but we drove the screw further into the caput this time. Regular X-ray checks after the last intervention showed definite bone union between the collum stump and the caput and the last check 1½ years later (see Fig. 10) confirmed this. However, an obvious partial necrosis of the caput has arisen and the patient will undoubtedly suffer from arthrosis of this hip later. On the other hand we succeeded in preserving the contact between the head and collum stump. In the second operation this was decisive and in reality the only object we wished to attain.

We would not have experienced this "barrier" effect if we had used an ordinary Smith-Petersen nail. After this misfortune we tried a different fixation method on the next patient.

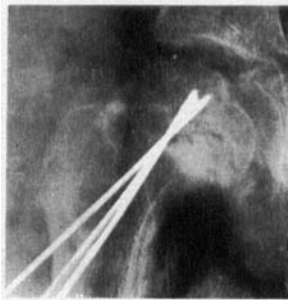
Case 4. A boy aged 10 (S. T.) was admitted for relatively extensive slipped epiphysis and was operated on by normal wedge osteotomy. But for the fixation we employed three fairly thick guides which we passed through the trochanter and

*Fig. 9.*

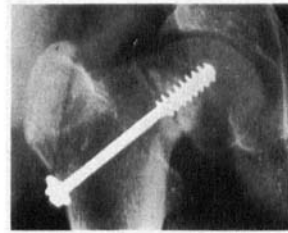
Same case as in Fig. 8. Four months after cuneiform resection: heavy resorption of the collum, diastasis. Partial caput necrosis.

*Fig. 10.*

Same case as in Fig. 8 and Fig. 9. After re-operation certain osseous union, but with irregular upper surface of the caput femoris.

*Fig. 11.*

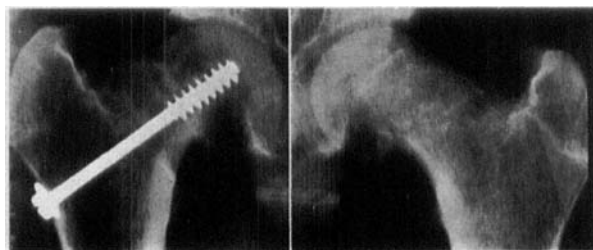
Case 4. Kirschner wires are used for fixation. The resection cleft is hardly visible one month after operation.

*Fig. 12.*

Case 5. X-ray taken shortly after wedge osteotomy.

collum femoris into the caput femoris in somewhat varying directions. We obtained also a good hold on the caput but we could see that every time we knocked the guides a little further in we moved the head of the femur away from the neck. We tried to knock on the trochanter with the aid of a Smith-Petersen punch but were not able to join the resection surfaces to each other because the guides were inserted so that they spread out from each other in the caput femoris while the distance apart was less in the collum. Therefore, we had to change the direction of the guides and the contact at the resection site was afterwards ideal (see Fig. 11).

Whether guides or thin nails are used they must either be passed in an absolutely parallel plane through the collum up into the caput from the trochanter—and, as a rule, this is much more difficult than is believed—or they must be inserted in such a way that the cutting point between them remains on the line of the resection, as in the example of our patient. The result $1\frac{1}{2}$ years later shows no sign of caput necrosis.

*Fig. 13.*

Same case as in Fig. 12. The result 1½ years after operation.
Left hip not operated on.

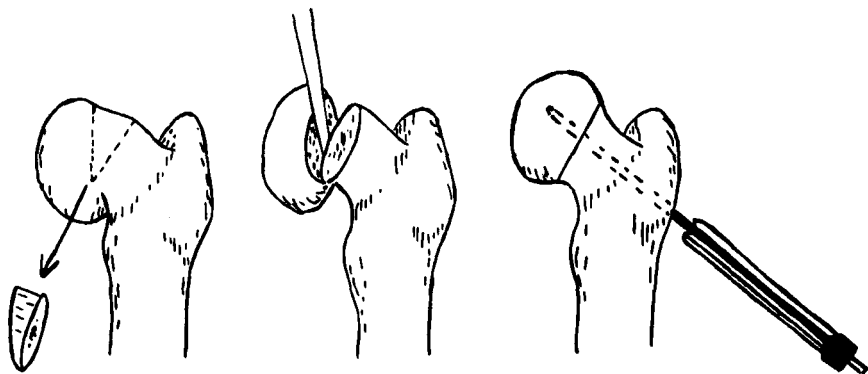
*Fig. 14.*

Diagram by Martin and Badgley. (Reproduced by Hiertonn).

As previously stated we remove the caput completely from the collum in these wedge resections. This is both because it really *can* be very difficult to preserve some of the periosteum on the posterior aspect in all cases and because we do not believe that the small connexion at the *back* of the periosteum and the synovial membrane is of any decisive importance at all for the blood supply of the caput (see earlier). In the next patient we preserved the periosteum on the posterior aspect and experienced the deformity of the collum in relation to the caput which we think is a consequence of this:

Case 5. A girl aged 13 (A. L. A.) was admitted 21/6/55 for a bilateral epiphysiolysis femoris capitis. Her right side was operated on by wedge osteotomy and fixed by a lag screw. This time there was a good view over the joint and much time was spent on an accurate and careful chiselling of the wedge. The periosteum below on the posterior aspect was left intact and we rotated the collum upward in the correct relation to the head. The contact became very good after we had obtained a good grip of the head with the screw (see Fig. 12). The X-ray 1½ years later shows the same position, there is no sign of necrosis of the joint head (see Fig. 13).

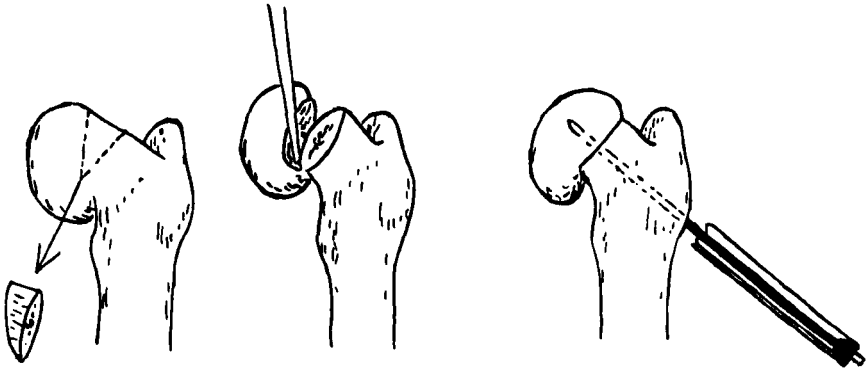


Fig. 15.

Diagram of what the result very often becomes (see text).

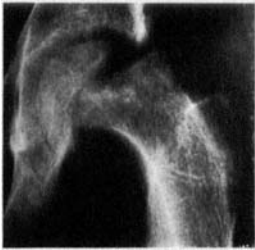


Fig. 16.

Case 6. Completely new slipping in the upper end of left femur.



Fig. 17.

Same case as in Fig. 16 after reduction. Ideal position.

This case shows that it is not possible to obtain an ideal position of the collum in relation to the head unless they are completely separated from each other. Here we achieved an *improvement* of the pronounced slipping on the right side since we obtained a position which resembles the condition on the other side where the slipping is moderate (see Fig. 13).

Fig. 14 shows a diagram by Martin and Badgley (reproduced by Hiertoon amongst others) and in our opinion it is much too optimistic respecting the anatomic result following a wedge osteotomy. Fig. 15 shows the condition which we think must of necessity arise when the periosteum is to be preserved dorsally and beneath. The position is partially corrected, but the contact between the collum and caput will occur corresponding to the upper part of the resection surface of the caput.

All the patients reported so far have suffered from slipping which has existed for some time. This is seen amongst other things from the periosteal reaction which comes distally between the collum and the

caput and forms a smooth transition between them. The next patient who came in had a *completely new* slipping:

Case 6. A girl aged 12 (L. O.) was admitted on 1/11/56 with a completely new slipped epiphysis in the upper part of the left femur. An X-ray some weeks previously revealed an initial slipping which could be only discovered on a picture taken in Lauenstein's position. A frontal picture was described as normal. Some weeks later she suffered increasing hip pain, in conjunction with a moderate trauma and new pictures showed an advanced slipping (see Fig. 16). We tried closed reduction with the aid of zinc-paste-traction and 8-10 kgs load, also using inward rotation, but even if in the course of one week we neutralized the medial slipping of the head in relation to the collum, we did not prevent the backward slipping (plain to see on a lateral picture). Therefore, we operated on the patient with open reduction and fixed the caput to the collum with a screw obliquely upward and somewhat medially from the collum. Later X-ray checks showed an ideal position (see Fig. 17), including the last, which shows the position both in the frontal plane and in Lauenstein's position.

This method of fixing the caput to the collum is very simple. It does not demand any extra incisions in the trochanter region and with the correct size of screw it gives good fixation. In this case no wedge resection was performed because the slipping was quite new. *If wedge resection is to be performed we think that the same fixation can be used with equally good results.* "Bone pigs" are very useful when the slipping is not especially large and one wishes to perform epiphysiodesis in the original position. It is certainly a more physiological material. On the other hand it cannot be employed for wedge resection, because here a procedure ought to be used which forces the resection surfaces against each other so that intimate contact results.

Although not giving any further case histories it must be mentioned that we had admitted, at the same time as the three first patients, a girl aged 14 (S. E.) with an epiphysiolysis femoris capitis which another hospital had, at first, attempted to treat with closed reduction. Débrissement forcé had been undertaken, closed reduction, explorative arthrotomy with extirpation of a small piece of bone (from the acetabulum?) and finally write traction through the tibia for three months. On admittance on 10/11/55 there were severe flexion and adduction contractures in the hip; mobility was slight and painful, and X-rays showed almost full destruction of the joint space, so that we could do nothing else here but an arthrodesis.

CONCLUSIONS

The six patients on whom the author has given reports of the operative technique involved demonstrate all technical points which it is

necessary to know to achieve a successful result. Epiphysiolysis capitis femoris is, in itself, a condition which offers a danger to the nutrition of the head. An operation, however careful and accurate it may be represents a trauma and an increased danger that necrosis of the joint head may appear.

The result of the surgical treatment is, therefore, in these cases, more than in many others, dependent on personal experience and knowledge of all forms of hip surgery. The disease is not so frequent that many such cases are received at general surgical departments. It would, therefore, seem logical to try to collect these patients as much as possible in special departments. As far as the doctors giving the treatment are concerned, it is not in the first place the question of an orthopedic or general surgeon, but of the person who is to operate.

SUMMARY

The author reports on six cases of epiphysiolysis capitis femoris with advanced slipping, admitted to Martina Hansens Hospital in 1955-56. The patients were treated surgically with wedge resection and an account is given of a number of technical points and difficulties.

It is pointed out that a screw is a good method of fixation, very often better than a nail, and that solid vitallium screws should preferably be used. These have, however, the disadvantage that the screw threads are broad at the point and that it is often difficult to perforate the epiphysis plate in order to obtain a good fixation in the joint head's cancellous bone. If the screw is to be passed through the collum from the trochanter, it must be considered ideal to have a hole placed centrally down the length of the screw as is the case with Smith-Petersen's nail. In addition, the author believes that it is simpler and just as effective to fix the resection surfaces with a lesser screw (wing screw) from the front of the collum obliquely upward and medially in the direction of the centre of the joint head.

The author does *not* believe that it is of decisive importance to preserve the periosteum on the posterior aspect of the collum adjoining the caput. What is probably decisive is to create intimate and permanent contact between the resection surfaces and to effect good immobilisation.

RESUME

L'auteur rapporte six cas d'épiphysiolyse de la tête fémorale avec glissement avancé, admis à l'hôpital Martina Hansen en 1955-56. Les

malades ont été traités chirurgicalement avec résection en coin et il est rendu compte d'un certain nombre de points et de difficultés d'ordre technique.

Il est souligné que la vis est une bonne méthode de fixation, souvent meilleure que le clou et qu'il est préférable d'utiliser de solides vis de vitallium. Celles-ci présentent cependant l'inconvénient d'avoir un large filet à la pointe, ce qui fait qu'il est souvent difficile de perforer la substance épiphysaire compacte pour obtenir une bonne fixation dans l'os spongieux de la tête de l'articulation. Si la vis doit traverser le col en partant du trochanter, l'idéal est de pratiquer un trou placé centralement dans la longueur de la vis, comme on le fait pour le clou de Smith-Petersen. De plus, l'auteur croit qu'il est plus simple et tout aussi efficace de fixer les surfaces de la résection avec une plus petite vis (vis à ailette), de la surface du col obliquement vers le haut et médialement dans la direction du centre de la tête de l'articulation.

ZUSAMMENFASSUNG

Der Verfasser berichtet über sechs Fälle von epiphyseolysis capitis femoris mit vorgeschrittenem Gleiten, die am Martina Hansen Hospital in den Jahren 1955–56 aufgenommen wurden. Die Patienten wurden mittels Keilresektion behandelt. Ein Bericht über eine Anzahl von technischen Einzelheiten und Schwierigkeiten wird gegeben.

Es wird hervorgehoben, dass eine Schraube sehr gut, oft besser als ein Nagel, zur Fixation verwendet werden kann, und dass vorzugsweise solide Vitalliumschrauben verwendet werden sollten. Diese haben jedoch den Nachteil, dass die Schraubengänge an der Spitze breit sind und dass es daher oft schwierig ist die Epiphysenplatte zu durchbohren um eine gute Fixation im Markknochen des Gelenkscapfes zu erhalten. Wenn die Schraube vom Trochanter durch den Hals geführt werden soll, dann wird ein zentral gebohrter Kanal (wie beim Smith-Petersen Nagel) sich am praktischsten erweisen. Abgesehen davon meint der Verfasser, dass es einfacher und ebenso wirkungsvoll ist die resezierten Oberflächen mittels einer kleineren Schraube (Flügelschraube) von der Front des Halses schräg nach aufwärts und medial in der Richtung auf das Zentrum des Gelenkscapfes zu fixieren.

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