FROM THE NATIONALFORENINGENS HOSPITAL FOR SURGICAL TUBERCULOSIS, JUELSMINDE. CHIEF: HANS THOMSEN, DR. MED.

ON RESECTION OF THE KNEE

BY

HELGE SKARENBORG

45 cases of knee resection operated at the Coast Hospital during the years 1937-47 were studied. The patients were aged between 17 and 51 years.

Etiology. There were 34 cases of tuberculous osteoarthritis, and 2 with non-tuberculous conditions (one chondromalacia, one staphylococcal arthritis). In the remaining 9 cases the etiology was uncertain, but presumably it was tuberculous; 5 had other tuberculous foci (4 pulmonary, 1 had proctitis also) and one tuberculous spine. It should be mentioned that Wassermann, Gonococcal and Widal tests were performed on all the patients and were all negative in every case.

The symptomatalogy will not be discussed here, but the *duration of the symptoms before operation* is shown in Fig. 1.

Other Tuberculous Manifestations. 26 cases either had, or had had previously other manifestations of tuberculosis. In 11, pulmonary tuberculosis was confirmed by demonstration of tubercle bacilli in the sputum or stomach wash-out, the tubercle bacillus being of human type in all. 4 had previously had pleuritis. In all, 9 cases had had previous pleuritis. In addition to the primary foci, which will be discussed later, radiography showed 5 cases with healed pulmonary tuberculosis. 3 patients had tuberculosis of the spine, one with an abscess in the iliac fossa, and 2 had tuberculous osteomylitis elsewhere. 6 had tuberculosis in other joints. 2 had genital

tuberculosis (1 epididymitis and spermatocystitis, the other epididymitis and prostatitis), 1 renal tuberculosis and 3 tubercle bacilluria (without any other sign or symptom of urogenital tuberculosis). Of the last 6 the tubercle in the urine was of human type. Finally, one case had a tuberculous

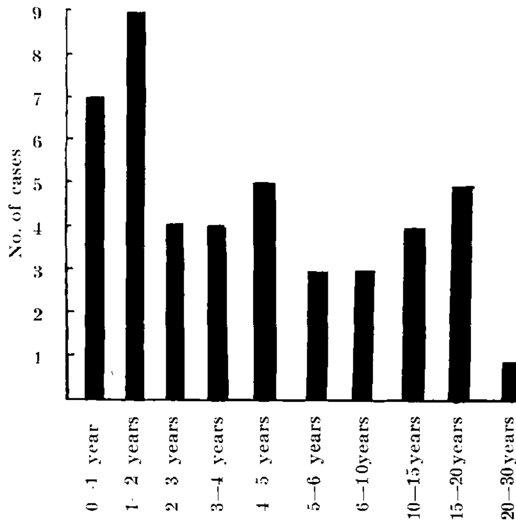

Fig. 1.
Duration of symptoms before operation.

ulcer in the retromandibular region and a tuberculoma on one leg.

Route of Entry. It is not possible to get a clear impression of in how many cases one could discover the route of entry, since not all cases had radiographs of the abdomen and neck. In recent years this hospital has begun to take routine radiographs of the neck and abdomen in all patients.

In this series, the route can be determined with certainty in 24, i.e. ca. 53 %. In 1, entry occurred through the tonsils; in 2, there was a double route, the tonsils and lungs, and the mesenteric glands and lungs; in the remaining 21 cases the primary focus was in the lungs.

It is permissible to say that if this question had been investigated systematically from the beginning the figure would almost certainly be considerably higher.

Skin Temperatures. In most of the cases (37) the skin temperature was determined by Ipsen's method. It was found that the skin temperature over the affected knee was from

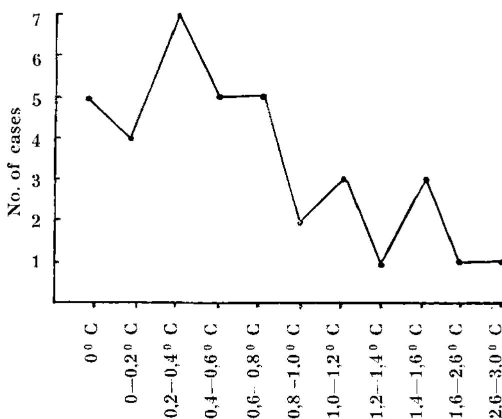

Fig. 2.

Distribution of differences of skin temperature on the 2 knees in 37 cases.

0-2.8° C higher than over the healthy knee. This is shown in Fig. 2, the abscisse representing the temperature difference, the ordinate the number of cases. The curve has a definite maximum at a temperature difference of below 1° C. Approximately the same curves were obtained for all 3 groups, viz. cases with active and inactive tuberculous osteoarthritis, cases of uncertain aetiology, and non-tuberculous cases. The last group includes, as already described, 2 cases, one chondromalacia which showed no temperature difference, and one staphylococcal arthritis with 0.9° C difference.

All groups are included in the curve in Fig. 2. Of the 5 cases which showed no temperature difference between the two sides 2 were of uncertain aetiology, 1 had inactive, 1 active tuberculosis and, as already mentioned, 1 had chondromalacia.

Indications. The knee was resected in all cases where it was thought that in spite of adequate conservative treatment, nearly full movement would not be recovered, since experience has shown that in these cases either relapse or a deforming arthrosis readily occurs. In practice, this means all adult patients except those with purely synovial involvement.

Operative Technique. In most cases the technique consisted of arthrotomy through a curved incision below the patella. The joint was widely opened, with the knee in acute flexion. After haemostasis was obtained, a curved resection of the joint surfaces was made with a saw. The raw surfaces were made to fit by means of a special curved file. All abnormal tissue was removed, and possible foci in the bone ends were curetted out. The patella was preserved in only 2 cases. A drain was only inserted if there was a sinus with mixed infection. The wound was closed with 4-5 catgut sutures in the capsule, and 7-8 fishgut sutures in the skin. 2 pins were then inserted percutaneously through the tibial tuberosity and the femoral condyles respectively, and fixed to each other by means of 2 special "stay-screws", as described by Hans Thomsen. (Ugeskrift f. Laeger, 1941, 1. 17.). Two small pieces of gauze and a little non-absorbent wool were used as dressing, and finally a plaster cast was applied from the groin to the heel. An assistant held the limb in the correct vertical position, the plaster slab was applied wet and held in position with a few circular strips. The patient was returned to bed with the limb raised about 60°.

The position was controlled radiographically immediately after the operation.

In 2 cases the operation was less radical. The inferior patellar ligament was preserved, and instead of making a curved saw-cut the cartilage was chiselled off, with, in one case the intercondylar eminence; the percutaneous pinning was also omitted.

The Anaesthesia. Ether anaesthesia was used in 41 cases, spinal analgesia in 4. There were no anaesthetic complications.

The post-operative course. There was no significant post-

operative haemorrhage. At the end of 3 weeks a window was cut in the plaster over the wound, and the percutaneous pins and the stitches were removed. 1 or 2 months later the plaster was split, and the posterior part kept as a plaster back splint. The patient was allowed up for half an hour daily when

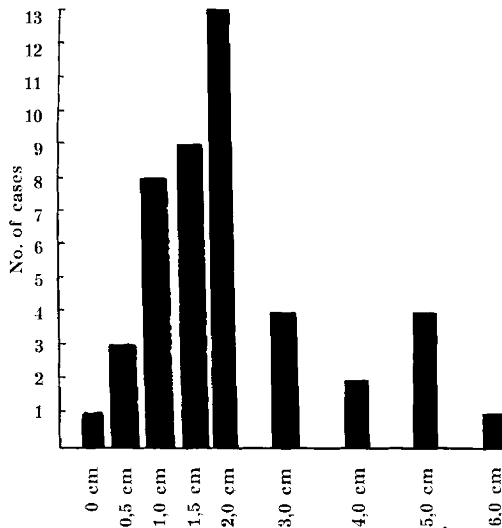

Fig. 3.

Centimetres shortening of the lower limb after re-section of the knee in 45 patients.

there was firmness at the resection site, usually after 2½-3 months. A week later he was allowed to walk with crutches, beginning with 1 hour a day, and after a further month he might begin to weightbear. He was discharged without any splint, and re-examined 3 months later.

Complications. There were only few complications. 1 case had a peroneal paralysis which recovered in 3 months. I complained of slight, constant pain in the knee. He was treated with diathermy and novocain injections with some improvement. In 1 case amputation was necessary about 2 years later. She was a woman aged 35 years who still had pain

in the knee after operation; later, oedema of the leg developed and the skin became cyanotic when the leg was dependent. Finally, 2 ulcerations the size of a florin appeared on the lower 1/3 of the leg with marked discoloration of the surrounding skin. Biopsy showed mild Monckeberg arteriosclerosis. Biopsy of the sciatic nerve showed no abnormality.

Condition. At operation 31 of the known tuberculous cases were active and 3 were inactive.

Position. Nearly all cases ankylosed in good position, i.e. slight flexion and a few degrees valgus. In only 2 cases was the position not ideal. One had about 10′ and the other 20′ varus position at the knee.

Shortening amounted to 0-6 cm, with an average of 2 cm. Figure 6 shows the shortening as abscisse and the number of patients as ordinate.

Consolidation occurred after 1-8½ months, with an average of 2½-3 months, except for 2 cases who still had no sound union at their last examination, 1 at 3 months, and the other 5½ years after operation. These 2 patients had not, however, as will be described below, any discomfort from the knee, though slight movements were still possible.

Working capacity. After discharge patients were not particularly incovenienced by the ankylosis. All could, as far as the knee was concerned, earn their own livings, except for the case already described who had pain treated by novocain injections. This patient still thought she couldn't work 7 years after the operation (functional).

Pathological anatomy.

1) Active tuberculous osteo-arthritis:

   Macroscopically. Sinuses in the region of the knee were present in only 3 cases.

   Findings at operation. Usually thickening of the capsule, erosion of the cartilage, and varying degrees of destruction of the menisci or the cruciate ligaments. Frequent pannus

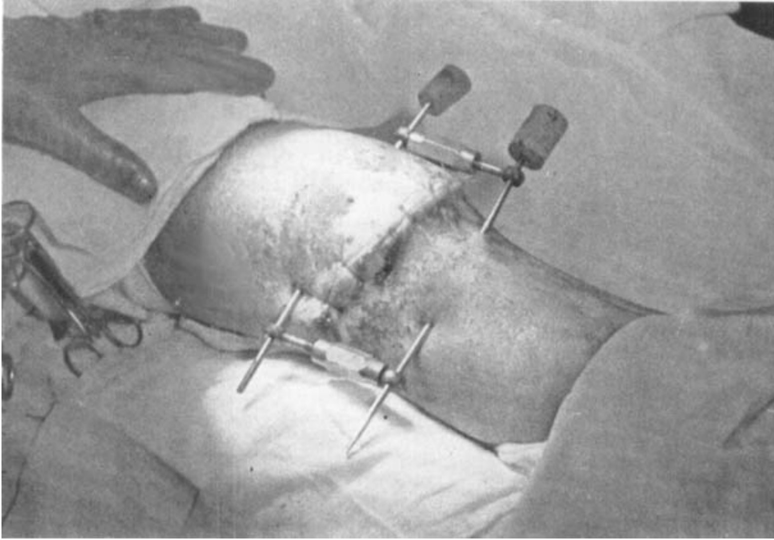

Fig. 4.

formation. The joint cavity was often obliterated by granulation tissue or fibrous adhesions. In 15 cases one or more caseous tuberculous foci were found on the sawed surface. Occasionally, there was abscess formation round the capsule. Sequestra formation was seen only in 1 case. *Histology*. The usual histological picture was seen: granulomata of epitheloid cells, containing giant cells of Langhans' type, and surrounded by lymphocyte infiltration. There was also a marked tendency to coagulation necrosis.

2) Inactive tuberculous oesteoarthritis. The 3 cases in this group showed only fibrous adhesions; histologically nothing abnormal was found in 2, and some fibrous degeneration in 1.
3) Cases with Uncertain aetiology. *Macrocscopically* the findings closely resembled those of the tuberculous osteoarthritis i.e. varying degrees of granulation, pannus, erosions of the cartilage and fibrosus adhesions. But no tuberculous

foci and no abscesses were found. In one case the joint appeared completely normal.

On histological examination 5 of the 9 cases showed plasma cell and lymphocyte infiltration, suggesting a chronic inflammation. In 2 cases there was fibrous degeneration, and in some places ossification of the cartilage. The remaining 2 cases showed no abnormality.

4) Non-tuberculous cases. One was found to be a case of chondromalacia. Facing each other on the patellar and femoral surfaces were sharply demarcated areas the size of a halfpenny where the cartilage was red and velvetlike but not eroded. The consistency was soft and elastic. Histology showed both degenerative and reactive changes. The cartilage had been destroyed and replaced by cellular and vascular connective-tissue. There were also degenerative changes in the capsules of the cartilage cells.

The other case was one of staphylococcal osteoarthritis. Macroscopically no abnormality was seen. Histology showed severe degenerative changes in the cartilage. The cartilage structure showed varying degrees of change, the ground substance being fibrillary, the cells small, narrow and spindle-shaped. On the surface was a layer of loose fine-meshed connective tissue with lymphocyte infiltration. In the medulla there was proliferation of a cellular connective tissue. No evidence of tuberculosis.

Bacteriology. In 27 cases the tissue, pus, etc. from the knee joint were examined for tubercle bacilli. Tubercle bacilli were found in 17; 13 were of human type, and 3 bovine; the type was not determined in the remaining case. In the 3 inactive cases TB had been demonstrated previously in abscesses from the knee. In only one of these was the type determined; it was human.

3 patients had, as already mentioned, sinuses near the knee. Human type TB was found in 2, and in 1 there was also a secondary infection with staphylococcus aureus. In the third case no bacteriological examination appears to have been made.

The post-operative radiographic appearances after resection are illustrated by the following 2 cases whose clinical data are described in brief:

1) An agricultural worker aged 21 years, who had had pleural empyema 13 years earlier. The R. knee was affected when he was aged 11 years. Repeated treatment with plaster and light. Was able to work on the land for long periods, but the symptoms recurred at intervals of 1-2 years. The skin temperature was 1.1° warmer on the affected side. Very reduced movement, and the smallest movement caused pain. Obvious muscle atrophy. Slight swelling of the knee. The patella fixed. Resection performed by the usual technique under ether anaesthesia. Post-operative course uncomplicated. Miscroscopy showed tubercles. No tubercle bacilli seen. After 2 months, sound union in excellent position. Shortening 1½ cm. Excellent health at follow-up examination 7 months later. (See figs. 7, 8, 9).
2) A labourer aged 44 years, who in addition to the knee lesion had a bilateral tuberculous epididymitis, tuberculosis of one seminal visicle, bilateral tuberculous osteoarthritis of the carpus, osteomyelitis of the spine, tuberculous bacilluria and TB of the L. lung. Pain began in the knee when he was 38 years old; later, swelling, tenderness and restricted movement. On admission the L. knee was found to be diffusely swollen.

   The patella's movement was reduced to 1/3 normal. The knee could be flexed to 110′. The tenderness corresponded with the joint line. The skin temperature was 1.5′ higher than on the normal side. Resection by the usual technique. Uncomplicated post-operative course. Microscopy showed tuberculosis. The position at the joint was 20′ varus and 10′ flexion.

   At the last follow-up examination 5½ years later there was still 5′ movement; the position as above. He was working on the railways and stood and walked about all day, though still using a celluoid splint. (Figs. 10, 11, 12).

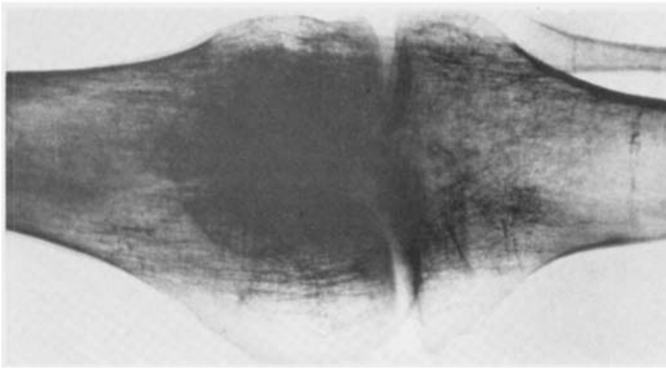

Fig. 7.
Radiograph of Case 1 immediately before operation.

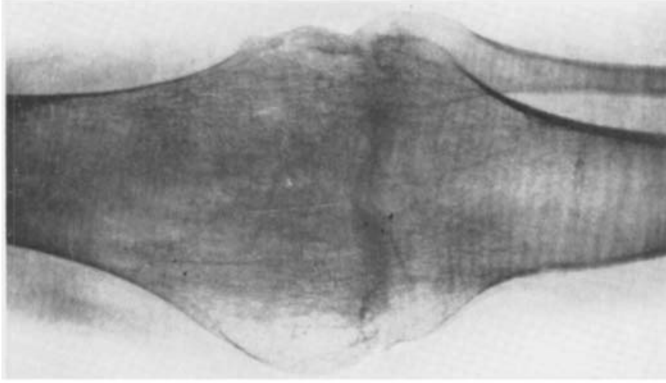

Fig. 8.
The same case 2 months after operation. Beginning ankylosis.

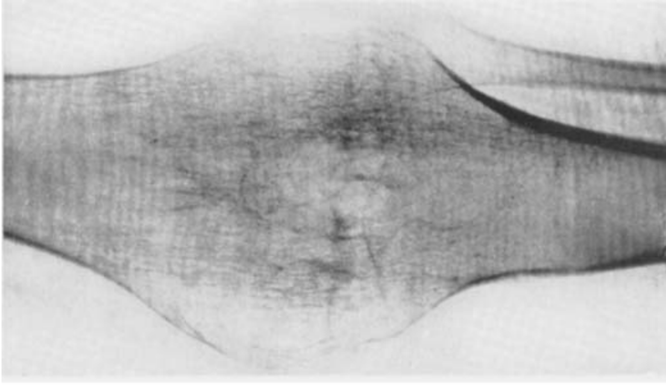

Fig. 9.
The same case 7 months after operation. Complete bony ankylosis

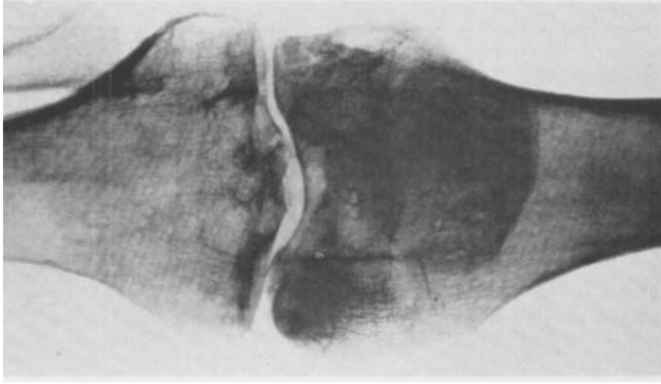

Fig. 10.
Radiograph of case 2 1 month before operation.

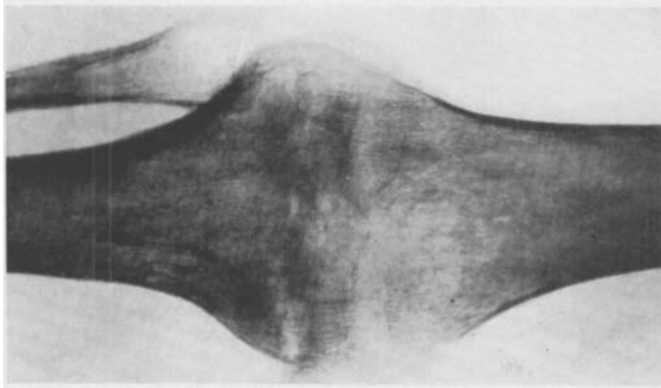

Fig. 11.
The same case 7 months after operation.

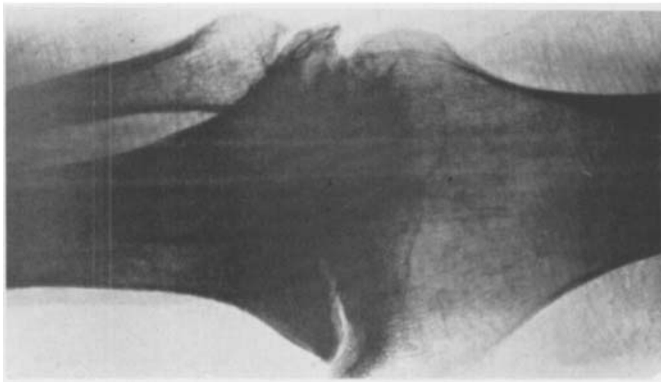

Fig. 12.
The same case 5½ years after operation. Pseudarthrosis at the site of excision.

SUMMARY

45 knee resections performed at the Nationalforening's Hospital for Surgical Tuberculosis, Juelsminde are discussed.

Etiology:

Tuberculous	34 cases
Non-tuberculous	2 cases
Uncertain	9 cases

26 patients had, or had had other tuberculous lesions.

Route of Entry could be determined in 53 % of cases. It was not, however, systematically searched for from the beginning of the series.

Skin temperature measurements by Ipsen's method showed 0-2.8′ rise in temperature of the skin of the affected knee; in most cases this was less than 1′.

The indications and technique for the operation are described.

The following results were obtained:

the position was good in all cases, except 2 which had 10-20′ varus.

the shortening was from 0-6 cm, with an average of 2 cm.

consolidation occurred after an average of 2½-3 months.

the patient's working capacity was good in all cases, provided they had no other disabling disease.

RESUME

45 résections du genou, pratiquées à l'Hôpital de Tuberculose chirurgicale de l'Association Nationale, à Juelsminde.

Etiologie:

Tuberculose	34 cas
non tuberculeux	2 cas
incertains	9 cas

26 des malades avaient présenté d'autres manifestations tuberculeuses.

La porte d'entrée a pu être déterminée dans 53 % des cas. La question n'a toutefois pas été systématiquement examinée depuis le début.

Mensuration de la température cutanée d'après Ipsen, a montré des variations de température de 0 à 2,8°, dans la plupart des cas 1 degré de différence.

Indications: tous les cas chez les malades adultes, à l'exception des formes synoviales.

Indications et technique comme indiquées, on a obtenu les résultats suivants:

Position bonne dans tous les cas, excepté dans 2 avec 10 à 20° varus.

Raccourcissement d'environ 2 cm en moyenne (0 à 6 cm).

Fermeté au bout de 2½ à 3 mois en moyenne.

Capacité de travail bonne pour tous les malades, à moins qu'ils ne souffrent d'autres maladies invalidisantes.

ZUSAMMENFASSUNG

45 Kniegelenksresektionen, ausgeführt am Nationalforeningens Hospital for kir. Tuberculose, Juelsminde.

Ätiologi:

Tuberkulöse	34 Fälle
Nicht Tuberkulöse	2 Fälle
Unsichere	9 Fälle

26 Patienten hatten oder hatten andre tuberkulöse Manifestationen gehabt.

Die Eingangspforte konnte man in 53 % der Fälle bestimmen. Die Frage ist jedoch nicht vom Anbeginn systematisch untersucht worden.

Hauttemperaturmessung nach Ipsen zeigte einen Temperatur unterschied von 0—2,8°, in den meisten Fällen unter 1 Grad unterschied.

Indikationen: Alle Fälle von erwachsenen Patienten mit Ausnahme der synovialen Formen.

Entsprechend der beschriebenen Indikationen und Technick findet man folgende Resultater:

Die Stellung ist gut in allen Fällen mit Ausnahme von zweien, die eine Varus Stellung von 10—20° zeigen. Verkürzung im Durchschnitt 2 cm (0—6 cm).

Festigkeit nach durchschnittlich 2½—3 Monaten.

Arbeidsfähigkeit gut bei allen Patienten, mit Ausnahme derer die andre invalidisierende Krankheiten hatten.