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Some Aspects of Bone and Joint Tuberculosis

Bone and joint tuberculosis is no longer very common and with the decline in its incidence other features of the disease seem to have changed. For example; before 1917 about seven-eighths of the patients were less than fourteen (14) years of age, while only three-eighths of the patients in the series presented here were less than fourteen (14) years of age at the onset of their symptoms.

The purpose of this paper is to present a series of seventy-three consecutive patients who were last discharged from the St. Boniface Sanitorium in the years 1944 to 1947. Bone and joint tuberculosis will be discussed and illustrated by x-rays from cases in this series.

Etiology

No conclusions regarding the ratio of bone and joint tuberculosis to other forms of tuberculosis can be drawn from this series since a large proportion of the orthopedic cases in the Province of Manitoba are sent to the St. Boniface Sanitorium. It is reported that three and seven-tenths percent of general tuberculosis hospital patients have bone and joint tuberculosis.

Twenty-three of the seventy-three patients in this series were North American Indian or Breeds.

Less than nine percent were under five (5) years of age at the onset of their symptoms. The average age of the seventy-

three patients was twenty-two (22) years.

There were twenty-nine (29) female and fourty-four (44) male patients in this series.

Many cases are preceded by trauma and this may be a predisposing factor or merely an incident precipitating symptoms. Experimental animals which have been infected have a higher incidence of tuberculosis in joints which have been traumatized than normal. However, tuberculosis never localizes in an area of severe injury such as a fracture.

Forty-five (45) of the seventy-three (73) patients had a detectable focus of tuberculosis preceding the onset of bone and joint disease by an average of one and one-half ($1\frac{1}{2}$) years. Thirty-four (34) were preceded by tuberculosis pulmonary disease, eight (8) by pleurisy, one (1) by skin infection, one (1) by peritonitis, and one (1) by lymphadenitis.

The tubercle bacillus is thought to gain entrance through the respiratory system or alimentary system. The majority of bone and joint lesions undoubtedly result from a tuberculous bacillaemia, but some cases are probably lymph-borne. It is thought that some cases of Pott's disease may result from infection from the prevertebral lymphatics or even from the thoracic duct.

Secondary extension, presumably from the bone and joint lesion, occurs quite frequently. There were twelve (12) cases of other tuberculosis appearing in patients apparently clear at the time of onset of the bone and joint lesion.

Fourteen (14) of the seventy-three (73) patients had

involvement of more than one region. The locations involved in this series were:

Pott's disease	-	38 patients
Hip	-	19 "
Knee	-	10 "
Ankle	-	4 "
Shoulders	-	4 "
Elbow	-	1 "
Wrist	-	4 "
Sacro-iliac	-	2 "
Localized osteitis	-	6 "
Diffuse osteitis	-	4 "
Periostitis	-	2 "

Pathology

Tuberculous disease of bone may occur as a localized or a generalized osteitis. There are also two forms of pathological lesions. The usual type is a softening and destruction of trabeculae with caseation leading to pus and cold abscess formation. The less common lesion, "caries", results in little or no caseation. There is abundant formation of soft tuberculous granulation tissue leading to rarefaction of bone.

Tuberculosis can involve a joint in three different ways. Occasionally a near-by tuberculous osteitis causes a non-specific reactionary synovitis. Thus a focus in the greater trochanter may cause synovitis of the hip without actually infecting the joint. Occasionally there may be a primary infection of the synovium without involvement of the bone. Most commonly,

tuberculous arthritis results from the invasion of the joint from a localized osteitis which is usually in the metaphysis. When the joint becomes involved the synovium undergoes slow proliferation with a hypertrophy of the villi. The synovium becomes even thicker than in rheumatoid arthritis and is grey in color. It may show tubercles on the surface. Granulation tissue overgrows the articular cartilage destroying it most extensively along its free margins. Surface destruction by granulation tissue does not take place in the regions of contact. Subchondral granulations develop which absorb articular cortex and attack the cartilage from below. This may lead to destruction of the entire articular cortex or to deep areas of necrosis at the joints of greatest pressure forming "kissing sequestra". Cartilage is not so much eaten away but is separated in flakes or even a complete cast of the articular surface. Fluid is usually scanty and contains many "melon-seed" or "rice" bodies of fibrin.

Muscles and other periarticular tissue undergo gelatinous degeneration.

Caseous material and sequestra form a "cold abscess". This is separated from neighboring parts by a limiting wall, the outer layers of which are fibrous and cellular tissue, the inner layer is granulation tissue covered with a yellowish or pinkish-grey necrotic membrane, which is easily separated from the underlying parts. The fluid is of whitish color, composed of serum, leukocytes, emulsified caseous material, and fibrin. Masses of cheesy necrotic tissue and sometimes minute fragments of bone float in the fluid.

Diagnosis

The average duration of symptoms before a reasonably certain diagnosis in the cases in this series was one and one-half ($1\frac{1}{2}$) years. The onset is usually insidious and the patient does not seek medical advice for sometime. However, many of the patients in this series were misdiagnosed when first seen. Even when tuberculosis is suspected it is often many months before a diagnosis can be made. One (1) case had negative x-rays of the knee for twenty (20) months after the onset of symptoms.

Systemic reaction was quite mild in the majority of cases. Fever was absent in many and was always minimal unless there was secondary infection. The blood sedimentation rate was normal in twenty (20) cases when first admitted to sanitorium and the seventy-three (73) averaged plus thirty-two (32) by the blood sedimentation index. The haemoglobin may be normal and the whole group averaged seventy-six (76) percent on admission. There is often a leukopenia with relative lymphocytosis.

The arthritis is similar to other diseases. "Night-cries" are frequently present in younger patients. "White-swelling" describes the peculiar doughy swelling resulting from the hypertrophy of the synovium and periarticular gelatinous degeneration. Local temperature is usually slightly elevated. Increase in synovial fluid may be present but is usually not conspicuous in tuberculous arthritis. Abscess or sinus formation was present in forty-four (44) of the seventy-three (73) patients. The regional lymph glands are usually enlarged.

The Mantoux reaction appears to be of little value in diagnosis. Twenty-one (21) of the seventy-three (73) patients were tested. Ten (10) were positive to one in ten-thousand

dilution, six (6) were positive to one in one thousand, and two (2) were positive to one in one hundred. Three (3) cases were negative to all dilutions. One (1) negative case had generalized tuberculosis while the other two (2) had Pott's disease.

Positive diagnosis can be made by demonstrating the bacilli in the pus from an abscess, fluid from a joint or biopsy tissue. Culture or guinea-pig inoculation greatly increase the efficiency of diagnosis. Histological examination is often negative due to difficulty in selecting characteristic tissue.

X-ray diagnosis is not pathognomonic. The earliest x-ray signs are merely increased radiability and soft tissue swelling. Later there is a regional atrophy of bone. There is a decreased density of articular cortex where the cartilage surfaces are not in contact and preservation of cortex in regions of cartilage contact. If secondary invasion of the bone occurs at the traumatized points of contact, large bilateral areas of necrosis occur at opposing points in the bones. Detachment of such areas form "kissing sequestra". Bone production occurs under three (3) conditions; secondary infection, calcification of an exudate, and periostial involvement.

Prognosis

Twenty-four (24) patients died and two (2) more had a poor prognosis in this series of seventy-three (73) patients, making the mortality rate about thirty-six (36) percent from all causes. However, these patients have not been followed for many years. Only about nine (9) of these deaths could be directly attributed to the bone and joint tuberculosis. Five (5) of these were from toxæmia from infected sinuses. The most common cause of death was pulmonary tuberculosis.

Treatment

There is no form of treatment of bone and joint tuberculosis which is not subject to dispute. However, there are certain principles which seem reasonably well founded.

Tuberculosis is a general disease; it is never confined to the skeletal system. Since pulmonary tuberculosis is present in the majority of cases treatment of the lungs must also be considered. Bed-rest should be instituted until the acute phase has passed. Ultra-violet irradiation may be of benefit to the morale of the patient but probably has no specific curative effect.

Care of abscesses or sinuses is extremely important. Abscesses should be aspirated through healthy tissue whenever they appear near the surface. Incision of an abscess should only be undertaken if secondary infection is already present. Sinuses should be dressed aseptically to prevent further secondary invasion.

Complete rest of the affected joint is uniformly accepted as the most important local treatment for arresting the disease and preventing deformity. Correction of deformity is essential for the return of function except in the case of Pott's disease.

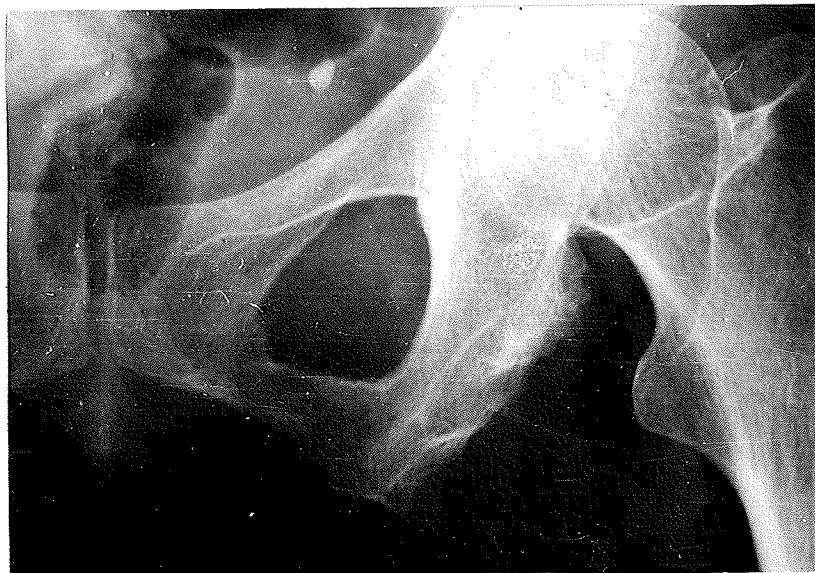
If the disease is confined to the synovium complete cure without loss of function is probably possible, but when bone destruction has occurred normal function cannot be retained without danger of recurrence.

The value of arthrodesis is greatly disputed. If the operation is completely extra-articular and mechanically sound it may be of value even in arresting the acute stage of destruction. If the nature of the joint makes it impossible to fulfill these requirements then arthrodesis would fail in most cases and add to the risk of sinus formation. On the other hand, if the disease has passed the stage of destruction and healing has begun even intra-articular arthrodesis may be of value in hastening the complete inactivity of the disease, in preventing its recurrence, and in abolishing pain in the destroyed joint.

When the disease is well localized it may be possible to completely excise it. Sometimes amputation is indicated.

Tuberculous Periostitis

There were two (2) cases of tuberculous periostitis in the seventy-three (73) patients in this series. Both cases were complicated by active pulmonary tuberculosis and other bone and joint tuberculosis. One (1) case involved the ischium and the other case the zygoma. Only the latter case was complicated by a sinus. The ages at the onset were probably forty (40) years and eight (8) years respectively.



Case 2862. Tuberculous Periostitis of Ischium

The primary focus may appear in the periostium or the outer surface of the cortex of the bone. The disease spreads rapidly along the surface of the bone and invades the bone to some extent. In dense bone such as the tibia only superficial necrosis results but in cancellous bones such as the vertebrae deep destruction rapidly follows.

In most cases the disease becomes arrested spontaneously with rest of the part and general care of the tuberculous patient.

Localized Tuberculous Osteitis

There were six(6) patients with localized osteitis in the seventy-three (73) patients in this series. The locations were: three ribs, sternum, first thoracic transverse process, radius, metatarsal, and greater trochanter. All were complicated by other tuberculosis and four (4) patients had other bone and joint lesions. All but one (1) case had abscess formation. The age of onset varied from five (5) years to thirty-one (31) years. All were diagnosed soon after their probable onset except the tuberculous osteitis of the greater trochanter which was only diagnosed after fourteen (14) years and which spread to the hip joint after thirty-one (31) years. Only one case died.



Case 2978. Localized Tuberculous Osteitis of Metatarsal

The disease usually begins in the metaphysis of the long bones. The cancellous tissue is destroyed producing a cavity in the bone. Later an area of sclerosis appears around the cavity. This area of sclerosis is usually less than that round an area of pyogenic osteitis. However, it is often impossible to differentiate tuberculous osteitis from other forms without aspiration of material for examination.

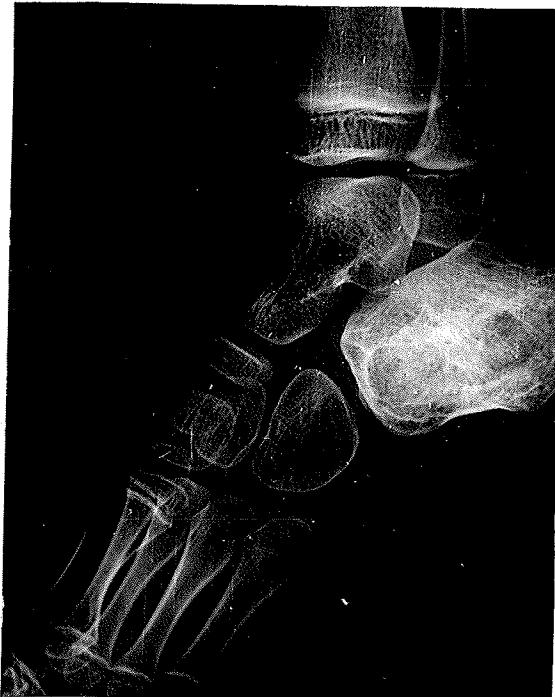
This condition generally runs a prolonged course and there may be a history of chronic aching over a period of many years.

Natural arrest usually occurs even without immobilization of the part. Resection of the bone when possible, such as the ribs, usually cures the condition. After sclerosis has appeared around the cavity careful cleaning and scraping probably hastens the cure.

Diffuse Tuberculous Osteitis.

There were two (2) patients with diffuse osteitis in the seventy-three (73) patients in this series. One (1) patient had multiple involvement of the metatarsals while the other had involvement of a phalanx in the hand, metatarsal, and both os calcis. Both cases were complicated by pulmonary tuberculosis. The first patient also had tuberculosis of the wrist and the second had localized osteitis of the radius.

Only the os calcis had sinus formation. The first patient was ten (10) years old and the other five (5) years. Both recovered function.



Case 2849. Diffuse osteitis of os calcis and phalanx. Also localized osteitis of radius.

This condition is seen most often in the metacarpals, metatarsals, and phalanges where, along with syphilitic dactylitis, it is known as "spina ventosa". The tuberculous granulation tissue destroys the medulla of the bone and the cancellous tissue. The bone becomes enlarged and the periostium is lifted off. New bone is laid down by the periostium around the old diaphysis. The epiphysis, may be destroyed and the bone will be stunted or the joint may be involved.

The finger appears spindle-shaped and is slightly sensitive to pressure.

Treatment is directed towards the general condition.

Local treatment in the form of adhesive strapping may be of some value in partially immobilizing the part.

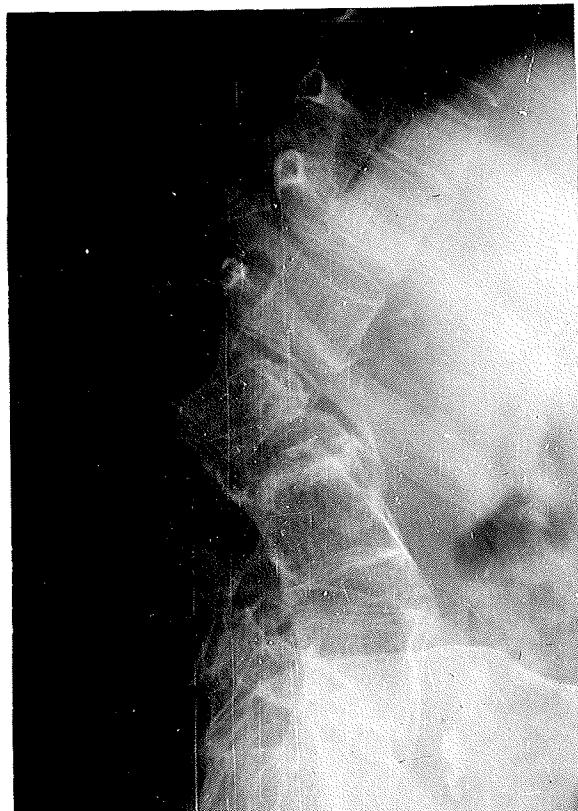
Pott's Disease

There were thirty-eight (38) patients in this series of seventy-three (73) with Pott's disease. Eighteen (18) cases were preceded by pulmonary tuberculosis, seven (7) by pleurisy, and one (1) by lymphadenitis. Eight (8) cases were accompanied by other bone and joint lesions. Nine (9) cases were complicated by paraplegia. Twenty-seven (27) cases had demonstrable abscesses. The average age of onset of symptoms was twenty-five (25) years and the average duration of symptoms before diagnosis was fifteen (15) months. Fourteen (14) cases died and two (2) others had a poor prognosis. Two (2) deaths were from non-tuberculous diseases.

Ten (10) of the thirty-eight (38) cases had involvement of more than one (1) vertebra. Two (2) cases had more than one focus separated by normal vertebrae. The involved vertebrae were distributed as follows:

	Cervical	Thoracic	Lumbar	Sacral
1.	0	0	10	3
2.	0	1	13	
3.	0	1	12	
4.	1	1	12	
5.	0	1	10	
6.	0	2		
7.	0	3		
8.		5		
9.		7		
10.		8		
11.		9		
12		7		

The disease appears to begin in two different locations. First, it may invade the anterior part of the vertebral body just beneath the anterior longitudinal ligament. The granulation tissue then advances along the front of the spine and it invades the underlying bone. If it advances along the anterior longitudinal ligament without deeply invading the bone, it is known as "spondylitis superficialis".



Case 3033 - Pott's Disease
showing invasion along
anterior longitudinal ligament.

Secondly, it may enter along the branches of the posterior spinal artery into the body of the vertebrae, usually appearing in several minute foci near the upper or lower epiphysis. The intervertebral disc offers some resistance to the spread of the disease but when the bone is destroyed on either side is rapidly disappears.

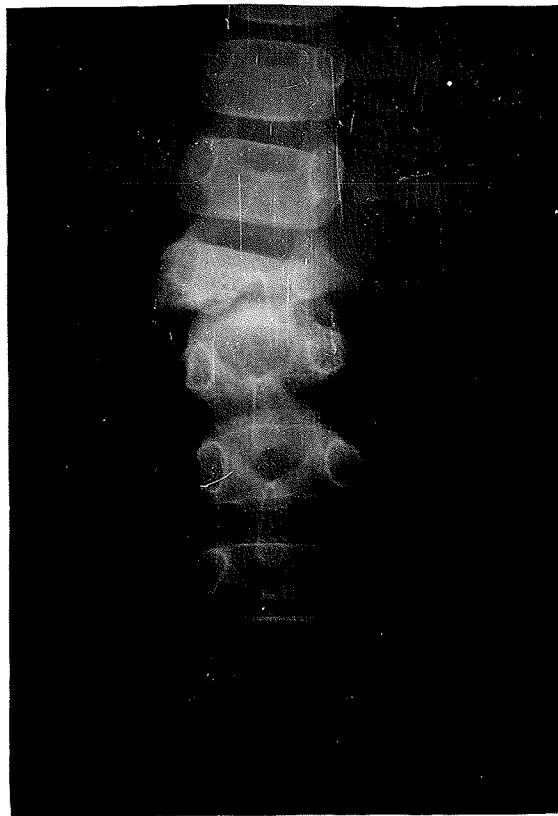


Case 3084 - Pott's Disease
showing destruction of disc.

Examination of the back for Pott's disease should include certain special tests. Passive flexion is best tested in the child by placing him on hands and knees and

lifting him with the examiner's forearms under the abdomen. Limitation of flexion is evident if the back remains nearly straight instead of bending over the forearms. Passive movement can also be tested by placing the patient face down and lifting the legs, gently sway the body from side to side. Psoas contraction is demonstrated by placing the patient face down on the table and pushing the pelvis flat with one hand, the leg if lifted with the other. The knee should normally lift two or three inches from the table. Psoas abscess is usually best demonstrated by placing the patient on his side with the thigh flexed. The examiner's hand is pressed down into the iliac fossa.

In the lumbar and lower two dorsal vertebrae where free movement is prominent, painful stiffness is usually present before destruction. In the early stages there is an increased lordosis. This results from an effort to relieve pressure on ~~the~~ anterior part of the spine and as a compensatory mechanism from flexion of the hips due to psoas spasm. Psoas spasm, with or without psoas abscess, may cause a limp or, if severe, forward inclination of the whole trunk. In the later stages the spine becomes straighter and finally projects backward in the characteristic "gibbus". Pain may radiate to the inguinal region, to the buttocks, or down the thigh.



Case 2978 - Pott's Disease
showing list produced by un-
even destruction of vertebrae.

The thoracic region from the third to the tenth vertebrae has little movement and deformity is often relatively painless. There may be a slight forward bend and the head may be tilted backwards, or to one side. There is often an elevation of the shoulders. Pigeon chest may result from spinal deformity. "Grunting respiration" is characteristic of disease in the thoracic spine. This is due to muscle spasm attempting to inhibit chest movement. Respiratory movements are largely

diaphragmatic and are quick and shallow. Expiration is accompanied by a grunt. Pain is referred to the abdomen as a persistant stomach-ache or to the front and sides of the chest. Intrathoracic abscess in the posterior mediastinum may cause an aimless cough and spasmodic attacks resembling asthma. Paralysis due to spinal cord involvement is most common in this region.

The third cervical to the second thoracic vertebrae is a region of free movement. The cervical spine becomes straighter and the head is usually turned to one side by muscle spasm. Pain is referred to the neck or down the arms. In some advanced cases the neck seems short and the head is tilted backwards. This is caused by a severe angular deformity at the third or fourth cervical which forms a shelf hidden under the occiput. Disease of the cervico-dorsal region often appears with paralysis before deformity is evident. A Horner's syndrome may result.

The occipito-axoid region is most important for movement of the head. The occipito-atloid articulation allows about twenty degrees flexion and thirty degrees extension. The alto-axoid point allows about sixty degrees rotation. Muscle spasm resulting from disease in this region causes an attitude of torticollis. The head may be fixed in the midline with the chin depressed or it may be tilted to one side. The patient often supports the chin with his

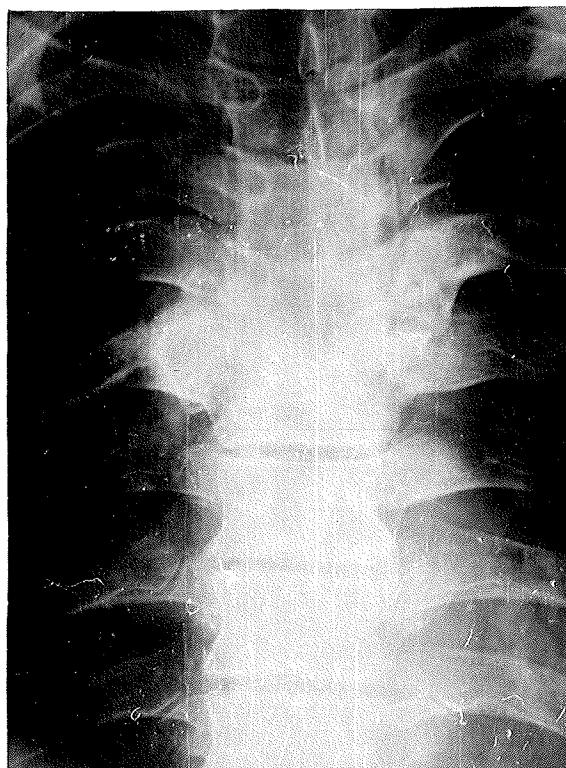
hands. Pain radiates in the distribution of the auricular and occipital nerves. The alto-axoid joint lies in line with the upper teeth and an abscess may bulge in the posterior pharyngeal wall causing symptoms of obstruction such as snoring, voice changes, difficulty swallowing, and spasmodic attacks of croup.

Twenty-seven of the thirty-eight patients with Pott's disease had a demonstrable abscess. In disease of the cervical spine the abscess may project forward behind the prevertebral fascia and appear in the mouth as a retro-pharyngeal abscess. It may pass between the scaleni and longus colli muscles to the interval between the trapezius and sternomastoid. Occasionally it spread round the sides of the vertebral bodies and appears close to the spines of the cervical vertebrae. With disease of the thoracic spine the abscess may remain localized on the front of the vertebra or may perforate the anterior longitudinal ligament and occupy the posterior mediastinum. It may extend laterally accompanying the intercostal vessels and appear at the mid-axillary line or beside the sternum. It may extend backwards and appear on the back. With disease of the lumbar region the abscess usually enters the sheath of the psoas muscle and appears below Poupart's ligament beside the femoral vessels or occasionally enters the femoral sheath and points on the inner side of the thigh or in the popliteal space. It may spread under the sheath of the iliacus muscle and

appear close to the anterior superior spine. It may extend laterally into the sheath of the quadratus lumborum and appear in the triangle of Petit.

The abscess may occasionally become secondarily infected with other organisms from the neighbouring bowel or lungs. Two cases in this series were unusual in that faecal fistulae developed from erosion of the bowel.

The abscess may cause interference with the function of neighbouring organs. Retro-pharyngeal abscess should be evacuated by aspiration in the mid-line of the pharynx. Intrathoracic abscess may require costotransversectomy if it causes pressure on the trachea or bronchi as shown by spasmodic attacks of inspiratory dyspnoea. Other abscesses should be aspirated when they approach the surface.



Case 2941 - Pott's Disease
showing intrathoracic abscess.

Paraplegia is a frequent complication of thoracic Pott's disease. It occurred in nine patients out of thirty-eight in this series. Eight of these cases were thoracic and one was cervical. Five of the nine cases died from various causes. Paraplegia was the first symptom in one case but occurred after pain in the remainder.

The calibre of the spinal canal is seldom lessened by the angular deformity of the spine and the dura mater resists direct destruction of the cord by the disease.

Paralysis is caused by an abscess pressing on the cord or oedema of the cord associated with pachymeningitis. It may be due to destruction of pedicles and dislocation of the vertebra or the pressure of a mass of necrotic bone at the site of angulation. Vascular occlusion may result in degeneration of the cord.

Paraplegia in extension results from an incomplete upper motor neuron lesion and eighty-five per cent recover.

Paraplegia in flexion is due to a complete upper motor neuron lesion and the prognosis is poor. Flaccid paralysis results from a lower motor neuron lesion either at the origin of the affected roots or a lesion at another site producing ascending and descending degeneration of the cord through vascular occlusion. In the latter case complete recovery is unknown. Since the process usually begins in the anterior portion of the cord and spreads backwards anaesthesia is a late symptom and when vibration sense is lost the prognosis is said to be

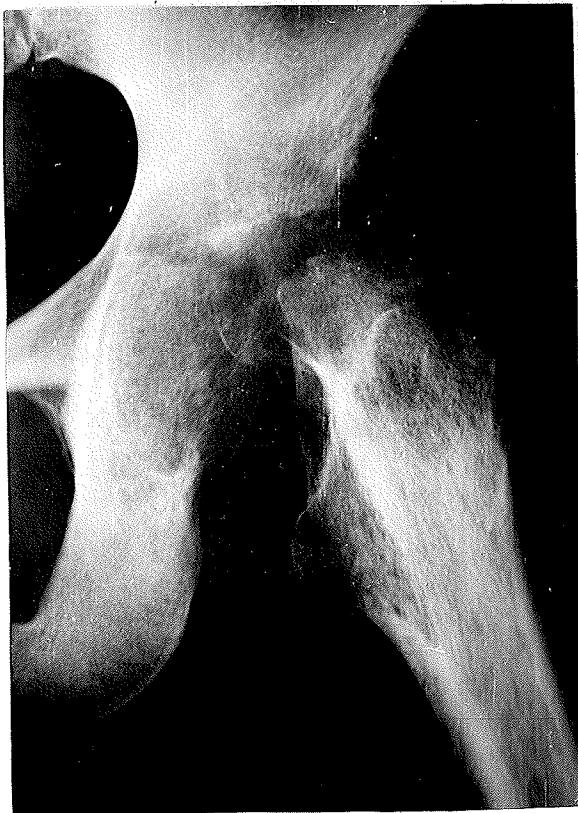
hopeless. The bladder is usually reflexly incontinent but the anal sphincter is less often affected. In the dorsolumbar region there is a flaccid paraplegia with atonic bladder. The canda equina is occasionally involved as a peripheral neuritis with pain, weakness, and numbness in the area supplied by the affected nerve.

Treatment of paraplegia is the same as for uncomplicated Pott's disease except that laminectomy or costo-transversectomy may occasionally be indicated when there is evidence that pressure from bone or abscess is the cause.

The treatment of Pott's disease consists of immobilization and prevention of further deformity. Existing deformity should not be altered because it would leave a weakened gap. In the acute stage of destruction recumbent immobilization in plaster shells or on the Bradford frame is usually instituted. After the stage of destruction has ceased spinal fusion is advocated by most authorities. Fusion may be done in young children with little or no apparent disturbance of growth.

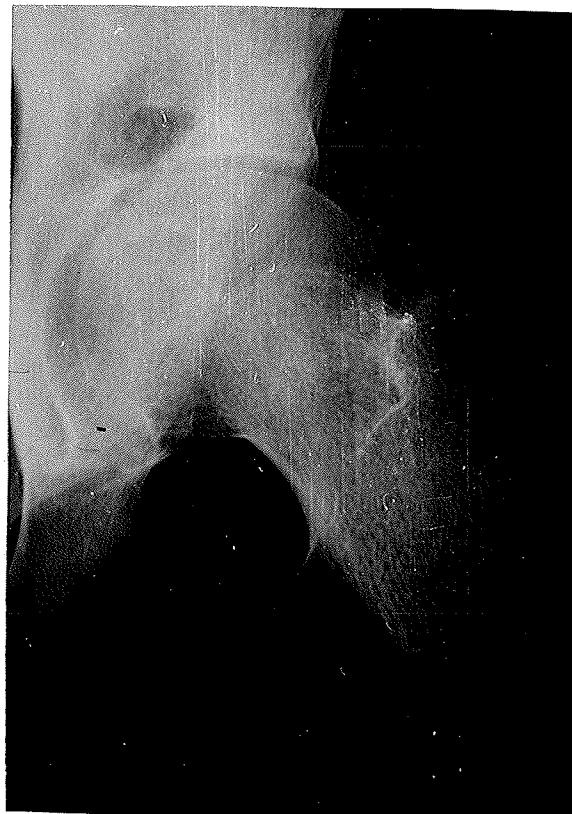
Tuberculosis of the Hip

There were nineteen cases of tuberculosis of the hip in the seventy-three patients in this series. Ten cases were preceded by pulmonary tuberculosis, one by pleurisy, and one by tuberculous peritonitis. Four cases, previously clear, were followed by pulmonary tuberculosis and one by meningitis. Seven cases had other bone and joint tuberculosis. Nine cases had abscesses. The average age of onset of symptoms was nineteen years and the average duration of symptoms before a reasonably certain diagnosis was six months. Seven patients died. No case was bilateral.



Case 2757 - Tuberculosis
of hip showing destruction
of the head of the femur.

The disease usually begins as several minute foci near the epiphyseal cartilage of the head of the femur. At least two cases in this series began in the acetabulum and one case existed as tuberculous osteomyelitis of the greater trochanter for twenty-nine years before involving the joint. Primary synovial infection may occur.



Case 2961 - Tuberculosis
of hip showing focus in
acetabulum.

When the tuberculous caries causes disintegration of the superior margin of the acetabulum, it is known as a "wandering acetabulum".

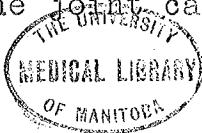
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Case 2076 - Tuberculosis
of hip showing wandering
acetabulum.

Limp is the most prominent early symptom and is usually accompanied by aching. Pain is usually a late symptom and is referred to the front of the thigh or the inner side of the knee.

The earliest deformity is usually a stage of apparent lengthening. The thigh is held in flexion abduction and outward rotation. This probably results from an attempt to lessen the tension in the joint capsule. The stage of apparent



shortening results from muscle spasm causing flexion, adduction, and internal rotation of the hip. There may be actual lengthening at an early stage as a result of granulation tissue in the acetabulum or from stimulation of the epiphysis of the head of the femur. Later true shortening appears due to absorption of bone. Limitation of motion in every direction is almost always present at an early stage, although there may be free movement up to the last quarter of its normal range.

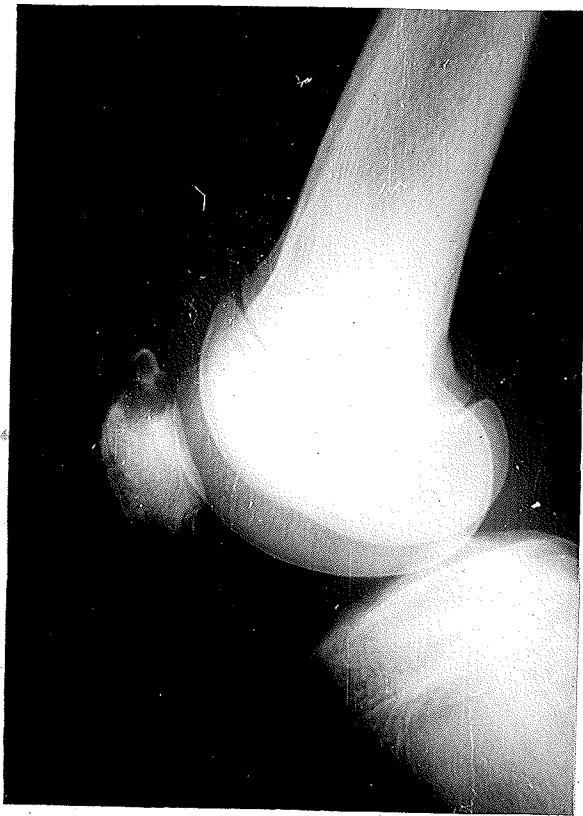
The Thomas Hip-flexion Test is performed by flexing the sound hip and knee just enough to obliterate the lumbar lordosis. While the spine and pelvis are flat on the table the patient should be able to put the other thigh flat on the table.

Treatment of hip disease should begin with immobilization in recumbency. Deformity can usually be corrected by Buck's traction or by multiple changes of spica with gradual correction. Immobilization can be maintained by the Thomas hip splint or plaster spica. Arthrodesis by one of the extra articular methods, such as that of Brittain or Campbell, may possibly be of value even before the stage of destruction has ceased. If intra-articular arthrodesis is used, it should not be considered until there is evidence of healing. Although some authors believe that operative fusion may be undertaken as early as four years of age, it is probably wiser to wait until twelve years of age.

Tuberculosis of the Knee

There were ten cases of tuberculosis of the knee in the seventy-three patients in this series. Six cases were preceded by pulmonary tuberculosis and one by pleurisy. Two cases, previously clear, were followed by pulmonary tuberculosis. Two cases were complicated by other bone and joint lesions. Only one case had an abscess. The average age of the ten patients, at the onset of symptoms, was eighteen years and the average duration of symptoms before diagnosis was over one year. One case died of pulmonary and three of generalized tuberculosis.

The primary involvement may be in the epiphysis of the femur or tibia. Sometimes it begins in the patella. Most authorities believe that primary synovial involvement is frequent. One case in this series had negative x-rays for twenty months before focus in the lateral femoral condyle was seen.



Case 2961. Tuberculosis of the knee
showing focus in the patella.

Clinically there are two distinct types. Chronic synovitis with subacute onset occurs especially in adults. Any chronic synovitis in childhood which shows no tendency towards recovery is almost always tuberculous. The second type has a primary focus in bone. This is the more common type and has an acute onset with pain, muscular spasm, and deformity.

There is a doughy swelling or pseudofluctuation from synovial thickening and periarticular degeneration. There is atrophy of the muscles about the knee and muscular spasm is usually present. Limitation of flexion is present early and slight limitation of extension also occurs. In addition

knock-knee or bow-leg deformity often results from destruction of one condyle more than the other. Outward rotation and backward displacement of the tibia is secondary to the flexion deformity.



Case 1797. Tuberculosis of knee showing flexion deformity and backward displacement of tibia.

Actual lengthening is caused by irritation of the epiphysis and may be as much as an inch or more. Actual shortening is caused by destruction of the joint space or the epiphysis. The length is almost always longer for the first two years of the disease but usually shorter when the period of growth is completed.

Treatment consists in reduction of deformity and immobilization during the acute stage. Some attempt may be made to correct the backward displacement of the tibia as well as the flexion deformity. This can be done most readily by wedge casts. However, care must be taken to cut the wedge so that the fulcrum is placed over the femoral condyle and not over the knee-joint otherwise the backward displacement would not be corrected. Immobilization can be maintained by plaster splints or the Thomas knee splint. In children, if the knee does not show any evidence of bone destruction after symptoms have been present for several months, it would seem reasonable to continue immobilization with the expectation that resolution will occur and function be returned. However, if a focus appears in the bone there is only one result which can be considered desirable and that is sound, bony ankylosis. In this case, arthrodesis should be performed as soon as there is evidence that destruction has ceased. Arthrodesis may be performed in children as young as three years of age with little or no loss of growth.

Tuberculosis of the Ankle and Intertarsal Joints

There were four cases of tuberculosis of the ankle in the seventy-three patients in this series. The youngest was five years of age and the oldest thirty-six years. The average duration of symptoms before diagnosis was about six months. Three cases were complicated by other joint involvement and three cases had pulmonary tuberculosis.

There were no deaths. One case had amputation because of presence of tuberculosis of the knee on the same side. Only one case had an abscess.

The primary focus of tuberculosis of the ankle joint is usually in the astragalus.



Case 2685. Tuberculosis of the Ankle.

The limp of ankle disease is distinctive. The patient walks on the heel with the limb externally rotated. Equinus deformity develops late when the foot is unable to bear weight.

Disease of the subastragaloïd joint is similar except that abduction and adduction are restricted.

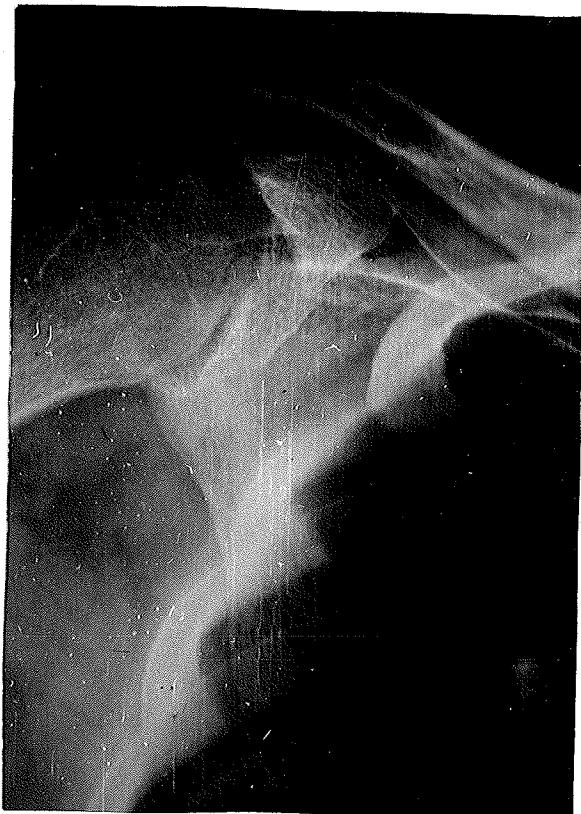
In the astragalonavicular joint the foot is usually fixed in abduction.

The disease tends to spread rapidly throughout the tarsus and sinuses are very frequent. For these reasons treatment is difficult and amputation is always indicated if there is any doubt about the patient's general condition. Patients in the younger age group should have the foot and ankle immobilized until destruction of bone has ceased. Although many authorities have shown good results from conservative treatment alone it is generally believed that arthrodesis at the optimal time hastens recovery as well as preventing recurrences. Amputation is probably the treatment of choice after middle age because of the high mortality rate.

Tuberculosis of the Shoulder

There were four cases of tuberculosis of the shoulder joint in this series of seventy-three patients. All were complicated by pulmonary tuberculosis, but none had other bone and joint lesions. Two cases had abscess formation. The youngest patient was fifteen years and the oldest fifty-one years. The average duration of symptoms before diagnosis was about one year. Two of the patients died.

The focus of tuberculosis of the shoulder usually appears in the head of the humerus. In a few cases the disease takes the form of "caries sicca" in which there is no swelling or abscess formation but which is accompanied by marked muscular atrophy.



Case 3079. Tuberculosis of the
Shoulder

In most cases abscess formation appears as a swelling anteriorly near the insertion of the deltoid. There is usually a dull ache with occasional referred pain to the region of the elbow.

Ankylosis usually occurs spontaneously in two to five years but permanent arrest may be hastened by arthrodesis after the stage of destruction has ceased. In children the optimum angle is found to be eighty degrees abduction and twenty degrees in front of the plane of the body.

Tuberculosis of the Elbow

Only one case of tuberculosis of the elbow occurred in the seventy-three patients in this series. This was a forty-two year old male who died from pulmonary tuberculosis. Abscess formation was present.

The focus of tuberculosis usually occurs in the olecranon process of the ulna.

Pain is localized at the elbow. There is the typical spindle shaped white swelling with slight local heat. Movement is restricted and becomes fixed midway between flexion and extension and midway between supination and pronation.

Treatment consists in immobilization in a plaster splint at about a right angle during the acute stage. Arthrodesis after bone destruction has ceased probably hastens arrest of the disease.

Tuberculosis of the Wrist and Intercarpal Joints

There were three cases of tuberculosis of the wrist in the seventy-three patients in this series . All were complicated by pulmonary tuberculosis and two had other bone and joint lesions. Abscesses were present in two cases. Age varied from ten years to thirty-one years. The duration of symptoms before diagnosis was established averaged about one year. One case died from arteriosclerosis. The ten year old patient had natural fusion of the wrist after six years of pain. One patient whose carpus was excised for tuberculosis had to have arthrodesis sixteen years later for persistant pain.

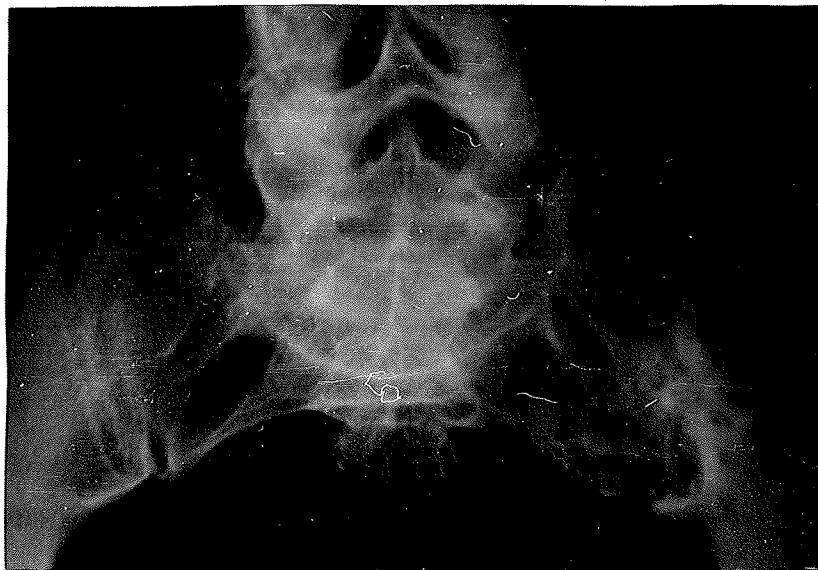
The primary focus usually appears in the lower end of the radius but may be in any of the carpal bones or primary in the synovium.

Pain is present locally and there is limitation of movement. Local swelling is easily detected and atrophy of muscles occurs later.

The wrist is immobilized in the cast in thirty-five degrees dorsiflexion. The elbow should be included in most cases. After destruction of bone has ceased the entire carpus with the triangular fibrocartilage may be excised but arthrodesis is probably the procedure of choice.

Tuberculosis of the Sacro-Iliac Joint

Two cases of tuberculosis of the sacro-iliac joint occurred in the seventy-three patients in this series. Both cases were complicated by other tuberculosis and one case also had involvement of the hip. Neither case had an abscess. Symptoms began at seventeen years and sixty-one years. The probable duration before diagnosis averaged about one year, but one patient had considerable pain in the same region fifty-one years previously. Neither patient died. One female had pelvic deformity resulting from arthrodesis.



Case 2962- Tuberculosis of
Sacro iliac joint

Abscess usually points around the anterior superior iliac spine or may pass through the greater sciatic notch to the buttock or may appear in the ischio-rectal fossa or break into the rectum.

Pain is present down the posterior of the thigh and leg or in the gluteal region. Pain is increased by bending, sudden movements and coughing. The gait becomes shuffling with the knees held close together.

Examination shows limitation of movement of the spine, especially flexion. There is usually a lumbar scoliosis which remains on lying down. Rectal examination reveals tenderness in the majority of cases. Straight leg raising is usually limited to about forty-five degrees. Compression of the iliac crests elicits pain in the region of the joint. Gaenslen's test is performed by having the patient on his back with one thigh off the edge of the table. The thighs are

simultaneously forcedly flexed and extended which produces a shearing strain through both sacro-iliacs without strain on the back.

Treatment of sacro-iliac disease is difficult because of the impossibility of obtaining complete immobilization. During the acute stage immobilization can be secured by a double spica. After destruction of bone has ceased arthrodesis hastens permanent arrest of the disease. This is probably best done by extra-articular fusion of the ilium to the sacrum.

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