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SURGICAL TREATMENT OF EPIPHYSEOLYSIS CAPITIS FEMORIS

By

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Since Wilson published his method of nailing in situ in 1938 this has become the recognised method in Sweden of dealing with early cases of epiphyseolysis capitis femoris. There has been some discussion whether the method brings about any early closure of the epiphysis or not and to obtain this Howorth has suggested an epiphyseodesis by "pegging" and Heyman and Herndon have suggested "grafting". The question does not seem to me, however, to be of any practical significance, since after a correctly performed nailing no displacement of the epiphysis needs to be feared.

Nailing complications have, however, been described in the form of caput necroses, separation of the epiphysis from the femoral neck on nailing, difficulty in taking out the guide and secondary fractures at the nail head (Wiberg, Howorth, Wilson, Severin, Jerre). As far as the necroses are concerned, I should like to emphasise Howorth's view that risk especially occurs if the nail is knocked in several times or too far, i.e., the operation is not performed in a satisfactory manner technically speaking. Howorth states that he has never seen any epiphyseal injury from "pegging", therefore he considers this operation to be best from this point of view too. In order to diminish the risk of epiphyseal injury it has been suggested fixation with wire, with screws and with Nyström nail (Compere, Howorth, Severin). Stability with wire fixation is probably considerably worse than with the three-flanged nail and Howorth points this out too. The advantage of screws is that there is no risk of any displacement of the epiphysis, but otherwise I cannot discover any advantages which this method may have over nailing. Severin believes that the risks of nailing can be "reduced or eliminated by using

a slender and more pointed nail". The Nyström nail is of this type and he has used it in 10 cases.

Most authors consider that a slipping of ⅓ of the epiphyseal diameter is the limit for fixation in situ while Martin and Klein et al. only admit 1 cm slipping. With larger displacements closed reduction has previously been attempted and this has succeeded particularly in acute cases while in other types only an apparent reduction was achieved, especially pointed out by Waldenström. The results of the closed reductions were, however, poor with a large percentage of caput necroses. Thus Jerre reports on 117 hips where attempts at reduction were made, which, however, succeeded only in 24 cases while 41.7 % of these had caput necroses. All orthopaedic surgeons have now also agreed that this method must only be used for absolutely acute fresh slipping, without employing the least force owing to the risk of injuring the blood supply to the caput.

According to Tucker the epiphysis obtains its blood supply from 3 directions: (1) Small vessels from the collum which penetrate the epiphyseal plate although he has never found such vessels before the age of 13 years. (2) Vessels from the lig. teres of varying importance. (3) Periosteal vessels which are the most important. The latter form 3 groups: anterior, upper posterior and lower posterior. In the more advanced epiphyseal slippings the upper periosteal vessels as well as the anterior probably lose function and in operations on such cases I have only found forward and upward a brittle easily detachable tissue without any large blood vessels. In such cases it seems to me therefore that it is of particularly great importance to try and protect the lower periosteal vessels.

In order to be able to perform the reduction with as little force as possible open reduction was attempted, freeing the caput with a chisel along the epiphyseal line. However, I believe that in such an operation the patient is exposed to the great risk of injuring the periosteal vessels nor are the operation results reported encouraging either, generally speaking. Klein and others give an account of 16 cases with 2 of "traumatic arthritis" while Howorth indicates very poor experience. He publishes 20 cases of open reduction with following plaster fixation, of which only 2 showed a clinically good result. Out of 11 cases with open reduction and internal fixation "degenerative changes" occurred in 4 cases. In 1948 Friberg described 12 cases with 1 caput necrosis while Badgley et al. the same year reported 15 cases with 1 caput necrosis and 5 "degenerative arthritis".

In order to diminish the risk of injuring the posterior lower periosteal vessels subcapital wedge osteotomy was introduced. A wedge with one aspect on the epiphyseal line and the base forward and upward is chiselled out in the collum, the leg is rotated inwards and abducted so that the collum resection surface obtains good contact with the caput, after which an internal fixation is carried out. Martin reports an investigation of this method in 7 cases, one of which had caput necrosis, Badgley et al. reports 34 hips with 1 caput necrosis and 10 "degenerative arthritis", Compere 20 hips with 1 caput necrosis and 1 "moderate deformity", Wiberg 12 cases with 1 caput necrosis and Hierton 38 hips with 5 caput necroses and 9 partial necroses or early signs of arthrosis deformans while 24 showed an anatomically and functionally good result, producing 63 % good results.

As great problems exist therefore in the approach to the treatment of epiphyseolysis capitis femoris, in the early stages as to the best method of fixation and in the more advanced cases whether and how the correction is to be carried out—I thought that it would be of value to present an account of my experience at the Orthopaedic Clinic in Härnösand.

The investigation comprises the period 1944–1955 during which 54 hips of 51 patients were operated on for epiphyseolysis capitis femoris. As will appear from Table I 37 boys and 14 girls were treated: 26 hips with fixation in situ, 4 with closed reduction and 24 with subcapital wedge osteotomy.

TABLE I

Operation	Boys	Girls	Hips	Average age	
				Boys	Girls
Nailing (One screw)	20	4	26	14.7	11.8
Reduction + nailing	4		4	14.2	
Wedge osteotomy	13	10	24	15.2	12

Fixation in situ.

Fixation in situ was performed in cases with up to ⅓ slipping and Sven Johansson's three-flanged nail was used in all cases apart from one where the fixation was made with a wing screw. The nail must be placed somewhat behind and below the centre, since I believe that in this way the risk of separation and further displacement is diminished. This view is based upon experience of the subcapital wedge osteotomies.

Closed reductions.

The closed reductions were performed with very great care and only in cases which clinically and roentgenologically were considered to have acute slipping. The reduction consisted merely in a careful inward rotation of the leg without employing any force so as not to injure the blood vessel supply. On the other hand it is clear that in many cases of acute slipping the supply is already seriously affected by the displacement of the caput. The reduction succeeded in 3 cases while it was only partial in the fourth case. After the reduction nailing was performed on all patients according to Sven Johansson. Figs. 1 and 2 are examples of such a case with acute slipping. It concerns a boy aged 14, who after falling from a chair had to stay in bed owing to pain from his left hip. He was admitted to the clinic where closed reduction and nailing according to Sven Johansson were performed. Figs. 3 and 4 show the same patient 4 years after the operation. He is free from pain and working as a bus driver.

Subcapital wedge osteotomies.

The wedge osteotomies were performed by means of a small anterior incision from the ant. sup. iliac spine and obliquely down over the thigh along the lateral edge of the sartorius. After dividing the fascia dissection progresse laterally of the sartorius and the rectus femoris. The capsule is opened with a cruciform incision and the leg is rotated strongly outward so that the epiphyseal cartilage may be seen. A wedge with its base forward and upward is chiselled out. the proximal chiselling occurring in the collum adjacent to the epiphyseal line and not, as generally seems to be the case, in the epiphyseal line. I believe that the conditions of healing are improved by this. Nor do I chisel completely through down in the lower part but fracture the last thin layer of bone so as not to injure the vessels. After the wedge osteotomy is completed the leg is rotated inward, the collum stump making contact with the caput section. Thus quite a large difference in level often occurs forward and upward between the narrow collum and the quite broad part of the caput. Downward, however, the collum and the edge of the caput lie on the same level. No attempt therefore must be made to centre the collum against the caput, since then there is a risk of injuring the lower retinacular vessels, which are naturally the only vessels which supply the caput in these cases. However, the assymmetry arising in this way gradually disappears on heal-

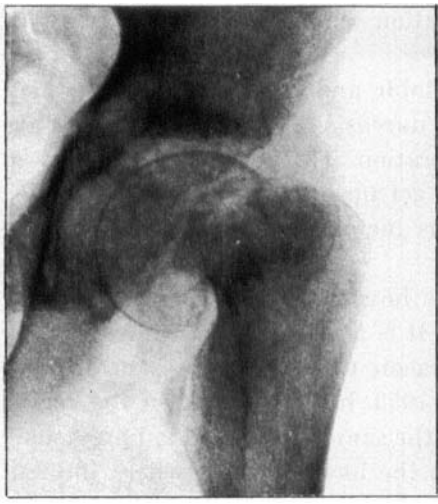


Fig. 1.

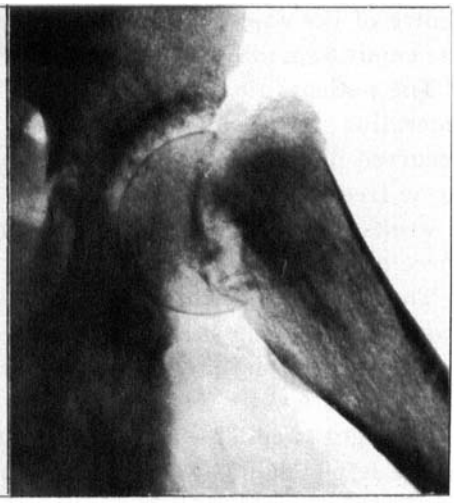


Fig. 2.

A boy aged 14 with acute slipping.

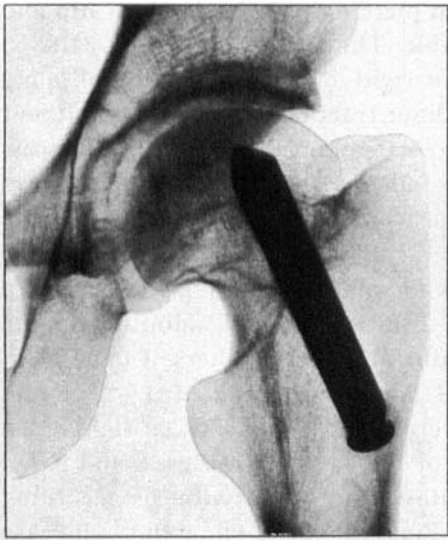


Fig. 3.

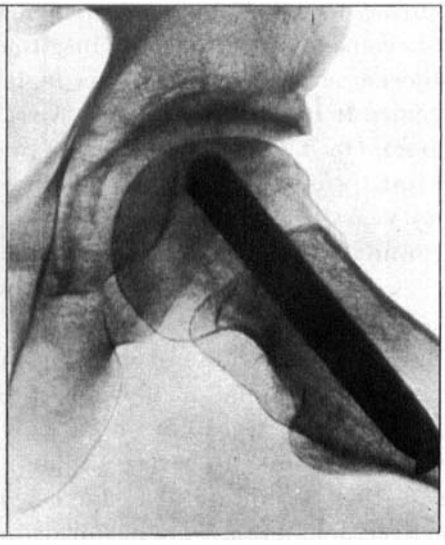


Fig. 4.

Same case 4 years after closed reduction and nailing.

ing and thus has no detrimental effect on the end result. In all cases the caput was fixed with Sven Johansson's nail apart from one where the surgeon was unsuccessful with the nailing and the patient was put in a hip plaster. The nail must be placed somewhat below and behind the

centre of the caput to avoid the rotation tendency back and below of the caput on nailing.

The patients lie on the extension table and generally with due consideration for their age are given narcosis. No complications have occurred in connection with the operation. The patients were allowed to lie freely in bed and generally to get up and put weight on the leg 6 weeks after the operation and this includes the patients in all the three groups.

The first case in this group shows how difficult it can be to judge from X-rays if the slipping is acute. It is a boy aged 15 whose left hip was treated by nailing at the Orthopaedic Clinic in Härnösand for epiphyseolysis capitis femoris. In July 1953, he felt aching in the region of the right knee. The trouble was of the same type as he had previously in the left knee. He was admitted to the local hospital where the nail in the left hip was removed. After further X-rays on the 28th a right-sided epiphyseolysis capitis femoris was discovered and the patient was referred to Härnösand. When he was about to enter the car for the journey to the clinic he felt a sudden piercing pain in the right hip and this considerably increased his trouble. The X-rays on arrival 31.8. 53 showed severe epiphyseolysis in the right hip joint and the slipping seemed to be acute. See Fig. 5. Kirschner traction was employed without effect. On 8.9. 53 a subcapital wedge osteotomy and nailing were performed after attempts at reduction failed. Figs. 6 and 7 show X-rays 2½ years after operation. He is free from pain and is in full athletic training.

The next case is a girl aged 13 who was previously given care at a coast sanatorium for a right-sided gonitis. She was admitted to the Clinic in 1953 owing to bone shortening and declared herself to be pain-free. On examination a right-sided bone shortening of 1½ cm and limping of the right hip were discovered. The X-ray showed right-sided epiphyseolysis with severe slipping of the caput. See Figs. 8 and 9. On 27.3. 1953, a subcapital wedge osteotomy and osteosynthesis according to Sven Johansson were performed. Figs. 10 and 11 show the same case 1 year after operation. She has free mobility in the hip and is free from pain.

Finally I shall describe a girl aged 10 who has admitted to the Clinic in September, 1947, owing to bilateral slipping of the femoral head, after trouble since June of the same year. Figs. 12 and 13 show X-rays of the left hip and Figs. 14 and 15 of the right hip. Subcapital wedge osteotomy and osteosynthesis according to Sven Johansson were car-

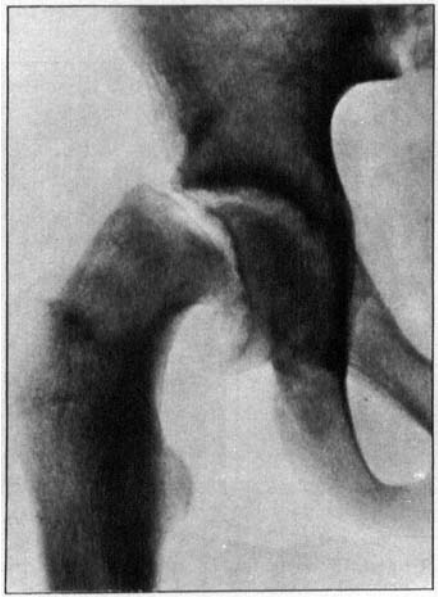


Fig. 5.
A boy aged 15 with severe epiphyseolysis capitis femoris.

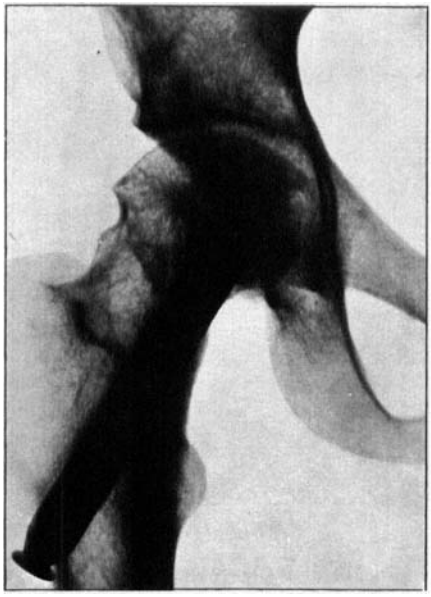


Fig. 6.

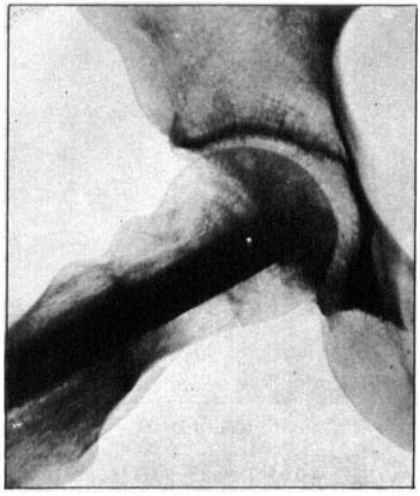


Fig. 7.

X-rays of the same case 2½ years after subcapital wedge osteotomy and nailing according to Sven Johansson.

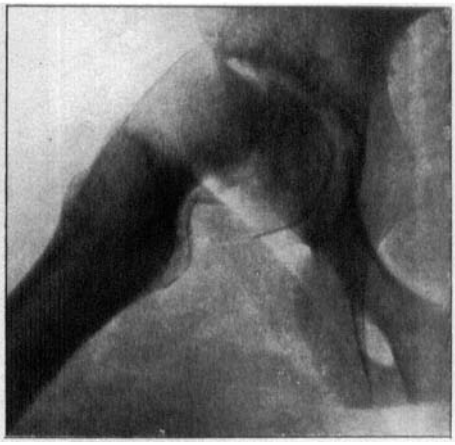
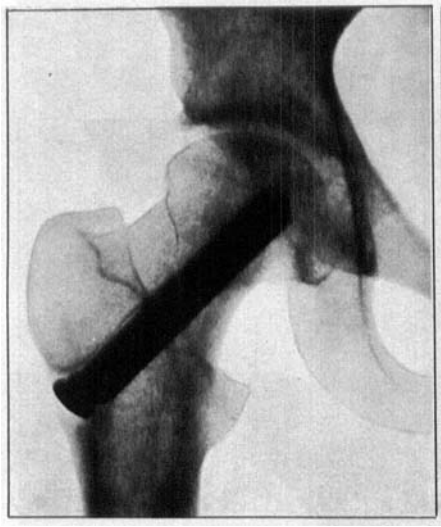


Fig. 8. *Fig. 9.*

Girl aged 13 with severe epiphysis slipping.



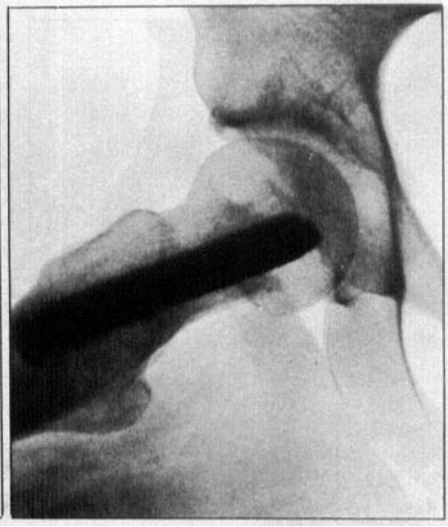


Fig. 10. *Fig. 11.*

X-ray 1 year after operation with subcapital wedge osteotomy and nailing.

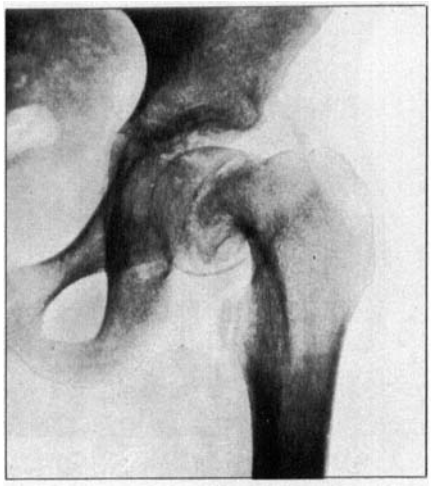


Fig. 12.

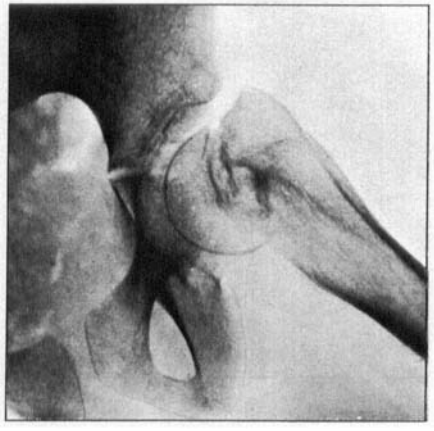


Fig. 13.

Left hip joint.

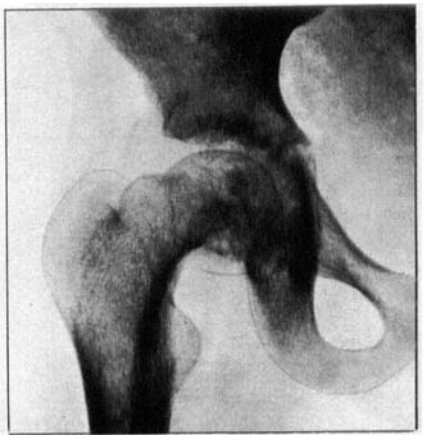


Fig. 14.

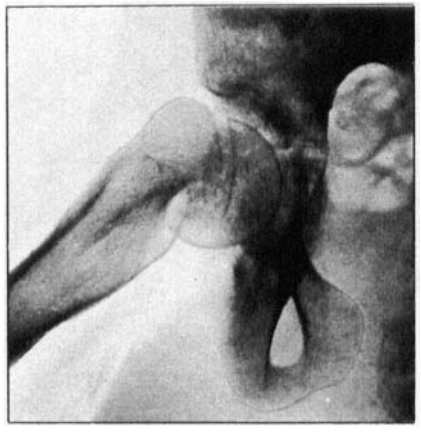


Fig. 15.

Right hip joint.
Girl aged 10 with bilateral severe epiphyseolysis.

ried out on 30.9. 47 on the left side and on 9.12. 47 on the right side. The post-operative course was uneventful and at re-examinations in 1950, '51 and '54 she was pain-free apart from tiredness on exertion such as skiing. On examination in '54 she was found to have worked for a year as a domestic servant and then to have changed to nursing. In

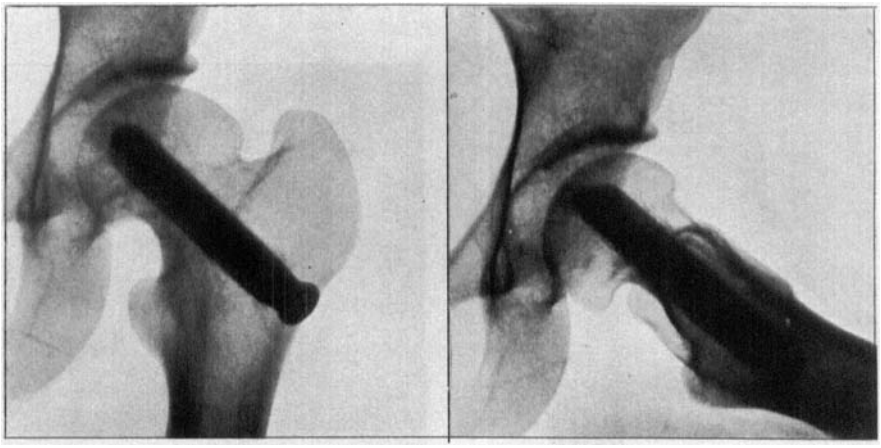


Fig. 16. *Fig. 17.*

Left hip joint.

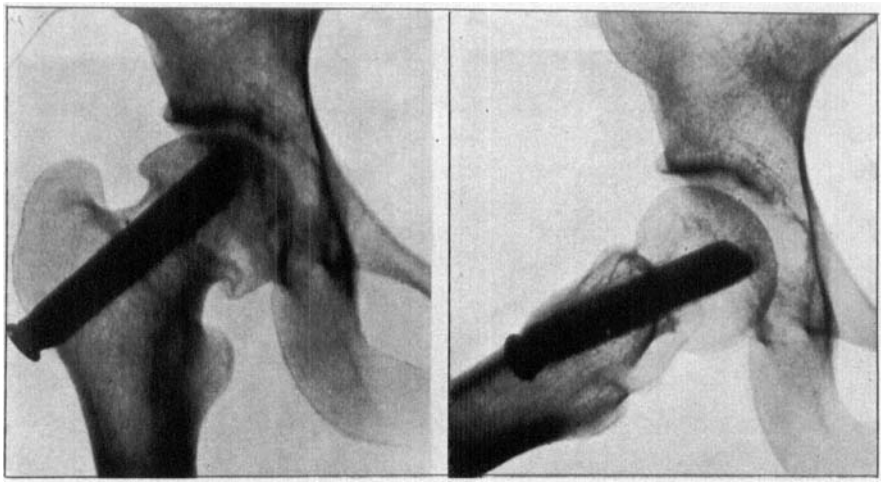


Fig. 18. *Fig. 19.*

Right hip joint.

X-ray of same girl 10 years after subcapital wedge osteotomy and nailing.

May, 1956, she had pain for some days from her left hip joint following exertion but she recovered after rest. At the last examination in June, 1956, she was free from pain. There was free mobility in the hip joints and she walked without limping. Figs. 16 and 17 show X-rays of the left hip joint and Figs. 18 and 19 of the right hip joint, 1956.

FOLLOW-UP

Two boys, whose hips were nailed in situ, and one boy on whom I performed a subcapital wedge osteotomy and nailing, did not attend for follow-up, so that this comprises 34 boys and 14 girls with 51 hips treated. See Table II.

TABLE II

Operation	Boys	Girls	Hips	Length of follow-up in years	Necrosis of caput	Traumat. arthrit.	90° flexion or more	Arthrosis deformans
Nailing (One screw)	18	4	24	1–10 (mean 4½)			24	2+1*
Reduction + nailing	4		4	1–9 (mean 4½)	1		4	
Wedge osteotomy	12	10	23	1–9 (mean 4)	1+1*	1	20	1+3*

* Changes before the operation.

Fixation in situ.

As Table II shows, 24 hips nailed in situ were seen for follow-up. The period between operation and follow-up varies from 1 to 10 years, on average 4½ years. In 2 of the cases secondary arthrosis deformans developed and in one case changes were present before operation. All the patients have more than 90° flexion in the hip joint and are fully at work with one exception who is mentally retarted. This gives 91.3 % good results clinically and roentgenologically.

Closed reductions.

One of the 4 cases of closed reduction had caput necrosis. As the table shows the follow-up took place 1–9 years after operation, on average 4½ years afterwards. All cases have 90° flexion or more in the hip joint. One patient who is mentally retarded and who has also been nailed in situ for epiphyseolysis in the other hip and therefore also reported in this group does not work owing to his mental handicap. The three others are working, the one with caput necrosis in an office; the latter has no trouble from his hip apart from a slight limp 4 years after operation.

Subcapital wedge osteotomies.

As Table II shows, the subcapital wedge osteotomies were re-examined 1–9 years after operation, on an average 4 years afterwards. One boy did not attend the follow-up but gave information that he was free from pain 3½ years after operation. The follow-up comprises therefore 22 patients with 23 hips operated on. Of these one patient had obvious circulatory changes even before operation and one patient was, as mentioned before, not treated by nailing but by hip plaster. If these two are excluded 21 hips remain on which subcapital wedge osteotomy and nailing were carried out and of these one had caput necrosis and one had traumatic arthritis with narrowed articular space. If both these are classed together, as caused by circulatory disturbances, then we obtain 9.5 % caput necrosis. There is an additional patient who had secondary deformans changes at the follow-up, which in all probality are due to a partial caput necrosis, since an indication of the caput smoothing away can be seen on earlier pictures. This should result in a total of 14.3 % caput necroses. 90° flexion ability or more exists in 20 hips and all the patients excepting one who is mentally retarded are working.

To sum up, I should like to point out that we have not had any poor experiences with Sven Johansson's three-flanged nail and that we shall therefore continue with this method of fixation in all less serious slipping, until it is shown that other methods of fixation give better results. As far as the closed reduction in the acute cases are concerned it is probably difficult to say whether an open reduction would be more beneficial, since the published series of open reductions scarcely provide evidence of this. The results of the subcapital wedge osteotomies with simultaneous nailing are satisfactory and I consider that this operation should be advised in all cases with more than ⅓ slipping, since the results without operation are definitely poor and with operation the patient is given a fine chance of achieving a good hip joint.

N.B. The author would like to thank the previous assistant doctor at the Clinic, Dr. Gerd Pettersson, for her valuable aid in the follow-up.

SUMMARY

During the period 1944–55 54 hips out of 51 patients were treated at the Orthopaedic Clinic in Härnösand for epiphyseolysis capitis femoris.

26 hips were fixed in situ, 4 acute slippings had closed reduction and subcapital wedge osteotomy was performed on 24 hips. In one case of subcapital wedge osteotomy no internal fixation was performed, all the others were fixed by three-flanged nail with one exception, which was fixed in situ by wing screw.

Two boys whose hips were fixed in situ and one boy with subcapital wedge osteotomy did not attend the follow-up so that this comprises 34 boys and 14 girls with 51 hips treated.

The period of follow-up for those nailed in situ was on average 4½ years. No caput necroses occurred. 2 patients have secondary arthrosis deformans.

The 4 acute slippings treated by closed reduction were followed-up on average 4½ years after operation. 1 patient had a caput necrosis.

23 hips with subcapital wedge osteotomy were followed-up on average 4 years after operation. Even before the operation 1 patient had obvious circulatory disturbance and 1 patient was not treated by nailing. 21 hips remain with subcapital wedge osteotomy and nailing. 1 of these had total and 1 partial caput necrosis and 1 traumatic arthritis with destruction of joint cartilage. Thus amongst these 21 patients with subcapital wedge osteotomy we had 14.3 % with circulatory disturbances.

We have had no poor results from fixation with three-flanged nail so that this method of fixation is recommended. The danger of caput necrosis occurring in extensive acute slipping is great and the reduction must be handled with extreme care. The results of the subcapital wedge osteotomies with simultaneous nailing are satisfactory and are advised in all cases with more than ⅓ slipping.

RESUME

Pendant les années 1944 à 1955, 54 hanches chez 51 malades ont été traitées à la Clinique d'Orthopédie de Härnösand pour une épiphysiolyse de la tête fémorale. 26 hanches ont été fixées in situ, 4 glissements aigus ont été remis en place sans intervention chirurgicale et il a pratiqué dans 24 hanches une ostéotomie subcapitale en coin. Dans un cas d'ostéotomie subcapitale en coin, il n'a pas effectué de fixation interne, tous les autres ont été fixés au moyen de clous à ailette, à l'exception d'un qui a été fixé in situ avec une vis à ailette.

Deux garçons dont les hanches ont été fixées in situ et un garçon

chez qui il a été pratiqué une ostéotomie subcapitale en coin ne se sont pas présentés aux examens complémentaires. C'est pourquoi l'étude porte sur 34 garçons et 14 filles avec 51 hanches traitées.

La durée qui s'est écoulée jusqu'à l'examen complémentaire des cas cloués in situ a été en moyenne de 4 ans et demi. Pas de nécrose de la tête. 2 de ces cas présentaient des arthroses secondaires.

Pour les 4 cas de glissement remis en place sans intervention chirurgicale, l'examen complémentaire a eu lieu en moyenne 4 ans et demi après l'opération. Il y avait chez un malade une nécrose totale de la tête.

23 hanches avec ostéotomie subcapitale en coin ont été réexaminées en moyenne 4 ans après l'apération. Chez un malade il y avait déjà avant l'opération des modifications circulatoires prononcées et un malade n'avait pas été cloué. Il restait ainsi 21 hanches avec ostéotomie subcapitale en coin + clouage. Parmi celles-ci, 1 avait une nécrose totale et 1 une nécrose partielle de la tête et 1 une arthrite traumatique avec destruction du cartilage articulaire. Nous avons ainsi parmi ces 21 malades chez lesquels a été pratiquée l'osteéotomie subcapitale en coin 14,3 % de dérangements circulatoires.

Nous n'avons donc pas fait de mauvaises expériences avec les clous à ailette et c'est pourquoi cette méthode de fixation est recommandée. Les risques d'une nécrose de la tête sont grands dans les cas de glissement aigu et la reposition doit être faite avec la plus grande prudence. Le résultat de l'ostéotomie subcapitale en coin avec fixation simultanée au moyen de clou est satisfaisant et elle est conseillée dans tous les cas où le glissement et supérieur à ⅓.

ZUSAMMENFASSUNG

In den Jahren 1944–1955 wurden an der orthopädischen Klinik in Härnösand 54 Hüften von 51 Patienten wegen Epiphyseolysis capitis femoris behandelt. 26 Hüften wurden in situ fixiert, 4 akute Gleitungen wurden unblutig reponiert und an 24 Hüften wurde die subkapitale Keilosteotomie ausgeführt. In einem Falle mit subkapitaler Keilosteotomie wurde keine innere Fixation vorgenommen. Alle die übrigen wurden mit dem Flügelnagel fixiert, mit Ausnahme von einem, der in situ mit einer Flügelschraube fixiert wurde.

Zwei Knaben, deren Hüften in situ fixiert worden waren, und ein Mädchen mit subkapitaler Keilosteotomie haben sich nicht zur Nachuntersuchung eingefunden. Dieselbe umfasst daher 34 Knaben und 14 Mädchen mit 51 behandelten Hüften.

Die Zeit der Nachuntersuchung ist für die in situ genagelten im Durchschnitt 4½ Jahre gewesen. Keine Kaputnekrosen sind vorgekommen. 2 Patienten haben sekundäre Arthrosis deformans.

Die 4 unblutig reponierten akuten Abgleitungen wurden im Durchschnitt 4½ Jahre nach der Operation untersucht. 1 Patient hat eine totale Kaputnekrose bekommen.

23 Hüften mit subkapitaler Keilosteotomie wurden im Durchschnitt 4 Jahre nach der Operation untersucht. Ein Patient hatte schon vor der Operation deutliche zirkulatorische Veränderungen und ein Patient wurde nicht genagelt. Es verbleiben daher 21 Hüften mit subkapitaler Keilosteotomie und Nagelung. Von diesen hat ein Patient total und ein anderer partielle Kaputnekrose bekommen, ausserdem einer traumatische Arthritis mit Beschädigung des Gelenksknorpels. 14,3 % von diesen 21 Patienten mit subkapitaler Keilosteotomie haben daher Zirkulationsstörungen aufgewiesen.

Schlechte Erfahrungen mit dem Flügelnagel haben wir daher nicht gehabt und wir empfehlen deshalb diese Fixationsmethode. Die Gefahr der Kaputnekrose bei ausgedehnten akuten Gleitungen ist gross und die Reposition mus deshalb sehr vorsichtig ausgeführt werden. Das Ergebnis der subkapitalen Keilosteotomien mit gleichzeitiger Nagelfixation ist zufriedenstellend und wird in allen Fällen mit mehr als ⅓ Gleitung angeraten.

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