FROM THE COAST SANATORIUM OF APELVIKEN, APELVIKSSTRAND, SWEDEN
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RESECTION OF THE KNEE-JOINT IN TUBERCULOSIS
RE-EXAMINATION OF 369 CASES

By

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Streptomycin, para-aminosalicylic acid and TB I (Conteben) have proved to be very useful in the treatment of tbc. This applies also to tbc of bones and joints, because the administration of these preparations has a favourable effect on fistulae and probably also on abscesses. It was therefore thought of interest to study the results obtained before the advent of chemotherapy and antibiotics. The investigation was carried out on tbc of the knee and limited essentially to resected joints, because in these cases treatment was fairly uniform and the diagnoses generally verified. Only 2 cases included in the present series have received chemotherapy: they are still undergoing treatment.

This series is one of the largest hitherto published on surgical treatment of tbc of the knee-joint. It was possible to draw statistical conclusions, especially as regards operative complications. Particular attention has been given to those factors capable of influencing the course of healing.

Definitions.

All ages given are to be understood as indicating the age at the time of operation.

Verified diagnosis is to be understood as tbc confirmed by histological examination of the operation specimen or by culture on synovia. The diagnosis was said to be certain when both clinical and roentgenological findings suggested tbc. Probable diagnosis is to be understood as clinically or roentgenologically suspected tbc. In all of the patients operated on, changes reported as tuberculous were observed.

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Ankylosis was said to be present as soon as distinct bridging trabeculae were oberved.

METHOD

The investigation was carried out on the basis of questionnaires. As many of the patients were living up to and over 1,000 kilometres away, personal interviews or re-examinations would have taken up too much time. It would seem, however, as if the information collected in this manner served the purpose of the investigation satisfactorily. Those patients in whom ankylosis was observed before, or on some occasion after they had left hospital were requested only to fill up the questionnaire, while the remainder were requested, in addition to this, to present themselves at the nearest hospital for roentgen examination of their knees. The roentgen films were then forwarded to the author.

Pre-operative roentgenographic classification was based essentially on the principles used by *Mortens*. Those cases in which foci were seen in the bone of the periphery of slightly involved or uninvolved articular surfaces were said to show "marginal destruction", those exhibiting slight erosion of the articular surfaces were classed under the heading "surface destruction" while those joints with deeper lesions were grouped as "deep destruction". The group "marginal destruction" was not subdivided.

Only sparse information was available regarding those patients who had died since discharge from hospital. Relatives, members of the hospital staffs and dispensaries and registration offices were often able to supply such information as date of death, direct cause of death, impairment of working capacity, stiffness of the knee and ability to walk.

Maximum sedimentation rate (SR) was said to be 10 mm for males and 22 mm for females. These figures are perhaps slightly higher than those generally given. Only SR measured within one month before operation were taken into account.

Judging by a perusal of the literature the observations published by *Blauel* 1904, *Mortens* 1948, *Sorrel & Sorrel-Dejerine* 1937 (henceforth abbreviated to *Sorrel*), and *Toumey* 1939, provide useful comparative figures that will be given in the following report. *Mortens'* thesis also contains an excellent review of the literature on tbc of the knee joint.

METHODS EMPLOYED AT THE COAST SANATORIUM OF APELVIKEN IN THE TREATMENT OF TUBERCULOSIS OF THE KNEE JOINT

As a rule the knee was resected in all certain cases, except in children, who were seldom operated on, and then only if it was thought that resection could be performed without damaging the epiphyseal line. Malposition was looked upon as a factor strengthening the indication for surgical interference. In adults synovitis clinically suggestive of the process being in the healing stage was said to contra-indicate resection. A poor general condition and/or an abundance of fistulae were also looked upon as contra-indications. Some patients refused resection.

Advanced age alone was not regarded as a factor contra-indicating surgery. Thus after 1931 only 9 of the 42 patients over 50 years of age were treated conservatively. Primary amputation was performed in 4 instances and resection in 29. (*Blauel* reported 1 case over 50 years of age, *Sorrel* 3, and *Mortens* none).

Progression or regression of the lesion in the knee had no definite influence on the indication for surgical intervention. Sometimes progression was even given as the reason for operation. In about half of the cases conservative treatment had preceded surgery. (*Blauel*: tbc of the knee joint, even progressive, indicates surgery. *Sorrel*: The affection must be well in the repair stage before operation. *Mortens*: Essentially the same principles as *Sorrel*'s. *Toumey*: Resection should be performed as soon as the diagnosis has been confirmed.)

Curettage, cautery, and puncture were measures often employed in an attempt to promote healing of fistulae and abscesses before operation. But neither fistulae nor abscesses were regarded as definitely contra-indicating surgery.

The age of the affection and SR values were apparently regarded as factors arguing neither for nor against surgical interference.

Resection was carried out on 2 patients 62 and 56 years old, who originally refused amputation. The former died after later amputation and the latter was released symptom-free 5 months after operation.

OPERATIVE METHOD

The operative method was uniform in 365 cases. Esmarch's bandage was applied around the thigh. The main incision was drawn along a curve proximal to the patella. The quadriceps was divided by diathermy and the bursa suprapatellaris was exposed before the joint was

Fig. 1.

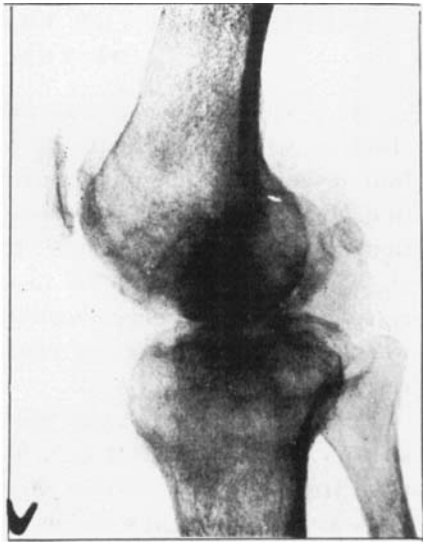

Fig. 2.

One month before operation.

opened. It was often necessary to chisel off the femoral insertion of the collateral ligaments to permit a good approach to the dorsal parts of the joint. Total synovectomy was performed and any abscesses were either curetted and cauterized with phenol + alcohol or, where possible, extirpated. The articular cartilage and a layer, a few millimetres thick, of the bone lamellae were then sawn off every articular surface of the joint and any persistent foci curetted. The ends of the bones were placed into position and fixed by means of thick catgut drawn through the occasionally chipped epicondyles, femur and tibia. The knee was then preferably fixed in a 5° flexion and 0-5° valgus position after one or more drains had been inserted in the operation wound. During the last ten years drainage was not employed, and apparently no disadvantage resulted from this. On the other hand, the records show that the insertion of drains was previously often followed by fistulation. The entire limb from the toes to the groin was fixed in plaster cut open in the front.

About 10 days after the operation the plaster was removed and the skin sutures withdrawn. The leg was then placed in a closed plaster cast from the ankle to the groin. The patient was instructed to support himself on the leg in order to obtain the best possible contact between the resected surfaces. As soon as the plaster cast was too large it was replaced by a new one, and after the swelling had subsided a leather

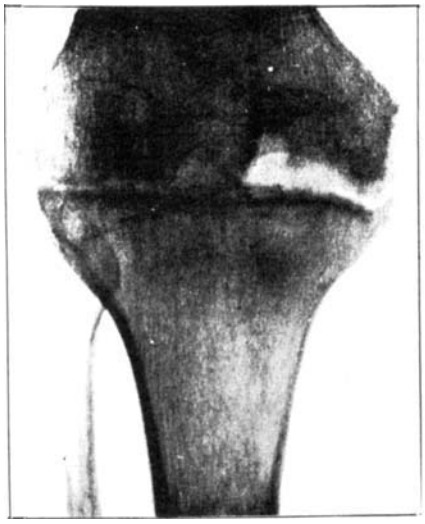

Fig. 3.

Fig. 4.

Five months after operation. Latero-dorsal bridging osseous trabeculae. Initial finding of curetted focus in the medial femoral condyle.

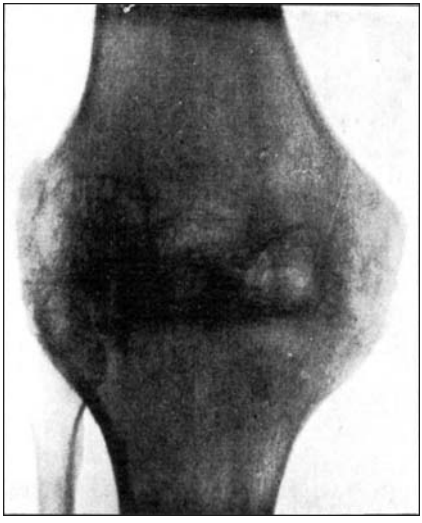

Fig. 5.

Fig. 6.

Eighteen months after operation. All the resected surfaces are united by osseous trabeculae. The focus in the medial femoral condyle is practically filled.

bandage was substituted for the plaster until ankylosis was roentgenographically confirmed.

(*Blauel, Mortens, Sorrel*: All employed essentially the same method although a thicker layer of bone lamella was probably removed from the articular surfaces. *Toumey*: Resection was minimal and the capsule and other soft tissue were not removed.)

POST-OPERATIVE BED REST

In uncomplicated cases the patients were confined to bed for 1-11 weeks (average 4.5 weeks), (*Blauel* reports 15 days, *Mortens* 6 weeks, *Toumey* 8 weeks and *Sorrel* 3 months. These figures seem to be dogmatic). In complicated cases bed rest of a varying period up to 96 weeks (average 8.7 weeks) was noted.

TABLE I

Postoperative bed rest (only survivals).

Bed rest in weeks	< 16 years				16-49 years				> 50 years				Total
	Uncomplicated course		Complicated course		Uncomplicated course		Complicated course		Uncomplicated course		Complicated course		
	M	F	M	F	M	F	M	F	M	F	M	F	
1- 2	2	—	—	1	1	1	3	1	—	—	—	1	10
3- 4	2	3	—	2	53	31	26	14	2	3	4	1	141
5- 6	8	2	2	2	26	20	21	25	4	3	2	2	117
7- 8	—	1	—	—	7	6	13	10	—	1	3	—	41
9-10	—	—	—	3	4	1	4	4	—	—	—	—	16
11-12	—	—	1	—	—	1	1	2	—	—	—	—	5
> 12	2	—	—	—	—	—	13	5	—	—	2	3	25
Total	14	6	3	8	91	60	81	61	6	7	11	7	355

Small fistulae and hematomatic openings did not prolong bed rest. Of the 25 patients who were confined to bed more than 12 weeks postoperatively, 4 were treated simultaneously for other tuberculous foci of the skeleton and 22 developed serious complications.

Arthroplasty.

Combined arthroplasty and resection was tried in four instances, all before 1936. In 1 case ankylosis was not established 17 years postoperatively and in 2 fusion was established after 2 years. In the fourth case ankylosis could not be dated. The results were therefore not encouraging.

Anesthesia.

Ether by the open method was applied in 229 cases, spinal anesthesia in 127 and combined anesthesia, mainly spinal + ether, in 10. As to the remaining cases, information about the type of anesthesia is unavailable. Ether anesthesia was regarded as less suitable, because movement of the patient when awakening might disturb the apposition of the resected parts. Furthermore, the use of ether in connexion with diathermy involves the risk of explosion of the gases. During the last 10 years practically only spinal analgesia has been employed.

The Series.

From the beginning of 1928 until the beginning af 1949 altogether 370 cases of tbc of the knee joint were treated *surgically* at the coast sanatorium of Apelviken: 1 with curettage of the patellar focus (see appendix) and 369 with resection (*Blauel* 400, *Toumey* 223 in 222 patients, *Sorrel* 120, *Mortens* 42). Primary amputation of the thigh was performed on 26 occasions. Solely *conservative* treatment including excision of juxta-articular foci was given in altogether 197 cases. All of these patients were treated after 1931. The reason why older cases were not included was that they could not all be traced with certainty. During this time 284 knee joints were resected. In altogether 593 cases of tbc of the knee joint, 347 (58.5 per cent) were seen in males.

In 11 patients the affection was bilateral: in 4 of them only one of the knee joints was resected and in 1 one thigh was amputated.

The number of affected knee joints was 604, of which 267 (44.2 per cent) were right-sided, and 337 (55.8 per cent) left-sided (*Mortens* 55.3 per cent left-sided). This difference was due practically entirely to the right and left distribution of arthritis among the men. Only among the males was the difference statistically significant: right 144 (40.6 per cent) left 211 (59.4 per cent). Judging by the statistical reports available in the literature, tuberculous genetis seems to show a predilection for males (*Mortens*). A possible explanation of this fact is that the heavier work, generally carried out by males, can perhaps favour the manifestation of arthritis. Among right-handed individuals the left leg is generally called upon to stand more strain than the right (*Ingelmark* 1943) and therefore the left knee is probably subjected to greater stresses.

Of the resected cases, 214 were males and 155 females. The average age was 29.5 years (*Mortens* 24.9 years).

Among the patients operated on, 10 were foreigners, 3 women and 7 children. The remaining patients were from different parts of Sweden, mainly from the north and from the middle of the country.

All the 348 patients released from hospital without having been subjected to amputation were requested to fill up and return the questionnaire. In this manner information was obtained in respect of 329, 55 of whom had in the meantime died. Of the other 19 or 5.5 per cent (*Blauel* 3.7 per cent, *Mortens* 0 per cent, *Toumey* 8.1 per cent) 9 were foreigners.

The diagnosis was verified in 284 (77.5 per cent) cases (*Mortens* 78.6 per cent, *Toumey* 65.5 per cent), of which 265 were confirmed by histological examination, 17 by guinea-pig inoculation, 1 by culture, and 1 by demonstration of tubercle bacilli in direct preparations. Biopsy specimens were removed pre-operatively in 39 cases. The diagnosis was regarded as certain in a further 82 (22.2 per cent) cases (*Toumey* 14.3 per cent) of which 34 showed fistulae before or after operation and 36 had manifest tuberculous foci elsewhere in the organism. In 3 instances the diagnosis was regarded as probable.

In 5 patients arthritis had healed before operation, which was performed solely to correct the malposed joint.

Of the 295 cases where information was available, 1 had been followed up post-operatively for 1 year, 29 for 1-4 years, and 53 for 5-9 years and 212 for 10-22 years (*Blauel* 1-27 years, *Mortens*, 11-25 years, *Toumey* 1-17 years). During the forties the number of knee joint resections decreased considerably owing to the markedly decreased incidence of tbc of the knee joint.

The age-distribution of the 369 resected cases was (deaths during hospitalization are given in brackets): 93 aged 10-20 years, 136 (6) aged 21-30 years, 70 (3) aged 31-40 years, 37 (3) aged 41-49 years and 26 (1) aged 50-60 years and 7 (1) 61-70 years (*Blauel* 24 under 6 and 187 under 16 years. *Mortens* 42 aged 5-41 years, *Toumey* 222 aged 5-over 30 years).

Amongst the 369 resected cases the lungs of 199 (54 per cent) were examined roentgenologically before operation. Pulmonary tbc was observed in 50 cases (13.6 per cent, *Blauel* 7.3 per cent severe pulmonary tbc, *Mortens* and *Toumey* 9.5 per cent).

For purposes of comparison the records of *197 cases, treated conservatively*, were examined. There were 93 children, 55 boys and 38 girls. The remainder consisted of 95 adults between 16 and 49 years of age (57 men and 38 women) and 9 (4 men and 5 women) over 50 years old. Thirty-two (16.2 per cent) died in hospital during treatment: 11 per cent of the children, 19 per cent of the adults under 50 years of age and 44 per cent of the adults over 50 years. The cause of

death was either meningitis or miliary tbc in 15 cases, pulmonary tbc in 5, skeletal tbc in 3, tbc elsewhere in the body in 5 (pleuritis, peritonitis, pericarditis and renal tbc) and cardial weakness in 3 and lung embolism in 1. The diagnosis was verified in 72 (36.6 per cent) cases: by biopsy in 32, guinea-pig inoculation in 38 and growth on substrate in 2. The average time of hospital treatment for the adults was 1.2 years for the men and 1.13 years for the women, for boys it was 2.48 years and for girls 2.42 years. These cases were not followed up after they had left hospital.

The 26 primary amputations of the thigh were performed on 2 boys and 3 girls, 13 men and 4 women under 50 years of age and 1 man and 3 women over 64. The diagnosis was verified in 11 cases and regarded as certain in the remaining 15, in 13 of which fistulae were seen pre-operatively. Operative complications were recorded in 13 cases: fistulae in 7, ruptured sutures in 2, hemorrhage in 1, secondary infection in 2, pleuritis (6 weeks post-op.) in 1. Of the patients subjected to amputation 9 (34.6 per cent) died: 4 within 14 days and 4 more (from pulm. tbc) within 4 months. A 65-year-old woman died of cardiac incompensation 11 months after amputation. Of the surviving 17, healing was recorded in 13 cases. Three of the patients had persistent fistulae when they left hospital and in 1 the stump was somewhat swelled. The average hospitalization was 1.9 years.

Amputation after resection was performed on 6 men and 4 women (2.7 per cent, *Blauel* gives 5.7 per cent, *Mortens* 7.1 per cent, *Sorrel* 2.5 per cent). Five of these 10 were 16-49 years old, the other 5 being over 50. The indications for amputation were vital in 4 patients, 3 of whom were over 50 years old. All had fistulae before resection. Primary amputation was considered in the treatment of 4 patients, 2 of whom died later, and amputation was recommended in 1 case. Three of these 10 patients died: 1 from meningitis, 1 from sepsis, starting from a fistula, and 1 from cardiac insufficiency and cachexia. The ages at death were 22, 51 and 62 years respectively.

The interval between resection and amputation was less than 3 months in 4 cases, 3-6 months in 4 cases, 10 months in 1 case, and 13 months in 1 case.

OPERATIVE FINDINGS

Apart from the abscesses (see below) none of the groups of findings given in table II seem to be predisposing factors for complications.

Operative complications (Table III).

Although the fistulae usually healed within a few months they were nevertheless classed as serious complications except in one instance in which the patient had a fistula that healed quickly after the operation. Pleuritis was recorded 2-4 weeks after operation. The patient with advancing pulmonary tbc and operated on under lumbar anesthesia died 6 months later at another sanatorium. The paresis of

TABLE II

Findings at operation.

	< 16 years				16-49 years				> 50 years				Dead		
	Normal		Complications		Normal		Complications		Normal		Complications		16-49 years		> 50 years
	M	F	M	F	M	F	M	F	M	F	M	F	Normal	Complications	Complications
Abscess	2	1	—	3	20	4	31	19	1	—	9	3	1	6	1
Destruction of cartilage															
Slight	—	1	—	—	16	7	16	3	1	—	3	—	—	1	—
Moderate	2	—	—	3	19	13	9	11	2	1	1	3	1	2	—
Extensive	8	3	—	4	20	21	28	26	1	2	2	2	—	3	1
Total	3	2	2	1	15	9	18	7	2	1	4	1	1	1	—
Adhesions	1	—	1	—	—	—	—	1	—	—	—	—	—	—	—
Not stated					23	11	16	17	—	3	2	2	—	3	1
Bone lesions in articular surfaces															
1-2	6	1	—	2	35	24	36	23	6	3	6	6	2	4	1
Several	5	4	1	4	35	23	33	24	5	2	4	—	—	2	—
Bone lesions outside articular surfaces															
1-2	—	1	1	2	23	19	21	17	—	—	1	4	2	2	2
Several	—	—	—	1	6	1	8	6	—	1	—	—	—	1	—
Nr. of cases	14	6	3	8	93	61	87	65	6	7	12	8	2	10	2

The total number of cases is accounted for only in the group "destruction of the cartilage". As to the cases missing in the other 3 main groups information as regards abscesses and skeletal lesions is unavailable.

TABLE III

Complications at operation.

Complication	< 16 years				16-49 years				> 50 years				Dead			
	Slight		Serious		Slight		Serious		Slight		Serious		16-49 years		> 50 years	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Fistula	—	—	2	6	1	—	54	39	—	—	8	6	5	2	1	1
Fistula + sec. infection	—	—	—	—	—	—	1	2	—	—	2	2	—	—	—	—
Abscess	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—
Pleuritis	—	—	—	—	—	—	1	(1)	—	—	—	—	1	—	—	—
Shock	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—
Hematoma	—	—	—	1	11	2	—	—	1	—	—	—	—	—	—	—
Hematoma + sec. infection	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Progression of *pulm. tbc.*	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Necrosis in wound	—	—	—	—	5	5(1)	1	2	—	—	1	—	—	—	—	—
Wound rupture	—	—	—	—	—	1	4	1	—	—	—	—	—	—	—	—
Sec. infection of wound	—	—	—	—	1	—	1	5	—	—	—	—	—	1	—	—
Unusual swelling	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Unusual increase in temp (2 weeks)	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Paresis of fibularis	—	—	—	—	—	—	(1)	—	—	—	(1)	—	—	—	—	—
Hemorrhage	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—
Pseudo-arthrosis	—	—	—	—	—	—	—	1(1)	—	—	—	—	—	—	—	—
Fracture at op. or mobilization	—	—	1	—	—	—	(1)	3	—	—	—	—	—	—	—	—
Postop. *eczema*	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—

The bracketed figures indicate the number of patients with an additional complication accounted for further up in the table but without brackets. None had more than 2 complications.

the fibularis seen in 2 instances practically disappeared 1½ years after operation. When questioned 12 years and 18 months after operation both patients disclaimed trouble from the paretic symptoms. Of the 5 fractures 3 occurred on flexion of the knee at operation and 2 in connection with attempted mobilisation after arthroplasty. All the fractures healed. Post operative eczema soon disappeared and was probably a reaction of the skin to iodine.

Complications occurred in 183 (49.6 per cent) cases. Post operative fistulae were recorded in 123 (33.3 per cent, *Mortens* 28.6 per cent, *Sorrel* 8.7 per cent, *Toumey* 35.7 per cent) and healed before release of the patients from hospital except in 10 or 2.7 per cent (*Blauel* 7.3 per cent, *Toumey* 10.7 per cent after 1 year). Complications occurred in 47.4 per cent of the men and in 31.8 per cent of these cases the complication consisted of fistulae, the corresponding figures for the women being 52.3 per cent and 35.5 per cent.

It would have been interesting to know whether the tuberculous affection was in the active, quiescent or regressive stage at the time of operation, but as most of the patients were operated on early—two thirds within 4 months after admission—(table V) and as the hospital records in the other cases were not informative in this respect, this was not possible. The SR recordings in 170 males and 133 women (table VII) were to a certain extent useful in this respect.

Factors possibly increasing the frequency of complications were: extensive roentgenological changes, advanced age, short pre-operative illness, short duration of treatment, fistulae and abscesses, tuberculous foci elsewhere in the body and increased SR.

Pre-operative roentgenography.

Marginal destruction was seen in 135, superficial destruction in 93, deep destruction in 137, no destruction except for decalcification in 4. The frequency of the complications was roughly equal in all 4 groups, that of superficial destruction possibly being slightly higher. The difference found on comparison with the other groups was less than twice the mean error.

Age seemed to be of subordinate importance in the development of complications. Of 33 patients over 50 years, subjected to resection, 20 (60.1 per cent) developed complications. The difference between this frequency and that in the remainder of the series (48.5 per cent) was only 1.3 times the mean error.

Hence, nothing indicates that patients over 50 years of age are less suitable for resection (cf. *Blauel* and *Sorrel*).

The duration of illness before operation is compared with the post-operative complications in table IV. (*Toumey* 6.5 years). The dispersion among the complicated cases is about 4.8 years and for the remainder 6.3 years. The difference between the medians, 4.35 and 5.29 years respectively, is 0.94 year and the mean error is 0.58 year, so that the difference is 1.7 times the mean error. Complications were

TABLE IV

Average duration of disease in years before operation.

Age at op.	Uncomplicated course		Comclicated course, total		With postop. fistula		Average
	M	F	M	F	M	F	
< 16 years	7.1 (14)	6.2 (6)	5.8 (3)	5.3 (8)	3.0 (2)	5.2 (6)	6.34 (31)
16-49 „	4.5 (93)	5.4 (61)	3.8 (87)	5.5 (65)	4.1 (55)	5.6 (41)	4.69 (306)
> 50 „	11.8 (6)	4.9 (7)	2.3 (12)	2.3 (8)	1.9 (10)	2.3 (8)	4.58 (33)
Average	5.2 (113)	5.4 (74)	3.7 (102)	5.1 (81)	3.7 (67)	5.0 (55)	4.82 (370)

The bracketed figures given under every average indicate the number of patients in the group. One case with a postoperative fistula is not included because it was observed pre-operatively and healed quickly after the operation. The case with patellar lesions is included in the table.

recorded in 61 (58.7 per cent) of the 104 patients who had been ill for less than 2 years pre-operatively. Of the remaining 265 cases complications were seen in 122 (46 per cent). The difference is about 2.2 times the mean error. The frequency of fistulation was 0.5 times the mean error larger among those who had had the disease for less than 2 years.

Hence, the risk of complication was possibly slightly larger among those with a pre-operative illness of less than 2 years than among the remainder.

The frequency of complications in relation to *the duration of treatment before operation* is given in table V. The complicated cases were treated on an average for 4.9 ± 0.5 months and the remainder for

4.3 ± 0.4 months pre-operatively. Hence, no significant difference. The frequency of complications in the 189 patients operated on within two months after admission was 51.3 per cent; the corresponding figure for the 180 operated on after a longer hospitalization was 47.8 per cent.

TABLE V

Pre-operative care and post-operative course.

Hospitalization in months	< 16 years				16-49 years				> 50 years				Total
	Uncomplicated course		Complicated course		Uncomplicated		Complicated course		Uncomplicated course		Complicated course		
	M	F	M	F	M	F	M	F	M	F	M	F	
0- 2	8	1	2	3	50	27	46	31	2	4	9	6	189
3- 4	1	1	—	—	13	14	9	12	1	3	1	1	56
5- 6	1	1	—	2	12	9	9	3	2	—	1	1	41
7- 8	2	1	—	—	2	5	4	5	—	—	—	—	19
9-10	—	2	—	—	1	—	7	2	—	—	—	—	12
11-12	1	—	1	3	4	—	2	5	—	—	—	—	16
> 12	1	—	—	—	10	6	10	7	1	—	1	—	36
Total	14	6	3	8	92	61	87	65	6	7	12	8	369

In the present series the duration of hospital treatment before operation had no demonstrable influence on the frequency of complications.

Fistulae open at operation, were seen in 27 (7.3 per cent) patients (*Mortens* 12 per cent, *Toumey* 6.8 per cent). Post-operative complications in the form of infections or persistent suppuration were noted in 19 (70.4 per cent) of them.

The difference in the frequency of complications between those with and those without fistulae is not statistically significant (twice the mean error).

The frequency of complications in the 96 patients with *abscesses seen at operation* is given in table VI. Patients with abscesses in the fossa intercondyloidea (2 cases) are not included. The table comprises only cases in which the abscesses were completely or partially extra-articular but in communication with the joint. Only a few of them were diagnosed before operation.

TABLE VII

Tuberculous lesions elsewhere. Complications and S.R.

Age	Nr of tuberculous lesions elsewhere	Slight complications				Fistula				Other serions complications				No complications			
		Normal S.R.		Increased S.R.		Normal S.R.		Increased S.R.		Normal S.R.		Increased S.R.		Normal S.R.		Increased S.R.	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	0	—	—	—	—	1	2	1	2	1	1	—	—	6	1	1	3
< 16 years	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	2	1
	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
	0	7	2	5	4	9	4	10	11	1	4	2	3	42	21	18	11
	1	2	—	1	1	6	4	11	8	1	1	4	2	7	7	5	7
16-49 years	2	1	—	1	—	—	2	3	3	1	—	—	1	1	1	2	2
	3	—	—	—	—	—	—	1	1	—	—	—	—	1	4	—	1
	Several	—	—	—	—	1	—	2	—	—	1	—	—	—	—	—	—
	0	—	—	—	—	1	1	2	5	—	—	1	—	1	2	—	3
> 50 years	1	—	—	1	—	—	—	5	2	—	—	—	—	1	—	—	—
	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Several	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Total		10	2	8	5	18	14	35	33	4	7	7	6	59	36	29	30
			(6)				(22)				(6)				(33)		

The bracketed figures denote the number of cases with unknown S.R. in the respective groups.

TABLE VI

Abscesses observed at operation. Complications and sedimentation rate.

	Increased S. R.				Unknown S. R.				Normal S. R.			
	Fistula	Other complications		No complications	Fistula	Other complications		No complications	Fistula	Other complications		No complications
		Seri.	Slight			Seri.	Slight			Seri.	Slight	
Males												
< 16	—	—	—	—	—	—	—	1	—	—	—	1
16-49	12	3	2	5	5	2	—	4	8	—	2	11
> 50	5	1	1	—	2	—	—	—	—	—	—	1
Females												
< 16	2	—	—	—	—	—	—	—	1	—	—	1
16-49	10	—	—	1	4	—	—	3	3	2	—	—
> 50	3	—	—	—	—	—	—	—	—	—	—	—
Total	32	4	3	6	11	2	—	8	12	2	2	14

Among these cases the risk of complications in general and the risk of post-operative fistulation were established with a wide margin of accuracy. The risk of complications was significantly greater among patients with increased SR.

The frequency of complications related to tuberculous foci other than in the knee is given in tables VII and VIII. Of the 135 (36.6 per cent) patients (*Mortens* 14.3 per cent, *Toumey* 20.7 per cent) that had multiple tbc, 83 (61.5 per cent) had complications. Of the remaining 234 in whom only tbc of the knee was seen, 100 (42.7 per cent) developed complications. Serious complications in the form of fistulae were observed in 60 (44.4 per cent) with multiple tuberculous foci and in 62 (26.5 per cent) of the remainder.

The risk of complications in such cases is significently increased.

In patients with multiple tbc the risk of complications in general and the risk of fistulation post-operatively was not significantly higher when SR was increased than when it was normal, the difference being only somewhat more than twice the mean error.

The frequency of complications in those 50 cases with co-existent pulmonary tbc was not definitely greater than in those 85 with multiple tuberculous foci but not in the lung. The difference was 1.9 times the mean error. Of the 21 patients with pulmonary tbc and increased SR 18 developed complications, and of the 14 with normal SR complications occurred in 8.

TABLE VIII

Tuberculous lesions in organs other than the knee (135 cases).

Organ	Males		Females		Total number of lesions
	Number	Complicated course	Number	Complicated course	
Lungs	25	18	25	16	50
Kidneys + sex organs	8	5	8	3	16
Glands	8	7	6	4	14
Tendon sheaths	2	1	1	—	3
Eyes	1	1	3	—	4
Pleura	3	3	4	4	7
Peritoneum	—	—	1	1	1
Skin	3	3	2	—	5
Vertebral column	15	25	17	13	32
Ankle	3		4		7
Sacro-iliac joint	5		2		7
Elbow	4		3		7
Hand	2		4		6
Wrist	3		3		6
Ribs	5		1		6
Tarsus	4		2		6
Contralateral knee	3		1		4
Hip	3		1		4
Trochanter	2		1		3
Shoulder	2		—		2
Lower arm	—		1		1
Femoral diaphysis	1		—		1
	102	53	90	41	192

The influence of the localization of other tuberculous foci in the body on the risk of complications in patients with multiple tuberculosis was not analysed.

The importance of the pre-operative SR readings was discussed in connection with the description of the abscesses found at operation and together with multiple tbc. Of the 303 patients whose records were informative in this respect the SR was increased in 153 and normal in 150 (table XII). Among the former, complications occurred in 94 (61.4 per cent) and in 55 (36.7 per cent) of the latter. The difference is statistically significant. If the number of patients with pre-operatively observed factors (fistulae and multiple tbc) favouring complication be subtracted from these 303, the corresponding figures would be 76 with increased SR and 102 with normal SR, with complications in 42 (55.3 per cent) and 32 (31.4 per cent) respectively. *This difference too is statistically significant.*

The following factors played no manifest part in the occurrence of complications: considerable roentgenological changes, advanced age (over 50 years) and shortness of pre-operative treatment. *Probably* the development of complications was favoured by fistulae present before operation and when the duration of the disease was less than 2 years, before operation. Factors *definitely* favouring the occurrence of complications were: abscesses found at operation, multiple tbc (probably pulmonary tbc in particular) and increased SR before operation. In patients with abscesses, and probably also in those with multiple tbc, any co-existent increase in the SR favoured complications.

MORTALITY

Fourteen patients (3.8 per cent) died during the period at hospital when resection was performed (*Blauel* 1.7 per cent, *Mortens* 4.8, *Sorrel* 1.7 per cent). Eight (3.7 per cent) were men and 6 (3.9 per cent) were women. Only 2 (0.5 per cent) possibly 3 (0.8 per cent) died as a direct result of the operation:

1. A 43-year old woman with a history of 22 months was operated on under spinal anesthesia. Shock developed 18 hours post-operatively and the woman died 6 hours later. Autopsy showed chronic myocarditis and pleural empyema.

2. A 49-year-old man with a history of 1 year was operated on under spinal anesthesia. Post-operative shock occurred and, for 2 weeks, was followed by signs of cardiac incompensation. He died with hemoptysis 9 weeks post-operatively without having left his bed since the operation. Autopsy showed pulmonary tbc to be responsible for the hemoptysis. The heart was hypertrophic.

3. A 35-year-old woman with tbc manifest only in the knee at the time of operation. The post-operative course was uneventful and she left her bed at least 52 days after operation. Death from tbc meningitis occurred 3 months post-operatively. It is uncertain whether the operation can be held responsible for the development of meningitis in this case.

The remaining 11 deaths occurred more than 3 months post-operatively (tables II and III). The 2 patients over 50 are included together with those whose one leg was amputated secondarily. The remaining 9 patients were 21-49 years of age. The direct causes of death were: meningitis tbc 3, pulmonary tbc 3, tuberculous endometritis with fistulae 1, cardiac insufficiency 1, sepsis from bedsore after pneumonia 1. The post-operative hospitalization of these 11 patients varied from 4 to 23 months (average 7 months).

Of the 14 patients who died fistulation was seen pre-operatively in 4 and post-operatively in 9. All 14 had manifest tuberculous foci in other parts of the body. In 13 of them the foci were seen pre-operatively. Pre-operatively the SR increased in 8, was not known in 4, and was normal in 2, 1 of whom—a woman—had a border SR value of 22 mm. per hour. Pre-operative care varied from 0 to 16 months, the average being 4.3 months (cf. table V). The duration of illness before operation varied from 2 to 117 months, average 22 months (table IV). Age at death varied between 21 and 62 years (average 36.1 years).

TABLE IX

Mortality after discharge from hospital.

Cause of death	Known tbc at time of operation (elsewhere in organism)						Only tbc of the knee at time of operation		Total
	Lungs		Kidneys		Skeleton				
	M	F	M	F	M	F			
Pulm. tbc	4	5	—	—	1	1	4	—	15
Renal tbc	1	1	2	2	2	—	—	—	8
Meningitis + miliary tbc	1	2	—	1	1	—	—	—	5
Skeletal tbc	—	—	—	—	1	—	—	—	1
Salpingitis tbc	—	1	—	—	—	1	—	—	2
Peritonitis tbc	—	—	—	—	1	—	—	—	1
Tbc (sites not stated)	1	—	—	—	1	—	1	—	3
Not tbc	1	—	—	—	3	2	10	2	18
Unknown	—	1	—	—	1	—	—	—	2
Survival in years									
<1	3	2	—	—	2	—	—	—	7
1-2	2	1	—	—	1	—	2	—	6
3-4	1	3	—	2	—	2	1	—	9
5-6	—	—	2	—	5	1	1	—	9
7-8	1	—	—	—	1	—	3	—	5
>9	1	3	—	1	2	1	8	2	18
Unknown	—	1	—	—	—	—	—	—	1
Total	8	10	2	3	11	4	15	2	55

One patient died of cerebral hemorrhage. As he had definite renal tbc when released from hospital he has been included under this diagnosis.

In 55 (16.7 per cent) of the 329 cases traced after release from hospital the patients had died (*Blauel* 15.8 per cent, *Mortens* 11 per cent, *Toumey* about 6 per cent). The cause of the death and the post-operative survival in years will be apparent from table IX. Tbc was the direct cause of death in 35 (10.6 per cent) cases (*Blauel* about 15 per cent, *Mortens* 5.5 per cent). Post-operative survival varied from 5 months to 20 years (average 6.7 years). Of the 50 patients with mani-

fest pulmonary tbc before operation information was available regarding 47, of whom 27 (57.4 per cent) died post-operatively, tbc being the cause of death in 22 (47 per cent). Six of them died at the hospital. Information was available in respect of 82 of the 85 patients with multiple tbc without manifest pulmonary foci. Of these 25 (30.5 per cent) died post-operatively, 17 (20.7 per cent) from tbc. Three of them died at the hospital. The frequency of death from tbc within the period in question was significantly greater (more than three times the mean error) among those with multiple tbc including pulmonary foci than among those with multiple foci but not in the lungs.

After leaving hospital, 30 (24 per cent) of the 125 patients with multiple tbc died from tbc, the corresponding figures for the remaining 204 being only 5 (2.5 per cent). The difference in the risk of death from tbc between these 2 groups was 6 times the mean error.

Mortality after release from hospital was greater among those with multiple tbc, particularly when the lungs were involved, than among those with manifest foci in the knee only.

NEW TUBERCULOUS LESIONS AFTER RELEASE FROM HOSPITAL

Of the 329 traceable cases in which amputation was not performed new foci had developed in 52 (15.8 per cent). See table X. Of the 204

TABLE X

New tbc lesions after release from hospital.

		< 16 years		16-49 years		> 50 years		Total
		M	F	M	F	M	F	
	Total	1	2	9	3	1	—	16
Pulm. tbc	Hospitalized	1	—	9	2	1	—	13
	Deaths	—	1	5	—	1	—	7
	Total	1	—	6	1	1	1	10
Renal tbc	Hospitalized	1	—	6	1	1	1	10
	Deaths	—	—	2	—	1	—	3
	Total	1	—	5	4	1	—	11
Skeletal tbc	Hospitalized	1	—	5	4	1	—	11
	Deaths	—	—	—	1	1	—	2
Meningitis and miliaris. Died in hospital		—	—	2	2	—	—	4
	Total	—	—	2	9	1	—	12
Tbc elsewhere	Hospitalized	—	—	—	7	1	—	8
	Deaths	—	—	2	2	—	—	4
Total no. of patients		3	2	24	18	4	1	

There were 53 new foci in 52 patients, 43 of which were treated in hospital and 20 died, 19 from tbc.

patients who had manifest tbc foci only in the knees at the time of operation, 31 (15.2 per cent) developed new foci; this was also the case in 21 (16.8 per cent) of the remaining 125 patients. In the former group there occurred 5 (16.1 per cent) deaths from tbc and in the latter 14 (66.7 per cent). The risk of new tuberculous manifestations was not significantly greater among those with multiple tbc before operation than among the remainder. On the other hand mortality from tbc was statistically greater among those with multiple foci than for the others in the event of new tuberculous manifestations.

Recurrences indicating surgical interference were recorded in 2 men, 26-29 years old (table XI). In one case a skeletal focus was curetted 3 years post-operatively. Since then—9 years—he has been symptom-free. In another, a small abscess was incised and healed 11 months post-operatively. When last seen 4½ years post-operatively the patient disclaimed symptoms. A third case, a 40-year-old man, was roentgenographed 3 years after operation and an almond-sized focus was suspected in the line of resection. He wears no bandage and is symptom-free. The joint is ankylotic.

In 9 patients, 5 men and 4 women, the operated knee began to fistulate after release from hospital. In 6 cases the fistulae were open for 1-4 months and in 3 cases 3-4 years. In one of the latter arthroplasty was performed in connexion with the resection, and the joint is still loose.

Complaints after release from hospital (Table XI).

Many said that they did not find the stiff leg troublesome, some were able to go ski-ing, play tennis, drive a car etc., although women doing household work and men occupied as lumberers in winter found the stiff joint a nuisance.

Sixty-two (21.2 per cent) claimed symptoms. Of the 3 with open fistulae 2 died 11 and 7 years, respectively, after the operation. The third patient, a 59-year-old woman, reported 4½ years after the operation that the fistulae had practically healed.

Persistent pain was reported by 3 patients. Pseudoarthrosis was seen in the roentgenogram of a 38-year-old woman with a history of one year and with tbc of the knee only at the time of the operation. The joint is said to be steady. In the other 2 there was ankylosis and no skeletal tuberculous foci could be detected. The cause of the pain is obscure. One of them is imbecile. In addition to the case just mentioned pseudoarthrosis formed in a 45-year-old man with 41 years' history, manifesting tbc in the knee only. He was operated on a little

TABLE XI

Troubles after release from hospital.

Trouble	Condition on release from hospital																						Total nr. of pat.
	< 16 years						16-49 years										> 50 years						
	Fist.		Ankylos.		No ankyl.		Fist.		Swelling		Ankylos.		No ankyl.		Unknown		Fist.		Ankylos.		No ankyl.		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
Fistula, healed within ½ year	—	—	—	—	—	—	3	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—	3
„ „ „ 1 „	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	1	—	—	—	1	—	2
„ „ later	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2
„ not healed	—	—	—	—	—	—	1	1	—	—	1	—	—	1	—	—	—	1	—	1	—	—	3
Pain, brief	—	—	1	1	—	—	—	2	—	—	7	5	7	1	2	—	—	—	2	1	—	1	28
„ persistent	—	—	—	—	—	—	—	—	—	—	1	1	—	1	—	—	—	—	—	—	—	—	3
Swelling, brief	—	—	—	—	—	—	1	1	—	—	7	2	8	3	3	—	—	—	3	—	1	—	27
„ persistent	—	—	—	—	—	—	—	1	—	—	1	3	—	1	—	1	—	—	—	—	—	—	6
Loose joint	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	2
Recurrence. Osteitis or abscess.	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	2
Fistula after release	—	—	—	—	—	—	—	—	—	—	2	1	3	3	—	—	—	—	—	—	—	—	9
No symptoms	—	2	6	5	6	3	4	7	—	1	61	49	47	29	4	5	—	—	5	6	3	2	231
Unknown	—	1	4	5	—	—	2	4	—	1	9	10	12	4	3	3	—	—	1	—	1	—	52
Still undergoing treatment	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	1	3

Many of those who had trouble after the operation had various symptoms so that they are accounted for in several columns of the table (25 cases).

more than a year ago. As the pseudoarthrosis was unknown when the patient left hospital, the case has not been included in table III. This also applies to a 16-year-old girl with tbc manifest in the knee only. The loose joint is the only trouble she now has, 6 years after operation. In a fourth case pseudoarthrosis was seen in combination with fistulae, 1 year post-operatively, for which reason the leg was amputated.

Of the 3 still undergoing treatment 1 is a 35-year-old woman with spondylitis involving several vertebrae and with renal tbc seen after operation. Post-operatively she had fistulae which did not heal definitely until treated with streptomycin. The joint is not ankylotic. The other 2 patients, 55 and 68 years old respectively, were operated on 18 months ago. In the younger one, a woman, the margin of the wound became necrotic; later secondary infection and fistulation occurred but responded favourably to streptomycin. The joint is now clinically but not roentgenologically ankylotic. The other patient, a man, had fistulae post-operatively but they healed spontaneously. The knee has not yet become ankylotic but, when bandaged, is painless. The surfaces of the resected part are separated by a diastasis of about ½ centimetre. All 3 of the above patients have left hospital.

Of the 52 classed as unknown in table XI, 32 have died.

Patients' opinion of operation results were given by 272 (table XII).

TABLE XII

Patients' (272) opinion of the result of the resection (figures are percentages).

Age at op.	Excellent 69,9		Good 29,4		Poor 0,7		No of cases	
	M	F	M	F	M	F	M	F
< 16 years	84.6	33.3	15.4	66.7	—	—	13	3
16-49 „	77.2	62.2	22.1	36.7	0.7	1.0	136	98
> 50 „	40.0	75.0	60.0	25.0	—	—	10	12
Average	75.5	62.8	23.9	36.3	0.6	0.9		

The men were possibly somewhat more satisfied with the results than the women were. The difference is, however, not statistically significant.

Post-operative use of bandage was reported by 160 men and 116 women no longer undergoing treatment: 22 men and 16 women had worn a bandage less than ½ a year and likewise 22 men and 16 women had worn a bandage more than 2 years. The difference between the men and the women in the various age groups, with respect to the average time they had worn a bandage, was at most 0.13 year. Bandages were worn on an average 1.25 years. Such a long time would

probably not have been necessary if the patients had been examined more regularly at hospitals. After leaving hospital they usually consulted private practitioners in their home towns and discontinued use of the bandage when the joint had felt firm for a long time. The corresponding time for patients under 16 years was 1.33 years, for those between 16 and 49 it was 1.20 years and for those over 50 it was 1.39 years. In the last-mentioned group the longest time was 3½ years and the next, 2½ years. In the group 16-49 years the maximum time was 11½ years and the next, 7 years. In the group under 16 years of age the corresponding figures were 3½ and 2½ years.

TABLE XIII

Number of months after operation before patients began to work. Information available in respect of 266 patients.

Months	Duration of disease before operation, in years													
	1		2		3		4		5		6		> 7	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
0- 2	1	1	1	—	—	—	—	—	—	—	—	—	1	—
3- 4	2	4	1	4	—	1	—	—	2	1	1	—	6	3
5- 6	11	2	1	4	1	2	—	1	1	1	1	—	4	4
7- 8	4	2	1	2	2	1	1	2	—	1	—	1	5	7
9-10	10	2	—	5	1	2	1	3	3	1	—	1	6	1
11-12	10	7	5	—	—	1	2	—	2	—	—	1	7	3
13-14	1	1	2	—	—	—	1	—	1	1	—	1	—	1
15-16	4	3	1	2	—	—	—	—	1	—	—	1	—	6
17-18	4	—	1	—	1	1	—	—	2	—	—	1	2	1
19-20	1	1	—	—	—	—	—	—	—	—	—	—	—	—
21-22	1	—	—	—	—	—	1	1	—	—	—	—	—	2
23-24	3	—	3	—	—	—	—	—	2	—	2	—	2	—
> 24	7	1	5	1	2	2	1	1	1	2	1	—	4	4
Never	3	2	2	1	—	—	1	—	—	—	1	—	—	—
Total no. of patients at work	59	24	21	18	7	10	7	8	15	7	5	6	37	32

Working capacity after resection (Table XIII).

Of the 266 patients who replied, 62 per cent had returned to work within 1 year after the operation and 84.2 per cent within 2 years. Finally 96.2 had been at work. The patients commenced work after an average period of 13.6 months post-operatively.

Information as to working capacity was given by 273 patients: of 22 over 50 years old, 16 (73.7 per cent) could return to work, of 16

under 16 years all could work and of 235 aged 16-49 years 230 (97.9 per cent) were able to work, and 11—including the previously mentioned imbecile woman—were disabled. The average number of individuals in the various groups able to work was 96 per cent.

Ten patients had certainly never been able to work. Of these 3 are still undergoing treatment, 2 are pensioners, but their knees are healed and firm, 2 have tbc elsewhere, 1 is unemployed but still has mild pain and swelling of the knee 2 years post-operatively. One patient, who has a healed tuberculous coxitis of the other side, is unable to work on account of weakness of the legs. The knee is healed. The 10th case, the previously mentioned 59-year-old woman with fistulae 4½ years after operation, cannot work on account of the fistulae.

Of those who returned to work, 19 women and 8 men later became disabled. In 26 cases the reason given was "cause other than the knee".

The men seemed to have been operated on at an earlier stage of the disease than the women, and also to have recovered sooner (table IV and XIV). Table XIV gives an idea of the patients' opinion of the length of illness.

TABLE XIV

Average total duration of disease in years.

Age at op.	Tbc of knee only		Tbc elswhere also		Average
	M	F	M	F	
< 16 years	8.3 (12)	6.0 (6)	6.5 (2)	3.5 (2)	7.11 (22)
16-49 „	5.0 (100)	6.6 (64)	5.5 (36)	7.4 (33)	5.86 (233)
> 50 „	4.0 (4)	5.0 (8)	5.5 (4)	10.5 (2)	5.56 (18)
Average	5.32 (116)	6.37 (78)	5.57 (42)	7.35 (37)	5.94 (273)

The bracketed figures denote the number of patients.

Interrupted training, occupations and change of occupation.

The desired training or education was impossible for 2 men. One patient wanted to enter the university, the other wanted to join the police force. Of 17 under 16 years of age 12 claimed educational delay, average delay 18 months. The average delay claimed by the other 21 patients was 3.2 years. Five patients who did not report their occupations are not included in this average.

The question as to change of occupation was answered by 145 men and 101 women. Of the men 45 (31 per cent) had changed their occu-

pation entirely or partly on account of their knee trouble. The commonest new occupations reported by these 45 were: office workers 9, mechanics or the like 6, farm workers 5, shoemakers 4, tailors 3, shop assistants 3. Of the women 18 (18 per cent) had changed their occupation. Their new occupations were: housewives 9, dressmakers 4, shop assistants 2, office worker 1, factory worker 1 and telephonist 1.

Of the 100 men who have not changed their occupation on account of their knee trouble 46 are farm-, forest- or unskilled labourers, 30, mechanics or the like, 13, tailors, clergymen etc. and 11, office workers, goldsmiths and journalists.

Among the 83 women who did not change their occupation there were 62 housewives, 1 factory worker and 1 shop assistant, 10 dressmakers, photographers and bakers and 9 office workers, teachers etc.

Among the men who had changed their occupation 39 reported that they had earlier been doing active work: 8 returned to this kind of work while 30 chose a more sedentary occupation. One patient who had previously been a shoemaker became a farm labourer. Of the 5 women with an active occupation before operation, 2 returned to similar work, while 3 chose a more sedentary occupation. A telephonist had employment as a shop assistant after the operation.

The patients were asked whether they could *walk* without trouble. Of the 161 men 143 (89.9 per cent) answered in the affirmative, the corresponding figures for the 113 women being 94 (83.2 per cent). The average number for men and women together was 86.5 per cent. Many answered "Yes, but on level ground".

Of the 150 men 92 (61.3 per cent) stated that they could *dance*, the corresponding figures for the women being 66 out of 108 (61.1 per cent).

Of 152 men 124, (81.6 per cent) but only 42 (38.5 per cent) of the 109 women, said that they could cycle. The average for men and women together was 163.6 per cent. This marked difference was probably due to the different life the men led and to psychological factors.

25.6 per cent of the patients changed occupation on account of the resected knee. The stiff knee did not seem to affect choice of occupation or manner of living essentially. It seems as if the stiffness of the knee joint need not essentially influence working capacity and mode of life.

Roentgen examinations after resection.

The shortening was judged on the basis of roentgenograms taken before and after resection (table XV). Measurement with a greater

TABLE XV

Shortening on account of resection, as observed in roentgenogram.

Shortening in cm	Roentgenogram before operation							
	No destruction		Marginal destruction		Surface destruction		Deep destruction	
	M	F	M	F	M	F	M	F
½	—	—	—	1	—	—	—	—
1	—	1	17	13	12	13	4	5
1½	—	1	24	11	17	6	16	16
2	1	—	15	16	11	11	16	20
2½	—	—	15	8	5	4	10	6
3	—	—	2	3	2	1	9	5
3½	—	—	3	—	1	1	4	1
4	—	—	—	—	—	1	5	1
4½	—	—	—	—	—	—	2	2
5	—	—	—	—	—	—	1	—
Unknown	1	—	7	—	6	2	8	6
No. of patients	2	2	83	52	54	39	75	62
Average shortening	2	1.3	1.7	1.8	1.7	1.7	2.4	2.1

The average shortening for the whole series was 1.91 cm.

accuracy than ½ cm was impossible, because the knee was practically never examined roentgenologically in the same position before operation as afterwards. The post-operative ankylosis was verified in 151 men and 116 women or in 267 (82.4 per cent) out of 324 patients. Pseudoarthrosis was observed in 3, and in one there was still some mobility after arthroplasty. Three other cases were still undergoing treatment. 50 (15.4 per cent) patients have not had an opportunity to present themselves for the desired roentgenography. In 24 cases no information was obtainable.

In order to form an opinion of the time necessary for the formation of ankylosis after resection, I chose all the cases that were reviewed at least every 4 months after resection and found this interval to be on the average 5.86 ± 0.38 months (*Toumey* 8 months). No difference was seen between the men and the women in this respect. The time varied from 2 to 21 months. In 9 of these patients over 50 years old, the interval was on the average 6.6 months, and in 16 under 16 years it was 4.8 months (*Mortens*: ankylosis forms later in children). In the 16-49 age group ankylosis formed after an average time of 6.0 months.

The view that ankylosis forms quicker in adults than in children could not be confirmed. If anything, ankylosis forms quicker in children.

Information was obtained from 132 men and 87 women as to the angle subtended by the femur and the lower leg after the formation of ankylosis as measured in the roentgenogram.

The cases were classed according to essentially active occupations (Group I) and essentially sedentary occupations (Group II).

In the 90 men in group I the mean flexion was 6°.8 with variations from 5° hyperextension (1 patient, satisfied) to 20° flexion (1 patient, satisfied). The number of those not satisfied was 8 (9 per cent). 7 (11 per cent) of the 64 women in this group were dissatisfied with the position, which was on an average 5°.7 flexion. One patient reported 10° hyperextension, one, 5° hyperextension, and one, 25° flexion, but all three were content with the position.

Of the 42 men in group II with a mean flexion of 4°.5, 10 (24 per cent) were dissatisfied. Border cases were 10° flexion (11 cases, of which 2 were dissatisfied) and 0° (15 patients, of which 4 were dissatisfied). Of the 21 women in this group 3 (15 per cent) were dissatisfied with the angular position. Border values were 5° hyperextension (1 patient dissatisfied) and 15° flexion (2 patients, satisfied).

In the 277 patients with manifest ankylosis the leg had an average flexion of 5°.27.

Five degrees varus was seen in 10 cases, no angle in the frontal plane in 89, 5° valgus in 153 and 10° valgus in 25. The middle position in the frontal plane in 162 men was 3°.83 valgus and in 115 women, 3°.00 valgus.

Only 3 patients (1 man and 1 woman with 10° valgus and 1 woman with 5° valgus) were dissatisfied with the position in the frontal plane and all 3 thought they were knock-kneed.

Rotation of the lower leg in relation to the thigh could not be judged objectively; however, 5 men and 6 women claimed inward rotation: 5 of them were very satisfied with the result of the operation, 4 were satisfied and 1 was dissatisfied. One man did not state his opinion.

Changes in the degree of flexion after leaving hospital were observed by 10 patients. It increased by 10° in 5, by 20° in 1, and decreased by 10° in 4. Of 8 patients under 16 years the angle changed in 2 or in 25 per cent (*Blauel*: marked malposition in 44.9 per cent, moderate in 28 per cent). One boy showed an increase of 20°. After

resection but before ankylosis the epiphysis was roentgenologically intact. He has worn a bandage for 16 months post-operatively. Already at the operation one girl with 30° increased flexion after the formation of ankylosis showed a focus involving the proximal tibial epiphysis. All of these 10 patients wore a bandage for 9-17 months and in all except one the use of the bandage was discontinued without previous examination at the coast sanatorium.

Changes of angulation in the frontal plane were not observed.

Differences of 5° in angulation were not regarded as certain. They were recorded in 29 cases.

Of those with 5° or less flexion and sedentary occupations 25 per cent were dissatisfied and thought the leg to be too straight. Among these with active occupations no definite wishes were expressed regarding the position of the joint. Broadly speaking, 5°-10° flexion and 0-5° valgus seem to be suitable angles *when the shortening is slight.*

APPENDIX

A 24-year-old man with a history of 7 months was operated on 17 years ago when a tuberculous osteitis of the patella was curetted after a biopsy specimen of the capsule had shown tbc. The focus was not in communication with the knee-joint. He left hospital 5 months post-operatively after 6 weeks' confinement to bed. After this the mobility of the joint was practically normal and he was able to perform heavy work as a dock worker. Roentgenologically the articular surfaces are slightly uneven but show no signs of decalcification, no foci, and no definite decrease in the inter-articular space[1].

SUMMARY

Three hundred and sixty-nine resected cases of tuberculosis of the knee joint answered questionnaires,—and some cases were examined roentgenologically,—particularly with regard to the post-operative course. Indications for surgery were wide except among children. In connexion with multiple tuberculosis, tuberculous abscesses in the knee joint and increased sedimentation rate before the operation, a statistically significant increase in the frequency of complications was observed. Fistula before operation and a case history of the disease of less than 2 years before operation probably increased the risk of

[1] This case was mentioned already by S. v. Rosen in his diss.: „Die infektiösen Krankheitsprozesse der Kniescheibe", Acta orth. scand. suppl. III, p. 61-66, 1939.

complication. On the other hand, advanced age, considerable roentgenological changes, and only short treatment before the operation had no obvious effect on the incidence of complications.

Mortality from tuberculosis after leaving hospital was greater among those with multiple tuberculosis than among the remainder.

Two years after the operation 84 per cent had returned to work and, finally, 96 per cent were capable of working.

Ankylosis was seen roentgenologically in 83 per cent, and 15 per cent reported a stiff knee joint. Pseudo-arthrosis developed in 0.9 per cent. Of the remaining cases 3 are still undergoing treatment and in 1 there is a certain degree of mobility after arthroplasty.

A suitable angle between the tibia and the femur seems to be 5°-10° flexion and 0°-5° valgus.

Slight but radical resection for a wide range of indications (except children) gave good results, very well comparable to those in the series of other authors. *Sorrel* reported fewer post-operative complications, but since he did not give details as to the duration of the illness before operation etc., direct comparison is difficult. *Toumey*'s method of not resecting changed soft tissue did not seem to produce better results than the operative method used in the present series.

One case of tuberculous synovitis and patellar osteitis operated on solely by curettage of the patellar focus is referred to.

RESUME

369 cas de résection d'articulations tuberculeuses du genou ont été réexaminés à l'aide de questionnaires et, dans certains cas, de radiographies, pour constater notamment les résultats de l'operation.

Les cas ont été opérés sur des indications très larges, sauf chez les enfants. Dans les cas de tuberculose multiple, d'abcès tuberculeux de l'articulation du genou et lorsque le taux de la sédimentation globulaire était élevé avant l'opération, on a constaté une plus grande fréquence des complications. Des fistules avant l'opération, ainsi qu'une durée de maladie inférieure à 2 ans, accroissent vraisemblablement aussi les risques de complications. Par contre, il ne semble pas qu'un âge de plus de 50 ans, des changements radiologiques étendues et une courte durée de la maladie jouent de rôle évident en ce qui concerne les complications.

La mortalité due à la tuberculose après que le malade avait quitté l'hôpital a été plus forte chez ceux souffrant de tuberculose multiple que chez les autres.

Deux ans après l'opération 84 % des malades travaillaient et à la fin de la période d'observation 96 % étaient aptes au travail.

Une ankylose radiologique a été constatée chez 83 %. 15 % ont déclaré avoir le genou raide. Des pseudarthroses se sont développées dans 0,9 % des cas. Sur les autres cas, 3 sont toujours en traitement et un a retrouvé une mobilité partielle après arthroplastique.

Il semble que le meilleur angle entre le tibia et le fémur soit entre 5 et 10° de flexion et 0 à 5° valgus.

Une résection prudente mais radicale, sur la base de larges indications (sauf chez les enfants), a donné de bons résultats, qui peuvent se comparer aux autres observations. *Sorrel* a eu peu de complications post-opératoires, mais il est difficile d'établir des comparaisons, étant donné qu'il ne fournit aucune indication quant à la durée de la maladie, etc. La méthode de *Toumey*, qui consiste à ne pas réséquer des parties molles malades ne semble pas présenter d'avantages sur la méthode opératoire appliquée dans mes cas.

Il est rapporté un cas de synovite tuberculeuse et d'ostéite patellaire opérés par simple évacuation du foyer patellaire.

ZUSAMMENFASSUNG

369 Fälle von Kniegelenkstuberkulose wurden mit Hilfe von Fragebögen, und Röntgenuntersuchungen in gewissen Fällen, unter besonderer Bezugnahme auf den postoperativen Verlauf untersucht. Die Operationsindikation war, abgesehen von Kindern, weit. Bei multipler Tuberkulose, tuberkulösen Abszessen im Kniegelenk und erhöhter Senkungsgeschwindigkeit vor der Operation, hat man eine sichere Frequenzzunahme von Komplikationen beobachtet. Fistelbildung vor der Operation, sowie eine kürzer als zwei Jahre dauernde Erkrankungzeit hat wahrscheinlich das Operationsrisiko erhöht. Dahingegen hat das Alter über 50 Jahre, schwere röntgenologische Veränderungen und eine kurze Pflegezeit vor der Operation keine wesentliche Rolle in der Entstehung von Komplikationen gespielt.

Die Gefahr des tödlichen Ausganges nach der Entlassung war grösser in Fällen mit multipler Tuberkulose als in den übrigen.

Zwei Jahre nach der Operation waren 84 % der Fälle arbeitsfähig und schliesslich waren 96 % erwerbsfähig.

Röntgenologisch konnte man in 83 % eine Ankylose nachweisen, und 15 % hatten ein versteiftes Knie. Pseudarthrose entstand in 0.9 % der Fälle. Von den übrigbleibenden Fällen sind drei nicht fertigbehandelt und einer weist eine gewisse Beweglichkeit nach einer Gelenksplastik auf.

Als geeignetster Winkel zwischen Tibia und Femur werden 5°—10° Beugung und 0°—5° valgus angesehen.

Sparsame aber radikale Resektion auf breiter Indikationsbasis (abgesehen von Kindern) hat gute Resultate gegeben, die sich mit denen in übrigen Materialen messen können. Sorrel hat seltenere Komplikationen gehabt, aber da die Krankheitsdauer u. a. nicht angegeben wurde, ist ein direkter Vergleich schwierig. Toumeys Methode, veränderte Weichteile nicht zu resezieren, scheint gegenüber der Methode, die in meinem Material verwendet wurde, keine Vorteile aufzuweisen.

Ein Fall von tbc-Synovitis verbunden mit Patellarosteitis, der mittels operativer Ausräumung des Patellarherdes allein behandelt wurde, wird erwähnt.

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