Spine and Spinal Orthoses

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Foreword
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JAYPEE

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3 CHAPTER

Disorders of Spine and their Orthotic Management

GOOD ORTHOTIC PRACTICE

Patient must have confidence in his orthotist. An orthotist must therefore (i) make the patient care as his first concern, (ii) provide good standard of practice and care, (iii) treat the patient with respect, dignity, confidentiality, and (iv) involve him in decision making. He should keep professional knowledge and skills up to date, and work within the limits of his competence, and be honest and open, and act with integrity. These are a few important points and must be kept in mind.

EXAMINATION OF PATIENT

An orthotist must have an adequate knowledge of anatomy and biomechanics of vertebral column including muscles controlling its stability and movements.

Female patient must be examined in the presence of a female attendant. Patient's age, sex, occupation, life style, social history and previous illness and the main complaints with duration should be recorded.

Patient is asked to suitably undress. The posture, any visible deformity like scoliosis, kyphosis or lordosis is noted. Spinous processes are palpated throughout its whole length from base of the skull till end of the sacrum, to check alignment, any deformity or tenderness. Paraspinal muscles, thigh, calf and buttock are palpated for tenderness, spasticity and wasting. Leg length discrepancy is checked by comparing the levels of the iliac crests. The findings are recorded for future reference.

Movements on flexion, extension, lateral flexion and rotation, active as well as passive should be checked and recorded. Appearance of any hump on flexion is noted.

Patient is asked to lie on his back (supine) with the head on a pillow. Movements of hip are examined. He is asked to raise the leg one after another. The angle by which each leg can be raised actively without pain is recorded. This test is known as *straight leg raising (SLR) test* and is normally 90° (Fig. 3.1).

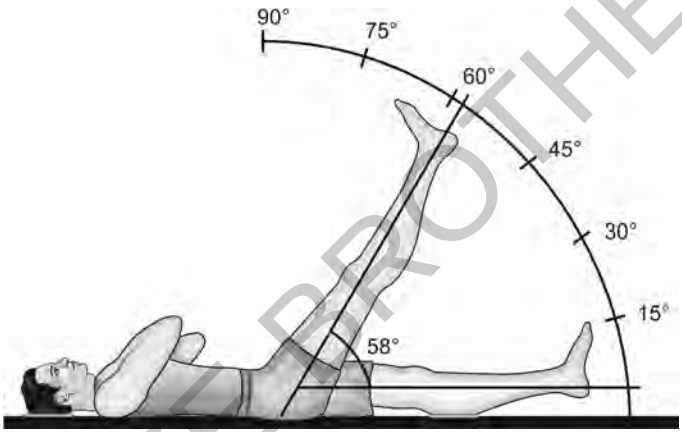


Fig. 3.1 Straight leg raising (SLR) test

If the patient experiences pain in the leg when the straight leg is passively raised beyond 30°, nerve root entrapment at the level of L4, L5 and S1, usually due to herniated disc is likely to be the cause. The test is then called positive. Back pain produced by straight leg raising is quite common and does not always indicate nerve root involvement.

Patient is then asked to lie prone (on his abdomen). Spine is re-checked for alignment, any deformity or tenderness. Sacroiliac joint on either side, indicated by the dimple, is examined for any tenderness. Compressing and distracting the anterior superior iliac spine is also checked for any tenderness.

Patient is then examined for any gait deviation or limp on walking. He should also be reviewed at regular intervals.

CLASSIFICATION OF SPINAL DISORDERS

Disorders of spine and their management can be described in various ways. One of the simple ways is to classify them according to the causative factors, as following:

- **Common disorders**
  - Low back pain
  - Acute lumbago (acute lower back pain)
- **Congenital abnormalities**
  - Spina bifida
  - Hemivertebrae
- **Spinal deformities**
  - Scoliosis
  - Kyphosis
  - Lordosis
- **Spinal arthritis**
  - Osteoarthritis (Spondylosis)
  - Rheumatoid arthritis
  - Facet joint arthropathy
  - Ankylosing spondylitis
- **Infective disorders of spine**
  - Vertebral osteomyelitis
  - Tuberculosis of spine (Koch's spine)
- **Mechanical derangements**
  - Intervertebral disc prolapse
  - Spondylolysis
  - Spondylolisthesis
  - Spinal canal stenosis
- **Sciatica**
  - Intervertebral disc herniation
  - Spinal canal stenosis
  - Piriformis syndrome
  - Spinal tumors
  - Trauma

  - Pregnancy
  - Pseudo sciatica
- **Traumatic conditions**
  - Fractures
  - Fracture with dislocation
  - Spinal cord injury (SCI)
- **Spinal tumors**
- **Spinal surgery**
  - Postoperative orthoses
  - Disc surgery without fusion
  - Disc surgery with fusion
- **Paralytic disorders**
- **Chronic strain and sprain**
- **Cervical conditions**
  - Sprain and strain
  - Torticollis
  - Cervical spondylosis and spondylitis
  - Fracture dislocation
- **Pediatric spinal conditions**
- **Miscellaneous conditions**
  - Scheuermann's disease
  - Osteoporosis
  - Obesity

COMMON DISORDERS AND MANAGEMENT

Low Back Pain

Nearly 80–85% of the population suffers from low back pain at some time or the other in their life. Low backache, lumbosacral strain, intervertebral disc prolapse, sciatic radiculitis and sciatica are included in this group. Low back pain can also be caused by other disorders like muscle weakness, osteoporosis, injury to the spine, skeletal instability, degenerative disc disease or facet joint arthropathy.

Muscle weakness enhances instability and aggravates disc degeneration, which may cause spondylosis or spur formation. Degenerative disc disease in addition to spondylosis may also lead to facet joint arthritis with back pain and also sciatica due to the root compression.

Orthotic Management

Prescription of spinal orthosis is based upon therapeutic requirement.

Lumbosacral orthosis (LSO) would reduce the pain and promote healing by trunk support and restricting movements of spine. When the LSO maintains the spine in mild flexion, weight transmission is through the vertebral bodies and thus reduces muscle activity and increases the facet joints space. This changed posture combined with increased intra-cavity pressure relieves the pain.

Minimal symptoms (Mild): In the absence of physical findings orthosis need not be provided and exercises are the best option. Analgesics may be given. Corset should be provided if there is no improvement.

Less severe symptoms (Sub acute): Patients with moderate pain with few physical findings are provided semi rigid orthosis (corset) to permit ambulation.

Severe symptoms (Acute): Spinal muscle spasm, severe sciatica, inability to walk or sit and progressive neurological deficit, all need bed rest as well as rigid spinal support. Rigid orthosis is used when corset does not relieve the symptoms. Rigid orthosis is more effective in limiting spinal motion and is useful in arthritis and realigning spine. However, it should be used for a limited period.

Following the relief of acute symptoms, early start of isometric exercises (where the muscles are exercised without or with little movements) are effective in most of the disorders.

Acute Lumbago (Acute Low Back Pain)

Lumbago is a symptom rather than a disease. In a typical attack of acute lumbago, the patient suddenly feels agonizing pain in the lumbar region of the spine, usually while stooping, lifting, turning, or coughing. The pain is often so severe that any movement is difficult and the patient

becomes stiff. With rest, the pain may gradually subside, but in some cases, the acute back pain can persist.

The pathogenesis of acute lumbago is not clear. It can be (i) *Mechanical disorders* like prolapse disc, spondylolisthesis, trauma and other congenital abnormalities, (ii) *Degenerative disorders* like degenerative disc disease and spondylosis, (iii) *Inflammatory conditions* like rheumatoid arthritis, epidural infection and osteomyelitis, (iv) *Neoplastic conditions* like primary or metastatic bone or spinal tumors, and (v) *Metabolic conditions* such as osteoporotic compression fractures, osteomalacia and chondrocalcinosis.

In many cases, the underlying lesion is a prolapsed disc that has not yet been severe enough to interfere with a nerve roots. It is in such cases that sciatica may develop later, as the size of the prolapse increases. Other causes of acute lumbago can be attributed to some other mechanical disorder, such as nipping of synovial membrane in one of the facet joints, or subluxation with consequent ligamentous strain, especially at an intervertebral joint that is unstable.

Orthotic Management

Thoracolumbosacral orthosis (TLSO) or lumbosacral orthosis (LSO) reduces pain and encourages healing by trunk support and restricting the movements of spine. In initial stages the patient may feel inconvenience or even may have discomfort that should subside in due course, unless it is due to the poor orthotic fitting, which would need rectification.

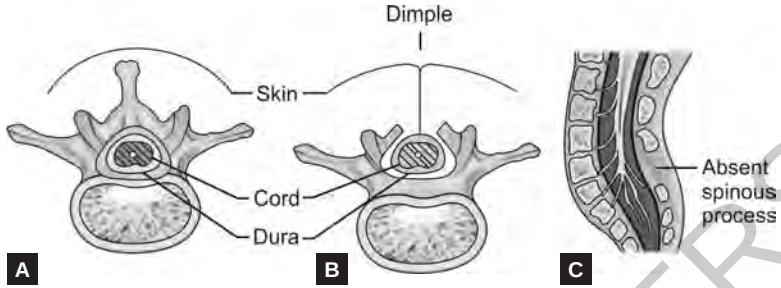
CONGENITAL ABNORMALITIES

Spina Bifida

Spina bifida is a neural tube defect that results from the failure of fusion of two arch centers, common in lumbosacral region.

- ***Spina bifida occulta:*** The spinal cord is normal and there is merely a radiological defect between the lamina (Figs 3.2A to C) that does not allow the spinal cord to protrude through.

  A band of fibrous tissue extends from the deep surface of the skin to the dura mater through a defect resulting into a dimple.



Figs 3.2A to C (A) Normal spine; (B and C) Spina bifida occulta

The presence of an over lying defect like dimple, lipoma, hemangioma, or a hair tuft indicates underlying defect. The pull by the fibrous band can sometimes lead to the defect like congenital talipes equinovarus (CTEV).

- ***Meningocele:*** It is herniation of meninges through the developmental defect in the vertebral column (Fig. 3.3).

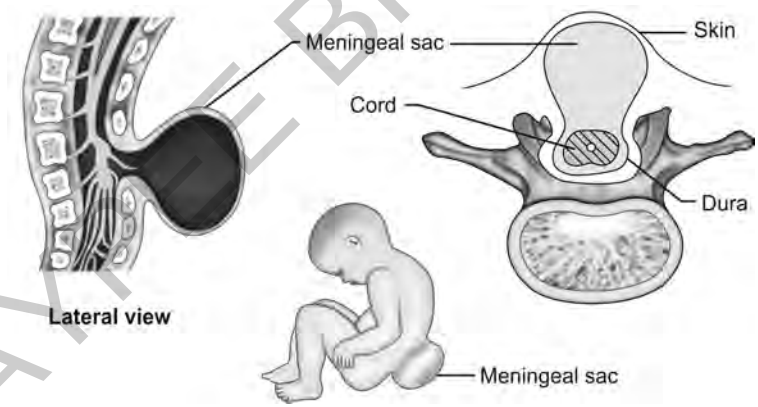


Fig. 3.3 Meningocele

The protruded meninges form a sac called *meningeal sac* without involvement of spinal cord and nerve roots. If this defect is surgically closed early, there may not be any residual disability.

- ***Meningomyelocele (Myelomeningocele):*** It is hernial protrusion of meninges and spinal cord through the defect in the vertebral arch.

The cord is usually adherent to the meningocele sac (Fig. 3.4). It is invariably associated with muscle paralysis, impaired sensations, skin ulcerations and deformities of the lower limbs as well as bowel and bladder incontinence.

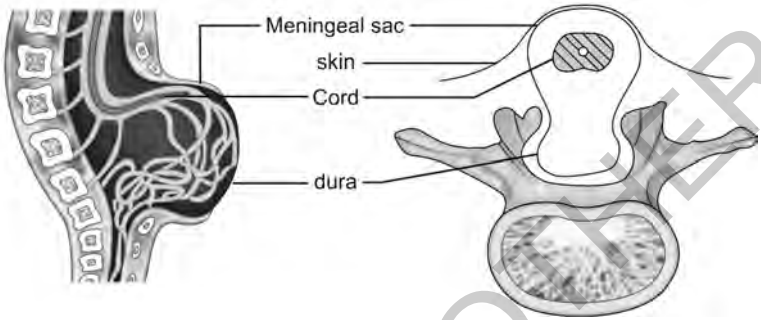


Fig. 3.4 Myelomeningocele

- ***Myelocele (Rachischisis):*** It is a birth defect involving the neural tube. There is failure of closure of neural tube producing an open spinal plate of nervous tissue that occupies as red granular area with leaking *cerebrospinal fluid (CSF)* from its center (Fig. 3.5). It is common at the lumbosacral region and often associated with *anencephaly* (absence of major portion of the brain, skull and scalp). Patient with this birth defect have motor and sensory deficits, chronic infections, and disturbances in bladder function and usually is incompatible with survival.

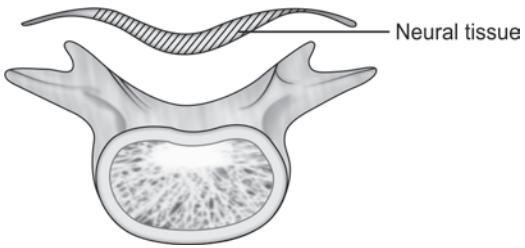


Fig. 3.5 Myelocele

Orthotic Management

For neurological deficit the trunk is required to be supported depending upon the weakness and level of defect. The spinal orthosis is modified for each patient and is used when there is a trunk weakness or paralysis with room to avoid pressure on posterior bulge. For any weakness of the limbs hip-knee-ankle-foot-orthosis (HKAFO), knee-ankle-foot orthosis (KAFO) or ankle-foot orthosis (AFO) is provided.

Hemivertebrae

This is a developmental anomaly where half of the vertebra fails to develop. The defective vertebra acts as a wedge in the spine leading to excessive curvature. It occurs in 5–10 per 10,000 live births, due to the developmental failure of one of the lateral vertebral chondrification centers, usually due to poor circulation. It occurs more commonly in females, and usually in the mid thoracic region (Fig. 3.6).

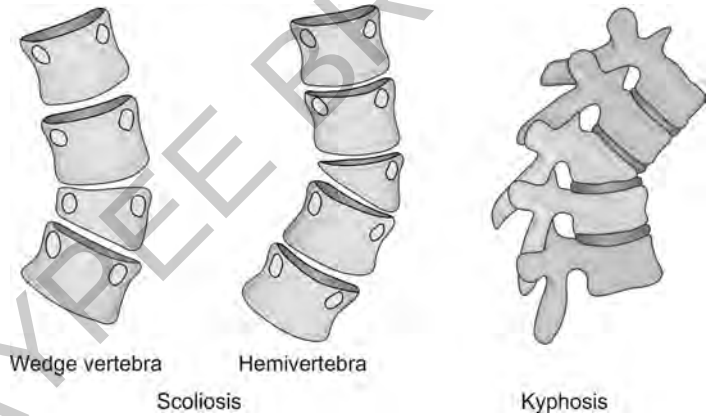


Fig. 3.6 Hemivertebra

This can result in an angulation in the spine such as scoliosis, kyphosis and lordosis. Severe angulation can lead to neurological signs that result from narrowing of the spinal canal and instability of the spine.

There may be lower limb weakness, back pain, paralysis, urinary or fecal incontinence. Most cases of hemivertebrae have no or mild symptoms and managed conservatively. Severe cases may respond to surgical spinal cord decompression and vertebral stabilization.

Orthotic Management

Milwaukee brace is the choice of treatment in most cases in early stages. This keeps the spine in corrected position with the help of corrective pads over the convexity. The main difficulty is that the brace has to be used for a prolonged period until the bony maturity of the patient.

SPINAL DEFORMITIES

Scoliosis

Scoliosis is defined as an appreciable lateral curvature of spine usually with rotational elements, where the vertebral body shifts towards the convexity of the curve and the spinous processes deviate towards the concave side (Fig. 3.7). If the deformity involves the dorsal spine, the result would be the diminution of the entire volume of the thoracic cage that may ultimately lead to respiratory impairment.

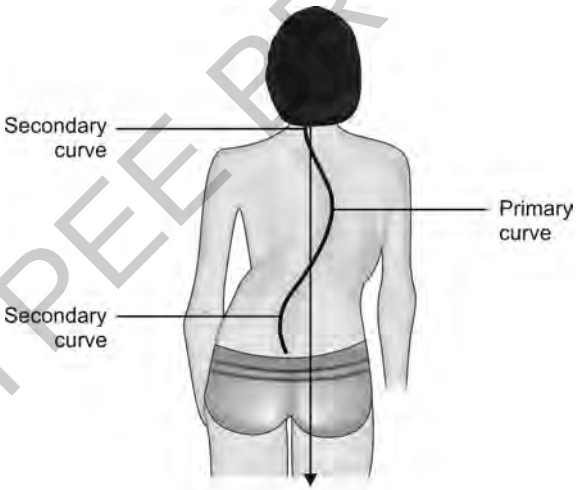


Fig. 3.7 Scoliosis

The scoliotic deformities are classified according to their magnitude, location, direction and etiology. This may be either nonstructural where the curvature can be corrected by change of posture, or structural, which is associated with alterations in vertebral anatomy. Scoliosis is classified as following:

- *Idiopathic scoliosis* (75%): This is the largest group where the definitive cause is not known and described as infantile (0–3 years), juvenile (3–10 years), adolescent (10–18 years), or adult type, according to the time of onset. Genetic factors are widely accepted since the disease has an increased familial incidence. The gene CHD7 is said to be associated with the idiopathic scoliosis.
- *Congenital scoliosis* is associated with congenital spinal anomalies such as hemivertebra, errors of segmentation and spina bifida.
- *Paralytic or neuromuscular scoliosis* is associated with poliomyelitis, cerebral palsy, spina bifida. Poliomyelitis has now tremendously reduced in India as a result of 'pulse polio program.'
- *Postural scoliosis* affects children of school going age and is characterized by a simple C curve without vertebral rotation. The deformity is fully mobile and correctable.

Other conditions that may lead to scoliosis include spinal trauma, pulmonary conditions and degenerative disc disease.

Symptoms: Scoliosis often do not have any noticeable symptoms and may go unnoticed. However, the height of the individual will be less than the average for his or her age. There will be prominent shoulder blade or ribs on convex side of the scoliosis, which would be obvious on forward bending. There may be back pain and in severe cases of scoliosis can lead to diminishing lung capacity, putting pressure on the heart, and restricting physical activities.

Diagnosis: It is made by asking the patient to stand upright and examined from behind. In mild cases the primary curvature of the spine is balanced by secondary curves in opposite direction above and below it (Fig. 3.7).

Patient is then asked to bend forward, a hump would appear towards the convex side of the spine as shown in Figure 3.8 (*Adam's forward bend test*).

On suspicion of scoliosis, X-rays of whole of the spine, Anteroposterior) and lateral views are taken in standing position. In growing individuals, X-rays are repeated at an interval of 3–6 months to check the progression of scoliosis. Magnetic resonance imaging (MRI) is indicated to visualize the spinal cord.

The scoliosis is quantitatively assessed by *Cobb's angle*, which is the angle between the lines drawn perpendicular to the upper end plate of the

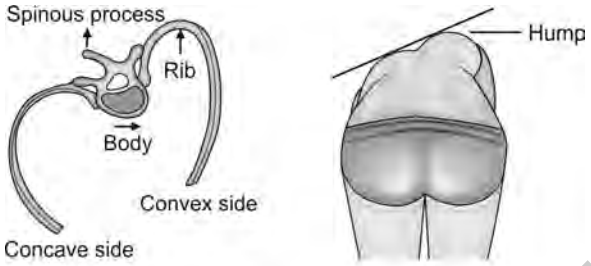
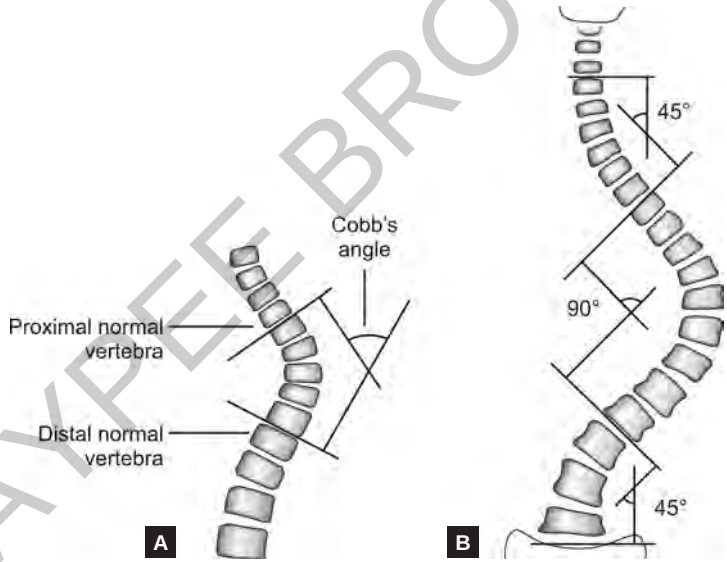


Fig. 3.8 Adam's forward bend test

uppermost vertebra involved and lower end plate of the lowest vertebra involved in scoliosis as shown in Figure 3.9A. For patients with secondary curves, Cobb's angles are measured for all the curves (Fig. 3.9B).



Figs 3.9A and B Cobb's angle

Orthotic Management

Orthotic management depends upon age, degree of curvature and general condition of the patient. Young patients with less than 20° of Cobb's angle should be kept under observation. They may gradually recover as

Spine and Spinal Orthoses

Salient Features

- Deals with the anatomy and biomechanics of the normal as well as pathological spine
- Describes various spinal disorders and how to manage them with the help of spinal orthoses, an aspect not really clearly understood
- Contains five chapters, namely Anatomy and Biomechanics of Normal Spine, Orthoses for Spine, Disorders of Spine and their Orthotic Management, Synopsis, and Checkout Procedures
- Helpful for the Clinicians, Rehabilitation Medicine Consultants, Orthopedic Surgeons, Orthotists, Prosthetists, Physiotherapists, Occupational Therapists, as well as for Medical Students, Postgraduate Residents of Surgery and Orthopedic Surgery, Students of Prosthetics and Orthotics, Physiotherapy and Occupational Therapy.

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He performed over 2,500 amputations/re-amputation and limb salvage procedures, a figure highest in India.

He was awarded National Technology Award by the President of India for the best invention of the year for developing *Polyurethane Prosthetic Foot* (1990); GEMS International Award for Excellence in Research (1990).

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