

SHELF OPERATION IN THE TREATMENT OF CONGENITAL DYSPLASIA AND SUBLUXATION OF THE HIP-JOINT IN ADULTS

With special reference to the prevention of secondary osteoarthritis

By

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The treatment of congenital dysplasia of the hip-joint and its sequelae is an unsolved problem. Walther & Moe (1954) stress the importance of early diagnosis and treatment, and they recommend that at birth, each infant should be systematically examined for a dysplastic hip and that treatment should be started at once.

But the diagnosis is quite often delayed and among patients above the age of 15 years who are admitted to a surgical department for hip-joint troubles, it is not uncommon to find a dysplastic hip-joint. This developmental abnormality of the hip may involve the acetabulum, head of the femur or its neck and so may represent in minor degree the anatomical changes found in congenital dislocation of the hip. It is common to find a shallow acetabulum, an increased neck-shaft angle of the femur (coxa valga), deformity of the femoral head or possibly a subluxation where the femoral head has moved upwards but still retains its contact with the acetabulum. A complicating osteoarthritis is often demonstrable in these dysplastic hip-joints.

The pathogenesis of the dysplastic hip-joints is unknown. Waldenstrøm (1932) was of the opinion that the congenital dysplasia of the hip depended on faulty development of the lateral part of the acetabulum, the acetabular rim. Wiberg has paid special attention to the development of the acetabular rim and its ossification. His anatomical and radiological studies have shown that there are three small accessory ossification centres—so-called ossa acetabuli—which normally ossify between the ages 11 to 17 years. These, in his view, may play a part in the development of the acetabulum. In subluxation the femoral head

may in some way, perhaps by pulling on the attenuated capsule, exert pressure on the upper acetabular rim and so hinder its development. Wiberg demonstrated that replacement of the femoral head caused an increase in the growth tendency of the rim and a normal development of these ossification centres, in cases treated early enough. In addition to the shallow acetabulum we have found that the femoral neck is often markedly valgus and the head buffer-shaped. Klapp (1906) considered that a neck-shaft of the femur of over 128 degrees is pathological, and that with such increased valgus position there is a predisposition for the femoral head to be subluxated or dislocated. He called this condition "coxa valga luxans".

CLASSIFICATION OF THE DYSPLASTIC HIP

The radiological examination permits a certain classification of the dysplastic hips. Wiberg introduced the CE-angle in 1939 and was the first to adopt a more detailed system with differentiation between dysplasia, subluxation and dislocation. The CE-angle is formed by two lines running from the centre of the femoral head, one parallel with the long axis of the body and the other running through the edge of acetabulum (Fig. I). Wiberg found in adults that the CE-angle normally is above 25 degrees, and that values below 20 degrees are pathological. Values between 20–25 degrees are uncertain. In addition to the CE-angle, the neck-shaft angle of femur (Fig. II) is measured. This is believed to be an important factor in the dysplastic hip-joint.

Based on the radiological examination the following groups will be used in this discussion:

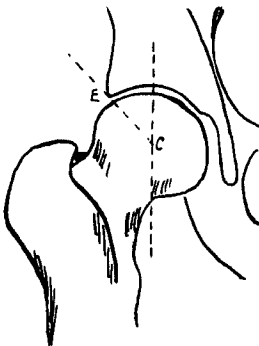


Fig. I.
CE-angle.

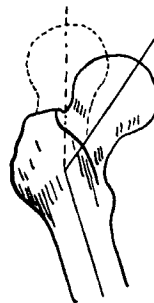
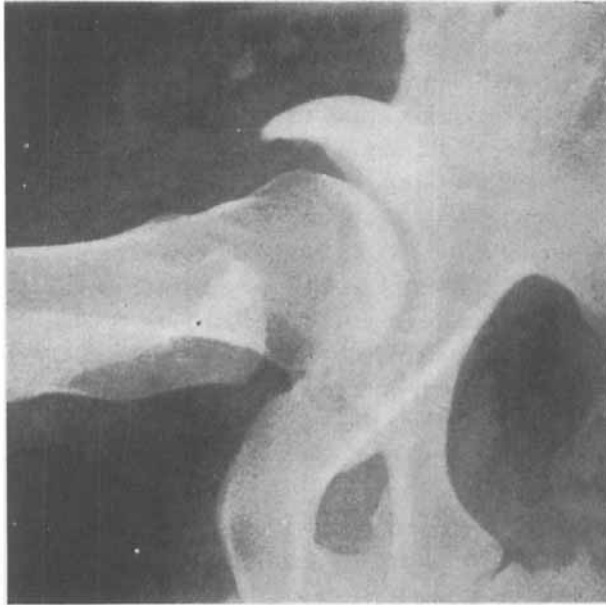


Fig. II.
The coxa valga position indicated in dotted line.
The neck-shaft angle is normally 128 degrees.

*a**b**c*



d

Fig. III.

Male 26 years with a dysplasia on the right side (a). Ideal position of the graft by x-ray control after the operation (b), and good shelf with well-formed structure five years later (c-d).

DYSPLASIA

CE-angle of less than 20 degrees and no break in Shenton's line.

SUBLUXATION

The femoral head is displaced upward and laterally and there is a break in Shenton's line, but there is contact between the head and the socket. The CE-angle may be slightly positive, zero or negative. A clear-cut differentiation between dysplasia and subluxation cannot always be made, because Shenton's line is not considered an entirely reliable guide as to the presence of subluxation. The line may not be visibly affected by minor lateral displacement of the head without upward displacement, and is somewhat affected by the degree of abduction or adduction of the femur.

THE SECONDARY OSTEOARTHRITIS

It is accepted that secondary osteoarthritis commonly arises in a dysplastic hip-joint with or without subluxation. Wiberg (1939), in a

series of 257 cases of osteoarthritis of the hip-joint, found that 25.7 per cent had a primary subluxation. These figures agree fairly closely with those of Lloyd-Roberts (1955), who found an incidence of 20.9 per cent. Gade (1947), in his study of 123 cases of osteoarthritis of the hip-joint, found that 47.97 per cent had a maldeveloped acetabulum. Wiberg (1939) has made a follow-up study of 19 cases of uncomplicated dysplasia and subluxation, aged from 13 to 60 years, in whom no osteoarthritis was demonstrable. Developing osteoarthritis was demonstrated radiologically in all of them 4 to 28 years later. Lloyd-Roberts (1955) has shown that the incidence of osteoarthritis is related to the degree of development of the acetabulum.

The whole femoral head with its hyaline cartilage is not uniformly exposed to joint stress. There is a "non-pressure area", which consists of the infero-medial surface of the femoral head and the marginal part of the cartilage. The first area corresponds to that part which is in contact with the acetabular fossa, and the marginal part of the cartilage tends to project laterally outside the acetabulum. The "pressure area" is that which articulates with the acetabular cartilage. In dysplasia and subluxation the "pressure area" is smaller, and the load which the joint is bearing is distributed over a reduced area. The common opinion is that "excessive wear and tear" is the causative factor of the secondary osteoarthritis in dysplasia and subluxation. Harrison, Schajovicz & Trueta (1953) have put forward the novel suggestion that the earliest degenerative changes in the articular cartilage are in those parts of the joint exposed but little, if at all, to the stresses and strains of joint function and consider that activity with the "pumping" action of alternate pressure is essential for the nutrition of the cartilage. In dysplasia and subluxation the "non-pressure area" is larger than in a normal hip. This may explain why these maldeveloped joints with a larger area where the pressure is insufficient, are predisposed to osteoarthritis.

Schede (1933) and Gade (1947) have shown that good therapeutic results can be obtained by means of the shelf operation in cases of acetabular dysplasia with incipient osteoarthritis.

TECHNIQUE OF THE SHELF OPERATION

The shelf operation for congenital dislocation of the hip-joint was first described by König in 1891. Since then this method has been modified by several surgeons, among them are Spitzzy, Lance and Albee.

The following technique of operation is used in our department:

No extension is used before the operation. The patient is placed in supine position, and the hip-joint is exposed from the antero-lateral aspect through a relatively short Smith-Petersen incision. The muscles are stripped from the ileum. In order to place the shelf at the proper level it is usually necessary to loosen the attachment of the joint capsule above the acetabular margin from above downwards, until the operator can palpate the acetabular rim with his finger. It is essential not to place the shelf too high, for then the end-result will be doubtful or bad. If the femoral head is anteverted, the roof must be placed anteriorly.

A groove is chiselled into the bone in the level of the acetabular rim. The groove must be about 3 cm long, 0.5 cm wide and 2 cm deep. There is no danger if the lamina interna of the ileum is penetrated. Then a graft is taken from the ileum where it has the greatest concavity which will be a suitable roof for the femoral head. The graft should be about 4×3 cm and about 0.5 cm thick. It is trimmed with bone cutters to fit the groove as accurately as possible. Then the graft is driven into the groove with the periost-covered surface towards the capsule (Fig. III). The muscles and skin are sutured without drainage.

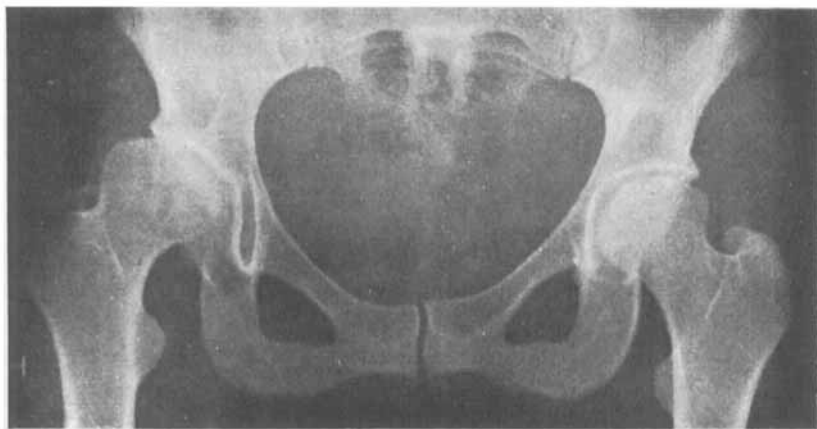
Physiotherapy is started a few days after the operation. The patients are allowed to get up 2 weeks after the operation with crutches. Weight-bearing is started two months after the operation, and a month later they are allowed to walk without crutches.

THE MATERIAL

It was thought that a follow-up study of patients with dysplasia and subluxation for which a shelf operation was performed, would be interesting. During the period 1938 to 1951 65 patients were treated for dysplasia and subluxation of the hip-joint by the shelf operation in our department. In 7 patients both hips were operated on, and a total of 72 shelf operations were performed. 9 of the patients were men and 56 women. The average age at the time of operation was $33\frac{1}{2}$ years, with the youngest 16 years and the oldest 60 years. The average observation period was 8 years and 3 months, with a maximum of 16 years and a minimum of 3 years.

The material deals with dysplasia and subluxation with or without secondary osteoarthritis at the time of operation. The osteoarthritic process is graded as follows:

Grade I: A decrease in the height of the joint space and a subchondral sclerosis in the acetabulum and femoral head.

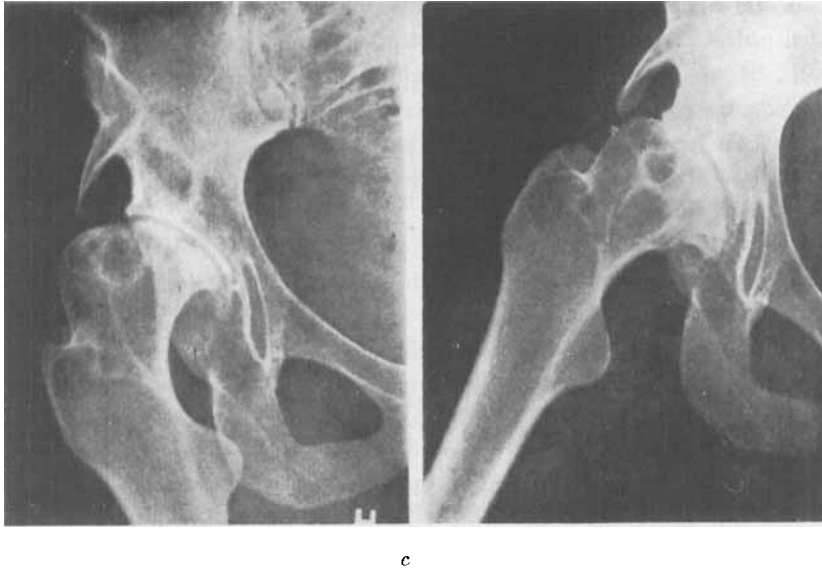
*a**b*

Grade II: The presence of grade I changes with, in addition, small osteophytes but no signs of destruction.

Grade III: Fully developed osteoarthritis with flattening of the femoral head and deformation by large osteophytes, cysts and signs of destruction of the cartilage. These changes represent the destructive phase of the osteoarthritis.

The material consists of 27 cases with dysplasia, which is classified as shown in Table I and 45 cases with subluxation, classified in Table II.

All the 65 patients were followed-up by questions and X-rays. 52 cases were followed-up personally. Each operated hip is recorded as a separate case. The patients have been questioned regarding pain and range of active movement, and if they benefited from the operation.

*Fig. IV.*

Subluxated right hip-joint with secondary osteoarthritis of grade III (a). The graft is placed too high without effect (b). Osteoarthritis is developing further (c).

TABLE I
Dysplasia-group.

Dysplasia	Number
Without osteoarthritic signs	10
With secondary osteoarthritis grade I	5
" " " " II	6
" " " " III	6
Total	27

TABLE II
Subluxation-group.

Subluxation	Number
Without osteoarthritic signs	4
With secondary osteoarthritis grade I	10
" " " " II	10
" " " " III	21
Total	45

13 of the operated hips were not improved. 59 showed improvement. But a patient's own report does not give the correct picture of the end-result, because a patient who omits heavy work or weight-bearing after the operation may improve or become symptomfree solely owing to the changes in his work and habits. In patients with subjective improvement, the radiological picture must also be satisfactory otherwise the result must be classified as bad.

The shelf is considered to be in a good position if it overhangs two-thirds of the femoral head in the a-p, and it must be placed over the vertex of the head in the sagittal plane. The base of the shelf must not be placed higher than 0.5 cm above the acetabular rim. If the shelf does not satisfy these criteria the result of the operation must be classified as bad (Fig. IV). The position of the shelf obtained in our 72 cases was analysed. In 12 cases the shelf was placed too high above the acetabular rim or too short laterally or not correctly aligned in the sagittal position. 9 of these cases had no symptomatic improvement.

The clinical assessment is based on the following:

Excellent: Good position of the shelf.

Free from symptoms without special precautions.
Free mobility.

Good: Good position of the shelf.

Improvement without special precautions.
Minimal restriction of the flexion and rotation.

Bad: Bad radiological result.

No or uncertain improvement with precautions.
Restricted mobility.

In the total material --50 cases had an excellent or good clinical result, constituting 69.4 per cent of the operations. The other 22 cases had a bad clinical result.

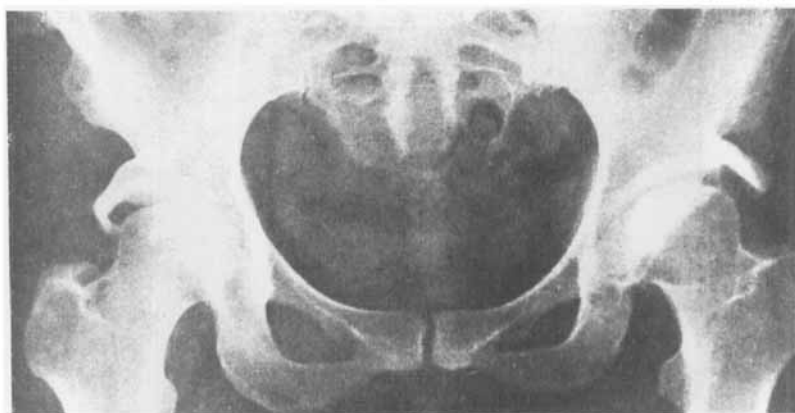
It may be of interest to analyse further each group separately and see whether the end-results in the dysplasia-group differ from those in the subluxation-group, and see whether the sub-groups with the 3 stages of secondary osteoarthritis at the time of operation affect the results.

Fig. V.

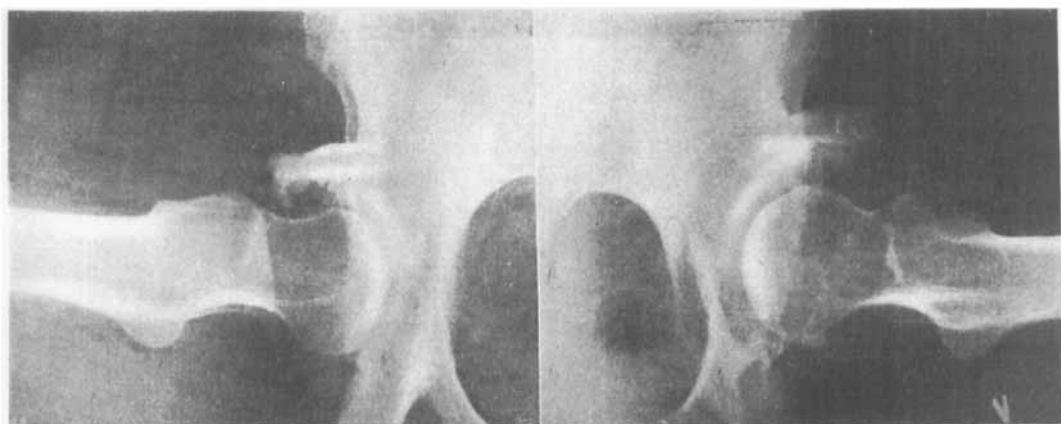
Bilateral dysplasia in a female 51 years old (a). 8 years after the shelf operations there was an excellent clinical result on the right side where the secondary osteoarthritis was slight. Good clinical result on the left side which had osteoarthritis grade II at the time of operation, but the osteoarthritis shows slight progress (b-c).



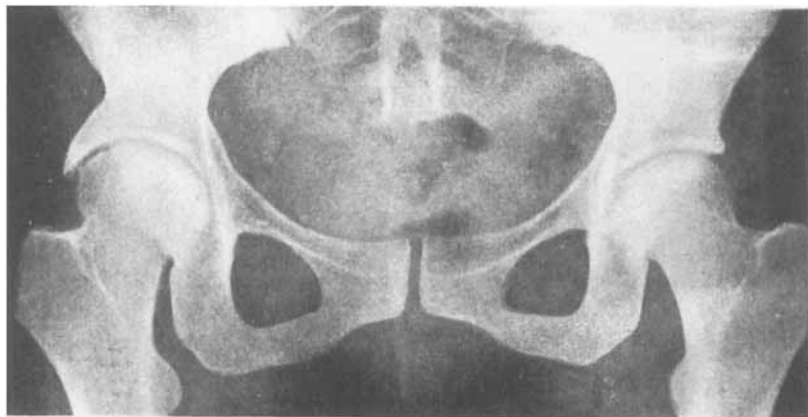
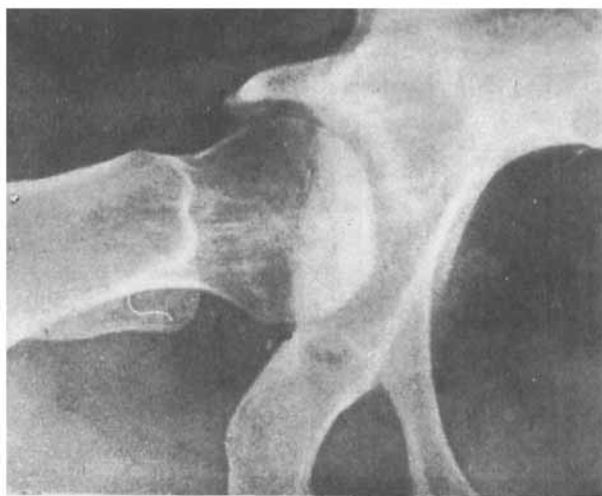
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*a**b**Fig. VI.*

Female 34 years old with dysplasia on the right side. 4 years after the shelf operation there was an excellent clinical result with ideal radiological appearance (a-b).

The results in the dysplasia-group are shown in Table III. The average age of the patients without osteoarthritis was 26 years, whereas it was 54 years in those with osteoarthritis of grade III. The average time elapsing between the onset of pain and the operation date is shown for the sub-groups in Table IV. From these figures and the average age at operation the osteoarthritis seems to develop by degrees after

TABLE III

The end-result in the dysplasia-group related to the degree of the secondary osteoarthritis.

Secondary osteoarthritis at operation time	No. of operations	Average age at operation in years	Average observ. time in years	Clinical result.			Radiological progress of secondary osteoarthritis
				Excell.	Good	Bad	
Without	10	26	7	7	3	0	none
Grade I	5	32	11	4	1	0	none
„ II	6	42	7	1	3	2	1
„ III	6	54	8	0	4	2	5

TABLE IV

Average duration of pain before operation in the dysplasia-group.

Secondary osteoarthritis at operation	Average duration of pain before operation	Average age at operation
Without	5 years	26 years
Grade I	7 „	32 „
„ II	8 „	42 „
„ III	10 „	54 „

the age of 26 years. In 27 cases of dysplasia treated by shelf operation we have the following results:

Excellent or good clinical result in 23 cases i.e. 85.2 per cent (Fig. V and VI). Bad result in 4 cases i.e. 14.8 per cent. One of these patients had osteoarthritic signs before and had an unsatisfactory shelf. The other three cases with bad results had a secondary osteoarthritis of grade II and III before the operation. At the end of the observation period the patients in the sub-group—dysplasia without osteoarthritic signs—did not develop any signs of osteoarthritis, and the signs in the sub-group—dysplasia with osteoarthritis grade I—were stationary.

All the cases in the dysplasia-group had an increased neck-shaft angle of the femur with values above 132 degrees. The average neck-shaft angle was 137.6 degrees.

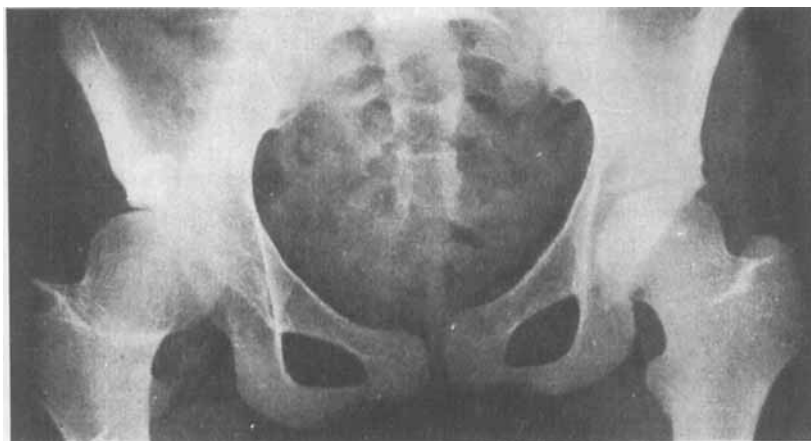
Out of the 65 patients 25 had dysplasia on the opposite side as well, but these lesions were slight and asymptomatic at the time of operation. They too were followed-up with an average observation period of 9 years. 15 out of these 25 hips were unchanged and all of these 15 had a neck-shaft angle of normal or slightly increased values i.e. under 132 degrees with an average of 130 degrees. 10 of the 25 hips with a neck-shaft angle over 135 degrees, with an average of 139 degrees, developed progressive osteoarthritic signs and were painful. A dysplasia combined

with an increased neck-shaft angle seems to develop osteoarthritis and pains earlier and more frequently than a shallow acetabulum with a normal neck-shaft angle of the femur.

The dysplastic hips in adults with a coxa valga should be treated by a shelf operation as soon as the diagnosis is established. Delay in the operation should be discouraged because the end-result is poor when osteoarthritis sets in. The shelf operation has also a value in dysplasia with slight osteoarthritis to relieve the pain and to arrest the osteoarthritis.

The results in the subluxation-group are shown in Table V. All the cases in this group had an increased neck-shaft angle with values above 130 degrees and up to 150 degrees. The average neck-shaft angle was 138.7 degrees and above the average value for the dysplasia-group. The average age of the patients with subluxation and no osteoarthritic signs was 19 years, and in those with grade III of secondary osteoarthritis it was 38 years. The average time elapsing between the onset of pain and the operation date is shown for the sub-groups in Table VI. Osteoarthritis seems to develop by degrees after the age 19 years and earlier in the subluxation-group than in the dysplasia-group. In our 45 cases of subluxation treated by shelf operation, the results are as follows:

Excellent or good clinical results in 27 cases i.e. 60 per cent (Fig. VII). Bad clinical results in 18 cases i.e. 40 per cent. The bad results



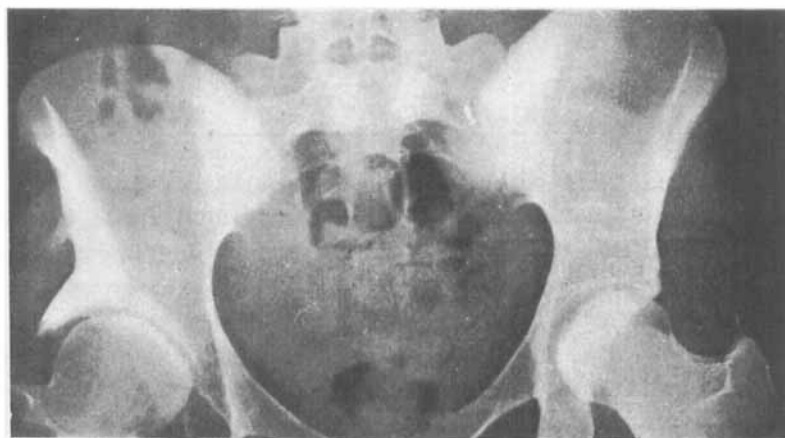
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Fig. VII.

Female 16 years old with slight subluxation on the right side, and the femoral head is buffer-shaped with an increased neck-shaft angle (a-b). Excellent result 8 years after shelf operation (c-d).



b



c



d

TABLE V

The end-result in the subluxation-group related to the degree of the secondary osteoarthritis.

Secondary osteoarthritis at operation time	No. of operations	Average age at operation in years	Average observ. time in years	Clinical result.			Radiological progress of secondary osteoarthritis
				Excell.	Good	Bad	
Without	4	19	12	3	1	0	none
Grade I	10	24	10	7	2	1	3
„ II	10	33	9	3	3	4	5
„ III	21	38	8	2	6	13	11

TABLE VI

Average duration of pain before operation in the subluxation-group.

Secondary osteoarthritis at operation	Average duration of pain before operation	Average age at operation
Without	8 years	19 years
Grade I	8 „	24 „
„ II	9 „	33 „
„ III	11 „	38 „

occur in subluxations with secondary osteoarthritis grade III, the destructive phase of the osteoarthritis. Further analysis of this sub-group shows that excellent or good results were obtained in only 8 cases and bad results in 13 cases. The patients in this sub-group can be treated more satisfactorily by other ways.

The shelf operation should be performed for subluxation in adults, as soon as the diagnosis is established. It is of great value in the congenital subluxation before the secondary osteoarthritis has set in or is minimal. The operation gives a good clinical result, and either prevents or delays the secondary osteoarthritis which is sure to develop in untreated cases.

SUMMARY

An assessment of the value of the shelf operation in dysplasia and subluxation of the hip-joint in adults is presented, based on a follow-up study of 72 cases operated on between 1938 and 1951. This operation had excellent or good results in 85.2 per cent of the dysplasias and 60 per cent of the subluxations. According to the follow-up study, the indications for shelf operation in adults are:

1. Dysplasia

- a. Asymptomatic with increased neck-shaft angle.
- b. With symptoms and only slight osteoarthritic signs.

2. Subluxation without or minimal osteoarthritic signs.

The shelf operation is contra-indicated in dysplasia and subluxation with a secondary osteoarthritis in its destructive phase.

RESUME

Une appréciation de la valeur de l'opération de la butée ostéoplastique dans les cas de dysplasie et de subluxation de l'articulation de la hanche chez les adultes est donnée en se basant sur l'étude de 72 cas opérés entre 1938 et 1951. Cette opération a donné d'excellents ou de bons résultats dans 85,2 % des cas de dysplasie et dans 60 % de ceux subluxation. En se basant sur cette enquête, l'opération de la butée ostéoplastique chez les adultes est indiquée dans les cas suivants:

1. Dysplasie

- a) asymptomatique avec angle col-corps du fémur accru
- b) avec des symptômes et avec légers signes d'osteoarthrite.

2. Subluxation sans ou avec légers signes d'osteoarthrite.

L'opération de la butée ostéoplastique est contreindiquée dans la dysplasie et la subluxation accompagnées d'une ostéoarthrite secondaire dans sa phase destructive.

ZUSAMMENFASSUNG

Eine Wertschätzung der Pfannendachplastik bei Dysplasie und Subluxation des Hüftgelenkes beim Erwachsenen, die zur Unterlage eine Nachuntersuchung von 72, zwischen 1938 und 1951 operierten Fällen, hat, wird vorgelegt. Die Operation war von 85,2 % ausgezeichneten oder guten Resultaten in Fällen von Dysplasie gefolgt und von 60 % bei Subluxationen. Aus der Nachuntersuchung kann der Schluss gezogen werden, dass die Anzeigestellung für die Pfannendachplastik ist:

1. Dysplasia

- a. ohne Symptome mit vergrößertem Hals-Schaftwinkel.
- b. mit Symptomen und nur leichten osteoarthritischen Zeichen.

2. Subluxation ohne oder mit nur sehr geringen osteoarthritischen Zeichen.

Die Pfannendachplastik ist kontraindiziert bei der Dysplasie und Subluxation mit sekundärer Osteoarthritis in einer destruktiven Phase.

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