

1

PART ONE

Theoretical Background, Joint Flexibility



Scan QR Code
for Video

JOINT FLEXIBILITY

Each joint has its own unique level of flexibility. Flexibility is the ability of a given joint (or joints) to perform an action at a significant level, for example, abducting the lower extremities as wide as necessary at the hip joint in order to perform a split. Flexibility training is based on improving range of joint movement. Muscles are only one of the factors limiting range of joint movement, but through proper stretching, range of joint movement can be substantially improved.

- **Stretching:** An attempt to increase range of joint movement by increasing the length of the relevant muscles.
- **Maximal range:** The range of movement that exercisers aspire to reach.
- **Optimal range:** The range of movement that exercisers actually attain without causing damage to the joint.
- **Maximal-optimal range:** Attainment of the exerciser's potential range of movement at a given stage of training.

Actions meant to expand the range of joint movement have a tendency to stimulate the stretch reflex. The stretch reflex is a protective mechanism that entails an abrupt shortening of the muscle in reaction to sudden stretching. We experience the stretch reflex when we fall asleep in a sitting position and our head falls forward (because the center of gravity in the head is above the eyes). Subsequently, the neck muscles respond to the excessive stretching by immediately and involuntarily shortening them (a reflex), bringing the head up with a jerk. This situation is familiar to students in especially boring lectures or drivers who fall asleep at the wheel. In the gym, stretching the chest muscles often stimulates the stretch reflex with its concomitant muscle contraction. This response causes

microscopic tears and inflammations in the muscle, damage that may accumulate in the long run to the point of terminating physical activity in those muscles. To prevent the stretch reflex it is necessary to work at a slow and controlled rate during stretching activities, especially those intended to improve flexibility.

TRAINING METHODS FOR DEVELOPING JOINT FLEXIBILITY

Power training is characterized by a shortening of the muscles. If stretches are not included as a regular part of training, the result may be a long-term negative effect on range of joint movement, mainly a loss of range of joint movement and a decline in quality of movement and performance. Short muscles also cause pressure on internal body parts creating muscular imbalance and, as a result, these points become highly vulnerable to pain. Shortened muscles reduce antagonist muscle tone which delays the development of muscle strength. Therefore, muscle training and flexibility training are mutually complementary. Good flexibility improves physical sport achievements and significantly reduces dangers of injury to the soft tissues: muscles, tendons, ligaments, spindles, and capsules.

Flexibility has Many Important Advantages

1. Reduces muscular resistance to movement.
2. Improves blood flow to and from muscles.
3. Improves and enriches movement variety and range.
4. Assists in the efficient utilization of power, speed, endurance, and energy conservation.
5. Helps to improve athletic performance.
6. Reduces risk factors for injuries thanks to range of movement and to large mobility “reserves” for muscles.
7. Creates muscle group balance.
8. Promotes muscular relaxation and reduces physical and emotional tension.



Scan QR Code
for Video

Before describing the most commonly used methods for developing flexibility, it is important to mention the factors that limit range of joint movement. Intrajoint factors are bone structure and joint type (e.g. ball-in-socket, hinge). Factors outside the joints include joint ligaments and bursas (which envelop the joints) and muscle length or volume. Other limitations arise from factors such as age, gender, temperature (internal and external), fatigue, emotional state, genetics, personality and occupation. In addition, pathological factors, degenerative changes, traumatic damage and others have to be considered. During the life cycle, the human body secretes a diminishing amount of hyaluronic acid that serves as a lubricant for collagen, a protein important for the connective tissues of the bones, cartilage,

ligaments and skin. As a result, more crossed connections are created that impair muscle lengthening and joint flexibility. In the absence of physical activity, the range and flexibility of joint movement decline significantly.

Since flexibility training has a positive effect on joint structure, it is important that all exercisers, and especially beginners (educate them properly from the start!), include flexibility training in each training unit. Flexibility training should entail a gradual work schedule that acts on each joint individually.

It is recommended to work in a specific order so as to stretch most of the joints: for example, limb order (from top to bottom or *vice versa*) or starting position (standing, sitting, lying).

The main part of flexibility training occurs through stretching exercises. Exercise can be considered flexibility training when the stretches are in the maximal-optimal range (movement range without causing damage). At a lesser range, the work is defined as stretch training. Stretching exercises should be performed only after proper preparation (raising body temperature). Also, they should be performed gently to avoid invoking the stretch reflex that could cause damage. The most effective type is passive stretching performed with the assistance of a partner, whereby exercisers relax their muscles and the partner manipulates the body for the stretch. It is important to note that a muscle lengthens only in response to some factor outside the body. It can shorten by itself.



Scan QR Code
for Video

THREE MAIN METHODS EMPLOYED TO IMPROVE FLEXIBILITY

1. The moderate static method – or the “active method” – develops flexibility without mobility and is based on activating the joint in the maximal-optimal range slowly and continuously. Exercises make use of the weight of the limb and/or body part being worked on and/or the assistance of adjacent muscle strength to facilitate direct activation of the joint (without outside assistance). The training effect is relatively moderate, risk of tissue damage is small, and the method is considered very safe. The slow and continuous movement helps to overcome the stretch reflex. Critics of the method say that the lack of dynamic exercise delays the development of dynamic flexibility (requiring movement) needed in many athletic activities.

Some include “the passive method,” which is based on activating the joint in maximal-optimal range using external mechanic force or the assistance of a partner to increase the joint tissue stretching. The duration of the stretch is about eight seconds, where the aim is to improve stretch duration from 10 to 30 seconds. Relaxation between stretches lasts four to six seconds. Passive stretches are about eight percent greater than static stretches.

2. The vigorous dynamic method – Also called the “ballistic method,” is characterized by rapid, large, rhythmic movements where the antagonist muscles

are stretched as a result of the actions of the agonists. It is based on activating the joint to maximal-optimal range by means of external force, for example by a partner, to increase joint tissue stretching. It is suitable for specific activities requiring activation of the joints in large movement ranges and at high speeds such as the strong leg swing in high jumping. The training effect is relatively high but care has to be taken not to activate the stretch reflex. Some trainers add music during dynamic stretches to encourage exercisers to continue to stretch their muscles and ignore the pain threshold. Warm-up before dynamic stretches is absolutely essential. To minimize the risk of damaging muscles and connective tissues attached to the joint being stretched, exercisers employ physical self-control and do not deviate from optimal movement ranges.

3. Proprioceptive neuromuscular facilitation (PNF) – A method that helps receive neuromuscular information, is also known in the professional literature as the “contract-relax method”: contract the agonist muscles and relax the antagonist muscles. It is based on a combination of passive stretching (by someone else), isometric or dynamic contraction, relaxation and repeated contraction. It is considered the most effective method for developing flexibility. Isometric contraction in maximal stretching facilitates high relaxation of the muscle because of the stretch reflex; therefore, it is possible to further expand the range of joint movement. PNF is usually performed in pairs: the exerciser performs isometric contraction with the partner’s assistance for a few seconds and then the exerciser releases the contraction. Immediately after muscle relaxation, the muscle is stretched to an even greater range.

For example, pectoral muscles are stretched this way: starting position – exerciser “A” stands and extends his hands behind his back, as close as possible to shoulder height. The exerciser tries to perform horizontal adduction (hugging movement) of the arms in front of the body while exerciser “B” prevents the exerciser from doing so (the effort is isometric). After exerciser “A” relaxes, exerciser “B” holds exerciser “A”’s hands together behind his or her back while trying to raise them carefully to shoulder level. It is important to bring the agonist muscle (in this case the pectoralis) to a lengthened state. Isometric contraction is held 6–8 seconds, followed by 4–6 seconds of relaxation, and then muscle stretching for 12–15 seconds. Each exercise should be performed four or five times with an eight-second pause between reps. As a result of the repetitions, it will be possible to see the pectoral muscles stretch so that exerciser “A” will finally succeed in interlocking his or her hands behind the back very close to shoulder height. Care should be taken during isometric contraction not to close off the air passages and not to damage tissues during stretching, (see the Valsalva phenomenon, in the book “Be Your Own Personal Trainer...” p. 39, Pinchas, 2026)”.

The illustrations on the next few pages will help trainees to understand the physical functioning of the anatomy in order to increase safety in training: Illustration 1 will describe and explain the components of the planes of motion.

This will be followed by a back view of the structure of the spinal vertebrae (Illustration 2), a front and rear view of the skeletal joints (Illustration 3), a front and rear view of the skeletal muscle (Illustration 4) together with the basic terms needed for basic descriptions and understanding of the stretching exercises and skill analysis.

MOVEMENTS OF THE SKELETAL SYSTEM

To describe various body movements while explaining and analyzing exercises, we use kinesiological terminology (kinesiology = the study of movement). A fundamental familiarity with a number of basic kinesiological concepts and terms adds to an understanding of the movement analyses presented later.



Scan QR Code
for Video

Anatomical Position

The reference stance for analyzing movement in physical activity is called the anatomical position. The body stands erect, limbs are straight, legs parallel with feet tending somewhat outward, arms hanging away from the sides of the body at an angle of about thirty degrees and palms of hands facing forward, with the thumbs on the outside (*see* Illustration 1).

The Three-movement Planes

1. **Sagittal plane:** The vertical plane that divides the body from front to back, dividing it into right and left parts.
2. **Frontal plane:** The vertical plane that traverses the body from right shoulder to left shoulder and divides the body into front and back parts.
3. **Transverse or horizontal plane:** The plane parallel to the ground that traverses the body and divides it into upper (superior) and lower (inferior) parts.

Movements in the Sagittal Plane

- **Flexion** – A movement that decreases the joint angle between two or more bones. For example, flexing the elbow joint reduces the angle between the forearm and the arm. In moving from the anatomical position to the fetal position, all the joints perform flexion.
- **Hyperflexion** – Flexing the joint beyond the anatomical position, for example, as in swinging the arm upward in a volleyball serve.
- **Dorsiflexion** – is performed in the ankle joint and it brings the top of the foot closer to the anterior tibialis muscle.
- **Plantar-flexion** – is performed in the ankle and entails moving the foot closer to the soleus muscle.
- **Extension** – A movement that increases the joint angle between two or more bones. Extension is the opposite of flexion.

- **Hyperextension** – Extending the joint beyond the anatomical position, for example, lowering the arm from a position of flexion and continuing to lead it back beyond the vertical line of the body, such as in walking and running.
- **Posterior pelvic tilt** – A movement of the pelvis that causes flexion of the lumbar spine and at the same time extension of the hip joints. Viewed from the side, the upper part of the pelvis rotates to the rear and the lower part of the pelvis rotates to the front.
- **Anterior pelvic tilt** – The reverse of posterior pelvic tilt. Here the movement causes extension of the lumbar vertebrae and at the same time flexion of the hip joints. Viewed from the side, the upper part of the pelvis rotates forward and the lower part of the pelvis rotates to the rear.

Movements in the Frontal Plane

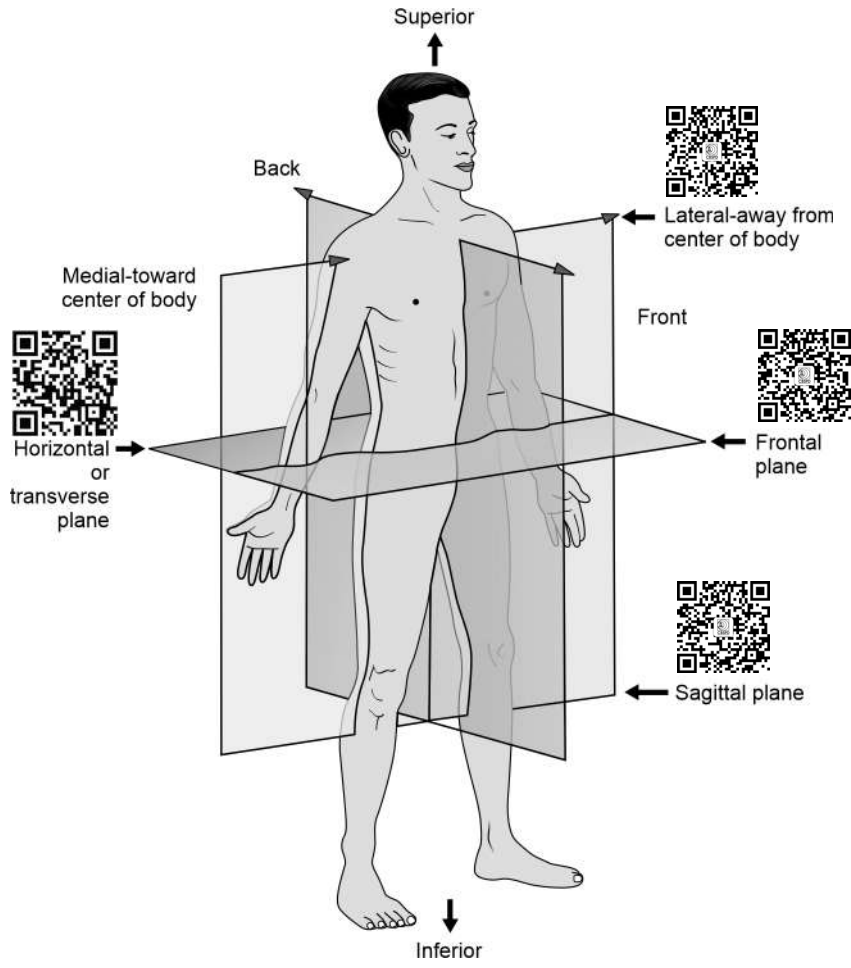
- **Abduction** – A movement to the side, away from the body, from the anatomical position. For example: raising the arm to the side.
- **Hyperabduction** – Abduction in which the movement goes beyond the optimal angle that the joint allows. For example, scratching one's right ear by bringing the left hand over the head.
- **Adduction** – The reverse of abduction, leading back to the anatomical position.
- **Hyperadduction** – Bringing a limb beyond the midline of the body, for example, when scratching the left shoulder with the right hand.
- **Elevation** – A movement of the shoulders towards the ears, as in shrugging as if to say, "I don't know".
- **Depression** – The reverse of elevation, back to the anatomical position.
- **Side-flexion** – Bending the head or the body to the side, for example, in bringing the ear to the shoulder.

Movements in the Horizontal Plane

- **Transverse or horizontal adduction** – The opposite of transverse abduction; for example, stand with both arms straight out to the sides, shoulder-width apart, bring arms forward along the shoulder line.
- **Rotation** – A turning movement performed in the spinal joint. Part of the body turns in rotation to left or right; for example, in shaking one's head to say "no".
- **Lateral rotation** – A turning outward of the upper or lower extremities; for example, the "snuffing a cigarette" movement when standing, pressing with the forward part of the foot as the toes turn to the outside in a rotational movement.
- **Medial rotation** – The reverse of lateral rotation, bringing the part of the body back to the anatomical position.
- **Pronation** – A rotational turning inward, unique to the wrist. In the movement, the thumb is turned from the anatomical position and is rotated towards the body.
- **Supination** – The reverse of pronation, returning to the anatomical position.



Illustration 1: The movement planes©

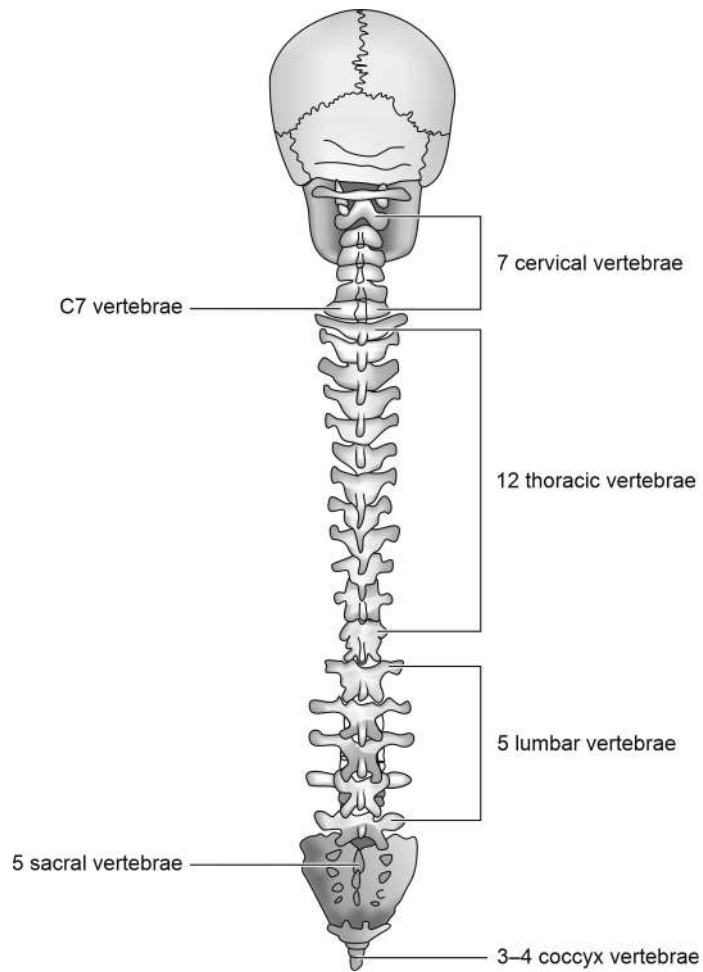


Descriptions of various body parts make mention of the following 12 terms, *see* Illustrations 2 to 4:

1. **Cervical vertebrae** – Seven very delicate vertebrae in the neck, designated by the letter “C.”
2. **Cervical lordosis** – The natural concavity of the neck in the area of the cervical vertebrae.
3. **Overarching cervical lordosis** – A movement that stretches the cervical lordosis beyond its normal curve.
4. **The seventh cervical vertebra (C7)** – The bottommost of the cervical vertebrae, characterized by a prominent projection at the base of the neck. It is easy to feel this bump, which is why it is used as a place marker.
5. The 12 thoracic vertebrae marked with the letter T (Thorax) or D (Dorsal).
6. **The coccyx (tailbone)** – The lowest bone in the spinal column.

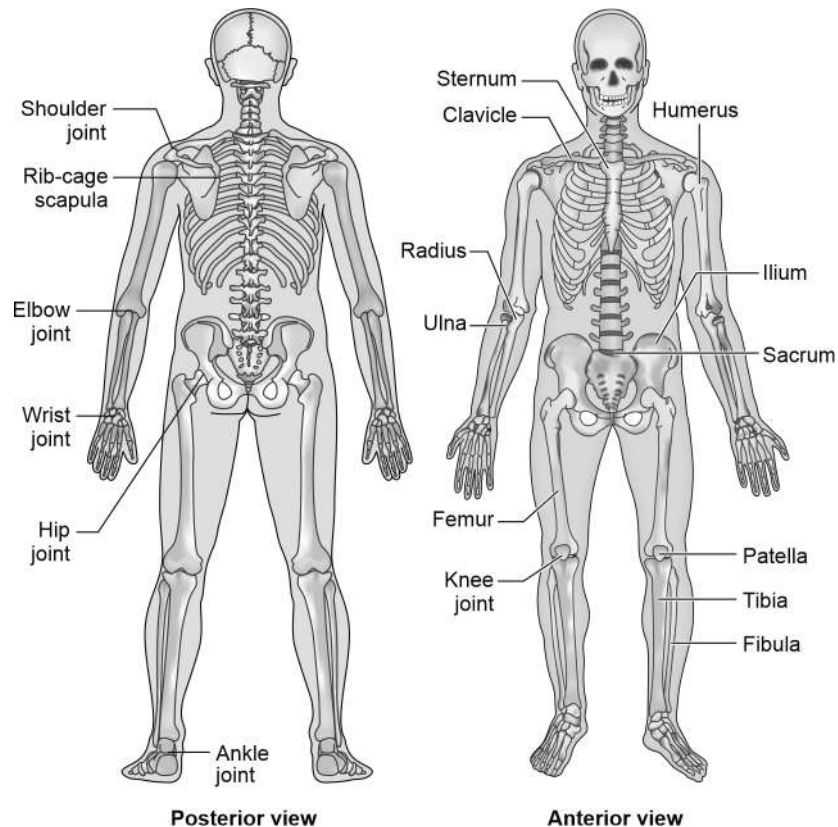
Spinal Column

Illustration 2: Spinal column: Posterior view©



Skeletal Body Joints

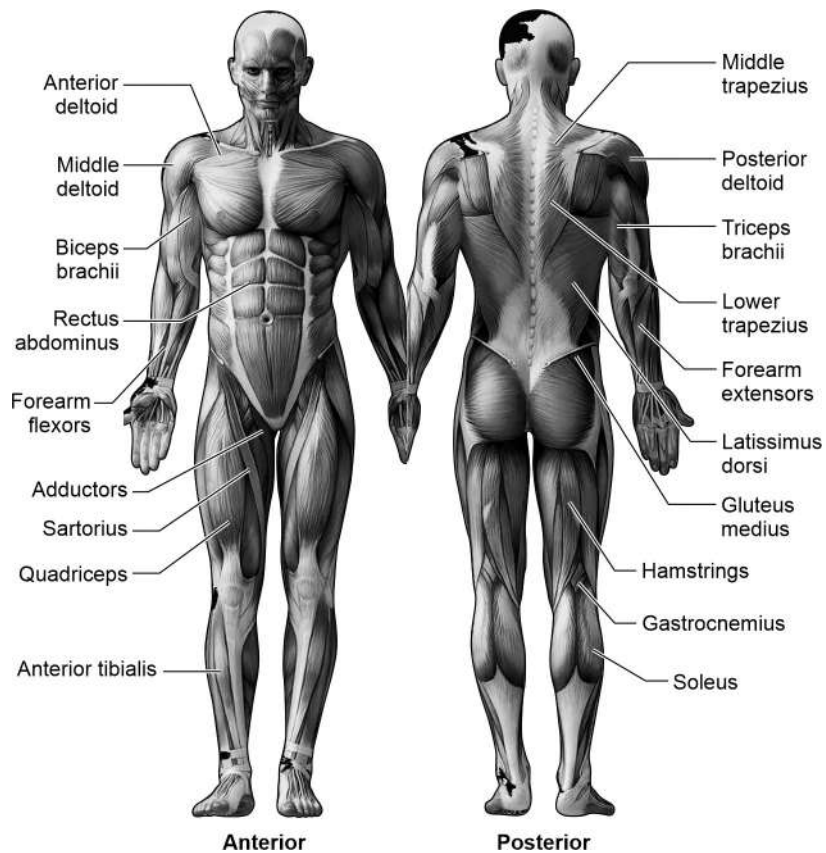
Illustration 3: Movement analyses of the exercises will be described according to the joints©



7. **The sternum** – The chest bone to which the ribs are +attached.
8. **Lumbar vertebrae** – The five spinal vertebrae in the waist (lumbar) area, designated by the letter “L”.
9. **Lumbar lordosis** – The natural concavity of the lumbar vertebrae.
10. **The patella** – The prominent bone covering the front of the knee.

Skeletal Body Muscles

Illustration 4: Anterior and posterior views of the external skeletal muscles©



11. **Shoulder girdle** – The area of the body across both shoulders. After the rationale and theoretical aspects of the flexibility component have been presented, the second part of the book will deal with practical instructions for performance of the exercises.