

be placed across the opening, thus preventing the hernia from again making its appearance.

It is unnecessary to say that the strictest asepsis should be enforced in this operative procedure.

Dermoid cysts, lipomatous tumors, and cystic tumors of other varieties occurring in this region should be dealt with in the same manner as in other portions of the body.

Among the acquired diseases which call for surgical treatment may be mentioned, first, the various curvatures of the spine. As these have already been treated under other heads, I may pass at once to the consideration of certain features in the treatment of Pott's disease. (The subject, as a whole, is discussed under the title *Spine, Tuberculous Disease of the*.) Should pressure of the cord be present, in this disease, an operation for relieving this pressure by removal of laminae should be

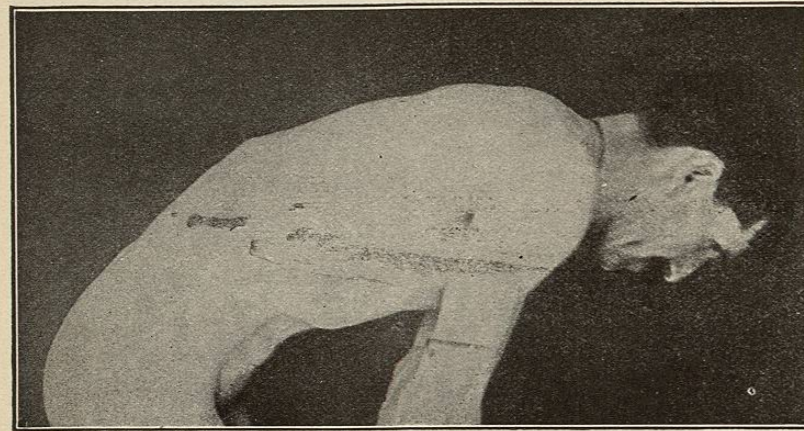


FIG. 4426.—Fracture of the Spine due to a Fall from a Height of Eleven Feet. Picture taken ten weeks after the occurrence of the accident. (Courtesy of Dr. Royal Whitman, of New York.)

performed. If fluctuation exists, denoting the presence of pus, the cavity should be evacuated by an ordinary trocar and cannula or an aspirating needle. Should the pus not be withdrawn as readily as expected, on account of broken-down tissue, the removal of this tissue can be facilitated by the use of an aseptic wire bent in the shape of a small hook. After the abscess cavity has been completely evacuated, it is advisable to inject a ten-per-cent emulsion of iodoform in glycerin. While iodoform does not act as a germicide, it has been satisfactorily demonstrated that it retards the growth of the tubercle bacilli. Numerous trials of this method have fully convinced me of its great utility in materially cutting short the disease. About one-half drachm of the emulsion is injected the first time, and if no unpleasant symptoms result this quantity, if necessary, may be increased at the next application. An interval of about seven or eight days should occur between the injections. When the needle is withdrawn, the puncture in the skin is closed with collodion or liquid celluloid, and a compress and bandage are applied to the part so as to cause the walls of the abscess to collapse. As the last step, the patient is placed in bed, slight extension and counter-extension are instituted, and absolute rest is enjoined. If the first injection proves beneficial, it will seldom be necessary to employ more than two or three of them. It is to be borne in mind that iodoform is not efficacious in cases of mixed infection, but only in those cases in which the disease is produced by the tubercle bacillus. When the disease occurs in childhood and when early diagnosed, the deformity can be entirely or almost entirely corrected and the spine made to assume its normal position. The details of the method which it is necessary to pursue will be found in the following article.

Contusions or Sprains of the Spinal Column.—On account of the complex structure of the vertebral column,

and of the large number of veins and nerve filaments which issue from the spinal cord contained within it, direct injuries inflicted upon this column may at times be followed by great loss of function. The symptoms presenting themselves depend very largely upon the degree of injury that has been sustained; this may be slight in extent, producing only temporary stiffness or soreness over a limited area; or it may, on the other hand, be more serious in character, as when the ligaments of the spine are either partially or completely torn away. Such serious results are observed in runaway accidents and after railroad collisions. When the ligamenta subflava are involved, severe hemorrhage of an extradural character may occur and paraplegia result; this, however, in many cases, is only of short duration, the extravasated blood being absorbed and recovery being the rule. When ex-

amined externally, the injured portion of the spine presents either a slight or considerable swelling, together with great tenderness and pain. In some cases the pain is so great at the point of injury that the patient involuntarily immobilizes the spine and in this way avoids any rotation or flexion of the column, the slightest degree of which often throws him into spasms. It is of the utmost importance in the examination of these cases that a correct diagnosis be made between contusions and fractures or dislocations of the spine. Cases of severe contusions present symptoms closely analogous to those of a fracture or a dislocation, such as partial or complete paralysis, corresponding to the seat of injury, and produced by either extra- or intradural

hemorrhage. These symptoms of paralysis, however, are transient, readily passing away after absorption of the effused blood. In some cases in which hemorrhage has been severe the symptoms are prolonged, and the diagnosis between contusion, fracture, and dislocation is made out only by a careful examination of the bony canal and the discovery of signs which are revealed after the swelling has sufficiently subsided.

The treatment for contusions of the spine is conducted upon general principles, namely, rest, position, etc.; pain is relieved by hot or cold applications, or by the administration of anodynes if the pain is severe. All friends and acquaintances of the patients are to be kept out of the room, light must be excluded from the eyes, and every precaution must be taken for relieving them of anything of an irritative character.

One of the unfortunate symptoms following contusion is great irritability and nervousness. As soon as the swelling subsides, ointments such as brown citrine or compound iodine are to be freely rubbed over the part. To allay irritability and nervousness, chloral hydrate, bromide of potassium, or hydrobromate of hyosine should be administered.

Fractures of the spine are quite rare as compared with fractures in other portions of the body. The portions of the column most frequently fractured are the cervical and dorsal regions, while the lumbar and sacral are very seldom the seat of this injury. The two vertebrae which are most commonly broken are the fifth and sixth cervical. Fractures of the cervical vertebrae terminate more frequently in death than do fractures of any other portions of the vertebral column. These fractures, as a rule, occur during middle life and are more frequent in the male than in the female, this being due to the fact that the occupation of the male renders him much more liable to these accidents. These fractures occur in the

body and arches, and there is every reason to believe, from statistics on this subject, that in the great majority of them they occur much more frequently in the arches than in the body of the vertebra. When these fractures occur, the majority of them are due to forcible flexion of the spine, the head and neck approximating, or the chest and the pelvis. Such injuries are apt to be produced by the caving in of an embankment, by a fall from a high scaffold, or by the doubling of the body in passing through a tunnel, as has been exemplified in several cases that have come under my personal observation. Whenever the injury is of such a nature as to produce a fracture in the vertebra, it is always accompanied with considerable laceration of the muscles and ligaments, and often with hemorrhage, which may be extradural or subdural. At times there is crushing of the bodies of the vertebrae, with greater or less displacement.

Fracture of the spine in the middle region without displacement may cause angular deformity, and, when proper support has been neglected, symptoms of pain and weakness similar to those of Pott's disease may persist indefinitely (Fig. 4426.)

The symptoms of fracture of the vertebrae are generally pronounced; they consist of deformity, crepitation, and partial or complete paralysis below the seat of fracture. There is usually great shock attending these injuries. In fracture of the vertebrae in the lower lumbar, sacral, and coccygeal regions, on account of the absence of the spinal cord, we have very seldom either a complete or a partial paralysis, but all the other signs of fracture are generally present.

The prognosis of fracture of the spine, especially when it occurs in the upper spinal region, is very unfavorable; if the patient should recover from the shock attending such injuries, he is very likely to be paralyzed the rest of his days.

Gunshot fractures of the vertebrae partake of the character of a compound fracture, and consequently are frequently complicated with infection and thus make the prognosis much more unfavorable.

In the treatment of fractures of the spine, the patient should be placed in a recumbent position and extension and counter-extension should be maintained. Gentle pressure should be made in such a manner as to relieve and correct the deformity. An air- or water-bed is preferable to any other contrivance for placing the patient upon. If it should be impracticable to obtain such a bed, a short hair mattress made perfectly smooth should be procured; but under no circumstances should the patient be placed upon a feather mattress. Extension can be maintained by applying Buck's extension apparatus to both legs, the weight and pulley being placed at the end of the bed, and counter-extension being maintained by a leather cap which fits the head and comes under the chin. In many cases this counter-extension can be improved by having the foot of the bed elevated higher than the head. If more than one vertebra has been injured, the parts may be held in position, and probable deformity prevented, by placing compresses of surgeon's wool on each side of the injury and holding them in place by adhesive strips. It is found necessary in almost every case to catheterize the patient, and great attention should therefore be paid to the toilet of the bladder, so as to keep this organ from chronic inflammation. The patient should be kept scrupulously clean, with plenty of fresh air, and a simple but nutritious diet should be prescribed. In quite a number of cases it will be discovered that a portion of the lamina is pressing upon the cord, and should this be recognized, an operation known as laminectomy should be performed. On account of the fatality of fractures of the spine and the helpless condition in which many patients are left from the effect of this injury, surgeons have felt themselves warranted in taking any steps, it matters not how heroic, for the purpose of saving or at least benefiting the injured. For this purpose, in recent years, the operation of laminectomy has been devised. It is true that the operation has not furnished as brilliant results as could be desired, yet some of the remarkable recoveries that

have been obtained by this operation have led many surgeons to believe that, should the operation be performed early enough, many lives might be saved which now are lost, and new laurels added to surgery. I am of the opinion that the delay in resorting to this operation has led to degenerative changes in the cord, and is responsible for the many unsuccessful issues; I would therefore urge an immediate operation in every case of fractured lamina. In a number of cases, owing to the amount of swelling, it is impossible for a surgeon to tell exactly what the conditions are until he has cut down upon the vertebrae and examined them. Aseptic surgery has made this possible, and when in doubt the surgeon should cut down upon the vertebrae and thus give the patient every opportunity for a complete recovery. The operation is performed in the following manner: The patient is placed with his face slightly downward and with a small hard pillow under the lower ribs, thus giving the spinal column a gentle curve; the parts are cleansed and made thoroughly aseptic, and an incision is made of from three and one-half to four inches in length, parallel with the tips of the spinous processes; the middle point of this incision corresponding with the seat of fracture. The muscular structures are now detached from the sides of the spinous processes, and the posterior surface of the lamina is brought into view. With a periosteotome the periosteum is separated from the bone; a procedure which should be carried out with great care, so as to preserve as much of the periosteum as possible. The wound is now held open by retractors and, if there is any hemorrhage, it should be entirely controlled, either by hæmostatic forceps or by the application of hot, sterilized water. The spinous processes are divided by a strong pair of bone forceps, thus enabling the operator to gain a perfect view of the laminae. The laminae are then either simply elevated or bit off by a pair of rongeur forceps. The membrane and spinal cord are now inspected. Should the dura mater show by discoloration the presence of blood, it should be incised, the imprisoned blood evacuated and the hemorrhage controlled, and the parts thoroughly irrigated with either a saline solution or sterilized hot water. After the cord and nerves have been carefully examined, cleansed, and placed back in the best possible condition, the dura mater should be adjusted and its edges brought together by interrupted catgut sutures. The muscular structures are sutured by the same material and the skin approximated by silk or silkworm sutures. After the operation, the patient should be placed on an air- or water-bed, shock should be combated, and every detail in the after-treatment should be carefully carried out.

Dislocations of the Vertebra.—In the great majority of cases dislocations are associated with fractures, but, in a few instances which come under the surgeon's observation, the dislocation is entirely uncomplicated with fracture. These injuries are either produced by forced flexion or by hyperextension, and may be either unilateral, bilateral, or complicated with hemorrhage in the cord. The vertebrae that are more prone to dislocations are the last dorsal, first and second lumbar, and the last cervical. With all of these dislocations we have either a partial or a complete laceration of ligaments and muscular structure, together with such complications as rupture of blood-vessels, injuries to nerves, and laceration of the intervertebral discs. As a rule, these discs are readily recognized, as they show a very great displacement from their normal position. Dislocations are distinguished from a fracture by an absence of crepitation or preternatural mobility. The great weight of authority is against any effort to reduce these dislocations, as by so doing it is feared that a more serious complication may arise and the patient lose his life; yet in some cases I believe it is the duty of the attending surgeon to attempt a reduction. This may be effected by traction, aided by flexion and rotation. It is the duty of the surgeon, before proceeding with this method, to inform the patient's relatives and friends of the great danger which accompanies this undertaking, and to obtain from them their sanction before he resorts to this measure.

Hemorrhage of the Cord.—This may be either extradural, subdural, or intraspinal. The symptoms following extradural hemorrhage are at first somewhat akin to those of laceration of the muscular tissue surrounding the spinal column; but later on, owing to the extravasation of the blood, great pain is felt in the region involved, and still later, in some cases, symptoms of paralysis supervene. In the subdural variety the pain and paralysis occur much earlier and are then followed in almost every case by paralysis. On the other hand, in the intraspinal variety, symptoms of paralysis come on immediately, thus simulating fracture or dislocation of the spine. In some cases of hemorrhage of the spinal cord, where the hemorrhage is slight, absorption may take place and an ultimate recovery ensue. In other cases in which the symptoms are prolonged, the patient, instead of getting better, gradually grows worse; in which event it is the duty of the surgeon to operate and evacuate the blood or remove the clots that have formed.

Abscess of the Spinal Cord.—In all cases of abscess of the spinal cord, when diagnosed, an operation for the speedy evacuation of the pus should be performed and drainage established.

Tumors of the Cord.—These tumors are either of a benign or of a malignant type, and when recognized they should be dealt with in the same manner as are similar tumors when found in the brain. *Paul F. Eve.*

SPINE, TUBERCULOUS DISEASE OF THE.—(Synonym, Pott's disease.) Pott's disease is a chronic destructive process that affects the bodies of the vertebrae, the anterior and weight-supporting portion of the spinal column. As the disease progresses the part of the spine above the weakened point sinks downward and forward, throwing into relief the spinous processes at the seat of disease. Thus an angular posterior projection is the

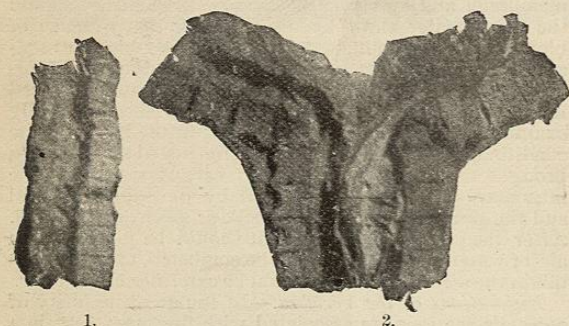


FIG. 4427.—Spinal Lesions in Pott's Disease. 1, Disease in two distinct regions of the spine; 2, a section of the spine showing the production of angular deformity.

characteristic deformity of Pott's disease, or rather of any process attended by local destruction of one or more of the vertebral bodies. If one vertebral body is destroyed, the projection is sharp and well defined; if several are involved, it will be less angular; and if one side of a vertebral body breaks down, there may be a slight lateral distortion as well.

The size of the deformity and its effect upon the individual depend in great degree upon its situation. If it is at either extremity of the spine the deformity is small, because so little of the spine is affected compared with that which remains free from disease. Thus, angular deformity in the upper cervical region simply shortens the neck, and disturbs the poise of the head. In the lowermost region it shortens the trunk and induces a peculiar attitude, but in either case the posterior projection or "hump" is slight; but when the middle of the spine is involved the opportunity for deformity is great and the entire spine may enter into the formation of the kyphosis.

PATHOLOGY.—The first indication of disease is usually found in the anterior part of a vertebral body beneath the longitudinal ligament. From this point the infected

granulation tissue, following the course of the blood-vessels, invades and destroys the adjacent spongy tissue. In other instances the disease may begin in several minute foci in the interior of a vertebral body near the upper or lower epiphysis. These, coalescing, gradually enlarge, forming a cavity; collapse follows and the deformity appears. Less often the disease advances beneath the anterior ligament as a form of tuberculous periostitis, without implicating deeply the substance of the vertebral bodies. The posterior part of the spinal column usually remains free from disease, unless it comes into direct contact with it.

The course and outcome of the disease depend upon its character. If the area of primary infection is limited, the local resistance may check its further progress and cure without deformity may follow. In other instances, although the area of active disease is small, it continues to progress and the deformity slowly increases, although unaccompanied by pain or by constitutional symptoms. In the majority of cases, however, the tuberculous granulations advance rapidly, destroying the bone or other tissues with which they come into contact. The usual retrograde metamorphosis to cheesy degeneration follows, and then very frequently liquefaction or abscess formation takes place.

In characteristic cases that come to autopsy during the progressive stage of the disease, one finds, on dividing the thickened tissues in front of the spine, a cavity the walls of which are lined with tuberculous granulations in various stages of degeneration and containing puriform fluids. The adjoining vertebral bodies present a worm-eaten appearance, and one or more of them is partially destroyed. Small fragments of necrosed bone and "bone sand" may be present, together with larger masses of degenerated tissue; less commonly sequestra of considerable size may be found, loose or embedded in the diseased area.

As the disease progresses it may force its way into the vertebral canal and press upon the spinal cord, involve its coverings, and cause paralysis of the parts below. Such a complication is more frequent when the disease begins in the centre or posterior portion of a vertebral body. In such instances the paralysis may precede the deformity. Pressure on the cord may be caused also by an abscess or a projecting fragment of bone. The calibre of the spinal canal may be lessened also by the pressure of the superincumbent weight upon the softened and thickened tissues at the seat of disease, but as a rule its capacity is not directly lessened by the characteristic angular distortion. In fact, pressure paralysis more often complicates cases in which the deformity is moderate or slight in degree than those in which it is extreme.

In rare instances tuberculous disease may appear in two regions of the spine simultaneously, but it usually begins in one or two adjacent vertebral bodies, one or both of which are partially destroyed. From this point the disease extends in either direction, and in ordinary cases the final area of deformity and rigidity shows that from three to six bodies are more or less involved before a cure is established.

At all stages of the disease resistance to its progress and local efforts at repair are evident in the affected parts. This is accomplished occasionally by contact and solid union of the adjoining surfaces of softened bone, but this is possible only when the area of the disease is small. If several bodies are destroyed there is usually backward displacement of the upper segment of the spine as it sinks downward. Thus the anterior surface of one or more of the bodies of the upper segment may be apposed to the upper surface of the lower body. In such instances the ankylosis is in part fibrous, in part cartilaginous, and in part bony. This may include the articular processes, the pedicles and laminae; in fact, ankylosis may be established here before repair has advanced appreciably in the anterior portion of the column.

Cure may be complete, no vestige of the disease remaining; or the diseased products may undergo calcareous degeneration and may be enclosed in newly

formed tissue. In other instances the disease is simply quiescent, and may show its presence from time to time by recurrent symptoms of discomfort, by abscess formation, or even by paralysis many years after apparent cure.

ETIOLOGY.—The etiology of tuberculosis of the spine does not differ from that of other bones; the subject is considered elsewhere.

Relative Frequency.—Tuberculosis affects the spinal column more frequently than it does any other single bone or joint. This point is illustrated by the statistics of tuberculous disease treated in the out-patient department of the Hospital for Ruptured and Crippled during a period of fifteen years: Tuberculosis of the spine, 3,207 cases; hip-joint, 2,230 cases; other joints inclusive, 2,408 cases.

Age.—Pott's disease, although far more frequent in the middle period of childhood (from the third to the tenth year), may occur at any time from earliest infancy to extreme old age.

STATISTICS FROM WHITMAN'S ORTHOPEDIC SURGERY.

	Cases.	Per cent.
Less than one year.....	38	3.1
Between one and two years.....	176	14.2
Between three and five years.....	627	50.2
Between six and ten years.....	234	18.3
Between eleven and twenty years.....	89	7.2
Between twenty-one and thirty years.....	43	3.5
Between thirty-one and fifty years.....	31	2.6
Over fifty years.....	11	.8

The youngest patient was two months old, the oldest seventy-one years.

Sex.—Sex exercises comparatively little influence upon the liability to disease of this region. In 3,822 cases 53.2 per cent. were in males and 46.8 per cent. in females (*loc. cit.*).

The Situation of the Disease.—The dorso-lumbar section of the spine is most often affected. Cervical disease is comparatively infrequent.

In the series of 1,355 cases (*loc. cit.*) the attempt was made to locate the origin of the disease by the most prominent spinous process in the tracing. The following are the conclusions:

Cervical.	Dorsal.	Lumbar.	Lumbo-sacral.
First, 3	First, 26	First, 94	13
Second, 3	Second, 43	Second, 96	
Third, 15	Third, 42	Third, 64	
Fourth, 20	Fourth, 46	Fourth, 57	No deformity.
Fifth, 13	Fifth, 49	Fifth, 6	Cervical, 2
Sixth, 22	Sixth, 76		Dorsal, 31
Seventh, 24	Seventh, 82	317	Lumbar, 22
	Eighth, 97		
	Ninth, 92		55
	Tenth, 110		
	Eleventh, 71		
	Twelfth, 120		
100	854		

Disease in two regions of the spine, 16.

From these statistics, which do not differ essentially from those reported by others, it appears that the disease is much less common in the cervical than in the dorsal region. This may be explained by the greater strain to which the middle and lower part of the spine is subjected, as well as by the relatively larger proportion of cancellous tissue which offers the opportunity for infection.

PROGNOSIS.—Pott's disease is the most serious of all the tuberculous affections of the bones and joints, because of the relative importance of the structures directly and indirectly implicated. Prognosis must include also the indirect influence of the deformity. In the typical "humpback" deformity the contents of the thorax and abdomen are necessarily compressed, the blood-vessels are distorted and the calibre of the aorta is thereby often much diminished, respiration is made difficult, and the circulation is impeded. As a consequence the heart is usually hypertrophied or dilated, and valvular insufficiency is not infrequent. Thus the vital functions which

are carried on at a disadvantage even under favorable conditions become impossible under the added strain of unfavorable surroundings, overwork, or disease. It is a matter of common observation that few of those who are markedly deformed reach old age. On the other hand, it may be assumed that slight deformities, or those which do not as directly interfere with the vital functions, exercise but little influence upon the future well-being of the patient. This emphasizes the importance of early diagnosis and efficient treatment.

The direct mortality of Pott's disease cannot be accurately estimated, but at least twenty per cent. of all patients die during the progress of the disease and within a few years after its onset, from causes directly or indirectly dependent upon the local lesion. Some of these die from general dissemination of the tuberculous infection and tuberculous meningitis; some from exhaustion following septic infection or from amyloid degeneration and exhaustion dependent on long-continued suppuration; some from tuberculosis of the lungs, and many from intercurrent affections that are fatal because of the devitalizing influences of the disease and its complications.

SYMPTOMS.—The most positive sign of Pott's disease is deformity. At an early stage of the process there may be but a slight irregularity in the contour of the spine, and if several adjacent vertebral bodies are affected the projection may be somewhat rounded in outline. But as compared with other deformities of the spine, that of Pott's disease is characteristically angular, because its cause is loss of substance.

This angular deformity was once thought to be essential for diagnosis, but it is simply the result of disease that may have existed for months, a disease whose presence may be detected long before it reaches the destructive stage.

The spine is the most important support of the body, an elastic column that accommodates itself to every movement of the trunk and limbs. The early symptoms of a destructive disease must be therefore pain and functional disability. The spine also contains the spinal cord, from which branch the nerves that supply the organs and members of the body, and in certain instances the sudden onset of paralysis due to extension of the disease backward might occur early in the process. Or, again, abscess, one of the common accompaniments of tuberculous disease, might, because of its size or situation, become the most noticeable symptom.

These are symptoms that may be misleading, and it is well, therefore, to consider them apart from those that indicate the primary effect of the disease upon the spine considered as an elastic support. These direct symptoms usually precede and always accompany the secondary or complicating symptoms, and upon them the diagnosis depends.

The primary and diagnostic symptoms of Pott's disease may be classified as follows:

- (a) Pain.
- (b) Stiffness.
- (c) Weakness.
- (d) Awkwardness.
- (e) Deformity.

The pain of Pott's disease is not usually localized at the affected vertebrae nor is it accompanied by sensitiveness to pressure or infiltration and swelling of the overlying tissues, as is usually the case when other bones are involved; for the vertebral bodies are within the trunk, almost as far from the spinous processes as from the anterior surface of the body.

Thus sensitiveness to direct pressure is unusual, and palpation, except in the cervical region, is of little diagnostic value.

The pain of Pott's disease is not localized, because the nerve filaments that supply the bodies of the vertebrae are insignificant parts of nerves that are distributed to distant points—to the head, to the limbs, to the front and sides of the body, and to these parts the pain is referred. Thus "earache" or "stomachache" or "sciatica" may