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EPIPHYSEOLYSIS CAPITIS FEMORIS TREATED WITH INFORATION[1]

BY

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At the meeting of the Scandinavian Surgical Association in Oslo 1939 the subject of discussion was the origin, development and treatment of epiphyseolysis capitis femoris.

In their introductory papers, Waldenström and Morville were concordant in the view that manual and bloody reposition should be avoided, and that the slipping of the epiphysis has to be arrested as early as possible. For this purpose, for several years Waldenström had employed the conservative method with confinement to bed and extension of the limb even though the treatment as a rule would take about one year. Since 1938, however, Waldenström had fixed the epiphysis by means of a nail ad modum Wilson—so far with a good result. Morville recommended to fix the epiphysis by inducing a rapid ossification in the epiphyseal line by drilling after the same principle as employed in drilling ad modum Graber Duvernay for painful arthrosis. Morville presented two cases with successful epiphyseodesis. As, thus, experiences were wanting with regard to the better method for fixation of the slipping epiphysis, Guildal suggested that, in order to obtain a sufficiently large material, patients with slipping epiphysis in Norway and Denmark should be treated with drilling while the fixation of the epiphysis by means of a nail should be continued in Sweden.

The present account of 15 cases of slipping epiphysis treated with drilling is aimed to present our indications, technique and

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results for comparison with Wiberg's 15 cases treated with nailing in the Orthopedic Clinic of Karolinska Institutet, Stockholm.

Drilling through the metaphysis up into the epiphysis in order to promote closing of the epiphyseal line appears to have been reported first by Ferguson & Kelin (1921). In the literature from 1924 to 1944 I have found only 13 cases altogether. It may be a few additional single cases have been reported, but I have not been able in the literature to find any fairly large series of epiphyseodeses induced by drilling. In spite of good results obtained in this way, Klein (1931) and Steindler (1943) prefer fixation by nail or conservative treatment.

MATERIAL

The present patient material consists of all the cases we have treated for minimal or moderate slipping of the epiphysis in the period from 1939 to 1944. The other cases, with marked or complete slipping—*i.e.*, exceeding one-third of the epiphyseal diameter—are not included because, in our opinion, such a pronounced slipping constitutes a contraindication for epiphyseodesis. In these cases the treatment has been osteotomy.

We have treated altogether 15 patients with drilling, and in one case the lesion was bilateral. But, as drilling was employed only on one side, epiphyseodesis was performed on 15 hips—4 females, 11 males. The age distribution of the patients was as follows: 2 patients at 11-12 years; 3 at 13-14 years; 9 at 15-16 years; and 1 at 17-18 years.

Only 2 patients showed symptoms of endocrine disturbances; 2 patients gave a past history of a presumably traumatic injury, but this had taken place after the patients had shown symptoms of a hip lesion. In these 2 cases the symptoms had lasted respectively 8 and 50 weeks, but they were greatly aggravated after the injury, and in one of the cases this aggravation was the reason why the patient entered the hospital. It cannot be ascertained, however, whether the epiphyseal slipping was aggravated by the injury. All the present cases are characterized by a protracted

period of illness prior to the treatment. In 8 cases the symptoms had persisted from 20 to 50 weeks, in 3 cases from 10 to 20 weeks, and in 4 cases from 3 to 10 weeks. So this material includes no instance of acute slipping—and this fact may perhaps be of some importance in estimating the failure of reposition on treatment with weight extension.

After the drilling the patients have been under observation at least 1 year (1 case), at the most 7 years (1 case), and the remaining 13 cases for 2-4 years.

The extent of the slipping is recorded in mm., measured in Lauenstein's position, even though the measurement is very rough and unreliable. Slipping up to 5 mm. was measured in 10 cases, 7-10 mm. in 3 cases, 15 mm. in 1 case, and 20 mm. in 1 case. The material contained no case in which slipping of the epiphysis was merely threatening.

TREATMENT

Nearly all the patients (12) were first treated—for about 4 weeks—with adhesive extension with traction = 1/10 of the weight of the patient, the extremity being kept in abduction or adduction together with inward rotation. In one case, extension in Semb's splint was employed. The purpose of this preliminary treatment was to try to obtain a more gentle reposition.

After this, drilling was performed with a 3 mm. drill from the lateral aspect of the femor up through the neck, metaphysis and epiphyseal line, to about the center of the epiphysis. Usually three canals were drilled. In 4 cases the drilling was performed with the aid of Sven Johansson's guiding wire, 1.5 mm.

The drilling was performed with our usual technique: marking of the center of the femoral head and the site of drilling on the femur after marks on the X-ray plate; and the drilling itself was made with a hand-drill under libella control; the placing of the drill was controlled roentgenologically. The postoperative treatment has consisted in 4-8 weeks confinement to bed, then moving about with the aid of crutches and canes for 2-4 weeks. At first, some of the patients were immobilized in

plaster cast. The patient was not allowed to put weight on the hip till the X-ray picture showed a sufficiently solid epiphyseodesis.

RESULTS

In all the cases an osseous closure of the epiphyseal line was obtained, and the slipping of the epiphysis was arrested from the point of time when the treatment commenced.

The functional results are estimated on the basis of the function of the joint, the presence or absence of complaints, and the capacity for work, as follows:

Excellent result: No complaint; function of the joint inhibited less than ⅓; and the patient fully capable of work.

Good result: No complaint; function of the joint inhibited ⅓; and the patient quite able to work.

Poor result: Complaints; poor function of the joint; and working capacity lowered.

Estimated after these principles in 15 cases the resulting epiphyseodeses were excellent in 11 cases, good in 2, and poor in 2.

When the result is estimated in relation to the extent of the slipping (Table 1), it was found to be excellent in every case

TABLE 1

Results of Drilling Treatment of Epiphysiolysis of the Hip.

Slipping of epiphysis	Number of cases	Results		
		Excellent	Good	Poor
5 mm.	10	10		
5-10 „	2	1		1 (arthrosis)
15 „	2		1	1 (arthrosis)
20 „	1		1	
	15	11	2	2

where the slipping was less than 5 mm. (10 cases). With a slipping between 5 and 10 mm., the result was excellent in one case, but poor in one, owing to complicating osteo-arthrosis that

was demonstrated roentgenologically, 18 months after the drilling. In 2 cases with a slipping of 15 mm., the result was functionally good in 1 case—no limp, but periodically static complaints after exertion; in the other case the result was poor—on account of osteo-arthrosis, ascertained roentgenographically 24 weeks after the drilling. In 1 case, in which the slipping amounted to 20 mm., the result was functionally good, without any complaints, but limping.

Epiphyseal necrosis or epiphyseal changes after the extension treatment were not demonstrated in any case. It may be that the larger degrees of slipping—10 mm. or more—dispose to complicating arthrosis, but naturally no definite conclusion can be drawn from so few cases.

After inforation with a 3 mm. drill, osseous closure of the epiphysis was found within 4-10 weeks in 7 cases, within 12-14 weeks in 3 cases, and in less than 48 weeks in 1 case. Inforation with wire drill was employed in 4 cases, but the healing time is difficult to estimate—owing to insufficient roentgenography —although we have to reckon with about 20 weeks.—Even though the war has prevented our roentgenographic control of the epiphyseal closing to the extent desirable for estimation of the healing time, it still is my impression that wire-drilling is less expedient, and that it is better to drill 4-5 canals with a 3 mm. drill.

The attempt at reposition with weight extension failed in all our cases but one, in which the slipping amounted to 20 mm. In this case the position improved but slightly and without any practical significance as far as the statistic results are concerned. Drilling appears absolutely to have a pronounced effect on the metaphyseal structural changes, and also the halisteresis subsides rapidly.

ANALYSIS OF THE UNSATISFACTORY RESULTS

In two cases the epiphyseodesis was complicated by invalidating arthrosis, on which account the two case records will be cited here.

CASE 3. (O. H. 1677/40).

Boy, 16 years old, with a past history of good health. During the last 3 months, increasing tiredness and limping in the left hip and leg; no traumatic injury, no signs of endocrine disturbances. Left hip outward rotated, adducted, shortening of 2 cm.; inward rotation greatly reduced, but other movements free. No muscular atrophy. Sedimentation rate, Wassermann reaction and gonoreaction normal. Roentgenography, 17/4/40: Moderate epiphyseolysis (8 mm.) of the left hip, pronounced metaphyseal changes, collum varum incipiens, decrease in the height of the articular cartilage, oblique epiphyseal line, poor static condition. No abnormality of the right epiphyseal line except that it is more horizontal than usual. Diagnosis: Epiphyseolysis of the head of the femur, with collum varum, and incipient arthrosis.

On 18/4/40: Drilling, with Sven Johansson's guiding wire. Postoperative treatment: Confinement to bed for 2½ months, then walking about on crutches for 2 weeks. Reexamination, 12 weeks after the operation: No complaint, shortening of 2 cm., lateral and rotatory movements markedly reduced, 2/3. X-ray examination 8 weeks after the drilling: Epiphyseal line almost closed, slipping arrested, height of cartilage lowered, no additional halisteration. X-ray examination, 18 months after the drilling: Pronounced osteo-arthrosis of the left hip, epiphyseal line closed, no slipping. At this time, pronounced complaints of arthrosis, which improved after treatment with extension.—During the following 2½ years the patient has been capable of light work (cooking), but he still has arthrotic pains periodically. In the schematic survey of the results (Table 1), this is classified as poor.

CASE 13. (O. H. 7901/43).

Girl, 16 years old. During the past year, periodical attacks of pain in the left hip and knee; pain increasing during the last week before admission. No history of traumatic injury; no sign of endocrine disturbances. Gait limping, shortening of left leg amounted to 2 cm. Left hip-joint strongly fixed; flexion 180/170;

adduction and abduction $^1/_2$; outward rotation $^2/_3$; inward rotation 0. Roentgenography of left hip: Slipping of the epiphysis (10-15 mm.), pronounced metaphyseal changes.

Attempt at reposition in Semb's splint with wire extension through the femoral condyles for 3 weeks gave no improvement of the slipping. In spite of the considerable epiphyseal slipping,

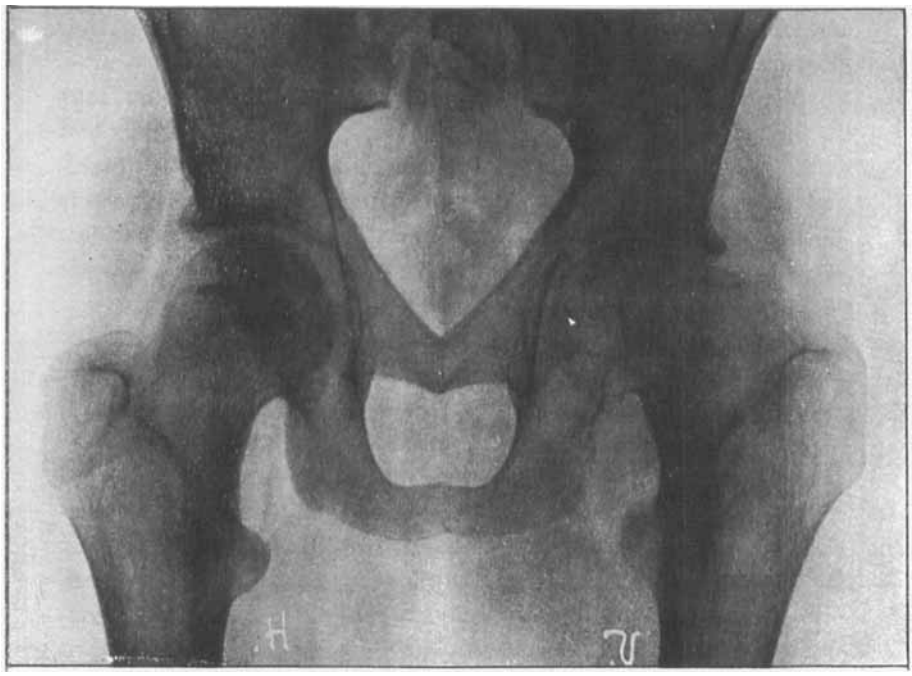

Fig. 1.
Roentgenogram from Case 13, taken 24 weeks after information. Arthrosis of the left hip.

4 drillings were still performed with a 3 mm. drill. Postoperative treatment: Plaster bandage for 8 weeks, no weight put on the hip for 12 weeks. Roentgenography, 7 weeks after drilling: Epiphyseal line almost closed; no slipping; but decrease in the height of the cartilage. Roentgenography after 17 weeks: Epiphyseal line completely closed; height of articular cartilage lowered.

Roentgenography after 24 weeks: Osteo-arthrosis localized to the upper surface of the head of the femur, on which the most weight is put; pronounced halisteresis.

This patient was free from pain during the first 6 months after the drilling. Then she had pain in the hip that subsided on confinement to bed. Reexamination, 15 months after the drilling: No complaint; the patient is able to walk 5 km., but the mobility in the hip is greatly reduced; able to work in sitting posture (sewing). The result is classified as poor.

These two cases with arthrosis are the only complications in the material. In case 3 it is most likely that the arthrosis had commenced already before the drilling; in Case 13 it was manifest roentgenographically 7 weeks after the drilling, whereafter it developed into a typical osteo-arthrosis, disabling the patient. In this case the possibility cannot be excluded that the arthrosis is the result of the drilling.

On the basis of the present material it is not possible to take any definite stand with regard to this serious complication.

In this connection, however, it will be appropriate to remind of the fact that extra-articular operations on the hip—*e.g.,* the Lance osteoplasty for subluxation of the hip—may be followed by severe aseptic, reactive, processes in the joint, with halisteresis, atrophy of articular cartilage, and finally osteo-arthrosis. On the other hand, however, complicating arthrosis may be seen also in untreated cases of epiphyseolysis or in cases given conservative treatment (Ferguson).

DISCUSSION

Now it is generally agreed that slipping of the epiphysis has to be arrested as early as possible and that such patients must not be left untreated. Ferguson has observed 31 untreated cases with epiphyseolysis at its early stage, and only in 3 cases did the epiphysis heal without slipping. But while thus it is the consensus of opinion that the slipping should be arrested at the earliest stage possible, preferably before the slipping has commenced—at the preslipping stage—the views are divergent

as to which method should be employed to induce closure of the epiphysis. It is a matter of choice between the conservative treatment that relieves the hip of its load and, to begin with, fixes the hip in extension or plaster bandage, and the more active method: fixation of the epiphysis by nailing, or epiphyeodesis induced by drilling.

The conservative method, which still is employed by many surgeons—*e.g.*, Hoffmeister, Steindler, Moore, Gormley—is not without inconvenience. Above all, it is very protracted, and with this treatment we have to reckon that the patient is barred from his usual work from 9-12 months. Further, the slipping of the epiphysis is not arrested in all cases; nor can the possibility be excluded that, with employment of Waldenström's technique, the long period with walking on crutches may overtax the so-called normal hip to such an extent as to elicit slipping of the epiphysis in this joint. It is a striking feature that bilateral slipping is encountered very often in Waldenström's material. Also epiphyseal necrosis may be seen even on slight slipping under conservative treatment. Thus, Moore gives the incidence of this complication to be 1 out of 29 cases, while more extensive slipping was found in 3 out of 23 cases. Besides, it may be that conservative treatment has a tendency to promote a curvature of the neck of the femur.

Fixation of the epiphysis with a Smidt Petersen nail was recommended by Wilson in 1938 on the basis of the material of 9 cases. Spotoft has treated one bilateral case in this way, with good result. Wiberg has given an account of 15 cases treated with nail fixation in the Orthopedic Clinic of the Karolinska Institutet in the period of 1938-41. In 9 of the cases the results were analyzed after a sufficiently long observation period—over 1 year—and in all the cases the slipping stopped without any complication; the patients got up soon, already after 12 weeks, and Wiberg thinks that this period may safely be lowered to 9 weeks.

As to closing of the epiphyseal line, the statements differ somewhat. Thus Wiberg holds that the epiphyseal line closes from 10 to 31 months after the nail is driven in, whereas Wilson

thinks that the closure takes place 4-6 months after. At any rate it seem doubtful whether the closure of the epiphyseal line may be due to the nail fixation when it takes up to 30 months —in particular, considering that in untreated patients the epiphyseal line closes earlier than normal, both on the affected side and on the normal.

Drilling has been employed but very little for this lesion. In the literature from 1924-39 Lütken found but 6 cases treated in this way with excellent result. Morville has reported 2 cases, Ferguson 1 case. Other authors—*e.g.*, Klein, Green, Moore—advise against the employment of drilling, though without giving particular reasons for this stand, and prefer conservative treatment or nail fixation. Still, in 1931 Klein used drilling in 3 cases with good result.—Our experiences with drilling show that in all the 15 cases treated in this way a solid epiphyseodesis was obtained without secondary slipping, and the period of treatment was relatively short—about 12 weeks.

In contrast to nail fixation, the drilling induces early ossification in the epiphyseal line. The functional result has been satsfactory, being poor only in 2 out of 15 cases—owing to complicated arthrosis. At present it is not possible to decide whether the appearance of arthrosis in one of the cases was post or propter.

So far, no such complications have been reported among the cases treated with nail fixation. Still, it may be that similar complications will turn up when the materials are sufficiently large.

The rapid disappearance of the metaphyseal changes soon after the drilling, I think, is likewise to be looked upon as a favorable sign of the effectivity of this treatment.

To me, then, it looks somewhat as a question of temperament whether nail fixation or drilling is to be employed for the treatment of slipping epiphysis. Technically, indeed, there is practically no difference between the two methods. A point in favor of the nail fixation is that the patient under this treatment may get up earlier, while the epiphyseodesis induced by drilling requires that no weight is put on the hip till the epiphyseal

union is sufficiently solid. On the other hand, I do not think, that the conservative treatment ought to be continued, as it takes too long time and it less reliable with a view to the functional result.

SUMMARY

1. Epiphyseodesis of the hip by drilling has been performed in 15 cases, within the period of 1939-44, with excellent result in 11 cases, good result in 2 cases, and poor result in 2.
2. Ossification of the epiphysis is seen about 12 weeks after the drilling.
3. No instance of secondary slipping has occurred.
4. In no case was any complication observed that might reasonably be ascribed to the drilling.

RÉSUMÉ

1. L'épiphysodèse de la hanche par forage a été pratiquée dans 15 cas entre 1939 et 1944, avec un excellent résultat dans 11 cas, un bon résultat dans 2 cas et un mauvais résultat dans les deux derniers cas.
2. L'ossification de l'épiphyse est apparue 12 semaines après le forage.
3. Après l'operation aucun glissement n'a été constaté.
4. Aucune complication pouvant raisonnablement être imputée au forage n'a été observée.

ZUSAMMENFASSUNG

1. Epiphyseodesis der Hüfte durch Bohren wurde in der Periode 1939—44 in 15 Fällen vorgenommen — mit ausgezeichnetem Erfolg in 11 Fällen, gutem Ergebnis in 2 und geringem Erfolg in 2 Fällen.
2. Ossifikation der Epiphysis wurde etwa 12 Wochen nach dem Bohren beobachtet.
3. Kein Beispiel darauf erfolgenden Abgleitens ist vorgekommen.
4. In keinem Fall wurde eine Komplikation beobachtet, die be-

gründeterweise dem Bohren hätte zugeschrieben werden können.

REFERENCES

Green, William: Boston Arch. Surg., 1945, *50:* 19.
Klein: Am. J. Surg. 1931, *46:* 681.
Lütken, Poul: Acta orthop. Scandinav. 1939, *X:* 118.
Mercer, Walter: Orthopedic Surgery, 1945.
Moore, Dunham Robert: Surg. Gynec. & Obst., 1945, *80:* 324.
Morville, Waldenström: Nord. kir. Forenings 22. Møde, 1939, 655-665, 660-677.
Nicolaysen: Nord. med., *7:* 1436, *6:* 733.
Spotoft: Nord. med. *II:* 1736-1739.
Wiberg, G.: Acta orthop. Scandinav. 1941, *12:* 179.