

From the Orthopaedic Hospital of the Invalid Foundation, Helsingfors, Finland
(Head: Professor Anders Langenskiöld, M.D.).

RESULTS OF RADICAL EVACUATION AND ARTHRODESIS IN SACRO-ILIAC TUBERCULOSIS

By

GEORG BAKALIM

Received 23.iv.66

Sacro-iliac tuberculosis is a relatively rare disease. Even before the introduction of tuberculostatic medication reduced the frequency of bone and joint tuberculosis in general, tuberculous sacro-ilitis was seldom encountered. Of a total of 3203 patients with lesions of the back treated at the Surgical Clinics I, II and III and the Surgical Outpatients Department, University of Helsinki, during the years 1951-1953, only 0.3 per cent had sacro-iliac tuberculosis, whilst tuberculous spondylitis, for instance, was diagnosed in 8.3 per cent (*Bakalim 1959*).

Previously, the prognosis of tuberculous sacro-ilitis was regarded as poor. *Seddon* (1939) reported a mortality of 10 per cent in isolated sacro-iliac tuberculosis, 25 per cent in connection with fistulization and 50 per cent in patients with concomitant tuberculosis in other sites.

The disease often begins insidiously, with a latency stage of long duration. There may be pain in various sites, depending on the location and extension of the lesion. Apart from pain in the sacro-iliac joints, symptoms indicative of other diseases of the lumbar region of the back (*e.g.* sciatica) or the hip joints may be present.

It is a generally accepted view that abscess formation and unilateral localization are indicative of tuberculosis, whereas bilateral involvement and complete ankylosis constitute evidence of spondylarthritis ankylopoetica. *Brocher* (1949) stated that he had never seen complete ankylosis in tuberculosis of the sacro-iliac joint. Apart from these two diseases, the only pathological conditions of the sacro-iliac joint to be taken into account in differential diagnosis are osteitis condensans ilei and rare primary tumours. The roentgenographic appearance of the latter is fairly typical, however. Increased sclerosis of the bony tissue in

the iliac part of the joint has been described in connection with various conditions in which the function of a lower extremity is impaired (*Solonen* 1957). In these cases the changes of the sacro-iliac joint always develop on the opposite side, as a result of the greater strain to which this joint is exposed.

Since the discovery of tuberculostatic drugs, direct surgical treatment has been attempted in the management of all kinds of bone and joint tuberculosis. The aim of eradicating the focus with its mass of granulation tissue and caseous necrosis, which constitutes a strain upon the organism, is to obtain more rapid healing than what is possible with conservative treatment alone.

Operative treatment of bone and joint tuberculosis was first tried at the end of the last century, but before the advent of antibiotics the results were unsuccessful. Subsequently, the predominant principle of conservative treatment utilized the benificent effects of rest, sunshine and fresh air (*Rollier* 1913).

The reports on surgical evacuation of foci adjacent to the sacro-iliac joint are few. *De la Sierre Cano* (1956) described a series treated by evacuation and subsequent arthrodesis performed by Smith-Petersen's method. Before the use of chemotherapy among 45 operated cases mortality was 7 per cent, whilst the death rate in a conservatively treated series was 15 per cent. Thanks to the introduction of tuberculostatic drugs, fatal cases has been entirely eliminated, however, *Horvat* (1956) excised the focus in 3 cases and packed the cavity with bone. *Roaf, Kirkaldy-Willis & Cathro* (1959), too, recommended evacuation of the focus. These authors performed arthrodesis by packing the cavity with the bone that had been removed on exposition of the sacro-iliac joint. It appears that a conservative attitude in regard to therapy is still common. Tuberculous sacro-ilitis is treated with chemotherapy, a plaster bed or an orthopaedic corset until the process has healed. After this, the patient is usually allowed to be up wearing a corset, or arthrodesis is performed (*Adams* 1961). Arthrodesis alone without evacuation must be regarded as a conservative method.

MATERIAL

At the Orthopaedic Hospital of the Invalid Foundation, tuberculous sacro-ilitis has been treated by operative evacuation and arthrodesis since 1950. The present series is small, comprising only 8 cases from the 10-year period 1950-1960, but in view of the low frequency of the disease it seemed futile to postpone a follow-up study for the sake of collecting a larger material.

The patients' age and occupations appear in Table 1. The erythrocyte sedimentation rate was not elevated in all cases, normal values being recorded in 3. The majority of the patients experienced pain in the affected sacro-iliac joint. In 3 cases an abscess could be palpated over the joint. Tenderness on palpation of percussion was a typical feature. The so-called sacro-iliac tests, by which movement of the joint is indirectly caused, were positive. A fistula was present in 2 cases. In one case the process was bilateral, which is rare, but only one focus was active. Table 1 also shows the occurrence of tuberculous processes in other sites.

Table 1.

Case no.	Occupation	Age yrs.	ESR mm/hr.	Other tuberculous foci	Abscess	Fistula
1	Farmer's wife	27	6	Pleurisy; spine	+	+
2	Housewife	22	10	Lung		
3	Labourer	36	4	Pleurisy		
4	Widow	62	46	Shoulder joint; spine		
5	Farmer	48	34	—	+	+
6	Clerk (female)	29	31	—		
7	Sempstress	46	96	Hip joint		
8	Labourer's wife	21	24	Lung	+	

In the initial stage of tuberculous sacro-ilitis the process may be so limited as to be hardly recognizable on the roentgenogram. In such cases tomography is a useful aid. As a rule, the disease begins as a small focus in the lower part of the joint. As always in tuberculosis of the bone, erosion, unsharp outlines and blurring of the structures signify activity. Prior to operative treatment of the focus its extension must, of course, be established by tomography.

As soon as the diagnosis was made in the present cases, preoperative treatment was instituted. It consisted of streptomycin, isoniazid and PAS. No plaster bed was used. The operation was performed about six weeks later. It was not regarded as necessary to await normalization of the erythrocyte sedimentation rate. The goal was to evacuate the focus as effectively as possible and thus to accelerate healing by ridding the organism of tuberculous tissue. At the same time arthrodesis was accomplished by bone transplantation. Autogenous bone was used except in one case, in which bone from a bone bank was employed. Streptomycin was administered locally. The joint was incised in the same way as in Smith-Petersen's arthrodesis.

As always when tuberculous foci are evacuated, the greatest problem is to find all ramifications of the process. During operation it is not

to inspect all corners of the sacro-iliac joint. If any tuberculous tissue is left, the intervention loses some of its value.

In the following, the present 8 patients are described in the same order as they were treated.

CASE HISTORIES

Patient no. 1. A farmer's wife, aged 27, who had had pleurisy eight years before she was admitted to the Orthopaedic Hospital of the Invalid Foundation. She had experienced pain in both hip joints for seven years. An inactive tuberculous lesion was present in the fifth lumbar vertebra. The general condition was not quite satisfactory. The erythrocyte sedimentation rate was not elevated. Tenderness on percussion was observed all over the lumbar region of the back and in particular over the right sacro-iliac joint. Half a year previously a fistula had developed in the right gluteal region.

The roentgenogram revealed extensive destruction of the right sacro-iliac joint, the upper part of which exhibited a large, sharply demarcated focus. More distally two small foci were detected. The affected area was surrounded by a markedly sclerotic zone.

The lesion was evacuated and the fistula was extirpated in September 1950. From the sacro-iliac joint a large focus extended into the iliac bone and a smaller focus extended into the sacrum. One gram of streptomycin was placed in the cavity, after which a muscular flap was introduced. No bone transplantation was performed. The wound did not heal immediately; a fistula developed, which did not close until four years later. Postoperatively streptomycin, PAS and isoniazid were administered.

Twelve years later the patient was summoned to a follow-up examination. She was in good health and able to do all the household work needed on a farm. The flexibility of the back was very good in all directions. The sacro-iliac tests were negative. The erythrocyte sedimentation rate was 11 mm/hr. The roentgenogram showed a partially ankylotic articular slit with three rather large defects, surrounded by a markedly sclerotic zone. The process was healed.

Patient no. 2. A married woman, aged 22. She had developed pulmonary tuberculosis one year previously, on account of which streptomycin and PAS therapy had been instituted. Before admission to the Orthopaedic Hospital of the Invalid Foundation she had experienced increasing pain in the left lower extremity for two months. The general condition was good. The sacro-iliac tests were positive. She exhibited slight right-sided scoliosis and straightening of the lumbar lordosis. The erythrocyte sedimentation rate was 6 mm/hr. The roentgenogram showed a tuberculous focus in the left sacro-iliac joint. The outlines of the joint were indistinct. In the articular region three focal rarefactions were discernible, the largest one as a defect in the sacrum, the size of a hazelnut. The outlines of the lower part of the joint were also unsharp. The pulmonary process appeared to be active.

In February 1951 the focus was evacuated. It was the size of the thumb's end and contained caseous necrosis and pus. Streptomycin was administered into the wound and the cavity was packed with the bone that had been removed on exposition of the focus. Histological examination showed typical tuberculous tissue.

The patient died of pulmonary tuberculosis ten years later. The postoperative course remained obscure.

Patient no. 3. A farmer, aged 36, who had had pleurisy eight years ago. Somewhat later a lesion had been observed in the right sacro-iliac joint. The patient was admitted to the Orthopaedic Hospital of the Invalid Foundation in October 1951. He had experienced pain in the lumbar region of the back, which had been stiffer than before. The general condition was good. The flexibility of the back was somewhat impaired in the lumbosacral region. The erythrocyte sedimentation rate was 4 mm/hr.

The roentgenogram showed partial distension of the sacro-iliac joint due to bone destruction, partial narrowing of the joint and absence of an articular slit. The joint was surrounded by sclerotic bony tissue. In its lower part a focus was observed, the size of a hazelnut, containing a sequestrum-like formation.

The focus was evacuated in October 1951. Streptomycin was applied locally and the cavity was packed with the bone that had been removed on exposition of the joint.

Eleven years later the patient was summoned to follow-up examination. Flexibility of the lumbar region of the back was somewhat impaired. The sacro-iliac tests were negative. There was no local tenderness. The erythrocyte sedimentation rate was normal. The roentgenograms showed an almost ankylotic joint with markedly sclerotic surroundings. On tomography no signs of an active process were detected. The patient was healthy, but did no manual work. He lived at a home for disabled veterans.

In this case a very old lesion was evacuated. Two years after the operation the process had healed.

Patient no. 4. A widow aged 62, who had been under hospital care three years ago for a tuberculous process in the fifth lumbar vertebra. Spinal fusion had been performed. Three months after she had discharged, the right sacro-iliac joint became tender. A roentgenogram showed nothing noteworthy. At this time she still received antituberculous medication on account of the process in the spine. Bed rest was prescribed, and the tenderness disappeared. Half a year later she was re-admitted to the Orthopaedic Hospital of the Invalid Foundation. The erythrocyte sedimentation rate was 46 mm/hr. The roentgenogram showed a very large focus of bone destruction in the right sacro-iliac joint. In the lower part of the joint a large slit had developed. The outlines were blurred. No sclerosis could be detected.

In July 1953 the tuberculous focus was evacuated. The sacro-iliac joint was found to be completely destroyed. The lesion extended into the sacrum and into the ileum. Furthermore, the pelvis exhibited a large abscess, which was evacuated. Streptomycin was placed in the wound. Owing to the patient's advanced age, no bone transplantation was made. Postoperatively, combined streptomycin, PAS and isoniazid treatment was given. The patient was treated with bed rest for ten months after the operation.

At follow-up examination nine years later the patient was healthy. The erythrocyte sedimentation rate was 12 mm/hr. All sacro-iliac tests were negative. Tomograph showed that the sacro-iliac joint was ankylotic and comprised a large defect

surrounded by markedly sclerotic tissue. The defect had decreased considerably, however, since the previous follow-up examination.

In this case the most remarkable features were the patient's advanced age and the fact that she was under antituberculous treatment on account of a spinal lesion at the time of onset of the process in the sacro-iliac joint.

Patient no. 5. A farmer aged 48, who had a tuberculous process in the right sacro-iliac joint since 1941. He had twice been operated upon at other hospitals on this account, the first time in 1941, when a fistula developed. On admission to the Orthopaedic Hospital of the Invalid Foundation the general condition was good. A fistula was present in the right sacro-iliac joint and another in the right inguinal fold. The former discharged pus. Fistulae were also observed in the left sacro-iliac joint and in the left gluteal region. The erythrocyte sedimentation rate was 34 mm/hr.

The roentgenogram revealed a rarefaction in the right sacro-iliac joint, the size of a finger-tip, with a sequestrum in the middle. The joint surfaces were throughout sclerotic. The left sacro-iliac joint was in part completely ankylosed, and it was also surrounded by markedly sclerotic bony tissue. Fistulography was only in part successful.

In November 1954 the focus in the right sacro-iliac joint was evacuated and fistulectomy was performed. The focus was the size of a plum. Streptomycin was applied locally and the cavity was packed with bone from a bone bank. Postoperatively, ordinary streptomycin and PAS therapy was administered, and the patient was treated with bed rest for three months. Fistulization did not recur.

At follow-up examination eight years later the patient had been healthy for seven years and had worked on his farm, although he had abandoned the heavies work. The sacro-iliac tests were negative. Roentgenograms showed healing of the lesion on both sides. Two small defects were visible in the right sacro-iliac joint, one in the middle and one more distally. The surrounding bony tissue was markedly sclerotic. The erythrocyte sedimentation rate was 12 mm/hr.

Patient no. 6. A female clerk, aged 29, who had mostly been healthy. During a pregnancy she began to experience low back pain and stiffness of the left leg and she began to limp. She was treated for ischiatica at another hospital, but the symptoms grew worse and she developed pleurisy. The delivery was normal. The trouble in the back persisted, and in the end she walked with the aid of a walking stick.

When the patient was admitted to the Orthopaedic Hospital of the Invalid Foundation, a swelling the size of a fist was observed over the left sacro-iliac joint. The erythrocyte sedimentation rate was 32 mm/hr.

The roentgenogram showed destruction of the left sacro-iliac joint. The outlines were very unsharp. The calcium content of the osseous tissue was normal. A tomogram showed destruction of the sacrum and ileum adjacent to the lower part of the joint. The contours of these bones were blurred.

In September 1958 the focus was evacuated. The cavity was packed with spongy bone from the ileum. Furthermore, the bone plate removed on incision was used. Streptomycin was placed in the wound, and postoperatively the patient received streptomycin, PAS and isoniazid.

At follow-up examination four years later the patient was healthy. She had taken

up office work nine months after the operation. The sacro-iliac joint was symptom-free. The sacro-iliac tests were negative. The erythrocyte sedimentation rate was 4 mm/hr. Roentgenographically the joint was entirely ankylosed and sclerotic. There were no signs of tuberculous activity. These findings were confirmed by tomography.

Patient no. 7. A sempstress, aged 46, who had developed tuberculosis of the hip joint at the age of 12. During the years 1950-1953 she had visited the outpatient department of the Orthopaedic Hospital of the Invalid Foundation on this account. Mobility of the hip joint was markedly limited, and the extremity of the same side was shorter than the other. In 1959 the patient began to experience pain in the lumbar region of the back and in the left hip. She was admitted to the Hospital in December 1959. The sacro-iliac tests were all positive. The erythrocyte sedimentation rate was 96 mm/hr. The roentgenogram showed a large focus of destruction in the lower part of the sacro-iliac joint. Antituberculous therapy was instituted and one month later, in January 1960, the focus was evacuated. The whole joint cavity was found to be destroyed, and two branches of the process projected into the sacrum. All tissue showing caseous necrosis was removed, Streptomycin was locally applied and the large cavity was packed with bone chips. Half a year later the erythrocyte sedimentation rate was 9 mm/hr. Two years later the joint was still tender, and as no fusion could be detected, another operation was performed, which revealed a focus situated more distally. It was evacuated and the cavity was packed with bone from a bone bank. In addition, the bone plate removed on excision of the focus was used. In this case the course was initially unfavourable from the standpoint of healing. The patient required treatment for four years. Later the process healed, but at the last follow-up examination ankylosis had not developed with certainty. The erythrocyte sedimentation rate was 11 mm/hr.

Patient no. 8. A labourer's wife, aged 21, who had been treated nine years ago at a sanatorium for patients with pulmonary tuberculosis. Before admission to the Orthopaedic Hospital of the Invalid Foundation she had experienced increasing pain for three months in the lumbar region of the back to the left. The pain radiated into the left femur. The patient had a limp and experienced difficulty in walking. Swelling over the sacro-iliac joint was observed. All sacro-iliac tests were positive.

The roentgenograms revealed changes in the whole of the left sacro-iliac joint. The outlines were indistinct and bone destruction and decalcification were observed. In addition, an old rupture of the symphysis and slight osteochondrosis in the thoracic region of the spine were detected. The erythrocyte sedimentation rate was 24 mm/hr.

In February 1960 the focus was evacuated. The cavity was packed with bone chips from the plate which had been removed on excision of the focus. Streptomycin was placed in the wound. After operation bed rest for three months was prescribed, after which the patient was gradually allowed to be up. At this time a fresh active pulmonary tuberculosis was detected, and the patient was treated for two months at a sanatorium. In spite of this complication the process in the sacro-iliac joint healed satisfactorily. The patient wore an orthopaedic corset of cloth for one year after the operation.

At follow-up examination three years later the patient was healthy. She had no subjective symptoms in the back, and she did all her own household work and nursed her children. The erythrocyte sedimentation rate was 19 mm/hr. The sacro-iliac tests were negative. Roentgenographically the sacro-iliac joint was in part ankylosed. In the lower part a defect was still visible. The surroundings of the joint were markedly sclerotic. No active lesions were revealed by tomography, either. The pulmonary tuberculosis had also healed.

RESULTS OF TREATMENT

The patients who had been operatively treated were summoned to follow-up examinations. In the meantime one patient had died of pulmonary tuberculosis. At the clinical examination attention was mainly attached to local tenderness, signs of abscess and the responses to the sacro-iliac tests. Furthermore, the investigation comprised roentgenography of the sacro-iliac joints, including special views in oblique projection, tomography and roentgenography of the thorax. In addition, the erythrocyte sedimentation rate was determined and urinary culture on Löwenstein's medium was performed.

The period of observation varied between four and twelve years. The main results of the following-up studies are compiled in Table 2.

Table 2.

Case no.	Time of observation in years	Subjective symptoms	Sacro-iliac tests	ESR mm/hr.	Roentgenographic findings	Occupation
1	12	Symptom-free	—	11	Ankylosis	Farmer's wife
2	Dead					
3	11	Symptom-free	—	4	Ankylosis	Pensioner in home for disabled
4	9	Pain in lumbar back	—	12	Ankylosis	Pensioner
5	8	Symptom-free	—	12	Ankylosis	Farmer (not doing heavy work)
6	4	Symptom-free	—	4	Ankylosis	Clerk (female)
7	4	Symptom-free	—	11	No activity, no ankylosis	Sempstress
8	4	Symptom-free	—	19	Ankylosis	Housewife

None of the patients exhibited local tenderness over the sacro-iliac joints. No abscesses and no open fistulae were observed.

The sacro-iliac tests were negative in all cases.

Six of the 7 patients were subjectively symptom-free. One patient (No. 4 in Table 2) experienced low back pain, but nothing noteworthy could be detected.

The erythrocyte sedimentation rate was elevated in one case (No. 8 in Table 2). This finding could not be accounted for.

Roentgenographically no signs of activity in the form of blurred structures with diffuse outlines were detected. Complete ankylosis, such as is seen in spondylarthritis anchylopoetica, did not occur. The articular slit was partly visible on the roentgenograms, ankylotic sections alternating with gaps. Irregular, markedly sclerotic areas were a typical feature. It should be borne in mind that sclerosis is typical of the reparative stage of bone tuberculosis.

The roentgenograms of the thorax showed no active lesions.

Fresh tuberculous foci had not developed in other sites.

Urinary culture on Löwenstein's medium revealed nothing noteworthy.

Five patients out of 7 were fit for work. Of those unable to work, one was pensioned on account of old age and the other lived in a home for disabled veterans. The sacro-iliac joints of both these patients were symptom-free.

DISCUSSION

The purpose of the present follow-up study was to analyse the results of radical operation and arthrodesis in the cases of sacro-iliac tuberculosis treated by this method at the Orthopaedic Hospital of the Invalid Foundation during the years 1950–1960.

Although the series is small, a follow-up study was considered to be of interest from the standpoint of evaluating the usefulness of operative treatment in the future.

The objective of operative evacuation of a tuberculous focus is to rid the organism all at once from the affected mass, including necrotic tissue, sequestrum and pus. This method of treatment has become possible thanks to the discovery of antibiotics.

Surgical treatment of the focus must, however, be preceded by antibiotic medication for about six weeks. There is still reason to remember the complications formerly threatening in the form of miliary tuberculosis and meningitis.

In connection with operative treatment the following aspects attract

most interest: 1) indications, 2) the need of arthrodesis, 3) the results of treatment, 4) mortality.

Radical excision with simultaneous transplantation of bone in order to cause ankylosis should be considered in all cases of tuberculous sacro-iliitis. As compared with other sites, the sacro-iliac joint is relatively easy of access, although with the reservation that it may be difficult to find all ramifications of the process, which sometimes extend far into the sacrum and the iliac bone. It is essential to establish the extension of the lesion with the aid of tomography prior to operation.

The aim should be to bring about arthrodesis. This is accelerated by packing the cavity with autogenous spongy bone.

Considerable attention should be paid to the post-operative treatment. Medication should be extended over a period of two years. The problems of resistance are probably the same in bone tuberculosis as in other forms of the disease, but no detailed analyses of this question have been published. An attempt was made to master these difficulties by combined treatment with several preparations.

In the present series the results of treatment were good. Ankylosis had developed in 6 out of 7 patients (85.7 per cent). All 7 patients were healthy.

No deaths occurred in combination with operation. Fatalities can certainly be avoided by careful consideration of the indications in each case. Thorough pre- and postoperative treatment is of fundamental importance.

SUMMARY

A series comprising 8 cases of tuberculous sacro-iliitis, treated by operative evacuation of the focus and arthrodesis, is surveyed. The operation was performed after six weeks' treatment with streptomycin, isoniazid and PAS. The period of observation varied between four and twelve years. Six patients out of 7 were symptom-free. One patient died of pulmonary tuberculosis. In all 7 cases the process had healed. Five patients were fit for work. Two were pensioned, one on account of old age, the other on account of a war injury.

Radical excision with simultaneous transplantation of bone should be considered in all cases of tuberculous sacro-iliitis. The sacro-iliac joint is easy of access. Accomplishment of arthrodesis is desirable and is accelerated by simultaneous bone transplantation. Ankylosis had developed in 6 cases out of 7. No fatalities occurred in connection with

the operation. The pre- and postoperative treatment is of fundamental importance.

RESUME

Une série comprenant 8 cas de tuberculose sacro-iliaque traités par évacuation opératoire du foyer et arthrodèse est examinée. L'opération a été pratiquée après un traitement de six semaines par la streptomycine, isoniazide et PAS. La période d'observation a varié entre quatre et douze ans. Six malades sur 7 n'ont aucun symptôme. Un malade est décédé de tuberculose pulmonaire. Dans tous les 7 cas, le processus a été guéri. Cinq malades ont été capables de travailler, deux ont été à la retraite, l'un par suite de son âge, l'autre en raison d'une blessure de guerre.

Une excision radicale avec transplantation simultanée d'os doit être prise en considération dans tous les cas de tuberculose sacro-iliaque. L'articulation sacro-iliaque est facilement accessible. L'accomplissement de l'arthrodèse est souhaitable et est accéléré par une transplantation osseuse simultanée. Une ankylose s'est développée dans 6 cas sur 7. Aucun incident fatal n'est intervenu en relation avec l'opération. Le traitement pré- et post-opératoire est d'une importance fondamentale.

ZUSAMMENFASSUNG

Eine Reihenfolge von 8 Fällen von tuberkulöser Sacro-Ileitis, die mittels Ausräumung des Herdes und Arthrodesis operative behandelt wurden, wird vorgestellt. Die Operation wurde nach einer sechswöchigen Vorbehandlung mit Streptomycin, Ioniazid und PAS, ausgeführt. Die Beobachtungszeit war zwischen vier bis zwölf Jahren. Von 7 Patienten waren 6 symptomfrei. Ein Patient war an Lungentuberkulose gestorben. Bei allen 7 Patienten war der Prozess abgeheilt. Fünf Patienten waren arbeitsfähig. Zwei Patienten waren pensioniert, der eine wegen seines Alters, der andere wegen einer Kriegsbeschädigung.

Radikale Excision zusammen mit Knochenverpflanzung sollte in allen Fällen von tuberkulöser Sakro-Ileitis erwogen werden. Das sacro-iliakale Gelenk ist leicht zugänglich. Erhaltung einer Arthrodesis ist wünschenswert und wird mittels gleichzeitiger Knochenverpflanzung beschleunigt. In 6 von den 7 Fällen kam es zur knöchernen Ankylose. Kein Todesfall trat in Verbindung mit der Operation auf. Die vor- und nachoperative Behandlung ist von grundstätzlicher Bedeutung.

REFERENCES

- Adams, J. C. (1961) Outline of Orthopaedics. 207. E. & S. Livingstone Ltd., Edinburgh and London.
- Bakalim, G. (1959) Low Back Pain and Tuberculosis. *Ann. Chir. Gynaec. Fenn.* **48**, 141.
- Brocher, J. E. W. (1949) Die Wirbelseulenleiden und ihre Differentialdiagnose. Georg Thieme, Stuttgart.
- De la Sierra Cano, L. (1956) Focal Treatment of Bone and Joint Tuberculosis. *Reconstr. Surg. Traum.* **3**, 107. S. Karger, Basel - New York.
- Horvat, M. (1956) Die operative Behandlung der Knochen- und Gelenktuberkulose unter dem Einfluss der modernen chemischen und antibiotischen Behandlungsmittel. *Widerher. Chir. Traum.* **3**, 135. S. Karger, Basel - New York.
- Roaf, R., Kirkaldy-Willis, W. H. & Cathro, A. J. M. (1959) Surgical Treatment of Bone and Joint Tuberculosis. E. & S. Livingstone Ltd., Edinburgh and London.
- Rollier, A. (1913) Über die Sonnenbehandlung der Knochen und Gelenktuberkulose. *Z. orthop. Chir.* **32**, 337.
- Solonen, K. (1957) The Sacroiliac Joint in the Light of Anatomical, Roentgenological and Clinical Studies. *Acta orthop. scand.* Suppl. 27.
- Seddon, H. I. (1940) Sacro-iliac Tuberculosis, *Brit. J. Surg.* **193**, 28.