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Essentials of Exercise Therapy



Sheetal Patel

JAYPEE

Essentials of EXERCISE THERAPY

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CHAPTER 27

Posture

Chapter Outline

- Types
- Postural Mechanism or Postural Reflex
- Good and Bad Posture
- Factors Responsible for Development of Posture
- Postural Deviation
- Crawling Exercise

INTRODUCTION

Posture in general means the relative arrangement of the body parts on one another for a specific activity. The exact definition of posture is:

- "Posture is an attitude assumed by the body either with support during muscular inactivity, or by means of coordinated action of many muscles working to maintain stability or to form a base from which a movement can be initiated effectively".
- In simpler terms, posture is a position assumed by the body either with the support of a supporting surface or is maintained by the action of many muscles which work in coordination with each other.

TYPES

Posture is broadly classified into two types; static and dynamic posture.

Static Posture

It is the posture assumed when the body is not moving, e.g., sitting or standing, etc.

Static posture may be inactive or active.

- **Inactive posture:** As the name suggests, in this posture, the muscles are relatively inactive and the posture is maintained by the support of a surface rather than muscular activity, e.g., lying posture.

  As the body is supported, the muscular activity required to maintain this position is reduced to minimum. So, this position is used for resting and to teach relaxation. (While explaining posture, the term muscular activity refers only to the skeletal muscles or the voluntary muscles; we do not consider the involuntary muscles).

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- **Active posture:** This form of static posture is produced and maintained by muscular activity. The muscle works against an external force mainly the force of gravity which tends to pull the body downward. The muscles responsible for maintaining this position are collectively known as antigravity muscles. They work to maintain stability and keep the body in a state of equilibrium, e.g., sitting, standing, etc.

Dynamic Posture

In this type of posture, the body is in motion. So, dynamic posture is the posture maintained when the body is in motion, e.g., posture while walking, running, etc. This posture forms a base from which a movement can be initiated. Multiple muscles work to maintain this posture and at the same time produce movement.

POSTURAL MECHANISM OR POSTURAL REFLEX

Posture is produced and maintained by a complex yet interesting mechanism called sensory motor integration or simply known as postural mechanism. It involves sensory input from the visual, vestibular and somatosensory system to the central nervous system, which in turn produces the motor response required to maintain upright posture or produce a controlled movement in dynamic posture.

Postural Reflex

Posture is maintained by a reflex action called postural reflex. Like other reflexes postural reflex is an efferent response to an afferent stimulus.

The afferent stimuli arise from the following receptor organs **(Fig. 27.1)**:

- **Eyes:** The visual sensation helps to correct the position of the body with respect to the surrounding. Also known as righting reflex that helps the body to regain the normal erect position following any change in position.
- **Vestibular system:** This includes the three fluid-filled semicircular canals present in the middle ear. Any change in the position of the head causes movement of the fluid which stimulates the vestibular nerve and the sensation is carried to the brain.
- **Joints:** Receptors are present in the joint which are responsible for joint proprioception and kinesthetic sensation. They sense any change in the joint or movement of the joint and elicit reflex reaction to correct the position of the joint.
- **Muscles:** Mechanoreceptors present in the muscles (pacinian corpuscles, ruffini endings, muscle spindle, and golgi tendon organ) record changing tension in the muscles and elicit reflex contraction of the muscles responsible for correction of posture.
- **Skin:** The sensory receptors present on the skin plays an important role in the maintenance of posture, especially the skin over the sole of the feet.

The efferent response to the above stimulus is the antigravity muscles. These are the muscles responsible primarily for the maintenance of posture. These muscles have certain characteristics that enable them to work for a prolonged period of time without fatigue.

- They are usually multipennate or fan-shaped muscle, designed for production of power rather than range of motion.
- These muscles primarily have type 1 muscle fiber, otherwise, known as slow oxidative or red fibrers. They have highest resistance to fatigue.

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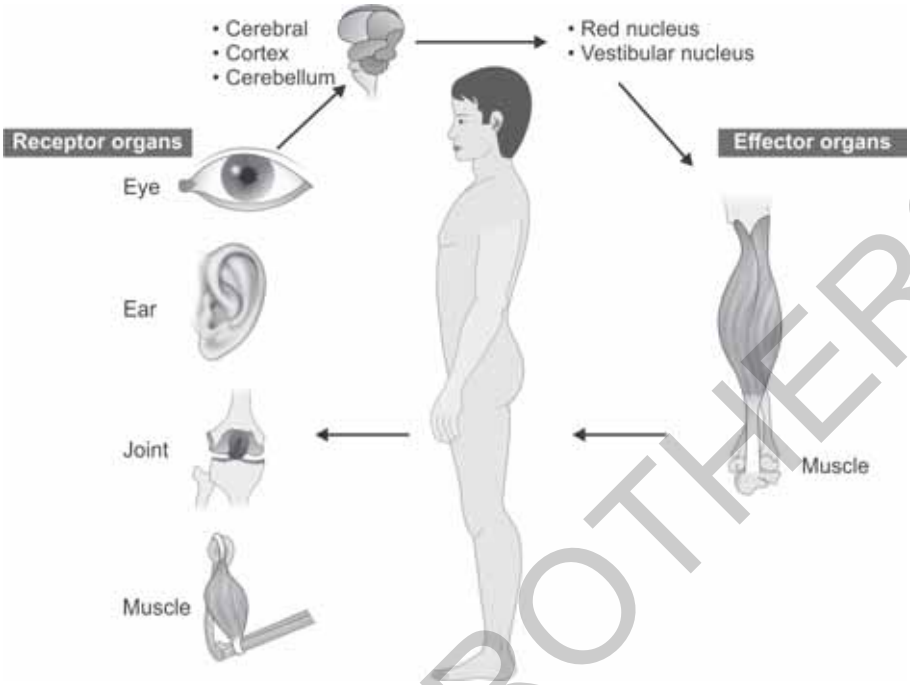

Fig. 27.1: Postural reflex.

GOOD AND BAD POSTURE

Posture, both static and dynamic, are gradually built up by the integration of many reflexes which together make up the postural reflex. Some of these reflexes are inborn while some others are conditioned, i.e., developed as a result of constant repetition of posture maintained by action of voluntary muscle.

Good Posture

Good posture refers to having a neutral spine maintaining all the natural curves of spine, where the muscle groups, joint, and the ligaments are aligned in a way that reduces fatigue and helps maintain the balance.

Good posture includes both static and dynamic posture. Static posture, as described, holds the body in normal aligned position and good dynamic posture is producing a required movement in an ideal pattern recruiting only those muscles responsible for producing the movement, at the same time stabilizing the other parts so that the required movement is produced effectively without straining other parts which are not involved in the production of movement.

Poor Posture

Poor posture in contrast has a deviation from the normal, where the normal alignment of the body is altered. This puts unusual stress on the muscle leading to pain and fatigue. When this posture becomes habitual it leads to stretching and shortening of muscles and ligaments and on long run also alters the bones and leads to something called deformity.

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FACTORS RESPONSIBLE FOR DEVELOPMENT OF POSTURE

Good Posture

- Awareness or knowledge of good posture.
- Well-functioning musculoskeletal system with good muscular strength and flexibility. Optimal muscle tone (relaxed muscle) is also an integral part of this.
- Other factors, such as general health of the patient, psychological state of the patient, and adequate rest to the body also contribute for development of good posture.

Poor Posture

Lack of knowledge of good posture, local or general pain, fatigue, and muscular weakness. Stiff joints, lack of self-confidence, and inadequate rest or sleep are all the causes that predispose the body to development of poor posture.

The Equilibrium of Posture

For the body to be stable or in equilibrium all the forces working on the body must be balanced. The force of gravity must fall exactly through the center of the joint and it must be counterbalanced by another force produced either by the muscles or the inert structures, such as ligaments and capsule. A good posture is one which maintains the normal alignment of all the body segments and maintains normal curvature of the spine. It is defined as follows:

Ankle

The line of gravity passes anterior to the ankle creating a dorsiflexion torque on the joint, which is counterbalanced by the plantar flexors, mainly the soleus muscle which pulls the tibia posteriorly on the fixed foot.

Knee

In the knee joint, the line of gravity passes anterior to the knee, keeping the knee in extension. When knee is fully extended (locked) no muscle action is required and stability is provided by inert structure, anterior cruciate ligament, or posterior joint capsule. When knees are flexed slightly, the line of gravity shifts posteriorly producing a flexor torque. The quadriceps muscle must work to prevent buckling of knee.

Hip

The line of gravity passes through the center of the hip joint. No muscle action is required as the joint is stable in this position. If the line of gravity shifts anteriorly, it causes flexion of hip, the extensors must work to counterbalance this force. If the line of gravity shifts posteriorly the tension in the hip flexors counterbalances it.

Spine

The line of gravity passes through the bodies of the lumbar and cervical vertebra and anterior to the thoracic spine. Activity of the muscle of the trunk and pelvis helps to maintain the balance.

Head

The line of gravity passes anterior to the atlanto-occipital joint. The posterior neck muscle and the tension in the ligamentum nuchae work to keep the neck head straight.

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POSTURAL DEVIATION

Any deviation from the normal alignment of the body is termed as postural deviation. There are multiple factors which lead to postural deviation. Common causes of postural deviation are as follows:

- Lack of education and awareness and education of correct posture
- Congenital deformity
- Muscle imbalance due to weakness or tightness
- Joint stiffness
- Poor ergonomics at work place
- Occupational demands
- Degenerative diseases
- Weak core muscles
- Obesity and sedentary lifestyle
- Lack of flexibility

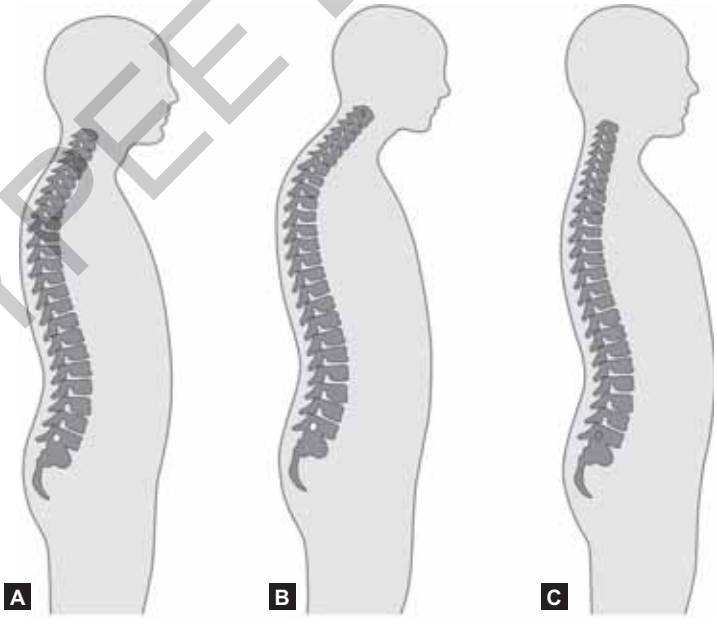
Postural deviation can be explained as deviation on sagittal plane or deviation on frontal plane.

Sagittal Plane Deviation

Cervical Spine (Figs. 27.2A to C)

Forward head posture (Fig. 27.2B)

This posture is characterized by increased flexion of lower cervical and upper thoracic and increased extension of upper cervical and atlanto-occipital joint. There might also be retrusion of temporomandibular joint.



Figs. 27.2A to C: (A) Normal spine; (B) Forward head posture; (C) Flat neck posture.

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Muscle imbalance

- **Tight structure:** Levator scapulae, sternocleidomastoid, scalene, and suboccipital muscle. If it is associated with elevated shoulder there might be tightness of upper trapezius.
- **Stretched structure:** Lower thoracic and upper cervical erector spinae muscles and the muscles of anterior neck are stretched and weakened.
- **Common causes:** Occupational or functional position requiring forward head position for an extended period of time, e.g., computer operator.

Flat neck posture (Fig. 27.2C)

There is flattening of cervical lordosis and flexion of atlanto-occipital joint. This posture may be associated with flat upper back position and temporomandibular dysfunction.

Muscle imbalance

- Short anterior neck muscle
- Stretched levator scapulae, sternocleidomastoid, and scalene
  Common cause: Acute spasm of upper trapezius.

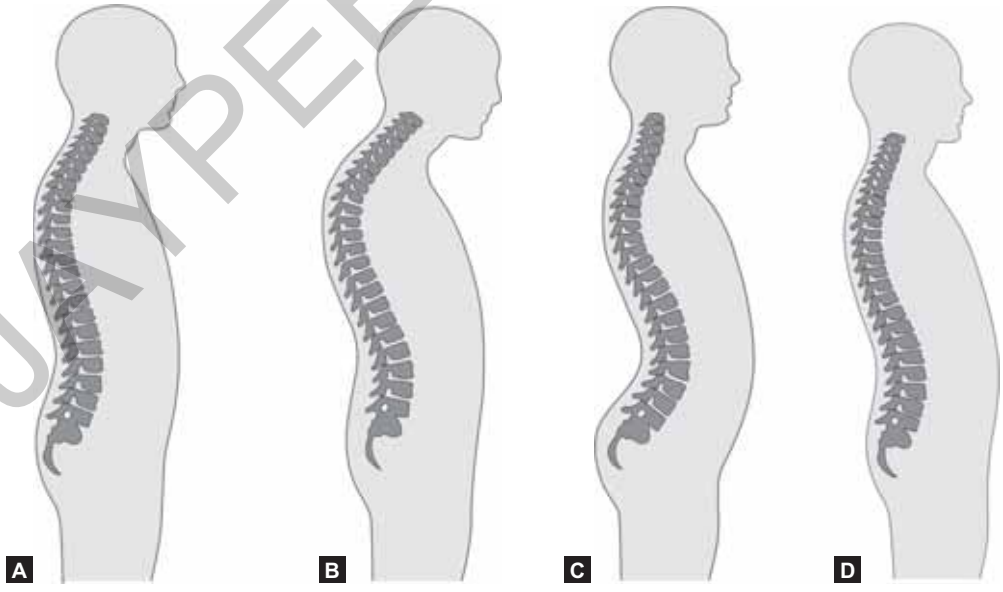
Thoracolumbar Spine

Kyphosis or round back (Figs. 27.3A to D)

This posture is characterized by increased thoracic kyphosis and protracted scapula. Secondary forward head posture might develop as the patient tends to assume this position to maintain the line of vision.

Muscle imbalance

- Tight muscles of anterior thorax (intercostals), thoracoscapular and thoracohumeral muscles (pectoralis major and minor, latissimus dorsi, serratus anterior, and levator scapulae), upper trapezius, and other muscles as in forward head posture.



Figs. 27.3A to D: (A) Normal spine; (B) Kyphosis; (C) Lordosis; (D) Swayback.

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- Stretched and weak thoracic erector spinae and scapular retractor (rhomboids and middle and lower trapezius).
  Common causes: Slouching for extended period of time and habitually relaxed upper back. Some pathological condition, such as ankylosing spondylitis leads to this posture.

Flat upper back posture (exaggerated military posture)

This posture is characterized by flattening of thoracic kyphosis, depressed scapula, and clavicle. Might be associated with flat neck posture.

Muscle imbalance

- Tight thoracic erector spinae and scapular retractor
- Stretched and weak scapular protractor and intercostals of the anterior thorax
  Common causes: Exaggerated upright posture for a prolonged period of time.

Pelvic and Lumbar Spine (Figs. 27.4A to C)

Swayback posture or slouched posture

This posture is mainly due to failure to maintain the normal curve due to muscle weakness and attitude to over-relax. This leads to exaggeration of all the normal curve of the spine, increased lordosis of lower lumbar spine, increased kyphosis of lower thoracic and upper lumbar spine (spinal flexion), and increased anterior pelvic tilt.

Muscle imbalance

- Tight upper abdominal, internal intercostals, hip extensors, and lower lumbar extensor muscles.
- Stretched and weak lower abdominal, lower thoracic extensors, and hip flexors.
  Common causes: As the name suggests, it results due to over-relaxed position or excessive fatigue, when the person completely yield to the effect of gravity. Antigravity muscle activity is voluntarily reduced so the spine is supported mainly by the passive structures, such as ligaments, joint capsule, and bony approximation at the end of range.

Flat low back

There is flattening of lumbar lordosis, decreased lumbosacral angle, and posterior pelvic tilt.

Muscle imbalance

- Tight trunk flexors (rectus abdominis and intercostals) and hip extensors
- Stretched and weak lumbar extensors and hip flexors

Lordotic posture

There is increased lumbar lordosis, increased lumbosacral angle, and increased anterior pelvic tilt and hip flexion. This position may be associated with increased thoracic kyphosis and forward head posture (kypholordotic posture).

Muscle imbalance

- Tight hip flexors [iliopsoas, tensor fascia lata (TFL), rectus femoris, and lumbar extensors (erector spinae)].
- Stretched and weak abdominal muscle (rectus femoris and internal and external oblique).

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Frontal Plane Deviation

Scoliosis (Fig. 27.4)

This usually involves thoracic and lumbar spine. Normally in frontal plane, the spine is straight. In scoliosis, there is a lateral curvature of spine associated with hip pelvis and lower limb.

Scoliosis is usually of two types:

1. **Structural scoliosis:** There is a fixed irreversible lateral curvature of spine with fixed rotation of the vertebra. There is a convexity in one side of the spine and concavity on other. There is a rib hump detected on forward bending, which is due to rotation of ribcage along with the thoracic vertebra.
2. **Functional scoliosis or postural scoliosis:** There is no structural deviation of the spine. It usually occurs due to a compensatory mechanism to limb length discrepancy or spasm of paraspinal muscles. The lateral curvature usually disappears with forward bending.

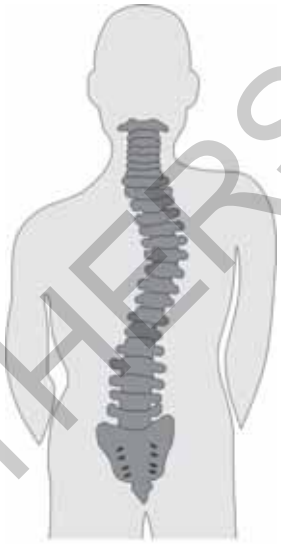

Fig. 27.4: Scoliosis.

Muscle imbalance

- Tight structures on the concave side of the curve
- Stretched and weak structure at the side of convexity

CRAWLING EXERCISE

Crawling is used as a mode of locomotion by toddlers before bipedal stance is achieved. It is also used in rehabilitation of patients with neurological deficit and as a part of mat exercises. Crawling helps in early weight-bearing on the upper limb, so it can also be used as an exercise to stimulate weight-bearing on both upper and lower limbs. It stimulates joint proprioception by causing joint approximation. Crawling is a genuine full body exercise involving a large group of muscles, such as gluteus muscle, quadriceps, calves, abdominal, hip, and shoulder musculature. Fitness professionals use various types of crawling exercises (bear crawl, leopard crawl, lizard crawl, etc.) to improve core stability and flexibility.

However, in physiotherapy, crawling exercises are used extensively to mobilize the spine and correction of spinal deformity, such as kyphosis and scoliosis, where active exercises are performed in prone kneeling position for stretching and strengthening of structures responsible for development of spinal deformity.

Principle of Crawling

While crawling, weight is distributed on all four limbs. Crawling movement in this position causes rotation of spine and simultaneous stretching thus functionally strengthens the muscle.

Advantages of Crawling Exercise

- Crawling is initiated in prone kneeling position. The horizontal position of spine allows more mobility of the whole spine. So various spine exercises performed in this position are more effective than performed in any other position.

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- In horizontal position, the postural curves disappear. With partially fixed curves, the back is longer than that in vertical position.
- The active correction of curves is better than the passive correction as it also strengthens the muscles along with stretching.
- Fewer assistance is required as the exercises are done actively.
- For children, this position is less tiring than upright position.
- Children adopt crawling exercises better than the other conventional stretching exercises.
- Once they learn the technique, it can be performed at home twice or thrice a day.

Klapp's Crawl

- Klapp's crawling method was developed in Germany in the beginning of the 20th century as a method for treating idiopathic scoliosis. This method was created by orthopedist Bernhard Klapp, and was developed by his son Rudolf Klapp. This method aims at correcting the spinal curvature by stretching and strengthening the back muscles**.**
- Klapp noted that only the bipedal animals develop scoliosis, whereas quadrupedal animals do not. Quadruped position unloads the spine as compared to bipedal position and also the spine has a large mobility in this position. So in quadruped position, it is easy to mobilize the spine as well as to stretch the tight structure.
- Klapp's method consists of a set of stretching and strengthening exercises. They are as follows:

Crawl Posture Near the Ground

In crawl posture near the ground, the subject is supported over their elbows at 90° with the hands in forward position. Head is in line with the body hips and knees in 90° of flexion. Then, the subject does thoracic hyperkyphosis and lumbar hyperlordosis **(Fig. 27.5)**.

Horizontal Sliding

In horizontal sliding exercise, the subject is in cat position with hip and knees at 90° of flexion, upper limbs are stretched forward without touching the elbows to the ground, and hands are



Fig. 27.5: Crawl posture near the ground.

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held shoulder width apart. Spine is extended and head is held straight in line with the spine **(Fig. 27.6)**.

Lateral Sliding

From horizontal sliding this subject slides his trunk and upper limbs toward the convex side, which is known as lateral sliding **(Fig. 27.7)**.

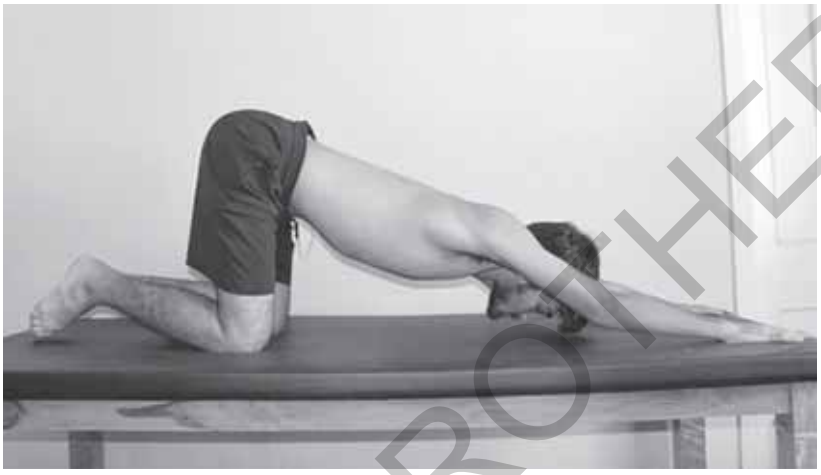

Fig. 27.6: Horizontal sliding.

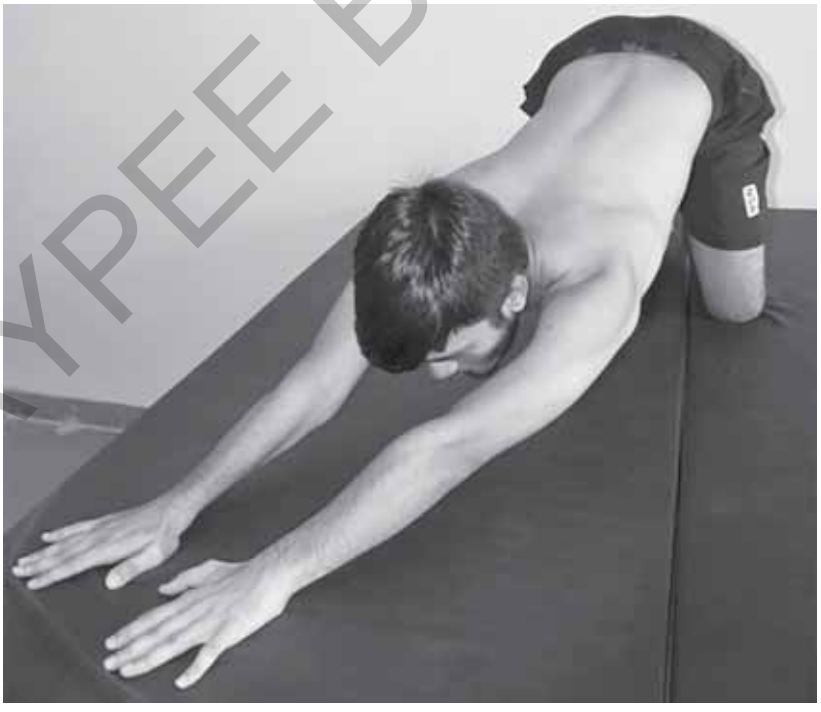

Fig. 27.7: Lateral sliding.

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Lateral Crawl

The subject is in a quadruped position with elbows extended but not locked, and hands and shoulder width apart. Hip and knees are in 90° of flexion and hips width apart. The upper limb at the side of concavity is taken forward and the same side of lower limb is extended backward. The head is rotated to opposite side (side of convexity) **(Fig. 27.8)**.

Big Arch

In big arch, the subject is in quadruped position. The elbow and the knee at the side of the convexity remains close to each other whereas the upper and lower limbs at the side of concavity are extended in diagonal pattern **(Fig. 27.9)**.

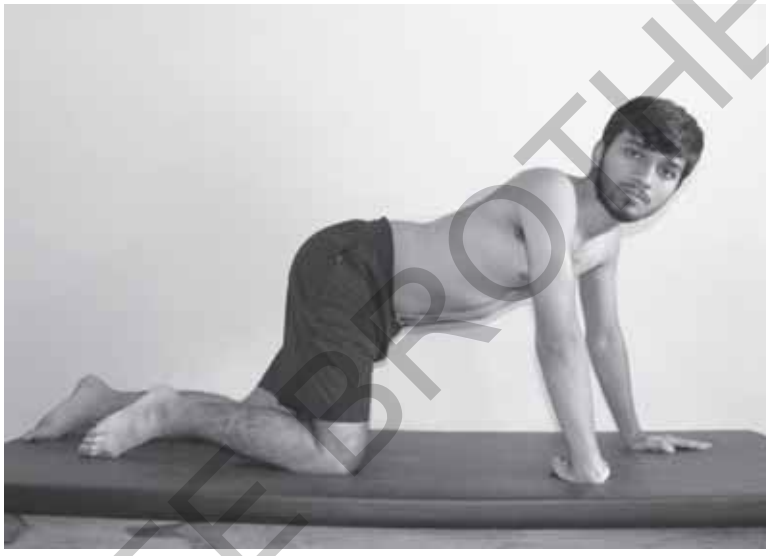

Fig. 27.8: Lateral crawl.

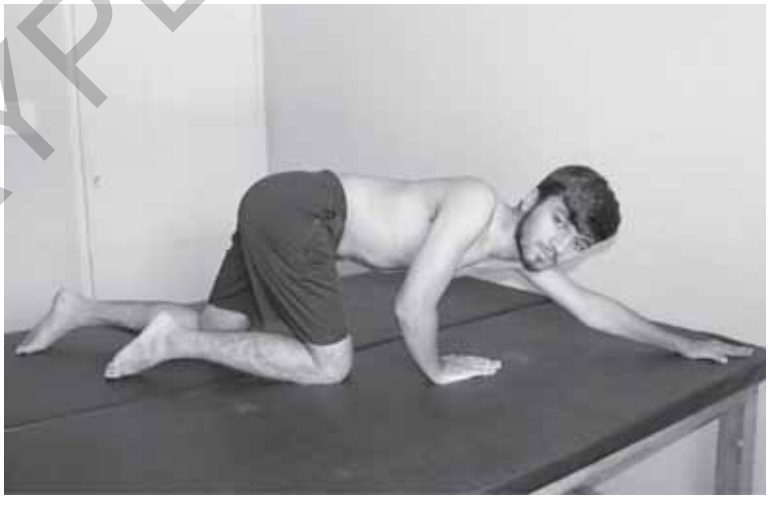

Fig. 27.9: Big arch.

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Fig. 27.10: Arm turn.



Fig. 27.11: Big curve.

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Arm Turn

In arm turn, the subject is positioned in cat position, upper limb at the side of concavity is extended with 90° of abduction, and the trunk is rotated to the side of concavity along with the head **(Fig. 27.10)**.

Big Curve

In big curve, from the quadruped position the upper limb and the lower limb at the side of the concavity are extended **(Fig. 27.11)**.

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Essentials of Exercise Therapy

Salient Features

- Book covers all topics of exercise therapy from the syllabus of all the universities of India.
- Book consists of all basic concepts for building student's foundation.
- The content given in this book is in easy-to-understand and comprehensive language.
- All the practical demonstrations have been presented with clinical photos for better understanding for the students.
- Special notes have been included after completion of important topics/chapters to highlight specific content.
- Laboratory practice and self-study questions are incorporated to enhance their clinical practice.

Sheetal Patel MPT (Musculoskeletal Condition) specialized in orthopedic conditions and is working as an Associate Professor at Shri KK Sheth Physiotherapy College, Rajkot, Gujarat, India. She has more than 15 years of experience in teaching as well as clinical work. She has guided more than 40 postgraduate students in last 10 years. Also she is actively mentoring and guiding her students for various presentations, poster presentations and many such activities.

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