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FUNCTION FOLLOWING ARTHRODESIS FOR COXARTHROSIS

With Special Reference to the Mobile Hip

by

GUÐMUNDUR GUÐMUNDSSON

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Akademisk Avhandling

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GUÐMUNDUR GUÐMUNDSSON

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I. INTRODUCTION

Albee introduced the intraarticular arthrodesis of the hip in 1908. Until quite recently this method has maintained a prominent position in the surgical treatment of painful coxarthrosis (Rütt 1969). According to the literature, the chief advantage of arthrodesis over other methods is that it gives permanent relief from pain and instability. The operation has therefore traditionally been considered well indicated for people doing heavy work or whose occupation involves much walking and/or standing.

The aim of the operation in bilateral hip disease has commonly been to achieve, not only stability and freedom from pain in the more severely affected joint, but at the same time to retard or arrest progress of the disease in the less affected hip. The leg on the fused side was thus intended to be used for main support (Watson-Jones 1956; Francillon 1957; Wiberg 1959; Herbert 1960; Mach 1964; Verheugen and Navarre 1964; Becker 1969).

However, a fairly extensive search of the literature failed to reveal adequate studies of the support pattern following arthrodesis of the hip or of the fate of the (unoperated) mobile hip, compared with its preoperative condition in the two forms of coxarthrosis, the primary and secondary.

This investigation attempts such a study of 125 cases who had 2 to 22 years previously undergone arthrodesis because of unilateral or bilateral coxarthrosis. The investigation comprised a registration of the static support pattern, a comparative study of preoperative and follow-up radiograms of the mobile hip and a clinical examination. The following parameters were studied:

a) the extent to which the fused hip was used for static support;
b) the incidence, rate and degree of radiographic deterioration of the mobile hip;
c) the incidence and severity of pain in the mobile hip and the limiting effect of pain on daily activities and working capacity.

II. MATERIAL AND METHODS

A. Classification of Coxarthrosis

On the basis of preoperative radiograms of the hips, the cases were classified as unilateral or bilateral coxarthrosis. Radiographic signs of osteophytes, narrowed joint space or structural changes, were used as criteria of coxarthrosis (Heripret, Danielsson and Dymling 1964). Distinction between primary and secondary coxarthrosis was based on the history and radiographic appearance.

B. Material

The source material comprised 336 cases treated at the Orthopaedic Departments of the Lund University Hospitals in Lund and Malmö. Arthrodesis because of coxarthrosis came into regular use in Lund in 1945 and in Malmö in 1952. All cases operated through 1965 were included in the source material. It consisted of 195 females and 141 males, a ratio of 1.3/1. The average age at operation was 55 years, the same for both sexes. Over half of the cases were 50 to 65 years old at operation (Fig. 1).

1. Base Material

Hospital records of 9 cases were missing or incomplete. This reduced the number of cases to 327 (Base Material) on which adequate data were available. From the records and radiographic descriptions of these cases it was found, that at the time of operation, 177 had unilateral and 150 bilateral coxarthrosis. The distribution between primary and secondary coxarthrosis was 191 and 136 cases, respectively.

2. Selection of the Probands

Only cases filling the following requirements were accepted:

a) the mobile hip must not have been rendered unfit for radiographic assessment by a high congenital dislocation or some intraarticular operation,

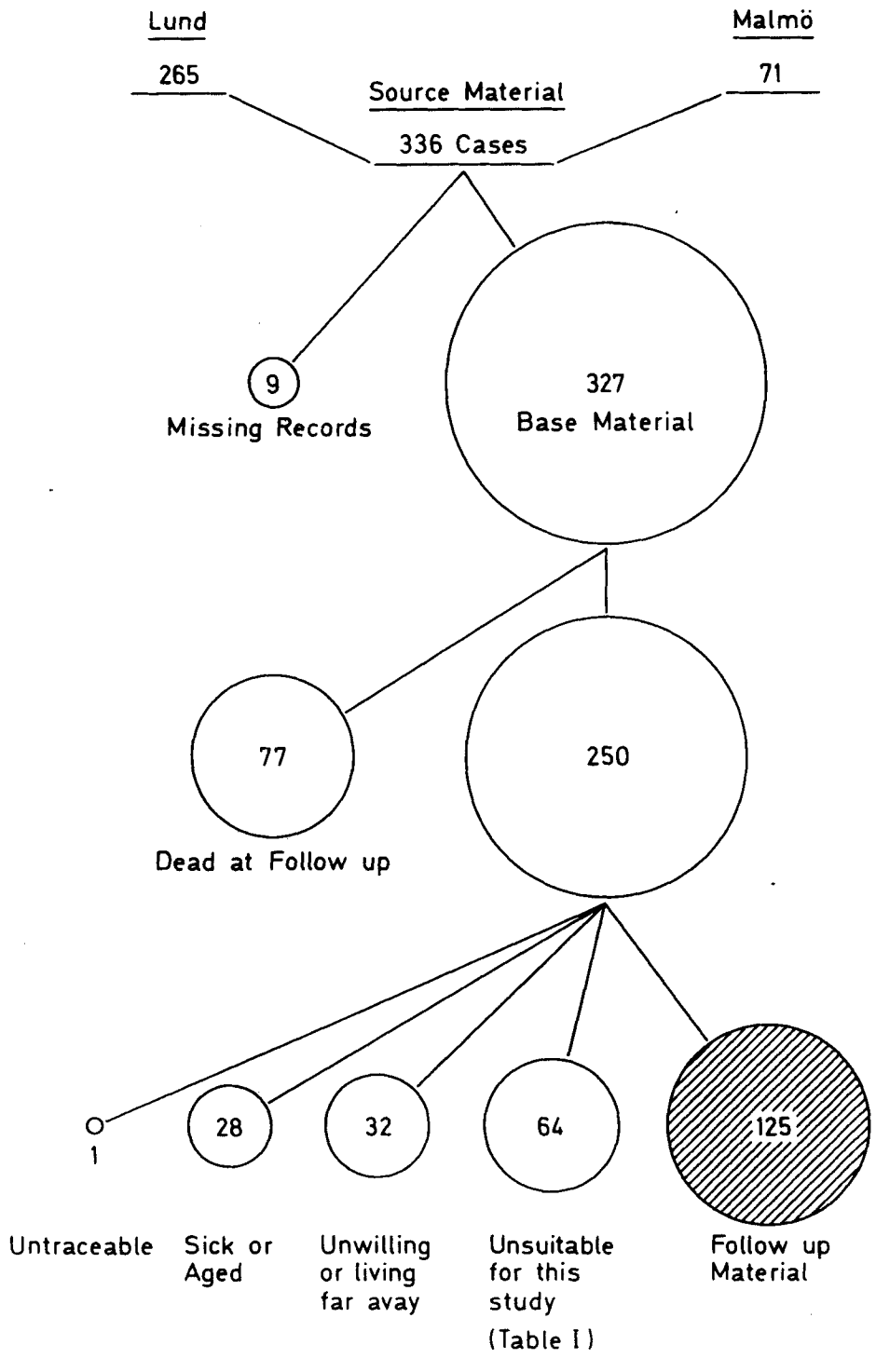


Fig. 1 The Material

b) radiographic and/or clinical signs of firm union in the operated hip,

c) available preoperative radiograms of the mobile hip or adequate radiographic and clinical descriptions of the preoperative state,

d) availability of the case at the time of follow-up examination.

Potential probands were contacted by letter and/or telephone. All those willing and able to participate were examined. In all, 159 cases were examined but 34 of these failed to meet the above requirements (non-union 28; arthroplasty of mobile hip 4; high congenital dislocation of mobile hip 2). A further 30 were excluded because of similar findings in the records and radiograms (Table I).

Table I. Cases found unsuitable for follow-up

Cause	Number
Mobile Hip:	
Arthroplasty or Resection	15
High Congenital Dislocation	3
Operated Hip:	
Resection (Girdlestone)	4
Non-union	41
Femoral Amputation	1
Total	64

In 12 cases the radiograms obtained at follow-up were inconclusive, i. e. lacking in definite radiographic evidence of solid union. All these hips were free from pain and clinically firmly united. Although osseous union may not always have been complete, all 12 cases were accepted as probands.

Of 16 cases in which preoperative radiograms of the mobile hip were not available, 10 were free from signs of arthrosis at follow-up. The remaining 6 had minimal changes, i. e. only slightly reduced joint space and/or marginal osteophytes. The interval between the operation and follow-up of these 6 cases was 15 to 22 years. It was therefore considered reasonably certain that these hips had been

normal at the time of operation. These cases were accepted as probands.

Four cases with bilateral disease at the time of operation were accepted as probands despite unavailability of preoperative radiograms of the mobile hip. The hospital records of all 4 cases contained adequate descriptions of the original radiograms.

3. Description of Probands

Seventy seven of the 125 probands were females and 48 males, a ratio of 1.6/1. At operation 75 probands had unilateral and 50 bilateral coxarthrosis, and 61 had primary and 64 secondary coxarthrosis in the hip that was fused.

The distribution within the different subgroups of the material was largely the same in the Base Material as in the Follow-up Material. (Fig. 2). The only appreciable difference was a relative loss of males with primary coxarthrosis and a corresponding gain of females with secondary coxarthrosis.

Of the 77 cases dead att follow-up, 42 were males. Two thirds of the 77 cases had had primary coxarthrosis.

a. Unilateral Coxarthrosis

Of the 75 cases operated for unilateral coxarthrosis, 50 had secondary and 25 primary coxarthrosis. The diagnoses in the secondary cases are given in Table II. There were 53 females and 22 males.

Table II. Etiology in 50 Probands operated for Unilateral Secondary Coxarthrosis

Etiology	Number
Developmental Disturbances:	
Dysplasia	9
Congenital Dislocation	6
Epiphysiolysis	2
Mb. Perthes	3
Coxa valga bil.	1
	21
Inflammation:	
Septic Coxitis	9
Tuberculous Coxitis	7
Osteomyelitis	1
Rheumatioid Arthritis	1
	18
Trauma:	
Fracture of Femoral Neck	11
Total	50

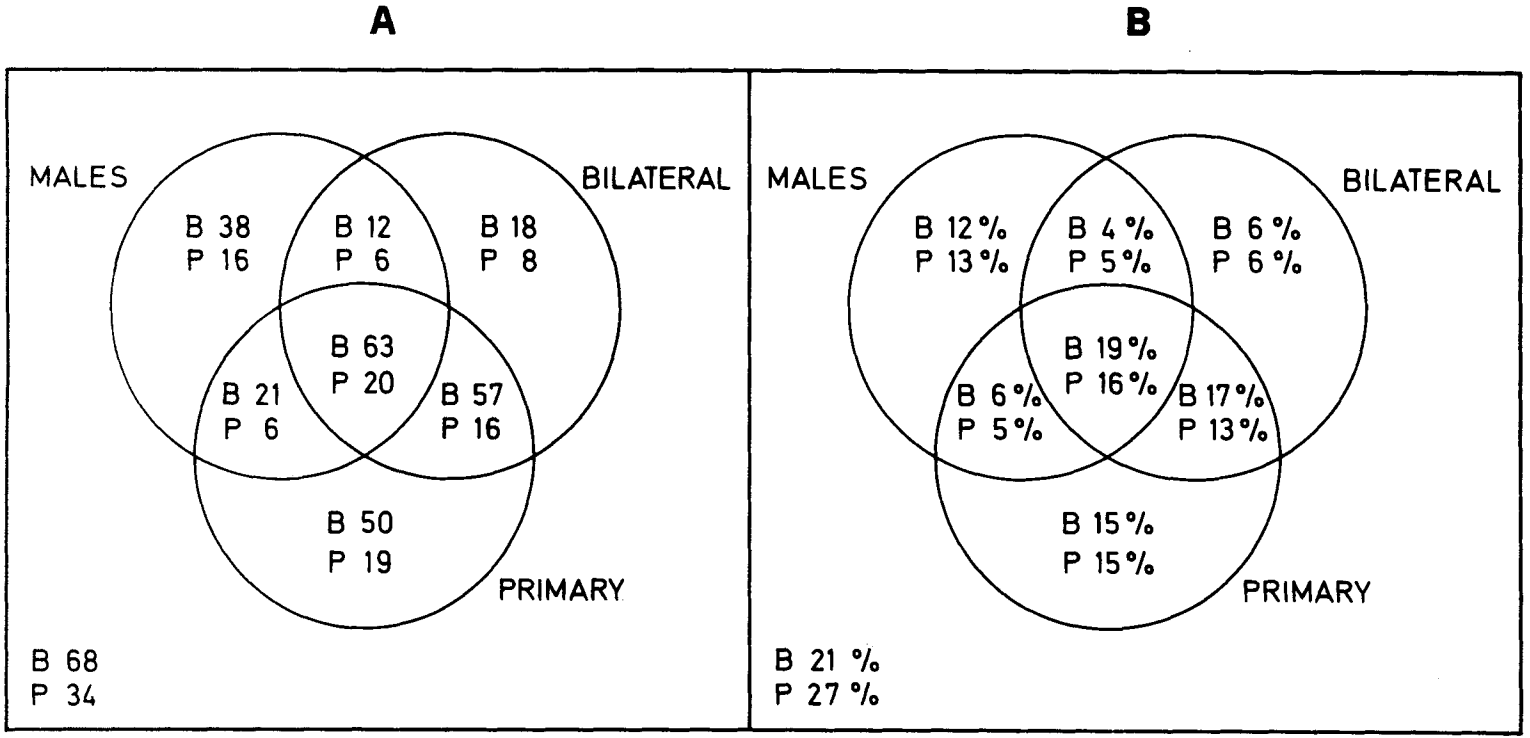


Fig. 2 *Distribution of Material in Terms of Sex, Laterality and Type of Coxarthrosis.*
A. Base Material (B, 327 Cases) and Probands (P, 125 Cases) according to Sex, Unilateral or Bilateral and Type of Coxarthrosis (Primary or Secondary)
B. Percentage of the total Number of Cases of Base Material (B) and Probands (P) within each of the eight subgroups

b. Bilateral Coxarthrosis

Of the 50 bilateral cases, 36 had primary and 14 secondary coxarthrosis (Table III). There were 24 females and 26 males.

Table III. Etiology in 14 Probands operated for Bilateral Secondary Coxarthrosis

Etiology Fused Hip	Type of Arthrosis Mobile Hip	Number
BOTH HIPS:		
Developmental Disturbances:		
Dysplasia	Same	4
Congenital Dislocation	"	1
Coxa vara	"	1
Inflammation:		
Rheumatoid Arthritis	"	4
ONE HIP:		
Developmental Disturbances:		
Epiphysiolysis	Primary	1
Mb. Perthes	"	1
Trauma:		
Fracture of Femoral Neck	"	1
Fracure of Acetabulum	"	1
	Total	14

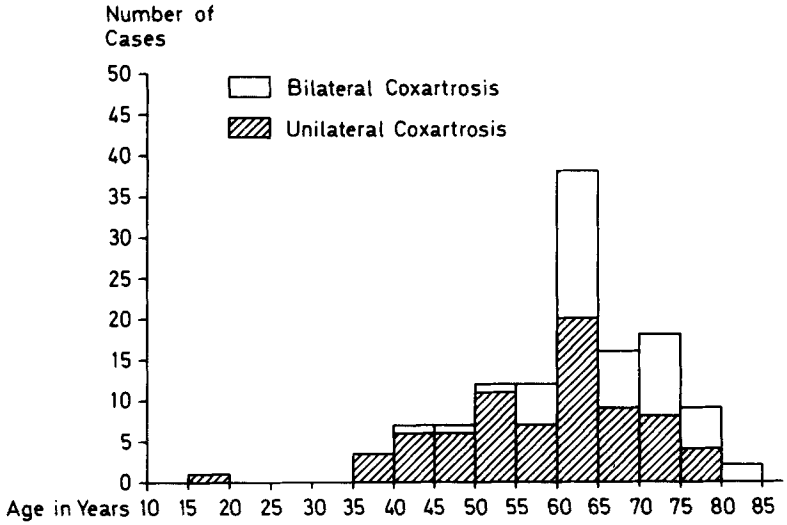
c. Age at Operation

More than half of the probands were 50 to 65 years old at the time of operation. The average age was 52 years, and was the same in both sexes. The average age of those with primary coxarthrosis was 8 years higher than of those with secondary coxarthrosis, or 56 and 48 years, respectively. The youngest proband at operation was 17 years and the oldest 74 years.

d. Age at Follow-up

Over half of the probands were 60 to 75 years old. The average age was 61 years (Fig. 3) and was the same in both sexes. The

average age of the probands with primary coxarthrosis, mainly bilateral, was 66 years, while the corresponding age of the probands with secondary coxarthrosis, mainly unilateral, was 57 years. The youngest proband at follow-up was 19 years and the oldest 84 years.



Males	1		2	4	3	4	16	8	3	6	1	= 48
Females		3	5	3	9	8	22	8	15	3	1	= 77
	1	3	7	7	12	12	38	16	18	9	2	= 125

Fig. 3. Age Distribution at Follow up

e. Follow-up Period

The interval between operation and the follow-up examination was 2 to 22 years. For 102 of the probands it was at least 5 years. The average interval was 10 years, and was the same for females and males and for unilateral and bilateral coxarthrosis.

f. Length of Hospitalization

Four probands were referred to their local hospitals a few days postoperatively for further convalescence. The rest were discharged as soon as they could walk and manage at home, usually with domestic help.

Of the remaining probands, 109 operated upon once, spent on the average 3.3 months (range 1-7 months) in hospital; 9 operated upon twice, 5.7 months (range 2.5-11 months); and the remaining 3 operated upon three or four times, 8 months (range 4.5-10 months).

The above figures include only operations for securing fusion, i. e. no osteotomies, extraction of nails or sequestrectomies etc.

C. Methods

1. Follow-up Procedure

The follow-up procedure was carried out from February 1968 to February 1969 and comprised a registration of the mode of static support, radiographic and clinical examinations.

The whole procedure took 2.5-3 hours. As a rule the static support test was carried out first and was performed by an assistant at the Balance Laboratory of the Department of Otolaryngology in Lund. Thereafter the radiographic examination was performed at the Department of Radiology, Section II, which serves the Orthopaedic Department. The radiographic examination was followed immediately by the clinical examination, which was always made by the author.

2. Static Support Test

a. Purpose

The purpose of the test was to find out:

i) which leg was preferred under static conditions in unilateral and bilateral coxarthrosis;

ii) whether this support pattern was influenced by the position of the fused hip and/or discrepancy in relative leg length;

iii) the number of shifts of leg most loaded and to compare this with what may be considered normal in healthy individuals;

iiii) whether the probands were able to load both legs equally and whether the ipsilateral and contralateral leg could be used for supporting leg (> 60% of body weight) alternately for a short period of time;

iiiii) the support pattern during Romberg's test and compare this with the preferred pattern in the first part of the test.

Of further interest was a comparison of the opinion of the probands and the results of the test as regards which leg was generally loaded with more than half of body weight.

b. Equipment

At the Balance Laboratory of the Otolaryngological Department, certain equipment was used for registration of Romberg's test (Henriksson, Johansson, Olsson and Östlund 1967).

After slight modifications this equipment proved well suited for studying the pattern of static weight distribution. It consisted of a platform (109 x 90 cm, height 21.5 cm) in two sections, enclosing two electric scales (Bofors Co., Sweden), working on strain gauge principles (Fig. 4). The scales, one for each foot, contained two strain gauges each. The platform and scales were movable, easily adjustable to individual requirements and indistinguishable from quite firm footing.

A voltage proportional to the weight on each scale was registered on an inkwriter (Mingograf), calibrated so that 100% of body weight gave identical amplitude, i. e. equal deviation from the base line, which represented even loading on both scales.

By recording the difference in voltage between the scales on one of the channels of the inkwriter (Channel 1), the difference in load on the scales was measured. On Channel 2 the algebraic values for deviations (deviations toward the right minus deviations toward the left or vice versa) were electrically integrated and recorded (Fig. 4).

c. Procedure

The static support test was developed by the author. The test lasted for exactly 20 minutes. With calibration and various delays the actual measuring time was often 5 to 10 minutes longer.

After adjusting the distance between the scales to the comfort of the proband, the scales were calibrated. The probands were not informed in advance of the various parts of the test. To begin with, they were asked to stand in their habitual manner as when waiting for a bus or standing in a queue. All other instructions were given at appropriate intervals.

i) Preferred mode of support was registered for two 5 minute periods, interrupted by 5 minutes of equal support on both legs (vide infra). This interruption had a dual purpose, first to find whether the probands returned to the same mode of support, and then to find whether the frequency of shifts increased in the latter period.

ii) During a 5 minute period the probands were asked to load both legs as equally as possible. They were routinely reminded of this about once every minute.

iii) In direct continuation of the above 15 minutes, the probands were instructed, first to load the mobile leg for 2 minutes in a relaxed manner to relieve the fused leg, and then vice versa by loading the fused leg.

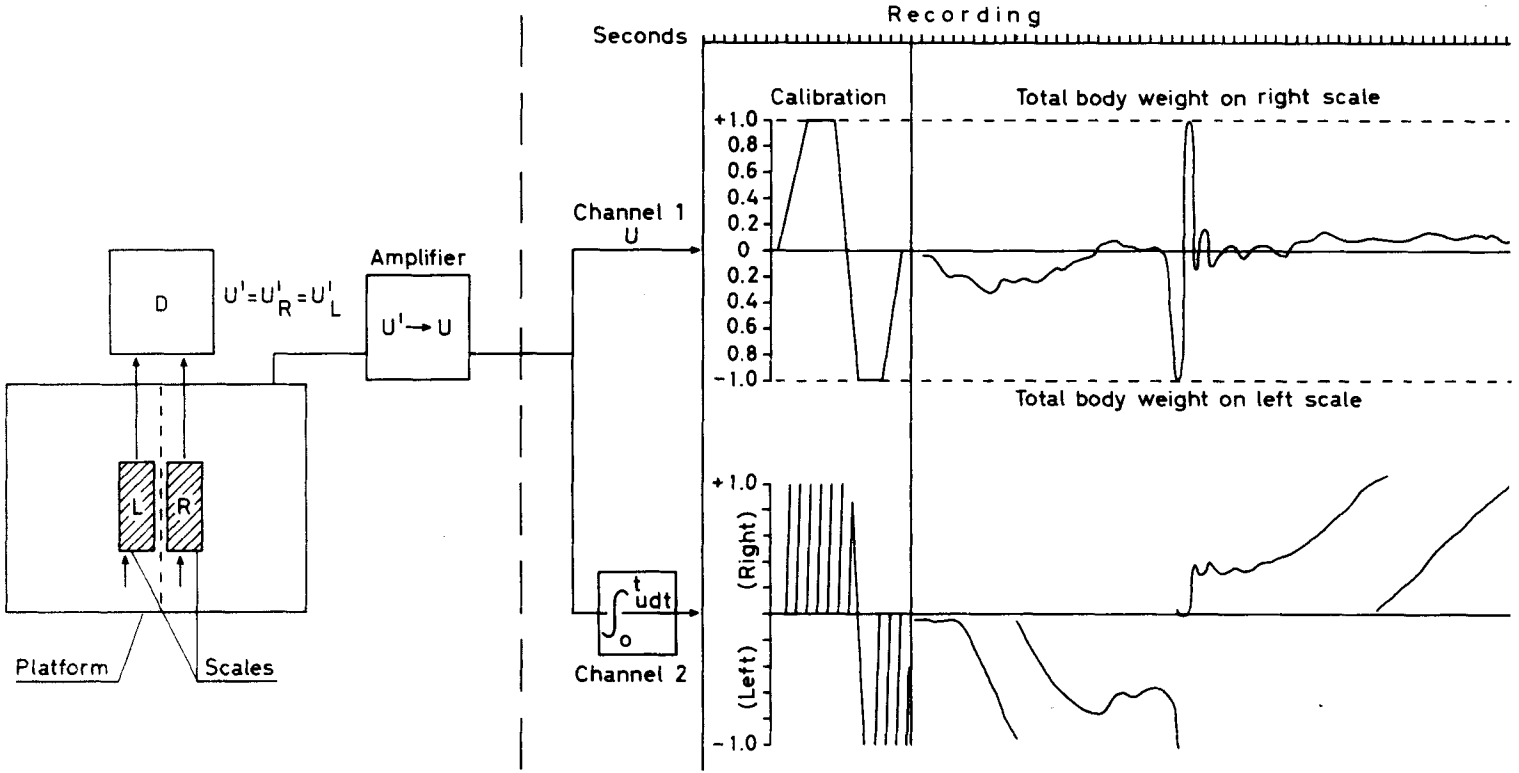


Fig. 4 Recording of Static Support Pattern

iiii) Finally, Romberg's test was carried out, the probands being instructed to stand with their eyes closed for as long as possible up to 1 minute.

All stages of the test were done successively. This proved fairly strenuous for some of the probands. None of the probands expressed difficulty in assuming or maintaining their habitual standing position. Two probands were allowed to use a cane to keep their balance. Eleven probands were tested twice at 3 to 11 month intervals. No appreciable difference was found between the results of the two tests.

d. Calculation

The tracings on Channel 1 (Fig. 4) represented the difference in loading of the two scales expressed as body weight (P). The tracings on Channel 2 represented the integrated loading difference expressed as body weight multiplied by time. The speed of integration was adjusted so that, during calibration with total body weight on one scale, the integrator was filled in one second, each stroke representing "1 body weight" per second (Fig. 4).

After each period of the test, the difference between the number of strokes on both sides of the base line was divided by the number of seconds in that period. The result gave a constant (k), by which the average loading on each of the two scales could be calculated from the expression $P = \frac{1 + k}{2}$ for the leg supporting the major part of body weight and $P = \frac{1 - k}{2}$ for the other during the period.

To avoid repitition and misunderstanding it was found convenient to express average loading of the fused leg as a percentage of bodyweight. Thus, if e.g. the average weight supported by the mobile leg during a certain period was 65% of bodyweight, it was expressed as 35% f.l. (fused leg).

3. Radiographic Examination

At follow-up all probands were subjected to radiographic examination af the pelvis, hips, lumbar spine and knees. The aims of the radiographic examination were primarily,

a) to assess radiographic signs of coxarthrosis as compared with those in preoperative radiograms. The severity of the changes was classified according to a numerical index (Table IV);
b) to determine the degree of ab- and adduction of the fused hip, by

a line representing the pelvic horizontal (vide infra) and a line drawn along the inner contour of the proximal femoral shaft.

Table IV. Assessment of Radiographic Severity

(Fr. Heripret, Danielsson and Dymling, 1964)

Severity		Index
Osteophytes:		
	None	0
	Visible on one pole of the joint	1
	Visible on both poles	2
	Bulky on both poles	3
Joint Space:		
	Normal	0
	Narrowed but larger than half normal width	1
	Smaller than half normal width	2
	Effaced over more than half femoral contour	3
Structure:		
	Normal	0
	Hyperdensity or cysts in caput or acetabulum	1
	Hyperdensity or cysts in caput and in acetabulum	2
	Grossly destroyed	3
Associated anomalies:		
	None	0
	Double Floor	1

Radiograms of the lumbar spine and knees had not always been taken before the operation. Comparison with the radiograms obtained at follow-up was therefore rarely possible, but these radiograms demonstrated arthrotic changes in other adjoining joints.

a. Procedure

The hip joint was always fused in a varying degree of flexion. If ab- and adduction is determined radiographically with the central ray directed on the symphysis, the flexed position will tend to increase the angle of abduction measured on the film and decrease that of adduction

In most cases the angle formed by the fused leg and the table could be easily eliminated by extension (lordosis) of the lumbar spine. However, owing to stiffness of the back, this was not always complete. This source of error was eliminated by the following procedure (focal distance 150 cm).

First Radiogram. With the proband supine on AP projection was taken with vertical direction of the rays, centered immediately above the symphysis. Film, size 30 x 40 cm, covering the whole pelvis and upper part of both femoral shafts. A metal measuring scale was placed under the proband, i. e. between him and a mattress covering the table.

Second Radiogram. The floating table top was moved laterally about 10 cm to center the beam over the fused hip. Film, size 30 x 40 cm, was placed longitudinally, covering the hip and at least 10 cm of the femoral shaft. The metal scale was in the same position as in the first radiogram.

Conventional frontal and lateral projections of the mobile hip, knees and lumbar spine were obtained.

b. Measurement of the Frontal Position of the Fused Hip.

The measurement was made as follows:
On the first radiogram a reference line was drawn through the lower ranges of the sacro-iliac joints. On the second radiogram a line was drawn along the inner contour of the upper femoral shaft. This radiogram was then superimposed on the first, using the metal scale as a landmark. The reference line of the first radiogram was then traced on the second. The angle thus formed by the two lines, gave the frontal angle of the fused hip.

i) The Neutral Position. In clinical practice the frontal position and motion in ab- and adduction have traditionally been measured from a zero position, in which the anterior contour of the thigh forms a right angle with the superior-anterior iliac spines.

This position actually represents a considerable degree of abduction in the hip owing to the inclination of the femur toward the median plane. In the upright position it will correspond to an abduction of the hip of nearly 10 degrees from the standing position (Charnley 1953).

The neutral angle, according to Weinreich (1960), is that in which the midpoint of the hip, knee and ankle joint are joined by a vertical line, representing symmetrical weight distribution between both legs. In this mechanical midposition, which is equivalent to a distance of about 18 cm between the midpoints of the two ankle joints, the long axis of the femur is adducted toward the midline.
Lindahl (1965) chose a basic position with the feet together. In this position the neutral angle is formed by the pelvic horizontal and the leg (femur). The angle varies with the width of the pelvis and the leg length. This factor must be taken into account to secure uniform measurements. The neutral angle was calculated from the distance between the femoral heads on the radiograms and the length of the normal leg, measured clinically.
ii) Calculation of the Neutral Angle. The neutral angle was calculated from the expression $\text{Cos } \alpha = \frac{P}{2L}$, P denoting the distance between the femoral heads and L the length of the normal (mobile) leg.
When the angle of the fused hip, as measured on the radiograms, was smaller than the neutral angle, the difference denoted the degree of adduction in the fused hip and, conversely, when greater, the degree of abduction. This method was employed throughout the investigation. It was tested by calculating the neutral angle in 10 normal persons and was found to deviate by at most three degrees from the angle measured directly on their radiograms.

4. Clinical Examination

The aim of the clinical examination was to assess and record:
a) the range of motion and degree of pain in the mobile hip,
b) the degree of flexion in the fused hip and
c) the state of the lumbar spine and knees.

Further, notes were made of the probands' accounts of their working capacity.

The physical examination was carried out in a conventional manner (Method of Measuring and Recording. American Academy of Orthopaedic Surgeons, 1965).

Published methods for assessment of pain (Judet & Judet 1952; Shepard 1954; Stinchfield 1957; Danielsson 1964) use a numerical index from (0) 1 to (5) 6. In the author's opinion hip pain was best assessed by its restrictive effects on daily activities and work or sleep and by the use of analgesics, rather than by noting starting

pain, pain when walking etc. Assessment was therefore restricted to the following four grades:

Grade 0: no pain.

Grade 1: slight or occasional pain, rarely interfering with work or daily activities, often relieved by rest and seldom requiring analgesics

Grade 3: moderate pain that may periodically interfere with work or activities and requiring frequent use of analgesics.

Grade 5: severe or disabling pain, curbing activities and work, disturbing sleep or so severe that the proband had been granted a disability pension.

Functional capacity after the operation was assessed by grading some daily activities and working capacity. The grading was based on Shepard's (1954) method, but slightly shortened. Thus e. g. limp and difficulty in putting on socks and shoes were omitted, as these were natural consequences of a successful arthrodesis and were present in all cases (Table XX).

5. Statistical Methods[1)]

Only well known statistical techniques were used (Blom, G. 1969), mainly the chi-square test. In a few cases the sign test and Student's t-test were applied.

Statistical significance was described as follows:

	$P>0.05$	= not significant
0.05	$> P>0.01$	= almost significant*
0.01	$> P>0.001$	= significant**
0.001	$> P$	= highly significant***

1) Data treated statistically by civil engineer Tore Persson, Department of Mathematical Statistics, University of Lund.

A. Static Support Test

1. Preferred Mode of Support in Standing

a. Support Pattern

Henriksson et al. (1967) who used the same equipment as that used in this investigation (cf. p. 13), found that normal persons seemed to deviate on the average 6 - 7% of body weight in the lateral direction. Therefore, deviations from the base line of up to 10% of body weight, were in the present investigation taken to signify equal weight distribution on both legs and henceforth termed equal support (40%-60% f.l.). Accordingly, an average load of > 60% of body weight on either leg during this part (10 min.) of the test, was taken as a sign of a clear preference for the leg in question (supporting leg).

The support pattern obtained with the above differentiation is illustrated in Fig. 5. There were two groups representing an average loading of > 60% of body weight on one leg and a middle group with equal loading on both. The mobile leg was used as a supporting leg three times as often as the fused leg.***

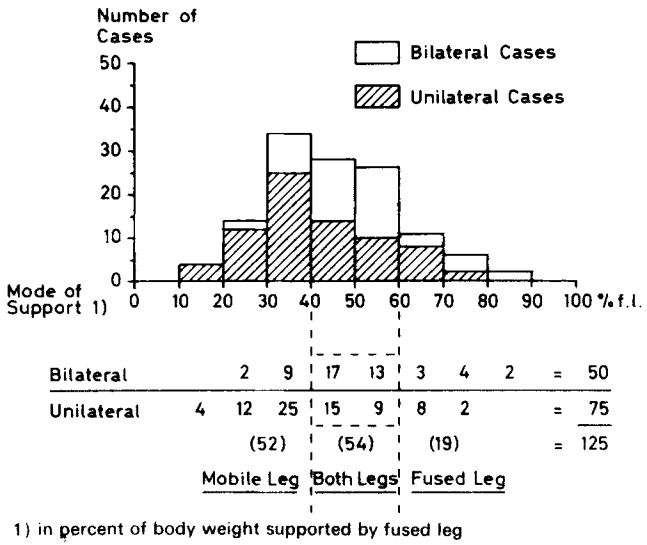


Fig. 5 Static Support Pattern. Preferred Mode of Support during 10 Minutes

The difference in support pattern between the unilateral and bilateral cases is also illustrated in Fig. 5. The main difference was that in two thirds of the bilateral cases both legs were loaded equally, whereas in over half of the unilateral cases there was a clear preference for the mobile leg.

One hundred and twelve of the probands showed the same support pattern in both 5 minute periods. In the 13 probands who did not, the mean value of both periods placed all but one within the group with equal support.

Comments

The opinion of the probands as to ~~which~~ the leg was generally loaded with more than half of body weight (main support) was compared to the results of the preferred support pattern. The base line (50% of body weight on each leg) divided the material in two parts (Fig. 5), two thirds (84) loading the mobile leg with more than half of body weight and one third (41) the fused leg. Six probands had even loading on both legs. These were divided equally among the two groups. The result of the test bore a close resemblance to the opinion of the probands as 87 (70%) thought they generally loaded the mobile leg with more than half of body weight during standing, 29 (23%) the fused leg an 9 (7%) both legs equally.

The opinion of the probands regarding the leg mostly used for support during standing was in agreement with the results of the test in over 75% of the cases. Most of the 32 probands whose opinion differed from the results of the test, displayed no clear preference for either leg (40% - 60% f.l.).

Hohman (1962) studied the support pattern in 75 cases with hip arthrodesis by letting them stand on two scales for 15 minutes. He found that the fused leg was loaded in the following manner: up to 1/4 of body weight 19%; 1/4 - 1/2 of b.w. 51% and over half of body weight 30%. The corresponding figures in the present material were: up to 1/4 of b.w. 7%; 1/4 - 1/2 of b.w. 60% and over half of body weight 33%, and thus in good agreement with those given by Hohman. Further, both investigations revealed that support by the fused leg and fairly equal support by both legs was more common than what is given in other reports based on clinical observations but without measuring devices (Table V).

Table V. Preferred Mode of Support in Standing.
Earlier Studies compared with the Present.

Author	Number of Cases	Support Pattern		
		Fused Leg	Mobile Leg	Both Legs
Hohman (1962)	75	22 (30%)	53 (70%)	
Hauge (1963)	75	10 (13%)	60 (80%)	5 (7%)
Mach (1964)	68	9 (13%)	59 (87%)	
Seevald and Debrunner (1964)	60	2 (3%)	52 (87%)	6 (10%)
Lindahl (1965)	35	6 (17%)	26 (74%)	3 (9%)
Demigneux (1968)	59	6 (10%)	47 (80%)	6 (10%)
Present Study	125	41 (33%)	84 (67%)	

b. Support Pattern in Relation to Frontal Position of Fused Hip.

There was a difference in support pattern between probands with adduction and those with abduction of the fused hip. In the former the fused leg was more often used for main support than in the latter. Of 38 probands with adduction of the fused hip, 16 used the fused leg for main support, compared with 25 of the 87 probands with abduction.

Cases with from 5 degrees of adduction to 5 degrees of abduction in the fused hip were pooled and the group was called neutral (Table VI). There were 58 cases with neutral position, 12 with adduction (range 6°-12°) and 55 cases with abduction of the fused hip (range 6°-25°). The distribution of the 41 cases which used the fused leg for main support, within the adduction, neutral and abduction groups was such that they constituted about 1/2, 1/3 and 1/4 of the cases in each group. The relative proportions within the three groups of the 19 cases which used the fused leg as supporting leg (> 60% f.l.) was roughly 1/4, 1/5 and 1/18 respectively.

Loading of the fused leg thus seemed to be facilitated by the neutral or adducted position.

Table VI. Preferred Mode of Support in Standing versus Frontal Position of Fused Hip

Support Pattern	Adduction		Neutral		Abduction		Total	Mean Support Fused Leg
	>10°	6°-10°	0°-5°	0°-5°	6°-10°	>10°		
<40% f.l.	1	2	12	16	11	10	52 (42%)	32% f.l.
40%-60% f.l.	2	4	8	9	20	11	54 (43%)	49% f.l.
>60% f.l.	1	2	6	7	3		19 (15%)	70% f.l.
Total	4	8	26	32	34	21	125 (100%)	44% f.l.
Number of Probands with Main Support by Fused Leg	3	4	9	10	10	5	41 (33%)	
Mean Support f.l.	65%	67%	63%	67%	61%	56%		63% f.l.

c. Support Pattern in Relation to Sagittal Position of Fused Hip.

The sagittal position of the fused hip varied from 15 to 55 degrees of flexion. The material was divided into three groups with regard to the angle of flexion. There were 39 probands with fairly small angles (range 15°-29°), 60 with moderate (range 30°-39°) and 26 with large angles of flexion (range 40°-55°).

The 19 probands who showed a clear preference for the fused leg were distributed among the three groups, roughly making, 1/6, 1/9 and 1/4 of the cases in each. The corresponding proportions for the 41 probands with main support by the fused leg was, 2/6, 2/7 and 2/5 (Table VII).

Table VII. Preferred Mode of Support in Standing versus Degree of Flexion of Fused Hip

Support Pattern	Degree of Flexion					Total
	10°-19°	20°-29°	30°-39°	40°-49°	≥50°	
<40% f.l.		14	28	9	1	52
40%-60% f.l.	2	17	25	9	1	54
>60% f.l.		6	7	5	1	19
Total	2	37	60	23	3	125
Number of Prob. with Main Supp. by Fused Leg	14		16	11		41
Mean Support f.l.	62% f.l.		62% f.l.	65% f.l.		63% f.l.

Comments

According to Seevald and Debrunner (1964) one of the reasons why most of their cases (Table V) loaded the mobile leg was excessive flexion in the fused hip. In the present material however, large flexion angles did not seem to have any adverse effect on loading of the fused leg.

d. Frequency of Shifting Leg of Main Support

The normal, energy saving static posture requires that body weight can be shifted freely (cf. p. 31) from one leg to the other. The number of shifts during the static support test was shown by the tracings of the inkwriter (Fig. 4). In the following a shift means that more than half of body weight was shifted from one leg to the other for at least 15 seconds.

The frequency of shifting was found to vary considerably with the support pattern. Those showing preference for one leg shifted more often in the early 5 minute period whereas those with equal support displayed increase in the number of shifts in the latter half of the test period. Further, the average total frequency of shifts was highest for those with equal support*** (Table VIII).

Table VIII. Preferred Mode of Support in Standing versus Number of Shifts of Supporting Leg

Support Pattern	Number of Shifts		Total	Average Number of Shifts
	First 5 min. Period	Second 5 min. Period		
<40% f.l.	22	15	37:52	0.71
40%-60% f.l.	69	86	155:54	2.9
>60% f.l.	18	6	24:19	1.3
T o t a l	109	107	216:125	1.7
Average Number of Shifts	0.9	0.9		

Comments

Smith (1953) observed 250 persons standing in bus queues and found that most of body weight was shifted among the legs, on the average, every 30 seconds. He found asymmetrical standing, i. e. what he considered nearly the whole weight of the body supported by one leg, to

be about four times as frequent as symmetrical standing.

Hohman (1962) studied the preferred manner of support of 75 probands with arthrodesis of the hip in standing during 15 minutes. He found that during the first few minutes the body weight was frequently shifted from one leg to the other, as a rule followed by a certain stability with slow variation. A change of supporting leg was rarely noted thereafter.

The remarkably small number of shifts during the static support test, compared with observations in normal persons, may be an indication of the restrictive effect of the fusion in this respect. The lower frequency of shifts among those mainly loading one leg suggests that the support pattern was deeply rooted and uniform, as shifts were less frequent in the second half of the test. Thus the two to threefold frequency of shifts among the probands who displayed equal support, may be explained by the fact that they had more symptoms in the mobile hip and therefore were less comfortable in any position. (Table IX).

e. Support Pattern in Relation to Leg Length Discrepancy

One hundred and seven of the probands had a discrepancy in relative leg length, 101 shortening and 6 lengthening of the fused leg. In 18 cases no difference was found.

The distribution according to support pattern and frontal position of the fused hip of the 52 cases with 2 cm or more of uncompensated shortening of the fused leg, during the static support test, was largely the same as that of the material as a whole (Table VI). Thus, 22 showed equal support and the rest preferred support by one leg (19 the mobile and 11 the fused leg). Still, the adducted or neutral position and support by the fused leg were somewhat more common in the 52 cases than in the rest of the material.

Equal support was on the other hand less common among the 21 cases with 3 cm or more shortening. Fifteen of these had preferred support by one leg (9 the mobile and 6 the fused leg).

Of the 6 cases with relative lengthening of the fused leg from 1 to 4 cm (average, 2 cm), 2 had compensatory heel raises on the mobile side. Four had equal loading on both legs and 2 preferred the mobile leg.

Eighteen cases had no measureable discrepancy in leg length. Eight loaded both legs equally, 7 preferred the mobile, and 3 the fused leg.

Table IX. Preferred Mode of Support in Standing versus Increase in Radiographic Index and Pain in Mobile Hip.

Support Pattern	Increase in Radiogr. Index 0	1	2	3	4	5	6	7	8	9	10	Total	Average Increase In Radiogr. Index	Number	Pain Index	Number
<40% f.l.	33	8	6	1	1	1	2					52	0.8	19	1.0	24
40%-60% f.l.	14	18	9	4	3	4	1		1			54	1.7	40	1.4	31
>60% f.l.	10	1	2	3			2	1				19	1.7	9	1.7	13
T o t a l	57	68										125	1.4	68	1.3	68

Comments

Relative shortening of the fused leg was slightly more common in the 41 cases with main support by the fused leg than in the rest of the material. Twenty of the 41 cases had an uncompensated shortening of 2 cm or more compared with 32 of the remaining 84.

Large, uncompensated shortenings ($\geq$ 3 cm) were most common among the 19 cases with preference for the fused leg. Thus, one third (6) of these compared with one sixth (9) of those preferring the mobile leg and only ninth (6) of those with equal support, had such large shortening.

Many of the probands had been reluctant to use a heel raise to compensate shortening of the fused leg. Only 46 of the 101 cases used a heel raise more or less regularly. Such compensation was seldom used if the shortening was less than 3 cm, but even 13 of the 41 probands with a shortening of 3 cm or more never used one. Of the 46 probands using a heel raise, 9 used it only intermittently or during working hours.

Practically all of the probands with a shortening of 2 cm or more had been prescribed a heel raise after operation. However, half of them had stopped using it because they felt that the fused leg had become too long and was more "in the way", often causing them to stumble or fall.

f. Support Pattern versus Radiographic Deterioration and Pain

The incidence and amount of radiographic deterioration and pain in the mobile hip was largest among those of the probands who preferred equal support or support by the fused leg (Table IX). Roughly two thirds of the latter showed increase in radiographic severity compared with one third of those who preferred the mobile leg. The difference was significant. As regards pain, three fifths of the former and nearly half of the latter had pain in the mobile hip.

The degree of deterioration and pain was thus least among the 52 probands who preferred the mobile leg for support. This was in good agreement with the views of many of the probands who stated that, as symptoms increased in the mobile hip, more of their body weights had been transferred to the fused side.

2. Instructed Modes of Support in Standing

a. Equal Support by Both Legs

Eighty nine (71%) of the probands managed equal support for a period of 5 minutes. Of the 36 probands who failed, 24 retained their preference for loading the same leg as they had in the first part of the test, 18 of them the mobile leg and 6, the fused leg. Of the remaining 12 probands, 8 who in the first part of the static support test showed equal support, had changed to support by one leg, 7 by the mobile leg and 1 by the fused leg. Of the remaining 4 cases, 3 had changed from support by the mobile leg to the fused and 1 vice versa.

Comments

It is difficult to explain why these 36 cases could not manage equal support, for e.g. leg length discrepancy, extreme positions of the fused hip or changes in the mobile hip or other joints, were not more common in this group than in the rest of the material.

b. Support by Fused Leg

One hundred and eleven (89%) of the probands could use the fused leg for support (>60% of b.w.) during a period of 2 minutes. This invariably involved more or less leaning toward the fused side and forwards.

Fourteen probands could not load the fused leg to such an extent, average 54% f.l. (range 41%-60% f.l.). Ten had preferred the mobile leg in the former part of the static support test. Their support pattern thus appeared to be confined to one mode. Possible contributary causes in 8 of the latter were as follows: 5 had a combined abduction of the fused hip and severe arthrosis of the mobile hip with little or no frontal motion, and 3 had pain in the ipsilateral knee when standing for any length of time.

c. Support by the Mobile Leg

One hundred and sixteen (93%) of the probands could use the mobile leg for support for two minutes. Of the 9 probands who could not, 5 had equal support in the first part of the static support test and 3 had preferred the fused leg. The remaining one of these 9 was the oldest proband in the material, an 84 year old woman with pain in the mobile

hip and suffering from vertigo, which might perhaps explain the inconclusive results of the test as, in this part she had 46% f.l. but 35% f.l. in the first part of the test. Of the 9 probands 6 had severe changes in the mobile hip with little or no frontal motion and, with pain (5 cases).

d. Romberg's Test

Finally, Romberg's test was carried out. Most of the probands managed to stand with their eyes closed for about 35-40 seconds or more. Ninety of the probands displayed the same support pattern as they did in the first part of the test.* * *

The support pattern was thus found to have almost the same features as that of the first part of the static support test. The main difference was that equal support by both legs was slightly more common in this part. Thus 22 probands who preferred one leg in the first part had changed to equal support whereas 9 probands with equal support in the first part, had changed to support (<40% f.l.) by the mobile leg, and 1 to the fused leg. Thus the final support pattern in Romberg's test was: <40% f.l. = 45; 40% - 60% f.l. = 66 and >60% f.l. = 14 probands.

Comments

The results of the second part of the static support test showed that in general the probands were able to load whichever leg they chose when a conscious effort was made to do so. However, a few probands did not seem to have much choice in this regard due to stiffness and/or pain in the mobile hip. For many of the probands support by the fused leg for 2 minutes proved exceedingly fatiguing and many expressed relief when this part of the test was over.

As a rule, support by the mobile leg was obviously better tolerated, even by many of those suffering from pain in the mobile hip. An interesting feature of the final period of the static support test was that most of the probands resumed their preferred mode of support from the first part of the test. This was interpreted as a further sign that the support pattern displayed was characteristic of the individual.

3. Discussion

The mode of standing and the forces acting on the hip joint under normal and pathologic conditions have been investigated by a number of authors (Walmsley 1933; Åkerblom 1948; Kelton and Wright 1949; Smith 1953; Schede 1956; Fürmaier 1959; Weinreich 1960; Denham 1959; Hohman 1962; Jonsson and Steen 1962; Casuccio 1964; Rydell 1966; Henriksson et al. 1967). The consensus of opinion is that if the standing position is to be maintained for any length of time, body weight is not supported equally by both legs. Instead the posture of "at ease" is adopted, i.e. the bulk of body weight resting on one leg with Trendelburg's sign positive. In this posture the large joints of the weight bearing extremity, hip and knee, are stabilized in the extended position by the strong ligaments reinforcing their joint capsules. Muscle activity is then largely confined to the interplay of antagonists for keeping balance, further facilitated by the passive counterweight of the unloaded leg (Fig. 6 b). This is the energy saving standing posture adopted during longer periods in which body weight is alternately shifted from one leg to the other, whereas maintaining balance on both legs requires considerably more muscle activity. A requirement for adopting and maintaining the former posture is that the line of body weight must pass through the center of the supporting foot, dividing the body into two balanced halves. A necessary condition for this is that the line of body weight passes medially to the supporting hip joint, which in turn involves lateral translation of the pelvis toward the supporting side along with lowering of the pelvis toward the unloaded side. The only other way of supporting body weight mainly by one leg is that with Trendelenburg's sign negative, which involves elevation of the pelvis on the unloaded side, abduction of the supporting hip joint and lateral translation of the pelvis along with a lumbar scoliosis convex toward the same side (Fig. 6 c). The posture with Trendelenburg's sign negative implies a continuous muscular effort, and is therefore not adopted for longer periods, in daily life only when walking.

After arthrodesis of the hip, standing on the fused leg can no longer be facilitated by translation of the pelvis toward the loaded side by adducting the supporting hip. There are two possible ways by which the arthrodesed person can load the operated side with more than half of his body weight. In order to establish balance he can either lean the upper part of the body toward the side of support (Fig. 6 d) or, by

forcibly lifting up the mobile side, the whole (fused) coxofemoral region can be brought to rotate around the axis of the subtalar joints until the line of gravity coincides with the supporting foot (Fig. 6 e). Both these postures require continuous muscular effort for keeping balance along with more or less compensatory scoliosis, the dimensions of which is dependent largely on the degree of abduction of the fused hip.

The results of the static support test were in agreement with the above considerations. Two thirds of the probands loaded the mobile leg with more than half of their body weight and 42% of the total number of probands used the mobile leg for support (>60% f.l.) by choice, whereas only 15% chose the fused leg for support. The question then arises in what respect the probands loading the fused leg differed from the rest. Naturally, a number of factors may influence the choice of leg for support, e.g. relative leg length, position of the fused hip, state of the mobile hip and symptoms from other adjoining joints, chiefly the back and knees.

Those probands who mostly loaded the mobile leg were of the opinion that support by the mobile leg was more comfortable, whereas main support by the fused leg was more tiring both generally and for the back. More seldom the fused leg was spared owing to the feeling that it was still the sick one and had to be protected. This impression seemed real for a few probands and may have been a factor the importance of which is hard to estimate. A few probands reported that they avoided loading the fused leg in public as they felt their buttocks protruded too markedly.

The probands who mostly loaded the fused leg gave entirely different reasons. Most of them thought the mobile leg had become too long after the operation. Those with large relative shortening of the fused leg were more or less compelled to stand with most of body weight on one leg or the other and some of these probands preferred standing on the fused leg than on the mobile leg, with the fused one hardly reaching the ground. This was in agreement with the results of the test as a large, relative shortening of the fused leg appeared to induce support by one leg.

Many of the probands in whom the mobile hip had become painful in the interval between the operation and the follow-up examination, reported that they had always used the mobile leg for support until it had become painful. Only then had they begun to shift more of body weight over to the fused side. This applied to many of the probands with an

equal support pattern. Thus, incidence and degree of pain in the mobile hip was least in the 52 cases who showed preference for the mobile leg.

As regards frontal position, main support by the fused leg appeared to be facilitated by the neutral or adducted position of the fused leg.

In more than half of the 41 cases with main support by the fused leg a combination of the above factors occurred. On one hand there was relative shortening and neutral or adducted position of the fused hip and, on the other hand, pain and/or stiffness of the mobile hip.

Symptoms from the knees did not seem to have a decisive influence on the support pattern although an occasionally contributary role was probable. Seventy six probands had knee symptoms, mostly in the form of slight and/or occasional pain. In 52 of these radiographic signs of gonarthrosis were found at follow-up. Radiographic changes were more common and slightly more advanced on the fused side.

Of the 19 probands who used the fused leg for support, 15 had some pain in the knees, 10 in the ipsilateral knee (fused side), 1 in the contralateral and 4 in both. Of the 52 probands who used the mobile leg for support, 13 had knee symptoms, 4 in the ipsilateral (fused side) knee, 3 in the contralateral and 6 in both. Of the 54 probands with equal support, 48 had symptoms from the knees, 24 in the ipsilateral, 6 in the contralateral and 18 in both knees.

Pain or fatigue in the lumbar region was a common complaint during protracted standing and sitting. Such symptoms were reported by 75 probands, 32 of whom felt that this impaired their standing and walking capacity. Sixty three of the former and 28 of the latter had radiographic signs of lumbar spondylarthrosis.

A slight increase in the incidence of lumbar pain with the degree of flexion in the fused hip was noted. Thus, one half (19) of the 38 probands with small degrees (10°-29°) of flexion, compared to three fourths (18) of the 26 with large flexion (40° - 50°) angles had back pain.

4. Conclusions

The support pattern when standing in a free or preferred manner showed that after arthrodesis of the hip the fused extremity was seldom used as the supporting leg it was intended to become. Eighty five percent of the probands either displayed equal support or prefer-

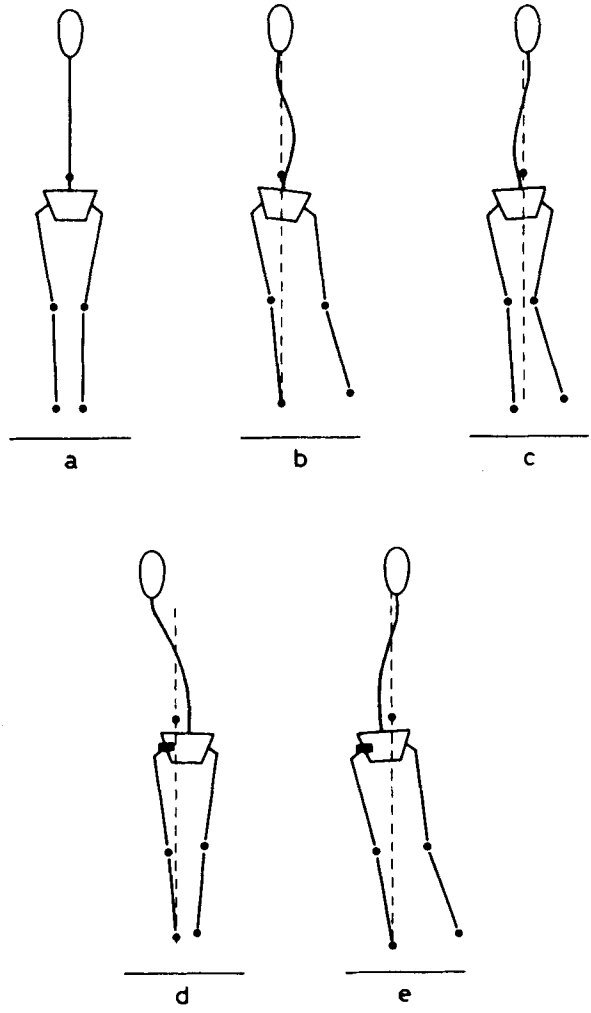


Fig. 6 Static Posture in a Healthy Individual:
a) Equal Support by both Legs
b) Support by One Leg (Pos. Trendelenburg)
c) Support by One Leg (Neg. Trendelenburg)
Static Posture after Arthrodesis of One Hip:
d) Support by the Fused Leg by leaning the Trunk Toward the Fused Side
e) Support by the Fused Leg by Lifting up The Mobile (Hip) Side and Rotation Around the Axis of the Subtalar Joints.

ence for loading the mobile leg. The support pattern registered by Hohman (1962), in 75 hip-arthrodesed subjects, showed similar results (cf. p. 22).

Not before the mobile hip had become painful or more painful than preoperatively, had more of body weight been shifted to the fused side by a conscious effort. This was borne out both by the probands' accounts and by the significantly higher incidence and degree of changes and pain in the mobile hip in those probands who displayed equal support and support by the fused leg.

Loading on the fused leg appeared to be facilitated by the neutral or adducted position of the fused hip and by shortening of the fused leg. On the other hand, the degree of flexion of the fused hip was not found to affect the support pattern.

The support pattern was very uniform in different parts of the test and shifts were markedly scarce compared with what may be considered usual in normal subjects.

In view of the results of the test and the opinion of the probands, it was concluded that the alleged supporting role of the fused leg has not been based on factual evidence.

B. Radiographic Examination

1. Arthrotic Deterioration of Mobile Hip

a. With Regard to Radiographic Appearance at Operation

i. Unilateral Coxarthrosis. Of the 75 cases without signs of arthrosis of the mobile hip at operation, 31 had developed such signs by the time of follow-up (Table IV). The average radiographic severity of the 31 hips was 1.9 index points (range 1-6), (Table X). Of these 31 cases, 16 showed only signs of incipient arthrosis. In 8 of the latter, fused because of secondary arthrosis, progress consisted of an osteophyte on one pole. The remaining 8, fused because of primary arthrosis showed either narrowing of the joint space or structural changes. In the remaining 15 cases reduction of the joint space was the most common finding in both types of arthrosis (9 secondary and 6 primary).

In unilateral coxarthrosis the course of the mobile hip was usually favourable for the first few years. Radiographic changes were mostly mild and although the incidence of arthrosis rose sharply after 5 years, two thirds of the hips showed no signs of arthrosis up to 10 years after operation. Of the remaining third, reviewed after a longer interval, half the number deteriorated (Table XI).

ii. Bilateral Coxarthrosis. Of the 50 cases with a varying degree of arthrosis of the mobile hip at the time of operation, the average radiographic severity had increased by 3.1 index points (range 1-8) in 37 (Table XI).

Table X. Observed Signs of Radiograhpic Deterioration of Mobile Hip

68 Cases with Radiog. Deter. of Mobile Hip	Number	Increase in Radiographic Index				Total Increase In Index	Mean Increase In Index
		Osteo-phytes	Joint Space	Struct. Changes	Double Floor		
Unilateral Coxarthros.	31	22	25	11		58	1.9
Bilateral Coxarthros.	37	34	44	34	2	114	3.1
T o t a l	68	56	69	45	2	172	2.5

Tabel XI. Rate of Radiographic Deterioration of Mobile Hip in Unilateral and Bilateral Coxarthrosis. Figures within Brackets: the 68 Hips which showed Radiographic Deterioration

Follow-Up Period	Unilateral Coxarthrosis		Bilateral Coxarthrosis		T o t a l	
	Number	Average Increase	Number	Average Increase	Number	Average Increase
<5 years	16 (3)	0.2 (1.0)	8 (2)	0.6 (2.5)	24 (5)	0.3 (1.6)
5-9 "	27 (11)	0.8 (2.0)	23 (18)	1.9 (2.3)	50 (29)	1.3 (2.2)
10-14 "	14 (7)	1.2 (2.3)	15 (13)	2.6 (3.2)	29 (20)	2.0 (2.9)
15-22 "	18 (10)	0.9 (1.7)	4 (4)	6.5 (6.5)	22 (14)	1.9 (3.1)
T o t a l	75 (31)	0.8 (1.9)	50 (37)	2.4 (3.1)	125 (68)	1.4 (2.5)

Forty one of the bilateral cases had had up to 5 in initial radiographic index. Thirty two of these showed progress. Average incidence and amount of radiographic progress was roughly the same in these five index groups, i. e. four fifths of the probands and over 3.0 index points' increase in each. Of the remaining 9 probands with an initial index of 6 or more, 5 had progressed, on the average 1.8 points.

As in unilateral coxarthrosis, joint space reduction was the commonest sign of progress. Structural changes occurred two and a half times as often as in unilateral coxarthrosis. Eleven of these 37 hips showed only one sign of progress. In 4 of these a new osteophyte had formed while in the 7 others the joint space had become narrowed. In the remaining 26 cases, joint space reduction was also the most common sign (Table X).

The radiographic deterioration of the mobile hip appeared sooner and progressed more rapidly in bilateral than in unilateral coxarthrosis (Table XI). Only one third of these cases had remained stationary for up to 10 years after operation and only one fifth for a still longer interval. The radiographic deterioration was also more severe in the bilateral cases (Figs. 10-12, p.74-79).

The difference in incidence of radiographic signs of arthrotic deterioration between the unilateral and bilateral cases was significant.

Average degree of arthrotic deterioration in the 75 unilateral cases was 0.8 and in the 50 bilateral cases 2.3 index points. The difference was significant *** (Table XII).

Table XII. Radiographic Deterioration in Unilateral and Bilateral Coxarthrosis

	Increase in Radiographic Sverity			
	0	1	2	3
Unilateral Coxarthrosis	44	16	9	6
Bilateral Coxarthrosis	13	11	8	18
T o t a l	57	27	17	24 = 125

Comments

Hohman (1962) reviewed 75 cases operated upon 1 to 7 years previously because of primary or secondary coxarthrosis. Of the hips free from changes at operation, he found that one fourth had developed

radiographic changes. Thirty of the present 75 unilateral cases were reviewed 2 to 7 years after operation, by which time degenerative changes had appeared in 7. Demigneux et al. (1968) found an incidence of 14 of 92 unilateral cases reviewed 5 to 15 years after operation. The etiological composition was not stated. In the present material 18 of the 42 unilateral cases, reviewed 5 to 15 years after operation, had developed signs of arthrosis. In a series of 75 cases Hauge (1963) found incipient arthrosis in only 6 of the mobile hips examined 5 to 20 years after the operation. All but 4 had been fused for tuberculosis or some unspecific inflammation. Mean age at follow-up was 36 years. The lower incidence in the last two series compared with the present, was probably due primarily to the higher percentage of secondary coxarthrosis and the lower average age in these two series.

Demigneux et al. (1968) reviewed 41 cases fused 5 to 15 years previously because of bilateral coxarthrosis. At follow-up 24 had been subjected to mobilizing operations of the other hip (5 before the fusion). Of the remaining cases, 14 had showed signs of mild arthrosis of the mobile hip at operation. At the review all were found to have deteriorated and 11 of them considerably. Merle d'Aubigné, Ramadier, Postel, Mozas and Vaillant (1964) reviewed 59 cases arthrodesed 2 1/2 - 12 years previously for bilateral coxarthrosis. Deterioration of the mobile hip had occurred in 31 cases, 8 of which had been operated upon. Of the present 39 bilateral cases with up to 12 years in follow-up time, 19 had deteriorated.

b. Type of Arthrosis of Fused Hip

Of the 75 unilateral cases, 50 hips had been operated for secondary, and 25 for primary, coxarthrosis. Of the 31 probands who developed signs of arthrosis 17 had had secondary and 14 primary arthrosis in the fused hip.

The average radiographic deterioration of the mobile hip was 0.7 in the 50 secondary, and 1.0 index points in the 25 primary, cases. Of the 50 secondary cases deterioration of the mobile hip was greatest in the 21 cases operated for arthrotic changes secondary to some developmental disturbance, mild in the 18 cases fused because of late effects of coxitis and absent in the 11 cases fused because of late complications of fracture of the femoral neck (Table XIII, A, B).

Of the 50 bilateral cases, 36 had primary and 14 secondary arthrosis of the fused hip at operation. In 28 of the former and in 9 of

Table XIII, A Arthrotic Deterioration in 50 Cases of Unilateral Secondary Coxarthrosis

Etiology	Number	Average Deterior-ation	Average Follow-up Period	Age at Follow-up	Number With Deter.
Developmental Disturbances:					
Dysplasia	9	1.7	12 years	64 years	6
Cong. Dislocation	6	1.0	7 "	55 "	2
Epiphysiol., Mb. Perthes Coxa Valga	6	0.9	15 "	56 "	3
	21	1.2	13 "	60 "	11
Inflammation:					
Septic Coxitis	9	0.3	9 "	50 "	3
Tuberculous Coxitis	7	0.6	11 "	51 "	2
Osteomyelitis, R. A.	2	0.5	3 "	31 "	1
	18	0.4	9 "	49 "	6
Trauma:					
Fract. Fem. Neck	11	0	10 "	64 "	0
Total	50	0.7	10 years	56 years	17

Table XIII, B Arthrotic Deterioration in 14 Cases of Bilateral Secondary Coxarthrosis

Etiology	Number	Average Deterior-ation	Average Follow-Period	Age at Follow-up	Number With Deter.
BOTH HIPS					
Developmental Disturb.:					
Dysplasia	4	1.8	10 years	55 years	4
Cong. Dislocation	1	4.0	6 "	58 "	1
Coxa Vara	1	0	8 "	60 "	0
	6	1.8	9 "	56 "	5
Inflammation:					
Rheumatoid Arthritis	4	1.5	6 "	58 "	2
ONE HIP					
Developmental Disturb.:					
Epiphysiolysis	1	1.0	7 "	64 "	1
Mb. Perthes	1	1.0	10 "	71 "	1
	2	1.0	9 "	67 "	2
Trauma:					
Fract. of Fem. Neck	1	0	10 "	84 "	0
Fract. of Acetabulum	1	0	14 "	55 "	0
	2	0	12 "	69 "	0
Total	14	1.4	9 years	60 years	9

the latter the radiographic severity had increased in the mobile hip. The average degree was 2.6 index points in the 36 primary and 1.4** points in the 14 secondary cases (Table XIV).

Table XIV. Arthrotic Deterioration in 61 Cases of Primary Coxarthrosis

Primary Coxarthrosis	Number	Average Deterior-ation	Average Follow-up Period	Age at Follow-up	Number With Deter.
Unilateral Cases	25	1.0	10 years	63 years	14
Bilateral Cases	36	2.6	10 "	67 "	28
T o t a l	61	1.9	10 years	66 years	42

Comments

Danielsson (1964) reviewed 91 unoperated cases (121 hips) from 8 to 12 years (average, 11 years) after clinical and radiographic diagnosis of coxarthrosis. The aim was to assess the prognosis of coxarthrosis and to provide a standard of comparison for operated cases. Radiographic changes were evaluated by comparison of initial and follow-up radiograms according to the scheme used in the present investigation (Table IV). All 121 hips had structural and/or joint space changes at the time of diagnosis. The two materials were well comparable as regards number of hips, age (cf. p. 48) and the average duration of the interval. Still, in the present material, 10 of the bilateral cases had been reviewed after more than 12 years. On the other hand, 85% of Danielsson's series had primary coxarthrosis, against 50% of the present material.

Danielsson found, that radiographic changes usually progressed (average, 1.4 index points) and that primary coxarthrosis progressed radiographically more than secondary (1.7 ± 0.13 versus 0.7 ± 0.13).*

These figures, when compared with radiographic progress in all the primary (61) and secondary (64) cases in the present material, were found to be almost identical (1.9 versus 0.8 index points).

As all the hips in Danielsson's series had structural and/or joint space changes at the outset, comparison with the bilateral cases was of even greater interest. Of the 50 bilateral cases of the present material, the primary also progressed radiographically more than the secondary cases.

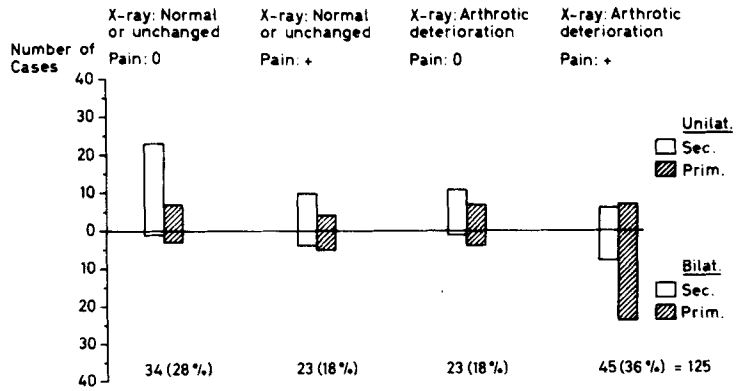
Of Danielssons's material one third showed no progression and in 8 hips signs of regression were observed. Of the 50 bilateral cases of the present material one fourth showed no signs of progression but in no instance were signs of regression observed.

The difference in radiographic deterioration of the mobile hip in the present 36 bilateral, primary cases (2.6 ± 0.12) and Danielsson's 104 hips (1.7 ± 0.13), followed up on the average 11 years after a diagnosis of primary coxarthrosis had been made, was significant.***

c. Interval Between Operation and Review

The interval was on the average the same for primary and secondary cases (10 years).

In unilateral coxarthrosis the average interval was over 3 years longer for the cases in which degenerative signs had appeared (Fig. 7). Of the 43 cases where the interval was less than 10 years, 14 displayed signs of deterioration compared with 17 of the 32, reviewed after a longer interval (Table XII).



Unilateral Coxarthr.	30	10	18	13	= 75
Bilateral "	4	9	5	32	= 50
Sec.	24	14	12	14	= 64
Prim.	10	9	11	31	= 61
Mean Radiographic Index at Follow up:	0.6	1.9	2.4	5.3	= 2.9
Mean Increase in Radiographic Index:			1.7	2.9	= 2.5
Mean Pain Index:		1.6		2.7	
Mean Follow up Period (in Years)	8.2	8.4	12.0	10.6	= 10.0

Fig. 7 Incidence and Degree of Radiographic Deterioration and Pain

Of the 75 unilateral cases, 19 were reviewed after 15 to 22 years. Eleven of these showed an increase in radiographic severity from 1 to 6 points (average, 2.1 index points), whereas 8 had remained stationary.

In bilateral coxarthrosis the cases with radiographic signs of progression had 3 years longer average interval than in the remaining 13 stationary cases (Fig. 7). Of 31 cases reviewed after periods up to 10 years, 20 had deteriorated compared with 17 of the 19 reviewed after a long interval.

Only 4 of the bilateral cases had been reviewed after 15 to 22 years. All 4 showed heavy radiographic progress, average 5.2 points (range 5-8). Of the 13 cases who had not progressed, the interval was less than 5 years in 6, between 5 and 10 years in 4 and 10 to 15 years in 3. The average for all 13 cases was 6.4 years.

Comments

In the unilateral cases the incidence of radiographic changes appeared to have increased more than their severity, while in the bilateral cases radiographic severity had increased steadily with time (Table XII).

Hohman in his series (cf. p. 38) found an incidence of 10% at review from 1 to 2 years and 45% after 6 years or more. The incidence in the present material was: 10 of 35 cases reviewed after 2 to 6 years and 58 of 90 cases reviewed after a longer period.

d. Frontal Position of Fused Hip

Eighty seven (70%) of the probands had various degrees of abduction (>5°) from the neutral angle. The average degree and incidence of radiographic deterioration was slightly higher in the abducted position than in adduction or the neutral position (Table XV), but the difference was not statistically significant. The ratio of unilateral and bilateral cases in the three position groups was: adduction 1.4/1; neutral 1.5/1 and abduction 1.5/1. Thus, the same proportion in all three groups.

Table XV. Radiographic Deterioration versus Frontal Position of Fused Hip. Figures within Brackets: the 68 Cases which showed Radiographic Deterioration

	Adduction	Neutral	Abduction
Unilateral Coxarthrosis	7 (4)	35 (11)	33 (16)
Average Degree	0.7	0.6	0.9
Bilateral Coxarthrosis	5 (3)	23 (16)	22 (18)
Average Degree	2.0	1.9	2.8
T o t a l	12 (7)	58 (27)	55 (34)
Average Degree	1.3 (2.2)	1.1 (2.4)	1.7 (2.8)

Comments

The abducted position of the fused hip was for a long time recommended to compensate for shortening of the leg. The rationale was, that when such shortening was marked this source of compensation could be utilized for obviating unsightly aids, for providing better feeling of contact with the ground ("Bodengefühl, Machacek 1956) and facilitate walking and standing without shoes.

The adverse effects of marked abductions have since been well recognized however and corrective osteotomies have not infrequently been reported (Hauge 1963). In the present material 3 such late osteotomies had been preformed. The abducted position of the hip renders the gait awkward and requires circumduction of the fused leg in the swing phase, and an increased strain is thrown on the back and the mobile hip during walking and standing, with time entailing a risk of degenerative changes with symptoms (Fürmaier 1959; Hohman 1962; Seevald and Debrunner 1964 and Demigneux, Rainaut and Cédart 1968).

The fact that radiographic deterioration, even though only slight, was largest in the abducted position, suggests that this may have been a contributory factor.

2. Discussion

Radiographic signs of arthrotic deterioration of the mobile hip

were observed in only 5 of the 24 probands reviewed up to 5 years after the operation. The fact that half of the unilateral and four fifths of the bilateral cases were found to have deteriorated by the time of review, more than 5 years after operation, and that the radiographic deterioration was more severe than in a comparable unoperated series (Danielsson 1964), and the absence of radiographic signs of regression, did not suggest unburdening of the mobile hip.

Training the arthrodesed subject to load the fused leg has been suggested by authors who at review had found that many of their cases had developed arthrosis and/or pain in the mobile hip (Leger 1956; Hohman 1962; Mach 1964; Demigneux 1967). It can hardly be expected however that such a measure would permanently affect their standing habits. Standing is largely an unconscious effort as long as it does not incur discomfort or pain. With easy, energy saving standing restricted to one side the arthrodesed subject will as a rule automatically exploit the pain-free, mobile leg for this purpose. Furthermore, biological factors and the forces acting on the joint during gait, are bound to be more important for the fate of the mobile hip than static strain.

The compensatory demands on the mobile hip during walking are well documented (Steindler 1955; Seevald and Debrunner 1964; Casuccio 1964; Ducroquet 1965). The only way the fused leg can be swung forward is by way of the pelvis with the mobile hip as a pivot. This occurs during the stance phase of the mobile leg when the joint is being loaded with at least twice the body weight as the pelvis tilts and rotates around the femoral head. It is reasonable to expect that such compensatory exertion hastens the degeneration of any joint not biologically fit and congruent. It may be argued that the stiffness of the fused hip before the operation had placed similar demands on the mobile hip. But as a successful arthrodesis leads to a more active life, the compensatory strain on the mobile hip will still be increased.

Other mechanical factors of probable importance for the fate of the mobile hip were, a) loss of suppleness of the gait as the remaining, normal segments of the extremity can only partially compensate for the loss of the hip joint, pelvic tilt and rotation being important factors in decreasing the vertical displacement of the center of gravity of the body (Saunders, Inman and Eberhart 1953); b) reduction of the contact area in the mobile hip due to the commonly occurring inclination of the pelvis toward the fused side (Pagani, Morosini and Buratti 1967) and c) walk-way studies have shown that the stance

phase on the fused side is diminished and prolonged on the mobile side (Seevald and Debrunner 1964) or on the "good side" in limping (Rydell 1966).

Other factors of possible importance were: age at operation (within the etiological groups), sex, body weight and occupation. No appreciable influence of these factors could be discerned.

3. Conclusions

Incidence of radiographic deterioration of the mobile hip in the present material was similar to that found in comparable, published series. The severity of radiographic deterioration in the bilateral cases, was however significantly higher than in Danielsson´s series of unoperated cases, with the same average follow-up interval.

Arthrodesis of the hip was generally well tolerated by the contralateral hip provided the latter was free from changes at the outset and the susceptibility associated with the primary form of coxarthrosis.

The professed relief of the mobile hip, when slightly or moderately affected, was not sustained by the findings of the present investigation, as with time the majority of these cases showed heavy increase in radiographic severity. The high rate of deterioration in bilateral coxarthrosis, particularly the primary form, strongly indicated that the fate of the mobile hip was dependent primarily on biological factors, i. e. its ability to withstand the mechanical surcharge thrown upon it. On the other hand, the fate of the hip was not found to vary appreciably with such factors as sex, occupation or body weight.

It was concluded that the increase in radiographic severity in the present material compared with that of Danielsson´s series, refutes the hypothesis that arthrodesis results in mechanical relief of the mobile hip.

C. Clinical Examination

1. Pain in Mobile Hip

a. Incidence

Sixty eight probands had pain in the mobile hip at follow-up (not to be confused with the 68 probands with arthrotic deterioration). Twenty-one had had pain also before the operation. Of the latter, 10 had become worse, 8 were unchanged and 3 had less pain than before. Thus half of the probands had either developed pain or become worse. The incidence of pain was significantly higher in the bilateral cases*** (Fig. 7).

b. Severity

At follow-up 35 probands had mild, 21 moderate and 12 severe pain in the mobile hip (cf. p. 19). In two thirds of the painful hips radiographic severity had increased. Degree of pain was significantly higher in these than in the remaining third with no increase*** (Fig. 7). The average increase in radiographic severity was three times as large in the 33 hips with moderate or severe pain as in the 35 hips with mild pain.

Of 43 overweight probands, 21 had pain in the mobile hip. Average severity of pain in these was the same (2.4 index points) as in the remaining 47 hips.

c. Relation to Range of Motion

Thirty-one of the mobile hips had less than 90 degrees of flexion and all but one of these had a flexion contracture. Twenty-eight of these had shown radiographic changes at operation and 23 had since progressed.

In all, 35 probands had a flexion contracture in the mobile hip, average 21 degrees (range 10°-65°). Thirty of these hips had shown changes at operation. Twenty-nine of the 35 probands had pain in the mobile hip with an average score of 2.8 index points.

Comments

Degel (1957) reviewed 115 arthrodesed cases from 3 to 8 years after operation. In thirty-nine (34%) the mobile hip had become pain-

ful or worse, it was unchanged in 61 and had become painless or better in 10.

Of 75 cases subjected to arthrodesis Hohman (1962) found that the mobile hip had become painful or worse within 1-7 years in 37%.

In the present material the incidence found at review within 10 years of the operation was the same as in the above two series, namely 27 of 74 cases (average, 2.6 index points). The corresponding figures for those examined after a longer period were 30 of 51 (average, 2.2 points).

In his unoperated series, Danielsson (cf. p. 41) found no relation between pain and etiology of the disease or sex. Two thirds of the hips in his series had become less painful during the follow-up period. In contrast, in half of the present material the mobile hip had become painful or worse*** (Table XVI).

Table XVI. Incidence of Pain in the Present Material compared with Danielsson's Series (1964).

Degree of Pain	Danielsson (1964)			The Present Material		
	Male	Female	Total	Male	Female	Total
Developed Pain (or More Severe)	10	10	20	19	38	57
Unchanged	3	11	14	2	6	8
Less Severe	28	42	70	2	1	3
Always Painless	11	4	15	25	32	57
Total	52	67	119	48	77	125

At the time of diagnosis all the hips included in Danielsson's series had structural and/or joint space changes. For comparison, 27 of the present 43 hips, with such changes at operation, had become painful or worse. The average age in Danielsson's series was 10 years higher in primary and 6 years higher in secondary coxarthrosis. This may have played some role as the amount of activity and work are likely to be less in the higher age groups.

Danielsson also studied the correlation between the severity of pain and contractures in various planes in 123 hips. He found that this correlation was strongest for flexion contracture. In the present material two thirds of the moderately or severely painful hips were found among the 35 with flexion contractures.

2. Working Capacity

At the time of operation 12 probands already had a pension, 8 because of age and 4 because of disability. In the remaining 113 cases one of the chief goals of the operation was to restore working capacity. Of the 113 cases, 21 were granted an old age (5) or disability (16) pension within 3 years after operation and never resumed working. Of the 92 cases who resumed work, 56 were females and 36 males.

Return to the same type of work as before operation was more common among those who had light occupations than among those with "moderate" or "heavy" work (Table XVII). Two thirds of those who returned to their former occupation had been operated upon for unilateral coxarthrosis (Table XVIII).

Table XVIII. Working Capacity After Operation

Working Capacity After Operation	Unilateral Cases		Bilateral Cases		Total
	Primary	Secondary	Primary	Secondary	
Resumed working after op.					
Same work as before op.	7	32	12	8	59
Lighter work than before	11	11	8	3	33
	18	43	20	11	92(74%)
Unable to resume work					
Disability Pension	4	3	8	1	16
Age Pension	—	1	4	—	5
	4	4	12	1	21(17%)
Pensioned before op.					
Disability Pension	1	1	1	1	4
Age Pension	2	2	3	1	8
	3	3	4	2	12(9%)
Total	25	50	36	14	125(100%)

Of the 113 cases, 69 had unilateral and 44 bilateral coxarthrosis at the time of operation. Of the former, 61 returned to some form of work, against 31 of the latter.

The interval between operation and resumption of work ranged from 3 months to 2 1/2 years, average 11.5 months. The average interval did not vary with category of work. It was 11.8 months in the 61 unilateral cases and 10.8 months in the 31 bilateral cases. It was on the average 10.4 months for males and 12.2 months for females. (fig. 8).

Table XVII. Type of Work before and after Operation. Probands not granted Pension at the Time of Operation.

Type of Work Before Operation	Number	Work after Operation				
		Heavy	Moderate	Light	Slight	None
Heavy	26	10	4	6	1	5
Moderate[1)]	43		16	10	9	8
Light[2)]	25		1	18	3	3
Slight[3)]	19				14	5
T o t a l	113	10	21	34	27	21

1) E.g. factory work, all work in large household (≥ 4 persons), all work in small household (<4 persons) + extra work.

2) E.g. all work in small household, light manual labour.

3) E.g. all work in small household except cleaning, clerical work.

Types of Work Represented:

Males (42)

Heavy: Farmer or farm labourer (10), construction worker (5), unskilled labourer (4), factory worker (3), mason (2), forester (1), well digger (1).

Moderate: Industry worker (2), butcher (1), baker (1), cooper (1), house cleaner (1), electrician (1), wholesaler (1), newsstand salesman (1), automobile reparator (1).

Light: Electrical technician (1), engineer-salesman (1), bicycle mechanic (1).

Slight: Director (1), light industry worker (1), clerk (1).

Females (71)

Heavy: None

Moderate: Housewife (5), housewife + (house-cleaning, farming, saleswoman, gardener, librarian, secretary)(24), waitress house-cleaner (1), home-worker (1).

Light: Housewife (18), housewife + (bookkeeping, shop assistant)(2) sales manager (1), part-day nurse (1).

Slight: Housewife (8), clerk (2), managing director (1), part-time shop assistant (1), secretary (1), maid (1), teacher (1), fur seamstress (1).

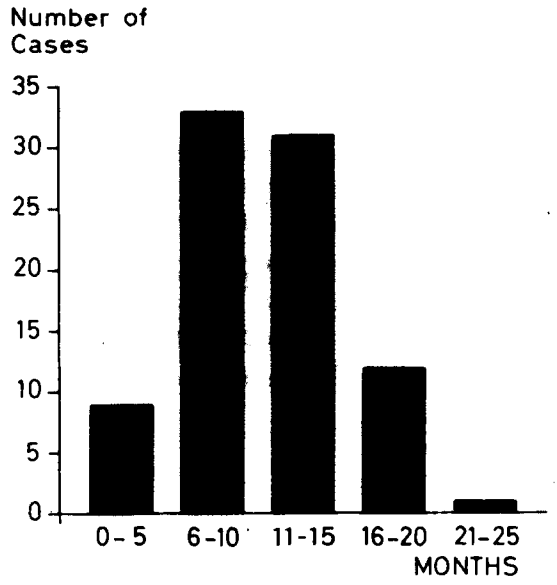


Fig. 8 Interval Between Arthrodesis and Resumption of Work in 92 Cases

Sixty four probands were pensioners by the time of the review. Thirty-one were receiving an old age pension and 33 a disability pension.

Of the 31 probands who were receiving an old age pension, 8 had been pensioners already before the operation, 5 within 3 years of the operation and had not resumed work and the remaining 18 had reached retirement age after having worked from 2 to 18 years, (average 6.6 years) after the operation. Of the 31 probands, 22 had been operated upon because of primary coxarthrosis (Table XIX).

Of the 33 probands who were granted a disability pension, 4 had been pensioned off before the operation, 16 within 3 years of operation and had not resumed work, and a further 13 after having worked for 1 to 20 years, (average 6.4 years) after operation. Of the 33 probands, 23 had been operated for primary coxarthrosis (Table XIX).

Of the 61 probands still working at the time of the review, 46 were still engaged in the same occupation as before operation (Heavy 5, Moderate 13, Light 15 and Slight 13), whereas 15 had taken up lighter work. Six of the 61 probands were receiving a partial disability pension. Over half of these 61 probands had been operated upon be-

Table XIX. Work and Pension after Arthrodesis for Unilateral and Bilateral Coxarthrosis.

Type of Coxarthrosis	Pension Before op.		Pension After op. No Work		Age Pension after Op. after having worked for: (years)					Disability Pension after Operation Having worked for: (years)					Still working at Follow-up: (years)					Total
	Age Pens.	Disab. Pens.	Age Pens.	Disab. Pens.	1-5	6-10	11-15	16-20	20-25	1-5	6-10	11-15	16-20	21-25	1-5	6-10	11-15	16-20	21-25	
Unilateral:																				
Secondary Coxarthrosis	2	1	1	3	1	2		1		1			1		12	14	5	5	1	50
Primary Coxarthrosis	2	1		4	3		2			4	1				4	4				25
Bilateral:																				
Secondary Coxarthrosis	1	1		1		1				1		1			2	5	1			14
Primary Coxarthrosis	3	1	4	8	5	1	1	1		2	2				3	5				36
Total	8	4	5	16	9	4	3	2		8	3	1	1		21	28	6	5	1	
	12		21		18					13					61					125

cause of unilateral secondary coxarthrosis (Table XIX).

In primary coxarthrosis the most common reason for a disability pension was pain and/or stiffness of the mobile hip. Seventeen of the 23 primary cases had been granted a disability pension for this reason. Five of the 10 secondary cases had been granted a disability pension because of pain and/or stiffness of the mobile hip. Common associated causes in both categories were obesity, cardiac trouble, a protracted postoperative course, sometimes with reoperations, symptoms referable to other joints (back and knees) and mental depression. In some cases difficulties in finding suitable work was probably a contributary factor.

Comments

Working capacity is, at least temporarily, frequently improved or restored after arthrodesis of the hip. The frequency with which this occurs depends on a number of factors, such as age, general health, type of work etc. (Karlén 1944; Mayr 1954 and Acchiapati 1962).

In the present material the chief difference in this respect was found between probands operated for secondary and primary coxarthrosis. Working capacity was improved more often and was more lasting among the former. Disability pension had since the operation been granted to 8 (12%) of the former and 21 (34%) of the latter.**

3. Restriction of Function

By assessing and grading some important daily activities, the degree of restriction of function in different parts of the series was compared (Table XX).

Walking Distance. The probands' assessment of their walking capacity was found to reflect their general functional capacity. Thus, the 62 who stated that they could walk over 1.5 kilometres, had a far better over-all functional capacity than the remaining 63 (Fig. 9; Table XXI).

Twenty probands (16%) thought that they had recovered their walking capacity after the operation; 14 had been fused for unilateral and 6 for bilateral coxarthrosis. Only in 3 of the 20 cases were radiographic signs of progress in the mobile hip demonstrable.

Thirty six probands (29%) claimed pain in the mobile hip to be the main cause of reduced walking ability. The index of radiographic

Table XX Activities of Daily Living

		Unilateral Coxarthrosis		Bilateral Coxarthrosis		Total
		Secondary	Primary	Secondary	Primary	
Walking Capacity						
Unaided	0	35	11	7	5	58
With one stick	1	11	10	6	22	49
With two sticks	3	3	1	1	8	13
With two trestles	4	1	3	—	1	5
Total		24(0.5)	25(1.0)	9(0.6)	30(1.4)	125
Walking Distance						
1.500 Metres	0	33	15	5	9	62
400-1.500 Metres	1	11	3	5	16	35
100-400 Metres	2	6	7	4	8	25
Less than 100 M.	3				2	2
Not outdoors	4	—	—	—	1	1
Total		23(0.5)	17(0.7)	13(0.9)	42(1.2)	125
Stairs						
Yes	0	39	17	11	20	87
With difficulty	1	11	8	3	15	37
No(only with help)	3	—	—	—	1	1
Total		11(0.2)	8(0.3)	3(0.2)	18(0.5)	125
Toilet						
Yes	0	36	15	9	27	87
With difficulty	1	14	10	5	9	38
No(only with help)	3	—	—	—	—	0
Total		14(0.3)	10(0.4)	5(0.4)	9(0.2)	125
Dressing						
Yes	0	40	22	13	23	98
With difficulty	1	9	2	1	11	23
No(only with help)	3	1	1	—	2	4
Total		12(0.2)	5(0.2)	1(0.1)	17(0.5)	125
Bathing						
Yes	0	23	5	4	10	42
With difficulty	1	17	10	7	14	48
No(only with help)	3	10	10	3	12	35
Total		47(0.9)	40(1.6)	16(1.1)	50(1.4)	125
Working Capacity After Operation						
Heavy Physical	0	5	1	1	3	10
Moderate	1	10	2	4	6	22
Light	2	13	10	4	7	34
Slight	3	15	5	2	4	26
None	4	7	7	3	16	33
Total		109(2.2)	65(2.6)	30(2.1)	96(2.7)	125
Total		243(4.9)	170(6.8)	77(5.4)	285(7.9)	125(6.2)

75 Unilateral Cases: 5.5 Points
50 Bilateral Cases: 7.2 Points
64 Secondary Cases: 5.0 Points
61 Primary Cases: 7.5 Points

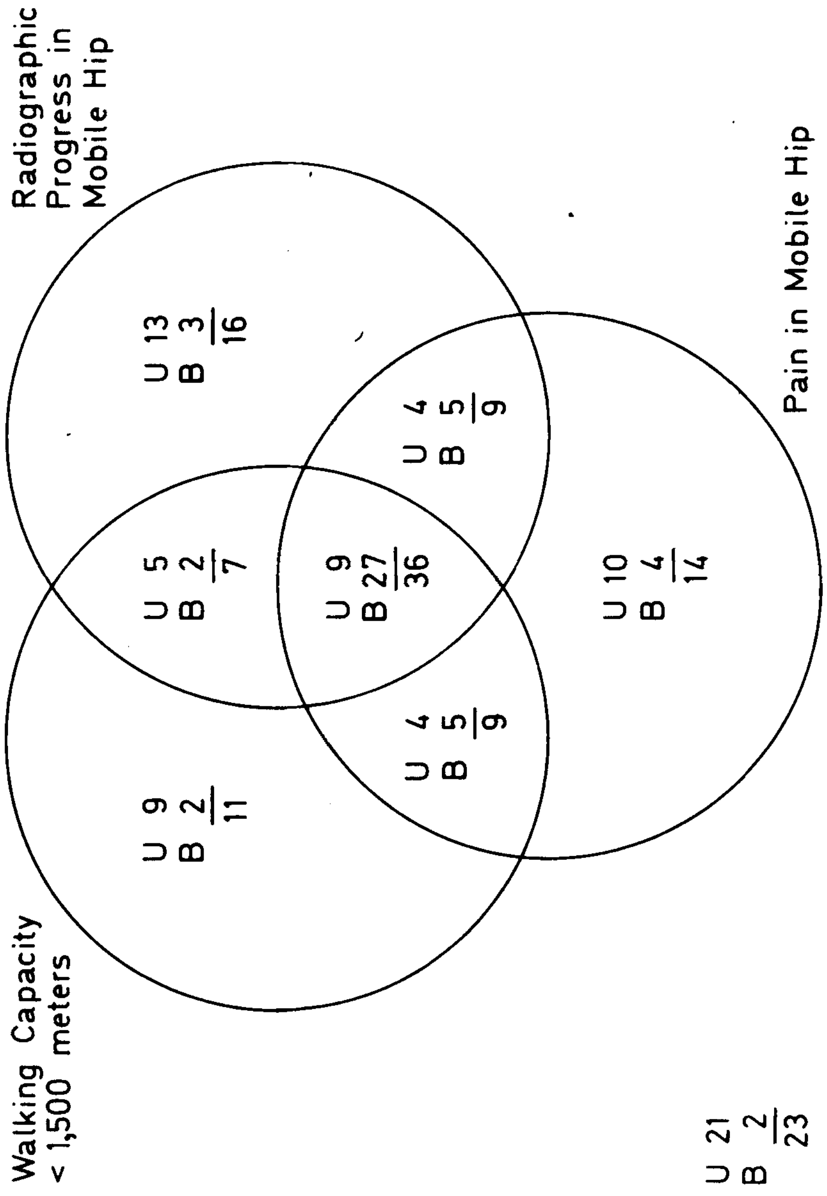


Fig. 9 Walking Capacity Versus State of Mobile Hip in Unilateral (U) and Bilateral (B) Coxarthrosis

Table XXI. Comparison between 62 Probands with Walking Capacity of 1.500 metres or more and 63 Probands with less.

Walking Distance	Unilat. Coxarthr. Sec.	Unilat. Coxarthr. Prim.	Bilat. Coxarthr. Sec.	Bilat. Coxarthr. Prim.	Number	Mean Age at Foll.-up	Restriction of Function	Mean R. Index at Foll.-up	Mean Increase in Rad. Index	Mean Pain Index	Sex Male	Sex Females
≥1.500 m	35	15	5	9	62	58.4 yrs	3.5	1.3	0.6	0.4	24	38
<1.500 m	17	10	9	27	63	63.9 "	8.9	4.4	2.1	2.1	24	39
Total	50	25	14	36	125	61.2 yrs	6.2	2.9	1.4	1.3	48	77

severity at the review was, on the average, 4.8 index points for these 36 hips, with an average increase in index of 2.5 points. The pain index was 2.8 points.

Of the 63 probands who could only walk less than 1.5 kilometres, 52 had pain and/or showed radiographic progress in the mobile hip. Reduced walking capacity was significantly more common among the bilateral cases*** (Table XXI).

Walking Outside. Most of the 49 probands that used one stick carried it in the hand on the operated side. For the 58 probands who could walk unaided, arthrotic progress was, on the average, 0.6 index point; for the 49 using one stick, 1,9 points, for the 13 using two sticks, 3.0 points; and for the 5 probands using two trestles, 1.0 point. That the progression among the 5 last probands using trestles was so slight was explained by the fact that only one of them used trestles because of symptoms in the mobile hip, whereas the rest used them mainly for balance outdoors. The latter 4 probands had markedly reduced mobility of the ipsilateral knee, one of which was ankylotic as a result of an intraarticular fracture.

Only 35 probands stated that walking on snow or in slippery roads was not difficult whereas 65 had difficulties and 25 never went out alone in such weather. Twice as many probands had difficulties in walking uphill (78) as downhill (34) and 13 could manage neither.

Stairs. Most of the probands had no difficulty in walking up or down stairs. Theoretically, the smaller the angle of flexion in the fused hip the more difficult it is to climb stairs. In the present material no such correlation was found. Thirty-eight probands had trouble getting on a bus or a train and 19 could not do so without help.

Difficulties in getting into a car were common (43 probands) and many could only get in from one side, i.e. with the mobile leg first. Some of the probands always had to sit in the front seat in order to have enough room for the stiff leg.

Toilet. Seventy per cent of the probands could manage without much difficulty. One third of the total number of probands used a heightened toilet seat and 20 had put handles on the wall to facilitate sitting down and rising from the toilet.

Twenty-four of the females had difficulties when passing urine. Thus, 21 were troubled by urine running down the stiff thigh and 9 of these plus 3 others were troubled by the stream of urine tending

to run in front of the toilet bowl. For 19 of the women these difficulties were constant and quite distressing. Some of them always carried a plastic container in their bags when away from home to prevent embarrassment. Seven of the total number of probands had not been able to use a toilet seat heightener and three had ever since the operation used the toilet in a standing positon.

Dressing. Except for socks and shoes, dressing was not difficult for 98 (78%) of the probands.

Putting on sock and shoe on the operated side proved to be an obstacle for nearly all of the probands. This was frequently solved by the help of another person or by the use of special aids. Only four probands could tie the shoelace on the fused side.

In addition to socks and shoes, putting on trousers was the commonest difficulty. Many had learned to use special aids or their walking sticks upside-down as a hook to make this task easier. Daily dressing time was assessed to be normal for 39 probands (2-5 min prolonged for 57 (5-10 min.) and markedly prolonged for 29 (10 min.).

Bathing. Eighty three probands (66%) had more or less difficulties when taking a bath. Thirty-five were dependent on help whereas others assumed a kneeling position or had special seats made for the bath. Still others had replaced the bath by a shower. All were dependent on help for cutting townails on the fused side.

4. Discussion

In coxarthrosis loss of function is caused by pain, faulty positions and decrease in range of motion. By arthrodesis two factors are permanently abolished at the price of eliminating what useful motion there may have been left in the joint. But one of the paradoxes of arthrodesis of the hip was the fact that its first goal, i.e. complete abolishment of motion in the joint in order to increase the overall functional capacity of the individual imposed serious restrictions on his pursuits.

Most of the probands, who before the operation had been on the brink of permanent invalidity, were glad to have sacrificed the remaining motion in the joint to obtain freedom from pain. For others the "completeness" of the stiffness had come as a shock and some of the probands had a period of mental depression after discharge when faced with the tasks of daily living, and a few still bitterly regretted

the operation. Many daily activities could be mastered only with difficulty and some had since the operation become unsurmountable obstacles, especially for the elderly probands. Stiffness of the fused hip, in association with pain in other joints, particularly the mobile hip, were the most common reasons for all degrees of disability.

5. Conclusions

Arthrodesis of the hip proved to be an effective method of eliminating the invalidity caused by pain and contractures in the arthrotic joint. As a measure of this fact three fourths (92) of the probands had been able to resume work, most (59) of whom had returned to their former occupation.

However, arthrodesis of the arthrotic hip is generally performed in the latter half of life when adaptability to changed conditions has become decreased. Consequently, probands with the primary form of coxarthrosis, particularly when bilateral, showed far less good functional results and the lowest rate of restored working capacity, whereas the opposite was true of probands with secondary coxarthrosis, especially those with unilateral affection.

It was concluded that as functional capacity after arthrodesis of the hip was largely dependent on age and painfree, compensatory motion of adjoining joints, most important of which was the mobile hip, the total functional gain was often of a temporary character.

IV SUMMARY

Chapter I INTRODUCTION

Since the beginning of the century arthrodesis has been one of the leading methods used in the surgical treatment of coxarthrosis. According to many authors, arthrodesis of one hip in bilateral coxarthrosis provides the patient with a supporting leg so that the mobile hip is correspondingly relieved from mechanical strain.

The aims of the investigation were to find: a) to what extent the fused hip was used for static support; b) the incidence, rate and degree of radiographic deterioration of the mobile hip and c) the incidence and degree of pain in the mobile hip and the influence of pain on daily activities and working capacity.

Chapter II MATERIAL AND METHODS

A. Classification

The cases were classified as unilateral or bilateral coxarthrosis on the basis of preoperative radiograms. Distinction between primary and secondary coxarthrosis was based on the history and on radiographic appearance.

B. Material

The investigation was based on a follow-up examination of 125 probands who had undergone arthrodesis of the hip 2 to 22 years previously (average 10 years) for unilateral or bilateral coxarthrosis in the two forms of the disease, the primary and secondary.

There were 77 females and 48 males. The average age was 52 years at the time of operation and 61 at the review. It was the same in both sexes. In 61 cases with primary coxarthrosis, mainly bilateral, the average age at the review was 66 years, and in 64 with secondary coxarthrosis, mainly unilateral, 57 years.

C. Methods

The investigation comprised a registration of the static support pattern, a comparative study of preoperative and follow-up radiograms of the mobile hip and a clinical examination.

The static support test was performed with the aid of two electronic scales, one for each foot, which were calibrated to the weight of the proband. The difference in loading between the two scales during a certain period could then be calculated from the tracings on an ink-writer. The purpose of the test was to ascertain the static support pattern in free and in instructed modes of standing (cf. p. 13). The test lasted for 20 minutes.

The radiographic examination comprised radiograms of the hips, pelvis, lumbar spine and knees. The chief aims of the radiographic examination were: a) to assess radiographic signs of arthrotic deterioration of the mobile hip by a comparison with the preoperative radiograms according to a numerical index (Table IV), and b) radiographic determination of the degree of ab- or adduction of the fused hip.

The clinical examination aimed chiefly at recording a) range of motion and degree of pain in the mobile hip; b) degree of flexion of the fused hip; c) state of lumbar spine and knees and d) the probands' accounts of their ability to perform daily activities and of their working capacity.

Chapter III RESULTS

A. Static Support Test.

The test showed that when standing easy for 10 minutes only 15% of the probands used the fused leg for support (> 60% f.l.) whereas both legs were loaded fairly evenly (40%-60% f.l.)by 43% and the mobile leg was used for support by 42% of the probands.

There was a distinct difference in the support pattern according to the state of the mobile hip. Thus, arthrotic changes and pain were significantly more prevalent in the cases with equal support and those who preferred the fused leg for support than in those who preferred the mobile leg. Further, loading of the fused leg appeared to be facilitated by the neutral and adducted position of the fused hip and by shortening of the fused leg.

The instructed modes of standing showed that 90% of the probands could use either leg for support for a period of 2 minutes whereas nearly one third of the probands could not distribute body weight evenly between the legs for a period of 5 minutes. Even loading of both legs was rendered more difficult by large discrepancies in leg length.

The support pattern in Romberg's test revealed that most of the probands resumed their support pattern displayed in the first part of the test.

As regards the leg generally used for support in daily life, the findings were in agreement with the opinion of 75% of the probands. Those whose opinion differed from the results showed no preference for either leg.

Compared with what may be considered normal, the number of shifts was markedly small, especially among those who showed a distinct preference for uneven loading.

It was concluded that the fused leg was generally not used for chief support in standing and did not afford relief of the mobile hip. The great majority of the probands had loaded mainly the mobile leg as long as it could be comfortably used for this purpose.

B. Radiographic Examination

The radiographic examination revealed signs of arthrotic deterioration of half of the mobile hips and that the prognosis of the mobile hip was not uniform.

A marked difference, depending chiefly on two factors, was observed, i. e. whether or not the mobile hip was initially affected with arthrotic changes and whether the other hip had been fused for primary or secondary arthrosis. This strongly suggested that the dominant factor deciding the future of the mobile joint was of biological nature. Thus, the mobile hip fared best in the absence of the above factors and by far worst in the presence of both.

The frequency and severity of radiographic changes in the mobile hip, when initially affected, did not suggest relief of its weight bearing functions by the fused hip. Far from being unburdened by the fusion of the opposite hip the mobile hip was subjected to heavy compensatory strain under both static and dynamic conditions which with time generally resulted in degenerative changes in the joint when biologically susceptible. In no instance were signs of regression demonstrable

in a joint initially affected. On the basis of these findings and in comparison with Danielssons's (1964) series of unoperated cases (cf. p.42), the prognosis of the mobile hip in bilateral coxarthrosis, especially of the primary type, was considered poor.

C. Clinical Examination

The working capacity and gross functional capacity was often improved or restored after healing of the arthrodesis. Ninety-two (74%) of the probands were able to resume work, 59 (47%) in their former occupations.

The extent and permanency of recovery was dependent on the state of other joints, especially the other hip, and on the proband's age. Consequently probands with the primary form of coxarthrosis, particularly when bilateral, showed far less good functional results and the lowest rate of restored working capacity, whereas the opposite was true of those with secondary coxarthrosis, especially in unilateral affection.

It was concluded that as long as the hip arthrodesed subject was relatively young with no other joints affected, the adverse effects of the arthrodesis were more easily neutralized. In the older age groups, particularly in primary coxarthrosis, the combined effects of advancing age and changes in the opposite hip frequently caused an early diminution of the functional gain achieved.

V. REFERENCES

ACCHIAPATI, G. (1962): Research on the residual work capacity in persons having had arthrodesis of the hip. Archivo di Orthopedia (Milano), 75, 822-8.

AHLBÄCK, S. O. and LINDAHL, O. (1966): Hip Arthrodesis, The Connection Between Function and Position. Acta Orthop. Scandinav. 37, 77-87.

ALBEE, F. H. (1908): Arthritis deformans of the Hip, A Preliminary Report of a New Operation. J. Amer. Med. Assoc. I., 1977-80.

BECKER, F. (1969): Die Hüftarthrodese. Rütt, A.: Die Therapie Der Koxarthrose, 274-289.

BLOM, G. (1969): Sannolikhetsteori och statistikteori med tilllämpningar. Studentlitteratur. Lund.

CASUCCIO, C. (1964): Le artrodesi. Trattamento Chirurgico della Coxartrosi. Relatione al XLIX Congresso della Societá di Ortopedia e Traumatologica, Venezia, 1964.

CHARNLEY, J. (1953): Compression Arthrodesis. E. & S. Livingstone Ltd., Edinburgh and London.

DANIELSSON, L. G. (1964): Incidence and Prognosis of Coxarthrosis, Acta Ortop. Scandinav. Suppl. Nr. 66.

DANIELSSON, L. G., DYMLING, J. F. and HERIPRET, G. (1964): Coxarthrosis in man studied with external counting of Sr 85 and Ca 47. Clin. Orthop., 31, 184.

DEGEL (1957): Verh. dtsch. Ges. Orthop. 44. Kongress 1956. Beiheft 88, 108 (1957).

DEMIGNEUX, F., RAINAUT, J., CÉDART, Cl. (1968): Étude de la hance opposée aux arthrodéses. Revue de Chir. Orthopéd, 54, nr. 7, 649-656.

DENHAM, R. A. (1959): Hip Mechanics. J. Bone Jt. Surg. 41-B, 550-557.

DUCROQUET, P. (1965): La marche et les boiteries. Études des marches normales et pathologiques. Ed. Masson, Paris.

FRANCILLON, M. R. (1957): Zur Orthopädie der Coxarthrose. Zeitschrift für Rheumaforschung, 9, 305-335.

FÜRMAIER, A. (1959): Überlegungen zur Statik des Arthrodesierten Hüftgelenkes. Archiv für Ortop. und Unfall-Chir., 51, 28-36.

HAUGE, M. F. (1963): Hofteankylose. En röntgenologisk og klinisk studie av den ankylotiske hoftes naboledd med henblikk på anatomiske og funksjonelle forandringer. Universitetsforlaget. Oslo.

HENRIKSSON, JOHANSSON, OLSSON and ÖSTLUND (1967): Electrical Analysis of the Romberg Test. Acta Otolaryng. Suppl. 224, 272-279.

HERBERT, J. J. (1960): Étude Critique Sur Les Arthrodèses De La Hance. Rev. Chir. Orthop., 46, 3-14.

HOHMAN, D. (1962): Untersuchungen zur Frage des Standbeines beim Hüftarthrodesierten. Archiv für Orthop. und Unfall-Chir., 54, 153-158.

JONSSON, B. and STEEN, B. (1962): Function of the hip and thigh muscles in Romberg's test and "standing at ease". An electromyographic study. Acta Morph. Neurol. Scand., 5, 269-276.

JUDET, R. and JUDET, J. (1952): Technique and Results with the Acrylic Femoral Head Prosthesis. J. Bone Jt. Surg., 34-B, 173.

KARLÉN, A. (1944): A Clinical Study on Arthrodesis for Arthritis Deformans of the Hip Joint. Acta Chir. Scandinav. Suppl. 96.

KELTON, I. W. and WRIGHT (1949): The Mechanism of Easy Standing by Man. Australian J. Experim. Biology, 27:508, 510.

LINDAHL, O. (1965): Functional Capacity after Hip Arthrodesis. Acta Orthop. Scandinav., 36, 453-458.

LINDAHL, O. (1965): Determination of Hip Adduction, Especially in Arthrodesis. Acta Orthop. Scandinav. 36, 280-293.

MACH, J. (1964): Die operative Hüftversteifung im Rahmen der Koxarthrosebehandlung. Archiv für Orthop. und Undfall-Chir., 56, 593-603.

MACHACEK, J. (1956): Winkelbestimmung bei Abduktionsosteotomie am Versteiften Hüftgelenk. Zeitschr. Orthop., 87, 408-413.

MAYR, H. (1954): Probleme und Erfahrungen an 200 Arthrodesen bei chronischen unspezifischen Hüftkrankungen. Zeitschr. Orthop., 84, 189-206.

MERLE D'AUBIGNÉ, R., RAMADIER, J., POSTEL, M., MAZAS, F., VAILLANT, J. (1964): L'arthrodèse de la hance. Revue de Chirurgie Orthopédique, 50, 789-812.

Method of Measuring and Recording. American Academy Orthop. Surg. (1965).

PAGANI, A., MOROSINI, C. and BURATTI, G. (1967): A kinesiologic study of arthrodesis of the hip. Europa Medicophys, 3/4, 265-287.

RÜTT, A. (1969): Die Therapie der Koxarthrose. Georg Thieme Verlag. Stuttgart.

RYDELL, N. W. (1966): Forces Acting on the Femoral Head-Prosthesis. Acta Orthoped. Scandinav. Suppl. 88.

SAUNDERS, M., INMAN, V. and EBERHART, H. (1953): The Major Determinants in Normal and Pathological Gait. J. Bone Jt. Surg., 35-A, 543-558.

SCHEDE, F. (1956): Der Stand des Normalen. Mechanik der Aufrechten Haltung. Theoretische Grundlagen für den Bau von Kunstbeinen. Zeitschr. Orthop. 88, Beilageheft.

SEEVALD, K. und DEBRUNNER, A. M. (1964): Untersuchungen über die Veränderung des nicht erkrankten Hüftgelenkes bei Hüftankylosierten. Zeitschr. Orthop., 98, 288-298.

SHEPARD, M. M. (1954): Assessment of Function after Arthroplasty of the Hip. J. Bone Jt. Surg., 36-B, 354-363.

STEINDLER, A. (1955): Kinesiology of the human body. C. C. Thomas. Springfield. Ill.

STINCHFIELD, F. E. and CAVALLERO, W. U. (1950): Arthrodesis of the Hip Joint. J. Bone Jt. Surg., 32-A, 48-58.

SMITH, J. W. (1953): Acta Orthop. Scandinav., 23.

VERHEUGEN, P. et NAVARRE, M. (1964): La place de l'arthrodèse dans la chirurgie des coxarthroses. J. Belge de Médicine Physique et de Rheumatol., 19, 25-32.

WALMSLEY, T. (1933): The Vertical Axes of the Femur and their Relations. A Contribution to the Study of the Erect Position. J. of Anatomy, LXVII, 284-300.

WATSON-JONES, R. (1956): Arthrodesis of the Osteoarthritic Hip Joint. J. Bone Jt. Surg., 38-B, 353-377.

WEINREICH, M. (1960): Zur Statik der Hüftarthrodese. Verh. dtsch. Orthop. Ges., 47 Kongr., 509-515 (Beilagehefte).

WIBERG, G. (1939): Studies on Dysplastic Acetabula and Congenital Subluxation of the Hip Joint. Acta Chir. Scandinav., Suppl. LVIII.

WIBERG, G. (1959): Höftleden, Nordisk Lärobok i Ortopedi. Bonniers, Stockholm.

VI. APPENDIX

A. Coded Specification of the Material (125 cases)

Column:

1-3	Number of Case	
4	Unilateral = 1	Bilateral = 2
5	Primary = 1	Secondary = 2
6	Male = 1	Female = 2
7	Pain Index = 1, 3, 5	
8	Increase in Radiographic Index = 1 - 10	
9	Frontal Position of Fused Hip =	≥ - 10° - 0° = 1 1° - 5° = 2 6° - 10° = 3 >10° = 4
10	Degree of Flexion in Fused Hip =	10° - 19° = 1 20° - 29° = 2 30° - 39° = 3 40° - 49° = 4 >50° = 5
11	Support Pattern (in percent of body weight loaded on fused leg) =	<40% f.l. = 1 40% - 60% f.l. = 2 >60% f.l. = 3
12	Support by Fused Leg for Two Minutes=	<40% f.l. = 1 40% - 60% f.l. = 2 >60% f.l. = 3
13	Support by Mobile Leg for Two Minutes =	<40% f.l. = 1 40% - 60% f.l. = 2 >60% f.l. = 3
14	Romberg's Test =	<40% f.l. = 1 40% - 60% f.l. = 2 >60% f.l. = 3
15-16	Age in Years at Follow-up	
17-18	Follow-up Period in Years	
19	Radiographic Index at Follow-up	

Unilateral Secondary Coxarthrosis (50 Cases)

Column:															
1-3	4	5	6	7	8	9	10	11	12	13	14	15-16	17-18	19
Developmental Disturbances:														
109	1	2	2	1		2	3	1	3	1	2	74	15	0
107	1	2	2		1	2	2	1	3	1	1	60	10	1
026	1	2	2	3	3	4	4	2	3	1	2	52	19	3
037	1	2	2		1	3	4	2	3	1	2	57	6	1
059	1	2	2	1		3	4	2	3	1	2	63	18	0
089	1	2	1	1	1	1	2	2	2	1	1	77	16	1
111	1	2	2	1	3	3	3	1	3	1	2	60	5	3
155	1	2	2	3	6	2	3	1	3	1	1	63	15	6
042	1	2	2			1	4	1	3	1	2	62	8	0
029	1	2	2	3	4	3	4	2	3	1	2	58	6	4
060	1	2	2		2	3	3	2	3	1	2	61	10	2
064	1	2	2			2	3	2	2	1	2	50	9	0
079	1	2	2			2	3	1	3	1	1	52	11	0
134	1	2	2	1		4	4	1	3	1	1	46	5	0
138	1	2	2			4	4	1	3	1	2	63	7	0
013	1	2	2	1		1	2	2	3	1	1	62	16	0
016	1	2	1		2	3	2	2	3	1	2	68	20	2
062	1	2	2	1		2	3	1	3	1	1	37	13	0
110	1	2	2		1	1	4	1	3	1	1	59	11	1
004	1	2	2		2	3	4	2	3	1	2	65	22	2
118	1	2	2			3	3	2	3	1	1	44	8	0
Inflammation:														
007	1	2	2	1		2	5	1	3	1	1	41	18	0
018	1	2	1		2	3	2	2	3	1	2	66	10	2
012	1	2	1			1	3	1	3	1	1	61	17	0
024	1	2	2			3	4	1	3	1	1	48	16	0
041	1	2	1	1	2	1	2	1	3	1	1	55	16	2
045	1	2	1		1	4	3	1	3	1	2	64	9	1
084	1	2	1		1	3	3	2	3	1	2	40	17	1
090	1	2	2			1	4	3	3	1	2	55	7	0

Unilateral Secondary Coxarthrosis (50 Cases)

Contd.
(Inflammation)

Column:

1-3	4	5	6	7	8	9	10	11	12	13	14	15-16	17-18	19
091	1	2	1			2	2	1	3	1	3	49	5	0
115	1	2	1			3	2	2	3	1	1	59	8	0
124	1	2	1			4	3	1	3	1	1	44	5	0
144	1	2	1			2	2	3	3	1	2	48	7	0
151	1	2	2	1		3	3	1	3	1	1	37	4	0
145	1	2	2	1		1	3	3	3	1	2	51	4	0
158	1	2	2	1		3	3	1	3	1	2	36	7	0
034	1	2	1		1	4	3	2	3	1	1	50	11	1
072	1	2	1		1	3	2	1	2	1	1	51	4	1
104	1	2	1			1	3	1	3	1	1	19	2	0

Trauma:

006	1	2	2			1	2	1	3	1	1	66	22	0
067	1	2	2			3	2	3	3	1	3	40	5	0
080	1	2	2			2	4	1	3	1	1	64	13	0
086	1	2	2			1	4	3	3	1	2	66	18	0
121	1	2	2			1	3	1	3	1	1	71	7	0
131	1	2	2			2	3	2	3	1	3	68	7	0
142	1	2	2			3	3	2	3	1	2	51	4	0
146	1	2	1			2	3	3	3	1	3	69	4	0
147	1	2	1	1		1	4	3	3	1	3	69	4	0
159	1	2	2			1	3	1	2	1	1	63	5	0
102	1	2	2			3	3	1	3	1	2	70	12	0

Bilateral Secondary Coxarthrosis (14 Cases)

Column:

1-3	4	5	6	7	8	9	10	11	12	13	14	15-16	17-18	19
BOTH HIPS														
Developmental Disturbances:														
009	2	2	2	1	1	1	3	2	3	1	2	57	14	2
035	2	2	2	3	3	4	2	2	3	1	2	59	12	8
053	2	2	2	1	2	2	2	1	3	1	1	61	7	3
098	2	2	2	1	1	3	3	2	3	1	2	42	7	4
149	2	2	2	3	4	2	1	2	3	2	2	57	6	9
108	2	2	1			1	4	2	3	2	2	60	8	8
Inflammation:														
074	2	2	2	5	1	1	3	1	3	1	1	50	9	2
070	2	2	1	5	5	3	2	2	3	1	2	69	6	8
099	2	2	1	3		1	3	2	3	1	3	61	5	2
123	2	2	1	1		2	2	1	3	1	2	49	4	10
ONE HIP														
Developmental Disturbances:														
133	2	2	2	1	2	1	3	3	3	1	3	63	7	3
153	2	2	1		1	3	2	2	3	1	1	71	10	5
Trauma:														
116	2	2	2	3		4	3	1	3	2	1	84	10	3
036	2	2	1	1		2	2	2	3	1	2	55	14	1

B. Radiographic Reproductions.

Fig. 10.

Case 17. Bilateral Primary Coxarthrosis.

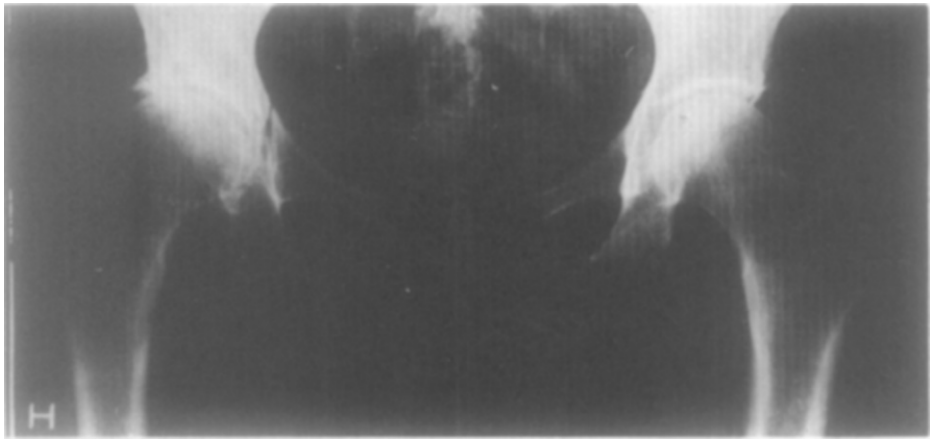
Female, aged 70 at follow-up.

1940: Debut of pain in right hip at the age of 42.

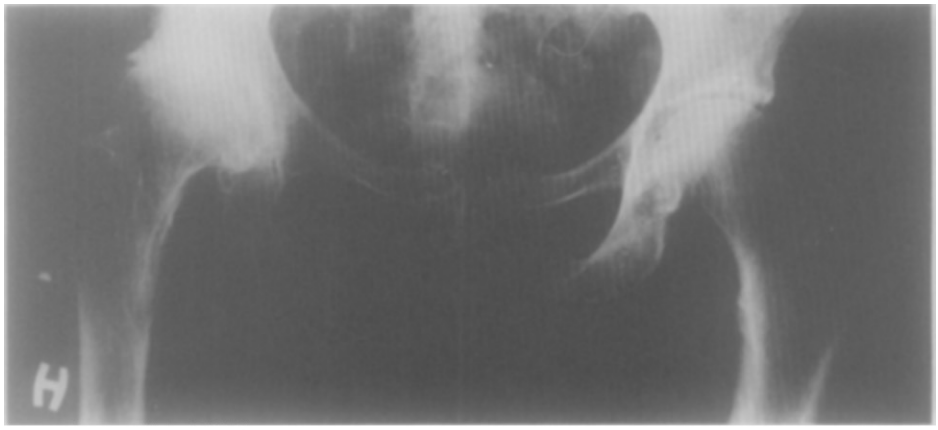
1952: Year of operation. Advanced arthrosis in right hip. ~~Left hip normal~~.

1960: Moderately advanced arthrosis in ~~right~~ left hip. Incipient subchondral cysts in left hip. Radiographic index, 1.

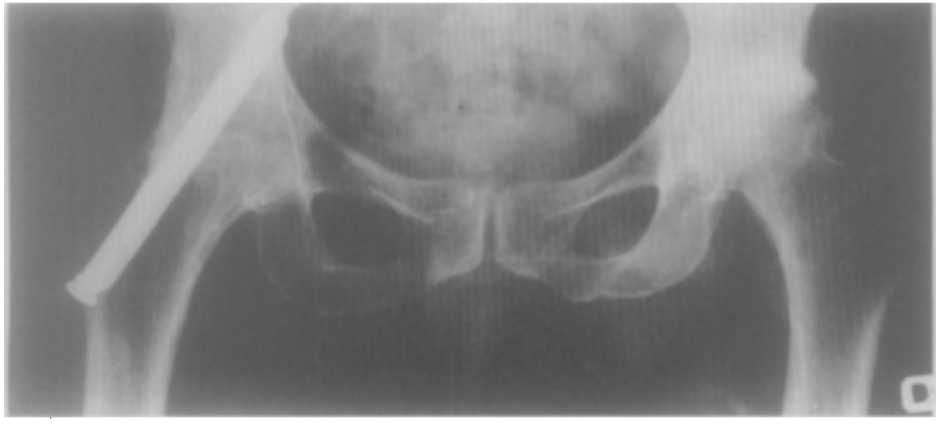
1965: Thirteen years postoperatively. Severe arthrosis of left hip. Patient receiving a disability pension since 2 years. Radiographic index, 9. Pain index, 3.



1940



1952



1960

1965

Fig. 11.

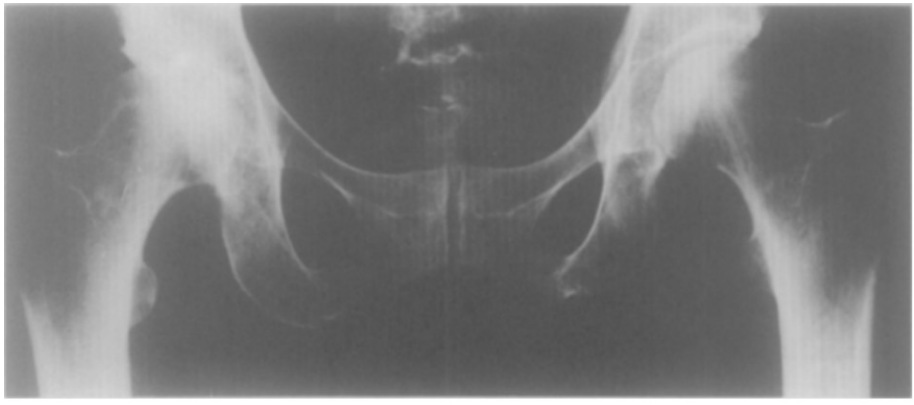
Case 83. Unilateral Primary Coxarthrosis.

Female, aged 64 years at follow-up.

1956: Pain in right hip at 52 years of age. Moderate arthrosis of rigth hip. Left hip normal.

1958: Year of operation. Rapid progress with increasing pain in rigth hip. Left hip normal.

1968: Ten years postoperatively. Incipient arthrosis of left hip. Radiographic index, 1. Pain index, 1.



1956

1958

1968

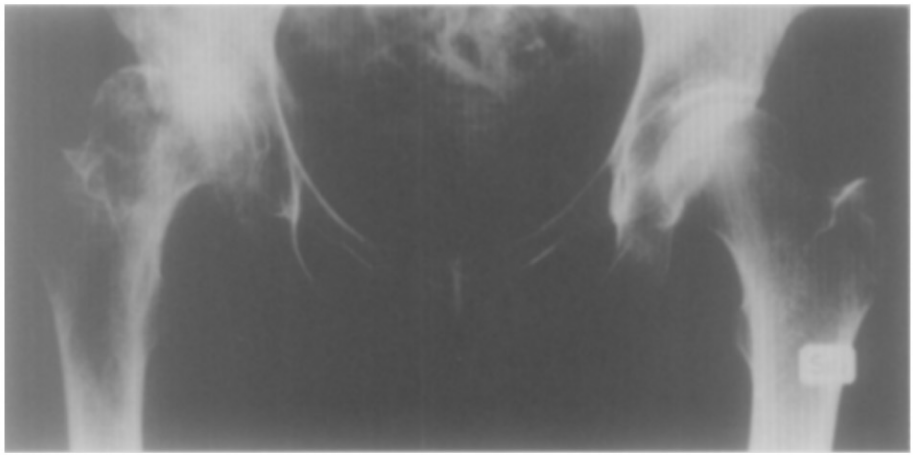
Fig. 12.

Case 029. Unilateral Secondary Coxarthrosis.

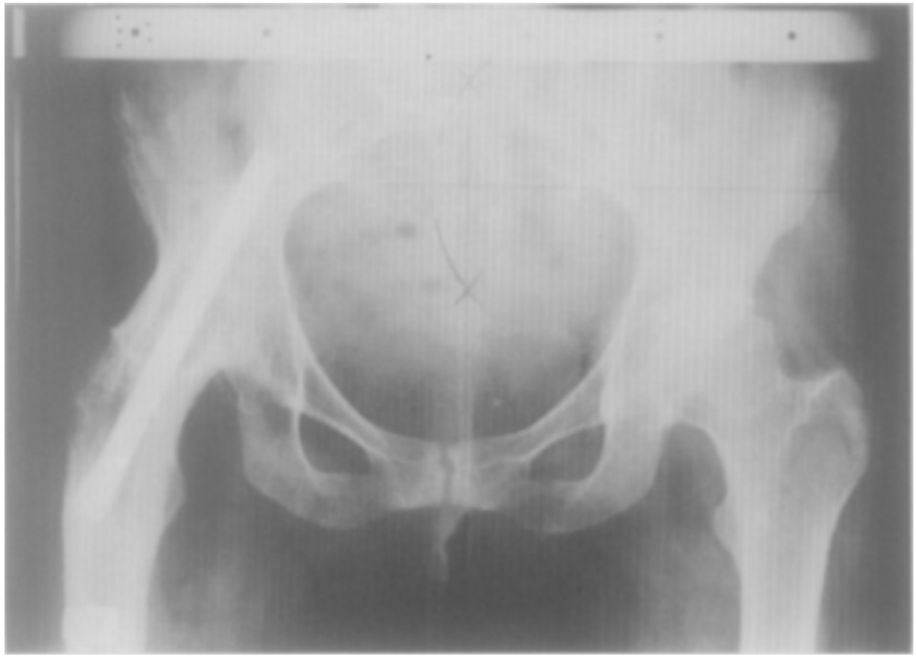
Female, aged 61 at follow-up.

1962: Year of operation. Left hip normal.

1968: Six years postoperatively. Moderate arthrosis of left hip. Radiographic index, 4. Pain index, 3.



1962



1968