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# Modern Surgery - Chapter 24. Surgery of the Spine

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## XXIV. SURGERY OF THE SPINE.

**Congenital Deformities.**—*Spina bifida*, or *hydrorrhachitis*, is a congenital cystic tumor due to vertebral deficiency, permitting protrusion of the contents of the spinal canal in the median line. The laminæ or spines of one vertebra or of several vertebræ may be deficient, most frequently in the lumbosacral region. *Meningocele* is a protrusion of dura mater and arachnoid, the sac containing cerebrospinal fluid, but no nerves and no cord-substance. *Meningomyelocele* (the commonest form) is a protrusion of dura mater and arachnoid, the sac containing cerebrospinal fluid, nerves, and cord-substance. The cord may spread upon the sac-wall or it may pass through the sac and re-enter the canal. *Syringomyelocele* is great distention of the central canal, the sac-wall being formed of the thinned cord. A spina bifida varies in size from that of a walnut to that of an infant's head; it grows rapidly during the early weeks of life; it is usually sessile, but may present where it joins the body a definite constriction, or even a pedicle; the base of the sac is covered with healthy skin, and the fundus is covered only by thin epidermis or by the spinal membranes themselves. Pressure upon the tumor is found to diminish its size and to increase the tension of the anterior fontanel, and possibly to cause convulsions or stupor. The cyst is translucent, and the margins of the bony aperture are distinct. Crying, coughing, or pressure upon the anterior fontanel makes the tumor more tense. Spina bifida is apt to be associated with club-foot, with hydrocephalus, and with rectal or vesical paralysis. Spina bifida usually causes death. A few meningoceles and a very few meningomyeloceles undergo spontaneous cure by the shrinking of the sac. Syringomyelocele is invariably fatal. The cause of death may be rupture of the sac or marasmus.

**Treatment.**—Very small protrusions which grow slowly and are covered with sound skin may be treated by the use of a compress and bandage, by an elastic bandage, or by applications of contractile collodion. It was formerly regarded as proper to tap and drain the sac. Injection was used by many. The sac being cleaned, the child was placed on its side and a little chloroform was given. A fine trocar was plunged obliquely in at the side through sound skin, little or no fluid being drawn off, and  $\frac{3j}{\text{ss}}$  of Morton's fluid injected (iodin, gr. x; iodid of potassium, gr. xxx; glycerin,  $\frac{3j}{\text{ss}}$ ). The trocar was withdrawn and the puncture was sealed with a bit of gauze and iodoform collodion. The child was put to bed. If injection proved successful, the sac was found to shrink; if the injection failed, it was the custom to repeat it at intervals of from seven to ten days (Jacobson, White). Surgeons now prefer excision of the sac. Bayer treats it as he would a hernia. Robson in some cases excises the entire sac.

**Sacrococcygeal Tumors.**—Dermoids external to the sacrum are occasionally seen in this region. Dermoids also arise between the rectum and sacrum. In the lower sacral or coccygeal region the cutaneous structures sometimes fail of complete coalescence and a *post-anal dimple* or *sinus* is the result. Such a sinus is lined with skin and its wall contains numerous glands and often hairs. It may inflame or suppurate. If it blocks up at the outlet



a form of dermoid develops. Teratomata, lipomata, and hydatid cysts may develop in the sacrococcygeal region.

**Treatment.**—Dermoids require extirpation. If a post-anal dimple causes no trouble, it is let alone; otherwise it is dissected out. It may or may not be possible to remove teratomata. Lipomata and hydatids are extirpated.

**Anosacral Cysts.**—These cysts develop between the sacrum and rectum and originate from remnants of the post-anal gut and neurenteric canal. Such cysts may be multilocular or unilocular. They can be detected by a finger in the rectum.

**Treatment.**—Some of these growths are removed after osteoplastic resection of a portion of the sacrum; some are removed by incising the rectal wall.

**Tumors of the Spinal Cord.**—Among congenital tumors are lipomata and cysts (dermoid, congenital, sacral, and fetal). Tubercle, gumma, psammoma, and fibroma may arise from the cord or its membranes. Glioma is the most usual growth. Primary sarcoma is rare. Angelioma may occur. Primary carcinoma does not occur in this region. A tumor rarely produces obvious symptoms until it is as large as a hazel-nut.

**Symptoms.**—Pain, stiffness of the back, areas of anesthesia, and progressively advancing motor paralysis are symptoms of spinal tumors. A tumor may produce the symptoms of compression-myelitis, locomotor ataxia, or myelitis. In glioma there are apt to be loss of ability to recognize variations of temperature (or even to distinguish between heat and cold), loss of the sense of pain, and paresis and atrophy of muscles. Contractures or paraplegia may arise from tumor. The location of the growth can be inferred by a study of the territory of paralysis and the zone of sensory disturbance. The tumor is always situated somewhat above the upper limit of anesthesia. In many cases the diagnosis is impossible. Gradually increasing painful paraplegia with pain in the back, and with sensory paralysis after a time appearing and ascending from the feet toward the trunk, points to tumor as a cause. The reflexes are at first increased, but are finally lost from below upward. Spasms may develop, and lateral spinal curvature may arise. If curvature arises, the concavity of the curve will be on the side of the tumor. Growths outside the membranes produce particularly pain and spasm; growths within the membranes produce especially motor paralysis and anesthesia.

**Treatment.**—If syphilis is suspected, give the patient a course of heroic doses of iodid of potassium, and administer mercury hypodermatically. In a focal lesion not due to dissemination of a known malignant growth perform the operation of laminectomy to permit of exploration and possibly of removal. The laminæ of at least three vertebræ should be removed and the tumor is looked for distinctly above the upper level of the zone of anesthesia. It is not necessary for the patient to wear a spinal support after the performance of laminectomy. McCosh truly says that operation for spinal-cord tumor is decidedly more hopeful than for brain tumor because localization is much more accurate and removal can be effected with less permanent damage. Lloyd collected 51 operations: 10 per cent. died and 31 per cent. actually recovered. If the tumor is found to be irremovable, McCosh suggests division of several nerve-roots to relieve the pain.

**Acute osteomyelitis of the vertebræ** is a rare disease; it may be



associated with osteomyelitis of other bones, but may occur alone. Infections of the viscera not unusually accompany it. Any part of a vertebra may suffer from it. This condition may follow cold, overexertion, or traumatism, and is more common in the young than in the old. The process may be superficial, or it may involve the bone deeply and widely. Suppuration always occurs; sequestra generally form; and phlebitis is a dangerous complication. Any region of the spine may be attacked, but the lumbar region is particularly liable to invasion. The situation of the abscess varies with the situation of the disease. If the vertebral bodies are diseased, the pus passes forward (retropharyngeal, mediastinal, psoas, or pelvic abscess). If the vertebral arches suffer, the pus passes backward (lumbar or dorsal abscess). The membranes of the cord, the cord itself, the nerves, and the vertebral articulations are frequently involved in the process. Staphylococci or streptococci may be grown from the pus.

**Symptoms.**—The general symptoms are those of osteomyelitis. The local symptoms depend on the seat of disease. If the posterior portion of the column is diseased, there is a hard swelling, which, in the neck, is in the middle line; in the dorsal and lumbar regions, in the middle or to the side; and in the sacral region, invariably to one side.

Rigidity of the spine always exists. If the vertebral bodies are affected, rigidity is noted, the spine is tender, and special symptoms appear, their nature dependent on the region affected (retropharyngeal abscess, etc.). Occasionally symptoms of meningomyelitis are noted. The constitutional symptoms of sepsis are marked. The condition is sudden in onset, and purulent collections diffuse widely and rapidly. These points enable the surgeon to make a diagnosis between osteomyelitis and Pott's disease. In osteomyelitis angular deformity very rarely arises, because the patient is obliged to be recumbent and because hyperostosis is taking place.

**Treatment.**—The patient is kept recumbent. His constitutional treatment is such as will combat sepsis (food, stimulants, etc.). A puriform area must be incised and disinfected. If bone denuded of periosteum is found, it is touched with a solution of chlorid of zinc or with the actual cautery. If a sequestrum exists, it is removed. A drainage-tube is inserted and dressings are applied (Müller, Makins, Abbot, and Chipault).

**Typhoid Spine.**—It was pointed out by Gibney that typhoid fever may leave as a legacy a painful, stiff, and weak back. The muscles of the back are found to be rigid and there is tenderness of one or more vertebræ. The pain may only be appreciated on motion, but in some cases there is aching even when the patient is at rest. The pain may be localized, may run into one or both thighs, or may be felt in the abdomen. The symptoms arise at an uncertain period after the fever, develop rapidly, and are occasionally associated with transient episodes of fever. Kyphosis or lateral curvature may develop. (See L. W. Ely, "Medical Record," Dec. 20, 1902.) Usually the patient is hysterical. The condition is due to osteitis and periostitis, or osteomyelitis. The prognosis is excellent.

**Treatment.**—The use of a plaster or leather jacket; counter-irritation by the hot iron; and later massage and electricity.

**Spinal Curvatures.**—There are four chief forms of spinal curvature: (1) lateral curvature (the scoliosis of the older surgeons); (2) posterior cur-



vature (the excurvation, gibbosity, or kyphosis of the older surgeons); (3) anterior curvature (the lordosis of the older surgeons); and (4) angular curvature (from spinal caries). The normal spine has four curves: the *cervical* curve, the convexity of which is forward; the *dorsal* curve, the convexity of which is backward; the *lumbar* curve, which is convex anteriorly; and the *pelvic* curve, which is concave anteriorly. The dorsal and the pelvic curves, which are primary, are due to the formation of the cavities of the chest and pelvis, and depend upon the shape of the bones (Treves). The cervical and lumbar curves, which are compensatory, depend upon the shape of the intervertebral disks, and only appear after birth when the erect position is assumed.

**Lateral curvature** (scoliosis) is a lateral deviation of the spinal column, often accompanied by rotation of the vertebrae and associated with increase or with diminution of the normal curves. Lateral curvature is predisposed to by weak muscles and ligaments, by the habitual assumption of strained and unnatural attitudes, by unequal length of the legs, and by paralysis of one leg. This distortion, which is commonest in girls, is apt to arise at the age of puberty (it is usually corrected in boys by outdoor exercise). The bones are soft and the muscles are weak, and this condition is often inherited. Rickets is very commonly associated with lateral curvature. Any condition of ill-health weakens the muscles; hence lateral curvature may arise after an acute sickness or in a person who outgrows his strength. An empyema with adhesions, by pulling on the chest-wall, may produce a curvature the concavity of which is toward the diseased side.



Fig. 337.—Lateral dorsal curvature to the right, and compensatory lumbar curve to the left.

The weak muscles cease to sustain the spinal column, and the ligaments stretch, relax, or lengthen. The commonest curve is toward the right in the dorsal region (because most people use the right hand more than the left). As soon as a dorsal curve to the right arises a compensatory lumbar curve (Fig. 337) takes place to the left, thus enabling the patient still to sit or to stand erect.

In almost all cases the vertebrae soon rotate, the bodies turning to the convexity and the spines turning to the concavity of the curve; hence the transverse processes toward the convexity project. The ribs follow the spinal rotation; the shoulder is elevated on the side of the convexity, and the hip on the opposite side is apparently, but not in reality, raised. As a matter of fact, the hip becomes prominent rather than raised. The intervertebral disks are apt to flatten out on the concavity of the curve. In very rare instances lateral curvature results from caries of a half of one or of several vertebrae. In a spinal tumor lateral curvature may occur, the concavity of the bend being on the side of the growth.

*Symptoms.*—An ordinary case of spinal curvature from weak muscles arises gradually. Stooping is noticed, and after a time pain is complained of in the dorsal and lumbar regions, and weakness in the back is detected by the sufferer. The pain is made severe by sitting long in one attitude. Anemia is manifest, and walking is awkward and ungraceful. When the shoes and clothing are removed, and the child stands with its back toward the surgeon and with the feet symmetrically together, the lower angle of the right scapula



(in a dorsal curvature to the right) is unduly prominent and is elevated above the left; the normal prominence of the right iliac crest is lost; the left iliac crest is unduly distinct; on marking the spinous processes with an anilin pencil the curve becomes manifest; tenderness is developed on pressing the spines only if there is marked neurasthenia; the normal dorsal anteroposterior curve is exaggerated; the abdomen is protuberant; the chest is flattened; the neck juts forward; and the breast on the same side as the concavity of the curve is more prominent and on a lower level than the other breast. Always observe if the anterior iliac spines are on a level or not, and always measure the length of the legs. The patient, with the knees extended, bends forward with the arms hanging loosely: the erector spinæ muscle between the iliac crest and the last rib is seen to be more prominent on the convexity of the lumbar curve than on its concavity (Bernard Roth), and the angles of the ribs on the side of the convexity of the dorsal curve are on a higher level than are those on its concavity. Have the child assume what it supposes to be an erect attitude, and let the surgeon correct this into the best possible position (Roth), and see how long the new position can voluntarily be maintained. A large percentage of these patients labor under pes planus. When there is no osseous deformity (that is, when the surgeon may, by manipulation and traction, correct the deformity), and when the spinal muscles are not paralyzed, the prognosis is good for complete cure. Roth states that cases without osseous deformity can practically be cured in one month, but the treatment must be continued for one year to prevent relapse.\* In a case with moderate osseous deformity the patient can be improved vastly by three months' daily treatment (Roth). Even in severe cases of bony deformity the pain may be relieved and the deformity be modified.

*Treatment.*—If one leg is too short, let the patient wear a thick-soled shoe. No treatment for weak muscles has ever been devised so utterly irrational and absurd as the prevention of all movement; and neglect of all treatment for lateral curvature does less harm in the vast majority of cases than immobilizing the spinal muscles by braces and supports. The muscular nutrition in these cases is to be restored, as is muscular nutrition in any other region, by scientific gymnastics, electricity, the douche, salt baths, frictions, and massage. Bicycles with specially constructed seats are used with advantage in some cases. The mode of exercise to be used should be directed by some one skilled in orthopedics, and the instruction in the details must be thorough and persistent. Roth's advice is to so re-educate the muscular sense that a patient can again know whether she is or is not standing straight; to maintain an improved position in sitting and standing; to use such clothing as will not interfere with the assumption of a normal attitude; to enforce systematic training of the muscles of the spine and thorax; and to give attention to the general health. In some cases where, in spite of all attempts at correction, deformity increases, it may be necessary to immobilize in hope of obtaining ankylosis and preventing further deformity. In those rare lateral curvatures due to caries a supporting apparatus must, of course, be applied.

**Anteroposterior curvature** (not from spinal caries or from hip-joint disease) is an increase of the normal anteroposterior curves. Increase of the dorsal curve is posterior curvature, kyphosis, or excurvation (Fig. 338, A); in-

\* Heath's "Dictionary of Practical Surgery."



crease of the lumbar curve is anterior curvature, lordosis, or saddle-back (Fig. 338, B). Both lordosis and kyphosis are apt to be present. Scoliosis has nearly always some anteroposterior curvature associated with it. Lordosis is apt to be compensatory, to prevent the center of gravity going too far forward. Lordosis is found in pregnant women and in very fat men. In an old man kyphosis arises from flattening out of the vertebral disks from pressure. Rheumatic gout may cause anteroposterior curvature. Anteroposterior curvature is often due to paralysis of the erector spinæ mass (from infantile paralysis). Pseudohypertrophic paralysis causes lordosis.

*Symptoms and Treatment.*—The symptoms of anteroposterior curvature are as follows: the thorax is flattened or pigeon-breasted; the shoulder-blades are widely separated and the scapular angles project; the abdomen is protuberant; the patient complains of backache and soon tires. A recent kyphosis disappears when the patient lies upon his stomach. The facts that the erector spinæ muscles are soft, and that pain is absent on concussion transmitted to the back, separate kyphosis from caries. Lordosis is unmistakable. When the spine is movable, employ the same plan of *treatment* as in lateral curvature, suiting the gymnastics to the deformity (Roth). In painful kyphosis with partial ankylosis endeavor to make the ankylosis complete in order to prevent pain, obtaining this result by applying a plaster jacket which laces up and letting the patient wear it for several years.

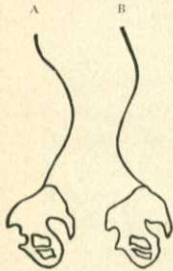


Fig. 338.—Kyphosis (A) and lordosis (B).

**Angular curvature** (spinal caries; spondylitis; Pott's disease) is usually due to tuberculous caries of the vertebral bodies, and occurs particularly in children who are predisposed to tuberculosis, but it may arise at any age. Any portion of the spinal column may be attacked. The dorsolumbar region is most prone to suffer. The chief *cause* is tuberculosis, but syphilis, secondary cancer, and acute osteomyelitis of the vertebræ are occasional causes. Blows or strains are often exciting causes. Angular curvature may develop after an exanthematous fever.

The cancellous tissue of the anterior portion of the vertebral body becomes primarily carious, or the inflammation begins in an intervertebral disk. (The changes of tuberculous osteitis have previously been set forth.) The body of the vertebra and the vertebral disk are destroyed, and the process extends to adjacent vertebræ. The weight which rests upon the spinal column causes softened bone to crumble, compresses the diseased vertebra and disks, and produces angular deformity (the anterior part of the spine formed by the vertebral bodies is shortened, the posterior part is not, and hence the spines project). In some cases the disease is spontaneously arrested by organization of inflammatory products, and ankylosis (fibrous or bony) in deformity is Nature's cure. In most cases, however, the disease spreads and caseous pus is formed, which, according to the route it takes, causes lumbar abscess, dorsal abscess, psoas abscess, or post-pharyngeal abscess (page 124). In some cases the spinal cord is compressed, but in most cases it is not, and even when it is compressed paraplegia is rare and is usually temporary. Compression of the cord may be caused by the displaced ver-

tebræ or by inflammatory material or caseous matter between the bone and dura mater, but is most often due to pachymeningitis. Caries of the cervical region constitutes a more dangerous disease than caries of either the dorsal or the lumbar region (dangerous pressure occurs more easily). Death may be caused by exhaustion, sepsis, hemorrhage, amyloid disease, pneumonia, peritonitis, pleuritis, tuberculous dissemination, pressure upon the cord, or inflammation of the cord or its membranes.

*Symptoms.*—The sufferer from Pott's disease, if a child, grows tired easily, his disposition alters, he becomes moody and irritable, and complains of vague pains in many places, is disposed to lean, rest, or lie down, and walks with the back rigid, which produces a peculiar gait. A painful spot is found by pressing upon the spines. Faradism to the back causes pain. Spasm of the erector spinæ mass is detected (Hilton, Golding-Bird). It is not proper to seek to develop pain by jarring the back or by pressing the head downward. The posture of the child and the muscular rigidity prove the existence of inflammation, and to seek to develop pain by the methods referred to may do harm, and at best can only call attention to what is already known. Pain in the back, which is increased by motion, by pressure, and by vertebral jars, may be absent until late in the case. Distinct pain and tenderness in the back often mean abscess-formation. Neuralgic pains pass into distant parts (sciatica, intercostal neuralgia) and are often linked with muscular spasm. A chronic bilateral pain in the trunk or extremities is suggestive of Pott's disease. "Chronic bilateral belly-aches in children are almost diagnostic" (Jordan Lloyd). The pain of dorsal caries can be relieved by lifting the shoulders; the pain of cervical caries by traction on the head. Cramp in the legs occurs in dorsal and in lumbar caries. The presence of the knuckle due to bending the spine at an acute angle is a very important sign of the disease. In many cases angular deformity appears late, in some cases it does not appear at all. An angular deformity is detected sooner in those regions where the normal curves are posterior than where the normal curves are anterior (Jordan Lloyd). The deformity appears early in the dorsal region, but late in the cervical and lumbar regions. In some rare cases lateral deformity occurs. Rigidity is an early sign of great importance. It is always present. Rigidity is manifest very early in cervical caries, tolerably early in lumbar caries, late in dorsal caries. Lloyd gives the following practical rules to enable us to detect rigidity.\* In the cervical region: seat the patient in a chair and tell him to nod the head affirmatively. Stiffness in nodding points to occipito-atloid disease. Tell him to look far to the right and then far to the left. Stiffness of these motions suggests atlo-axoid disease. Tell him to place his shoulders against the back of the chair and carry his eyes back along the ceiling. Stiffness in this movement indicates disease below the second cervical vertebra. It is practically useless to examine the dorsal region of an adult for rigidity, but such an examination can be made in a child. Place the patient prone on an adult's lap, mark the tip of each spinous process with an anilin pencil, make the child stand up straight, and observe if any of the marks fail to come nearer together. If it is seen that two or more marks do not approach each other, there is rigidity which prevents approximation. To test for rigidity in the lumbar

\* Birmingham Med. Review, April, 1897.



region lay the naked patient prone upon a couch. Grasp the patient's ankles and raise the pelvis from the couch. If the lumbar spine is flexible, the pelvis can be lifted without raising the chest from the bed, and the maneuver deepens the hollow of the loin. If the lumbar spine is stiff, the maneuver lifts the trunk and produces no alteration in the vertical outline of the lumbar spines. If a child with Pott's disease is asked to pick up something from the ground, because of rigidity or pain on movement he will not bend the back, but will bend the knees or get upon the knees. Paralysis may exist, and it is due to pachymeningitis more often than to pressure from bone. Cervical caries causes dyspnea and torticollis, the head requiring support with the hands. Dysphagia indicates abscess. In adults the first signs of Pott's disease to attract attention are headache, backache, neuralgia, girdle-pain, cramp, or even paralysis. In abscess due to caries of the dorsolumbar vertebræ the pus usually enters the psoas muscle and passes out of the pelvis below the junction of the middle and outer thirds of Poupart's ligament.



Fig. 339.—Plaster-of-Paris jacket (Sayre).



Fig. 340.—Plaster-of-Paris jacket and jury-mast applied (Sayre).

It may point here or may pass to the inner aspect of the thigh and point a little below the spot where a femoral hernia is met with if it exists. In a psoas abscess a mass is always felt in the iliac fossa above Poupart's ligament; in a hernia no such mass exists (J. T. Rugh). In sacral caries there is no deformity and frequently no pain. The diagnosis becomes apparent when bilateral abscess is detected in the buttocks or groins (Jordan Lloyd). If an abscess due to spinal caries opens spontaneously, healing will not occur, but mixed infection takes place and death, as a rule, soon follows.

*Treatment of Caries of the Spine.*—When recent caries of the spine is active and affects a child, when it is accompanied by pain and fever, and when paralysis threatens, insist upon perfect rest. Place the child supine on a hard mattress, and, if possible, take it, while in a rolling bed, out of doors daily. Leeches, blisters, or the hot iron over the area of pain may do good. When the activity of the process abates apply a fixation apparatus.

In diseases at or near the vertebro-occipital articulation, as long as dyspnea persists, keep the patient supine with a small hard pillow under the nape of the neck (Hilton) and a sand-bag on each side of the head and neck. After several months mechanical support can be given by Furneaux Jordan's method. Jordan applies his support as follows: The patient lies on a flat, hard table, his arms are raised above his head, and traction is made upon the head by means of a pulley and a weight. Cotton pads are placed over the ears, the back of the neck, and the clavicles, and are held in place by a flannel bandage applied as a figure-of-eight of the head, neck, and chest. The flannel bandage is overlaid with plaster-of-Paris bandages.\* In disease of the cervical region below the axis, or of the dorsal region above the seventh vertebra, use Sayre's jury-mast (Fig. 340), or some other form of head support. Sayre's appliance relieves the spine from the weight of the head and acts admirably. In most cases of dorsal and lumbar caries some fixation apparatus must be employed. The best of all fixation apparatus is Sayre's plaster-of-Paris jacket applied while the patient is suspended (Fig. 339). The Sayre apparatus applied in this manner is used for the treatment of caries of the lumbar region and the lower half of the dorsal region. When all subjective signs cease, substitute for Sayre's jacket a felt or sole-leather jacket which laces down the front. Caries of the upper half of the dorsal region is often treated by a Sayre's jury-mast (Fig. 340); but if the jury-mast fails, it may be necessary to place the patient horizontally in "an open cuirass, fitted to the back from occiput to sacrum, and combined with pulley extension to the head and pelvis." †

During the course of caries of the spine have the patient eat fat-forming and nutritious food, try to get him out often into the fresh air, and administer tonics and antituberculous drugs. Sea-air is very beneficial. When all active disease ceases, and only angular curvature remains, use an apparatus to combine extension with mechanical support, the plaster jacket being generally employed.

**Spinal abscesses** are treated as indicated on page 535. Treves opens the abscess in the loin, employing a vertical incision; introduces a finger, and examines the anterior surface of the vertebrae (if the patient be young and slender and if the disease affects the dorsal or lumbar region); irrigates with gallons of warm corrosive sublimate solution (1 : 5000); scrapes the wall of the abscess with the finger or rubs it with a sponge; irrigates again; scrapes again, and so on until the wall is cleared of débris; wipes the abscess dry, and sutures without drainage. The patient remains recumbent for months. It may be necessary to repeat the operation. If mixed infection occurs, drainage-tubes must be inserted. Treves formerly removed the carious bone, but many surgeons do not approve of removing bone. Halsted opens the abscess-cavity widely, removes as much of the wall as possible, and packs with iodoform gauze. Barker opens the abscess at its lower portion and inserts an irrigating curet. This instrument is a hollow gouge through which hot water flows. He scrapes and irrigates the abscess-wall with this instrument. When the water runs clear he withdraws the instrument, injects three ounces of iodoform emulsion, and sutures the wound.

\* See "Children's Deformities," by Walter Pye.

† Jordan Lloyd, in Birmingham Med. Review, April, 1897.



**Forcible correction of angular deformity** is advocated by Chipault and Calot in cases of Pott's disease without abscess. Forcible correction is only used, if used at all, in angular deformity of the middle and lower part of the dorsal region. It is not used in the cervical, upper dorsal, or lumbar regions. Before it is used a skiagraph should be taken, to show if bony ankylosis exists or if there is an abscess. If there is an abscess, it must be treated surgically, and must heal before forcible correction is attempted. If bony ankylosis exists, it must not be broken down. Only recent cases are suited for this treatment, and only cases in which very few vertebrae are involved (Gabaert). The operation is unjustifiable if any organs are tuberculous, and if a patient is in very poor health. It is particularly indicated when the deformity interferes with respiration or digestion, or when there is paraplegia. The operation does not injure the cord or its membranes. The operation is not entirely safe, and a number of deaths have been reported. Chloroform must not be given, as it seems to possess special dangers in this condition. Gabaert\* points out certain disasters which may follow forcible correction. They are: death during anesthesia; rupture of an abscess; subsequent paralysis of the legs and bladder; disseminated tuberculosis; and shock with convulsions and death. Forcible correction can be carried out as follows: the patient is anesthetized with ether, and is placed face down; one assistant holds the feet, another the head, another supports the abdomen, and another the pelvis. While strong traction is made on the head and feet, the surgeon makes forcible pressure on the projection. After the correction of the deformity a plaster-of-Paris support is applied so as to include the neck, trunk, and pelvis, the gibbosity being left exposed in order to avoid ulceration. A plaster-of-Paris support is used for at least six months. After forcible correction a large gap exists, and this does not fill up with bone, but with dense fibrous tissue, and in some cases the spines and laminae ankylose. When the support is first removed, there is usually a reappearance of the deformity to some degree. In some cases Calot resects the spines and laminae of the diseased vertebrae, and performs osteotomy of the ankylosed vertebral bodies.†

If paraplegia is due to disease of the mid-dorsal region, forcible correction should be attempted.

**Laminectomy** is warmly advocated by some surgeons in paraplegia from spinal caries. This operation is rarely necessary, but in some few cases is imperatively demanded. Many cases recover from paraplegia without operation—operation has a very heavy mortality; many are not benefited at all by it, but in some cases it has certainly saved life.

Laminectomy should not be undertaken until treatment by rest and fixation and extension has been applied for at least one year. Laminectomy is necessary in cervical caries to prevent asphyxia. The operation enables the surgeon to remove masses of inflammatory material which make pressure on the cord. The dura should not be opened unless there is evidently trouble beneath it, in which case it is incised and any tuberculous area removed, the dura being subsequently sutured. Ménard removes the transverse processes of the diseased vertebrae and the heads and necks

\* Ann. de la Soc. Belge, July 15, 1898.

† F. Calot, in Archiv. Prov. de Chirurgie, Feb., 1897.

of the associated ribs in order to give the surgeon access to the diseased vertebral bodies.

**Spondylitis Deformans.**—This is the name usually applied to osteo-arthritis of the spine. In this disease osteophytic formation takes place at the vertebral borders, and the vertebræ become ankylosed. The vertebral bodies as a rule are most affected by the disease, but any portion of a vertebra may be attacked, and often the heads of the ribs are anchored to the spine by bone.

The disease may begin in infancy, childhood, youth, adult life, or old age.

**Symptoms.**—There are decided and persistent pain and tenderness of the spine, and occasionally evidence of pressure on the nerve-roots. Early in the case deformity is apt to occur, because at this period there is inflammatory softening.\* The deformity is not angular, but is usually a total kyphosis, the column being bent forward from above and made into a single curve. Lateral curvature may occur.

**Treatment.**—Cure is impossible, but amelioration can be obtained.

The local and constitutional treatment is as for osteo-arthritis in any region. If curvature begins, a mechanical support must be applied.

**Injuries of spinal ligaments and muscles**, which may complicate more serious injuries or may exist alone, are caused by wrenches, twists, and violent muscular efforts (as in lifting). Railway accidents may be responsible for these sprains and strains.

**Symptoms.**—Injuries of the back, even without cord-injury, are frequently linked with very deceptive nervous symptoms. Symptoms are often severe, but are usually temporary. In some few cases the symptoms are persistent. Secondary disease of the cord is extremely rare. Any region may be affected, but the lumbar is most usually injured, and the entire spine may suffer. The three marked symptoms are pain, tenderness, and stiffness of the back. At the time of injury, and for a while after, there is often marked shock, and hysterical excitement is occasionally observed. The cardinal symptoms may arise very soon, but may not become severe for a day or two. The pain is not acute when at rest, but becomes acute on movement.† The pain is felt in the back, and sometimes darts into the extremities. The muscles of the back are rigid, the spasm being due to pain. The patient is very careful not to twist or bend the spine, because to do so increases pain. In a one-sided injury the rigidity is unilateral, and this symptom cannot be simulated. Often, but by no means always, the region of the back is swollen and the skin is discolored. The tenderness is not of the skin, but of the muscles. Firm pressure on a spot of real tenderness causes rapid pulse (Mannkopff). The vertebral spines are regular and are not mobile. There is no distant paralysis or hyperesthesia unless the cord is damaged (though in some rare cases the bladder and the rectum are paralyzed when no cord-lesion can be detected, and hyperesthesia may exist over the spines). Moullin tells us that the extremities feel weak because they are deprived of proper support on account of the immobility of the muscles of the back. For the same reason the action of the abdominal muscles is interfered with, and the power of micturition and of defecation is impaired (there are constipation and difficulty in emptying the bladder).

\* J. Jackson Clarke's book on "Orthopedic Surgery."

† Moullin on "Sprains."



The **treatment** of recent injuries comprises rest; the application of an ice-bag and leeching over the painful area. After a day or two hot fomentations, tincture of iodine, and inunctions of ichthyol and lanolin are used; and, later still, massage, douches, and frictions with a stimulating liniment are employed. Phenacetin helps to relieve pain, though in some cases opium is necessary. The injury is called "railway spine" when it is caused by a railway accident.

After the *immediate* effects of the accident subside *traumatic neurasthenia* is apt to arise. In this condition the patient grows tired easily and complains of pains and aches in the back and loins, interfering with or preventing work; paresthesia and numbness exist in the extremities; in many cases sexual intercourse is impossible because of premature ejaculation or of incapacity for erection; there are dyspepsia, eye-strain, insomnia, loss of memory, rapid and irregular pulse, cardiac palpitation, and mental depression or confusion. The reflexes are usually exaggerated, but they can be exhausted more easily than can the exaggerated reflexes of organic cord disease (because of irritable weakness). Some rigidity and tenderness exist in the back, and the skin over this region is often hyperesthetic. Attacks of retention of urine may occur. Hypochondria is not unusual.

*Treatment of Traumatic Neurasthenia.*—Employ rest, tonics, massage, douches, and frictions to the back. Secure sleep, and endeavor to bring about a gain in weight. If sexual incapacity or seminal emissions worry the patient, dilate the urethra with steel sounds.

**Traumatic hysteria** develops only in those predisposed by a neuropathic hereditary tendency; traumatic neurasthenia may arise in anybody. In the first disease the accident is only the *exciting* cause; in the second disorder it is *the* cause. Many cases of so-called "railway spine" are really examples of traumatic hysteria. Traumatic hysteria and neurasthenia may be associated. Neurasthenia is a condition of exhaustion associated with a number of chronic disorders; it forms a foundation on which hysteria is apt to build its structure. The structure of hysteria is made up of morbid impressionability, hyperesthesia of centers, lowered self-control, and sensitiveness of the peripheral nervous system. The accident plays a double part in producing traumatic hysteria: first, by its effect on the mind (psychical traumatism); second, by its effect on the body, which anchors the attention to one point. An area of pain or stiffness often serves as an autosuggestion which undergoes morbid magnification when viewed through the distorting medium of hysteria. Erichsen taught that the symptoms of what he named "railway spine" arose from inflammation of the cord and its membranes, a view now abandoned. A blow given to a hysterical person causes a feeling of numbness, and thus negative sensation from local shock may establish the idea of paralysis, or the traumatism, acting as a suggestion, may inhibit motor representations and destroy the normal ideas of motion and feeling (Charcot and Pitre). Terror always causes a feeling of loss of power in the legs, and the terror of the accident may thus develop the idea of paraplegia. The site of a traumatism may localize symptoms; for instance, a blow upon the eye may cause amaurosis or blepharospasm. It is important to remember Charcot's saying that a hysteria long latent and unrecognized may be awakened into obvious activity by a blow or an accident. Pitre

shows the same to be true of epilepsy. A not unusual lesion is hysterical traumatic monoplegia, not coming on at once after the accident, but usually some days afterward, and presenting flaccid muscles, the electrical reactions and reflexes remaining normal, but the muscular sense being lost (Pitre). The muscles usually waste. The skin of the paralyzed limb is anesthetic or analgesic. There may be anesthesia limited to a limb, hemianesthesia, or general anesthesia.\* Hysterical paralysis is usually associated with the permanent stigmata of hysteria—concentric contraction of the visual field, pharyngeal anesthesia, convulsive seizures, and hysterogenic zones (Clarke and Pitre). The permanent stigmata may be latent. Hysterical phenomena lack regularity of evolution, and they may be produced, altered, or abolished by mental influences or by physical forces which produce no effect on organic disease. In most hysterical conditions the general health is not profoundly impaired.†

*Treatment.*—By moral means chiefly. Gain the confidence of the patient. In many cases separation from family and friends is necessary and isolation is desirable. The Weir Mitchell rest-cure is the best plan of treatment, and all its details should be carried out faithfully.

**Malingering.**—Persons often pretend to suffer from maladies as a result of accident, which diseases do not exist in them. Some get well upon the rendering of a favorable verdict by a jury. In any case always examine carefully, so as to be able to exclude malingering. Note the patient's behavior and motions when his attention is diverted from his disease. *Meningomyelitis* can be excluded if there be no spasm, paralysis, hyperesthesia, paresthesia, or anesthesia at a distance (A. Pearce Gould). If pain has lasted for months, if pressure downward upon the head or shoulders does not increase pain, if the vertebræ are movable, and there is no angular displacement, exclude *caries*. Gould states that when there are wasted muscles, when moderate spine-movement is painless, but effort in bringing the body erect causes pain in the erector spinæ region, the trouble is a strain of the erector spinæ muscle. If the muscle is not wasted, and the pain is in bending forward rather than in straightening up, the vertebral ligaments are the seat of trouble. Unilateral spasm cannot be simulated. The administration of ether may dispose of a pretended paralysis, the patient moving the suspected extremity while drunk from the anesthetic.

**Concussion of the Spinal Cord.**—This term has no definite pathological meaning. It is probable that the condition is one of laceration of capillaries and of cord-substance.

The **symptoms** are shock, intense pallor, nausea, often vomiting, and sometimes syncope. With this condition special symptoms may be linked—as temporary paralysis, a girdle-sensation, numbness and loss of power in the limbs, hiccough, torticollis, coarse tremors, pains in the back and limbs, areas of anesthesia and analgesia—depending on the portion of cord lacerated.

**Treatment.**—The treatment in concussion of the spinal cord is the same as that for sprains. Traumatic neurasthenia and hysteria or organic cord-disease may follow this injury.

**Contusion of the spinal cord** may arise from a blow or a sprain, but it is usually due to extreme flexion of the spine. It causes hemorrhage into

\* J. Mitchell Clarke, in *Brain*.

† Read the works of Thorburn and Pitre.



the gray matter of the cord (hematomyelia). The symptoms are motor and sensory palsy and diminished reflexes. Some cases recover, but others end in myelitis.

**Wounds of the spinal cord** are rare, and are usually fatal. Wounds above the origin of the phrenic nerves cause almost instant death. Gunshot-wounds are the most usual form, the cord being damaged by the bullet and by bone-fragments. A knife is sometimes thrust in between the occiput and atlas.

**Treatment.**—In a suspected wound of the cord do an exploratory laminectomy, arrest hemorrhage, and if the cord is divided, suture it.

**Compression of the spinal cord** may be due to blood or to inflammatory exudate. *Compression from blood* may be due to *extramedullary* hemorrhage or to *intramedullary* hemorrhage. *Extramedullary* hemorrhage causes sudden pain in the back, the pain radiating from compressed nerve-roots; hyperesthesia and paresthesia in the area of the radiated pain; spasm of vertebral muscles supplied by the compressed nerves, sometimes of muscles whose nervous supply is below the lesion; tremors; convulsions; retention of urine; paralytic symptoms following the signs of irritation, but no absolute paralysis (Mills). A girdle-sensation is usual. *Intramedullary* hemorrhage causes pain, a girdle-sensation, abolition of reflexes, and paralysis. Spasms, rigidity, and paralysis come on early. Bed-sores may form, and retention of urine and incontinence of feces may be observed. Paralysis from hemorrhage is rapidly progressive from below upward (crawling paralysis).

**Treatment.**—If paralysis from spinal-cord bleeding extends rapidly, and life is endangered through the probable involvement of a vital center, perform a laminectomy, remove the clot, and arrest the hemorrhage. It is wise to always open the dura and inspect the cord. Extramedullary hemorrhage may be arrested by sutures or by packing. Intramedullary hemorrhage may be arrested by suture-ligatures or by packing. If an extramedullary clot is extensive, it is proper to make a second laminectomy near the lower end of the spinal column in order to permit the surgeon to thoroughly wash it out. The dura must be sutured and drainage is to be employed. If there is paraplegia, complete anesthesia of the paralyzed parts and entire abolition of the deep reflexes, operation is probably useless, but it is justifiable to try it because of a possibility that the cord is not completely divided. In some cases with persistent paraplegia the operation should be undertaken. If operation is not undertaken, have the patient lie upon his side and give morphin hypodermatically. If hemorrhage continues in the cord and if the patient be plethoric, perform venesection. Some surgeons advise hypodermatic injections of ergotin. To promote absorption of the clot and exudate give a combination of carbonate and acetate of ammonium, order pilocarpin, and employ spinal galvanism and hot douches (Bartholow).

**Fractures and dislocations of the spine** are very rare. The spinal regions most liable to injury are the atlo-axial, the cervicodorsal, and the dorsolumbar (Treves). A vertebra may be fractured alone, but dislocation without fracture, except in the upper cervical region, very rarely occurs. These two lesions, dislocation and fracture, are so often associated that the term *fracture-dislocation* is used by many surgeons to include them both. The **causes** of fracture and dislocation are direct force (seldom) and indirect

violence (commonly). Forced flexion or overextension is the commonest cause. In fractures from indirect force the cord generally suffers. In some cases the displacement of the vertebra lacerates the cord, the vertebræ return into place, and no deformity is detectable. Fracture-dislocation from direct force may occur at any part of the column, and in this accident the posterior vertebral segments are driven together, and the cord, as a rule, escapes injury. Fracture-dislocations from indirect force most commonly happen in the cervical and dorsal regions. In the cervical region reduction can usually be secured, but in the lumbar region reduction is impossible.

**Symptoms.**—In fracture-dislocation great displacement is unusual, but some is almost always recognizable (irregularity of the spines or angular deformity). There are pain (which is increased by motion), tenderness, ecchymosis, and motor and sensory paralysis. Priapism, cystitis, and retention of urine often occur. Horsley has pointed out that in many cases paralysis passes away only to subsequently recur, the recurrence being due to edema of the cord. In some cases of spinal injury there is temporary paralysis due to shock. Persistent paralysis may be due to laceration of the cord, division of the cord, or compression of the cord by bone, blood-clot, or products of inflammation. The extent of paralysis depends on the seat of the cord-injury. When the symptoms are not immediate in onset; when all the muscles below the seat of injury are not completely paralyzed; when there is some retention of sensation; when reflexes are present and muscular rigidity exists, we may be sure that the cord is not completely divided. When the cord is completely divided the symptoms are immediate, there is absolute motor and sensory paralysis, the muscles are relaxed, and the



Fig. 341.—Spine sawed. Fracture of the spinous processes of the seventh cervical and first and second dorsal vertebrae. Fracture of the bodies of the fifth, sixth, and seventh cervical vertebrae with displacement *backward* of the upper fragment. Total crush of the cord. The section passes a little to one side of the cord, which is seen in place, and the staining of the cord by hemorrhage into its substance shows plainly through the membranes even in photograph. The spinous processes of the second and third dorsal vertebrae were found fractured at the operation, and were removed (Thomas).



reflexes are absent. Whereas this latter symptom-group is present when the cord is completely divided, it may also be due to shock, when it will usually be temporary, but occasionally it persists some time even when the cord is not completely divided.

A. J. McCosh ("Jour. Amer. Med. Assoc.," Aug. 31 and Sept. 7, 1901) points out that definite pressure is indicated by marked symptoms and absence of reflexes. When there is not definite pressure, the symptoms are irregular; there is incomplete palsy, or muscles of the same group show different degrees of paralysis; anesthesia is partial; signs of irritation are not distinct and there are patches of hyperesthesia and zones of paresthesia. If in doubt, at the end of twelve hours perform an exploratory operation.

The prognosis depends on the amount of damage done to the cord. Fracture-dislocations in the cervical region produce obvious deformity, stiffness of the neck, and irregularity of the spines, and a displaced vertebra may occasionally be detected by a finger in the pharynx. Crepitus can rarely be detected unless a spinous process is fractured. The Röntgen rays aid diagnosis. The seat of cord-injury may be determined by a study of the palsy and other symptoms.

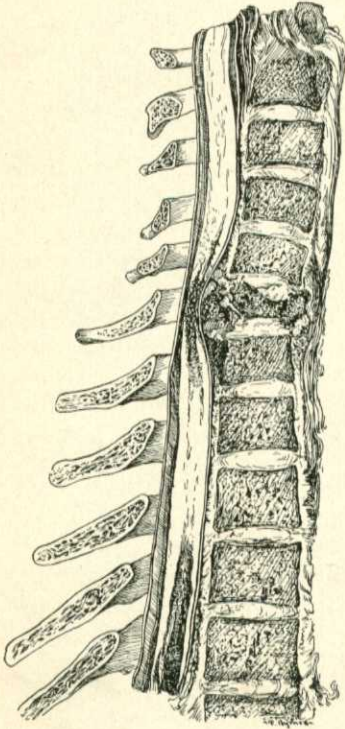


Fig. 342.—Fracture of the cervical spine; cord compressed by bone and blood. Hemorrhage into the cord at the seat of the lesion and below the lesion (Warren Museum). (From Scudder's "Treatment of Fractures." Drawn by Byrnes.)



Fig. 343.—Lesion of spine between fifth and sixth cervical vertebrae. Note position of arms, due to paralysis of subscapularis. Biceps anticus, supinator longus, and deltoid muscles intact. Elbow flexed, shoulders abducted and rotated outward (after Thorburn).

Fracture-dislocation of the atlas or axis usually causes instant death. When the displacement is only trivial, the patient may actually recover, but will probably die of secondary cord-disease. In injury of the third cervical vertebra the phrenic nerve is involved, the diaphragm is paralyzed, and death soon occurs. In fracture-dislocation of the fifth cervical vertebra the subscapularis muscles are paralyzed, but the biceps, brachialis anticus, supinator longus, and deltoid escape, and the patient assumes a characteristic attitude (Fig. 343). If the sixth vertebra is dislocated there is palsy

of the muscles of the hand. In injuries below the sixth vertebra no muscle of the arm, forearm, or hand is paralyzed at first, although after some days paralysis may develop. Damage to the cord above the sixth cervical vertebra produces anesthesia of the body below the injury and of the entire upper extremity except the shoulder. In injury just above the upper level of the seventh cervical there is body-anesthesia and anesthesia of the outer surfaces of the arms and ulnar margins of the forearms and hands. In any cervical injury there is body-anesthesia and diaphragmatic respiration, and in cases without paralysis of the arms there is sure to be pain. Injuries of the dorsal spine can be accurately located. There is paralysis of motion and sensation up to, or almost up to, the seat of injury. The arms are not paralyzed. Very great pain in the legs occurs if the lumbar enlargement is involved. In injury of the twelfth dorsal or upper lumbar vertebra there is paralysis of the bladder and rectum, an incomplete anesthesia, and a partial motor paralysis of the limbs.

**Treatment of Fracture-dislocations.**—When dislocation of the body of a vertebra obviously exists, the surgeon may attempt reduction by extension and rotation. The maneuver is very dangerous in the cervical region, and, as deaths have happened, some eminent surgeons advise against reduction when the injury affects that region. In fracture-dislocation the traditional plan is to straighten the spine, gently if possible, and to put the patient upon his back upon a water-bed or upon air-cushions. In fractures in the cervical region support the head and neck with sand-bags. Empty the bladder every six hours with a soft catheter, which is kept strictly aseptic. Take every precaution to prevent bed-sores. Some surgeons advocate reduction of the deformity by extension and counter-extension, and the application of a firmly fitting but removable jacket with the suspension collar (as used in Pott's disease). If this plan is employed, the head of the bed is raised and the collar is fastened to it. Every day extension is made gently from the shoulders in dorsolumbar fracture, and from the chin and occiput in cervical fractures. Extension may be maintained permanently until cure. Surgeons have come rather slowly to a belief in laminectomy. One deterrent factor has been the high mortality: Lloyd collected the records of 159 operations and found that 59 patients died almost at once and 39 died later. White says laminectomy should be performed for fracture or for dislocation when there is obvious depression of the vertebral arches; in all cases of pressure upon the cauda equina; when there are characteristic symptoms of spinal hemorrhage; and in some cases where rapid degeneration becomes manifest. Surgeons, as a rule, until recently agreed that operation is useless when there are motor paralysis, complete persistent anesthesia, and entire loss of deep reflexes, because these symptoms indicate the strong probability that total division of the cord has taken place. It is useless to operate for fracture-dislocation of the atlas or axis. In ordinary cases of fracture-dislocation below the axis in which the cord is not completely divided treat by extension for six or eight weeks, and then operate if the case is not improving. In hemorrhagic cases, or cases with marked depression of the arches, operate early. If signs of degeneration begin within six or eight weeks, operate at once. "In compound fractures, in injuries of the laminæ and spinous processes without a



complete crush of the cord, when symptoms are due to hemorrhage, when pachymeningitis arises, if the cauda equina is compressed, operate" (Thorburn).

My own convictions are that we should explore, as soon as shock has passed away, if we think it probable that the cord has been divided; and if it is found divided it should be sutured. If in any case we are in doubt twelve hours after the injury as to whether or not pressure exists, we should explore. If soon after the accident we think pressure by bone exists, we should operate. If the case is improving, we should not operate even if there are pressure-signs, unless there is a chance that pressure is due to bone, in which case we should operate. As McCosh says, pressure by blood or inflammatory exudate may pass away; pressure by bone cannot. Even long after an injury, laminectomy may be productive of some benefit.

The rather radical views set forth above arose largely from a knowledge of the well-known case operated upon by Stewart for total division of the cord. In a recent case of gunshot-wound of the dorsal spine treated at the Pennsylvania Hospital by Francis T. Stewart, and reported by Francis T. Stewart and Richard H. Harte ("Phila. Med. Jour.," June 7, 1902), an exploratory incision showed that the spinal cord was completely divided. There was a fracture of the laminae of the seventh dorsal vertebra. The spines and laminae of the seventh and eighth dorsal vertebrae were removed. The bullet-hole was recognizable in the membranes, and the bullet and some bone-fragments were removed. When the dura was opened, the ends of the completely divided dorsal cord were found to be three-quarters of an inch apart. Stewart freshened these ends and brought them together with two sutures of chromicized catgut. In this case a considerable degree of restoration of function took place. At the time of the operation, three hours after the injury, there was complete paralysis and absence of reflexes below the seat of injury; but sixteen months later the patient was able to voluntarily flex the toes, flex and extend the legs, flex and extend the thighs, and, while sitting, lift an extended leg from the floor. The movements of the lower extremity became more forcible when reinforced by contracting the muscles of the upper extremity while making them. The patient could stand with one hand resting on the back of a chair, and could get herself from her bed to her chair by sliding. The bowels were under perfect control; and there was no incontinence of urine when she was awake, although there was occasionally some when she was asleep. There were occasional cramp-like pains in the lower limbs. The sense of touch, temperature, pain, and position were perfect all over the previously paralyzed parts. Below the knee the localization of sensation was not so accurate. There was a slight amount of muscular rigidity; and on each side, an ankle and patellar clonus, which was easily exhausted. When the sole of the foot was tickled, the big toe flexed, the thigh abducted, and there was slight contraction of the anterior tibial, the ham-string, and the tensor vaginae femoris muscles. There were no reactions of degeneration and no trophic changes. There had never been any bed-sores.

In the light of this positive report, we must conclude that the spinal cord is able, under certain circumstances, to undergo a considerable amount of regeneration; and we must make our treatment more radical, in accordance

with this conviction. It is often impossible to tell whether the spinal cord is completely divided or seriously damaged without examining it; it can be examined only by exploratory operation; if the serious symptoms already indicated exist after shock has passed away, exploratory operation should be performed; if pressure exists, it should be removed; and if the spinal cord is found to be completely divided, it should be sutured. It is well to remember that Abbe's experiments have shown that there may be great difficulty in bringing the divided ends of the cord into apposition. In order to effect this, it may be necessary to resect a vertebra. In connection with the foregoing important case, we would note that Dr. Estes, of Bethlehem, has also operated upon a case of complete division of the spinal cord, in which suturing was followed by some restoration of function.

**Operations on the Spine.—Operations for Spina Bifida.**—A. W. Mayo Robson maintains \* that operation is not demanded when the sac is of small size and is well protected by sound integument; that operation is improper when a large portion of the column is fissured, or when paraplegia or hydrocephalus exists; that operation is advisable only in meningocele, in cases in which the integument is thin and translucent, in cases in which the cord is flattened out, or the nerves are fused. Robson has closed the osseous defect by transplanting periosteum.

*Instruments Required.*—Scalpels, dissecting and hemostatic forceps, scissors, mouse-toothed forceps, rongeur forceps, dural separator, Hagedorn needles and needle-holder, silk, silkworm-gut or catgut.

*Operation.*—Surround the sac by elliptical incisions. Find the neck of the sac, and if it contains no visible nerves ligate it and cut off the protrusion. Push the stump into the canal. Freshen the bone-margins and spring a piece of celluloid beneath them to close the gap (Park). Suture over the stump with small sutures of catgut.†

**Treves's Operation for Vertebral Caries.**—(See page 643.)

**Laminectomy.**—The instruments required for laminectomy are dissecting, mouse-toothed, and hemostatic forceps; scalpels; bone-cutting forceps; rongeur forceps; a dry dissector; a periosteum-elevator; sequester forceps; small scissors; straight and curved on the flat; a chisel and mallet; retractors; blunt hooks; a probe; tenaculum forceps; a spoon-curet; a sand-pillow; fine needles, curved and straight, large needles, and a needle-holder.

In the *operation* of laminectomy the patient lies prone and a sand-pillow is placed under the lower ribs. Make a vertical incision over and down to the vertebral spines, the middle of the incision corresponding to the seat of injury or disease. The sides of the spinous processes and the laminæ are cleared. The periosteum is incised in the angle between the laminæ and spines, and is lifted away from the arches. The spinous processes are cut off close to their bases by means of rongeur forceps, the laminæ are removed on each side with the rongeur, and the dura is exposed. In some cases of fracture fragments will be found on exposing the vertebra, or a blood-clot will be seen between the dura and the bone; in other cases the dura must be opened with scissors vertically in the middle line while it is

\* Annals of Surgery, vol. xxii, No. 1.

† A full consideration of the various plans of operating will be found in an article by Marcy, in Annals of Surgery, March, 1895.



grasped with mouse-toothed forceps. After reaching and removing the compressing cause, or after failing to find or remove it, close the dura with catgut, drain the length of the wound with a tube, stitch the superficial parts with silkworm-gut, and dress antiseptically.

**Puncture of the spinal meninges, or lumbar puncture,** was devised by Quincke, and has been carefully tested by many surgeons (Fürbringer, Naunyn, and others). It is employed as a means of diminishing cerebral pressure in hydrocephalus, cerebral tumor, uremia, and tuberculous meningitis. It has proved of little therapeutic value. In some cases the examination of the fluid has been of diagnostic value. Stadelmann has reported 37 cases in which tubercle bacilli were found in the fluid.\* Turbidity of the fluid indicates the existence of meningitis. Bloody fluid indicates hemorrhage within the arachnoid. The back is sterilized; the patient may lie prone, with a pillow under the belly, or may sit in a chair, with the body bent forward; no anesthetic is required. A Pravaz syringe is employed, and the point is inserted at the under surface of a spinous process. In some cases but a few drops of fluid will be obtained, in other cases several ounces may be removed. It is not wise to draw over 2 c.c. The flow should be spontaneous, and suction ought not to be used. Sometimes nausea, vertigo, and severe headache follow the operation, and sudden deaths have been reported. For a number of hours after tapping the patient should remain recumbent

\* Berliner klinische Wochenschrift, July 8, 1895.