College of Health and Medical Technologies - Al-Dour
Department of Physical Therapy
The second stage

Basic of Therapeutic Exercises

Dr. Fawzi Hammadi Mahdi

Lec 1 /

Dr.Fawzi Hammadi

Definition of Therapeutic Exercise :

Therapeutic exercise is the systematic, planned per- formance of bodily movements, postures, or physical activities intended to provide a patient/client with the means to

- **Remediate or prevent impairments**
- **Improve, restore, or enhance physical function**
- **Prevent or reduce health-related risk factors**
- **Optimize overall health status, fitness, or sense of well-being**

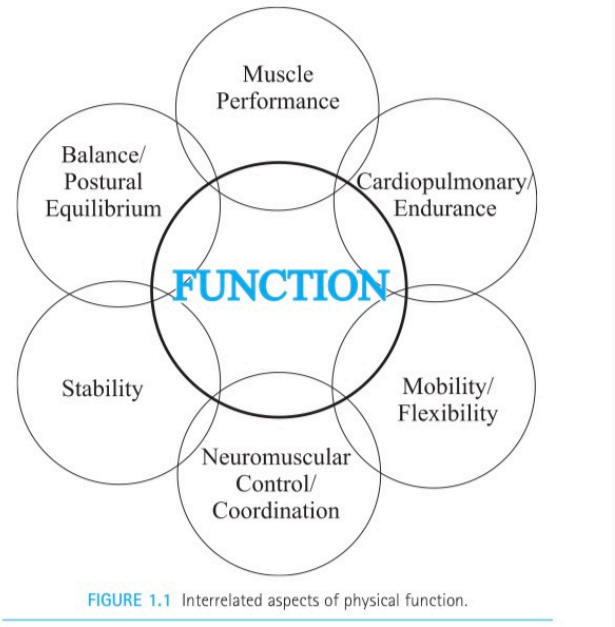
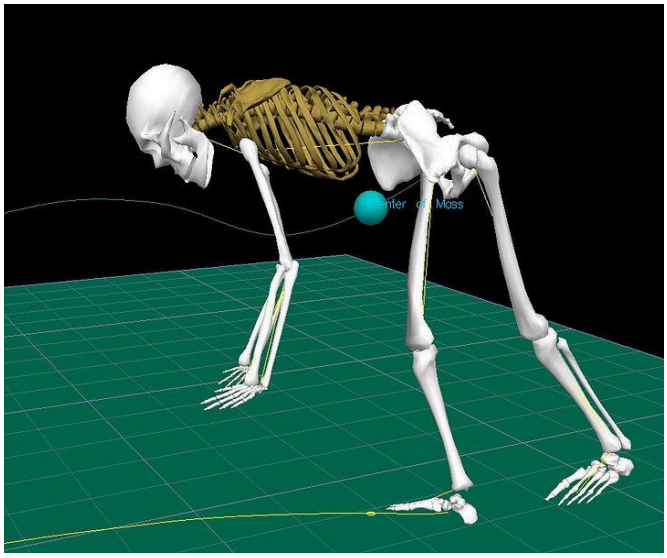


FIGURE 1.1 Interrelated aspects of physical function.

Human center gravity term :

has implications for all things related to posture, including issues such as swayback, the design of posture exercise programs, and much more. Gravity is a downward pull or force that the earth exerts on your body. Your centre of gravity is the point where the mass of the body is concentrated. Similar to Center of Mass (COM), center of gravity is the point in an object at which the entire body of the object is in balance in reference to gravity. The gravitational field affects the center of gravity since with variance the center of gravity value alters as well.

Centre of Gravity



The centre of gravity (COG) of the human body is a hypothetical point around which the force of gravity appears to act. It is a point at which the combined mass of the body appears to be concentrated.Since it is a hypothetical point, the COG does not have to lie within the physical boundaries of an object or person. One subjective way (there are objective measures) to approximate the COG of an object is to visualise it balancing on one finger.

Centre of Gravity in the Human Body

In the anatomical position, the COG lies approximately anterior to the second sacral vertebra , at the center of the pelvis. However, since human beings do not remain fixed in the anatomical position, the precise location of the COG is always shifting with each movement of the body and limbs. The proportion of body weight of the limbs, trunk, and head will also affect the location of the COG every time we move body positions.It is seen that in males, the center of gravity is in a slightly higher position due to larger shoulder mass.

Center of Gravity in different activities

The position of COG varies by individual, especially differing athletes. An athlete with longer and/or larger legs will likely have a lower COG, unless their upper body is also a relatively large structure and balances the mass of the lower body.
It is seen that in runners, the COG is in the lower region (inferior) of the pelvis, and in front of (anterior to) of the body since the runner generally has a forward lean, thus

helping with acceleration.
Lowering the position of your COG helps to increase balance and stability, since it needs to be lifted higher prior to moving outside the BOS. This can be seen in some yoga and balancing poses, gymnastics, track and field activities, and even in a handstand.
When something like a suitcase, grocery bag, or a backpack is carried, the COG will change as weight is added to respective areas of the body. This point of COG will change as the weight and position of a carried object changes, and is also based on the position and movement of the body.

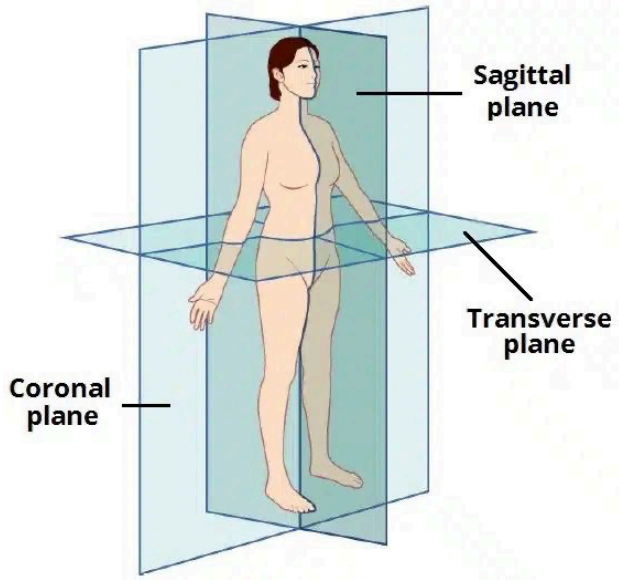
Stability and the Centre of Gravity

The direction of the force of gravity through the body is downward, towards the centre of the earth and through the COG. This line of gravity is important to understand and visualise when determining a person's ability to successfully maintain balance. When the line of gravity falls outside the Base of Support (BOS), then a postural reaction is needed in order to maintain balance.
When the line of gravity is within the BOS, an object or person is said to be stable. When the line of gravity falls outside the BOS, the object or person is said to be unstable. Given that the line of gravity must fall within the BOS in order to satisfy the criteria for stability, the following factors should be considered:

- **A larger BOS increases stability (the line of gravity must move a greater distance to fall outside the BOS)**
- **A lower COG increases stability (it's unlikely that the line of gravity will fall outside the BOS)**

The anatomical planes are hypothetical planes used to describe the location of structures in human anatomy.
They are applied to the human body in the anatomical position.

at the anatomical planes in more detail – in particular, the three most commonly used planes: sagittal, coronal and transverse.



Disability models:

1-International Classification of Functioning, Disability and Health (ICF)

When we think of human-centered design, there are two main types of design based on the target: private design, which targets individual interests and tastes, and public design, which targets optimal relationships among a larger number of people, mainly in public spaces. In the case of public design, because the target is a public space such as a train station, hospital, library, park, or school, the people who use the space can have diverse genders, nationalities, ages, and disability statuses. In other words, public design should be flexible enough to accommodate more "people."

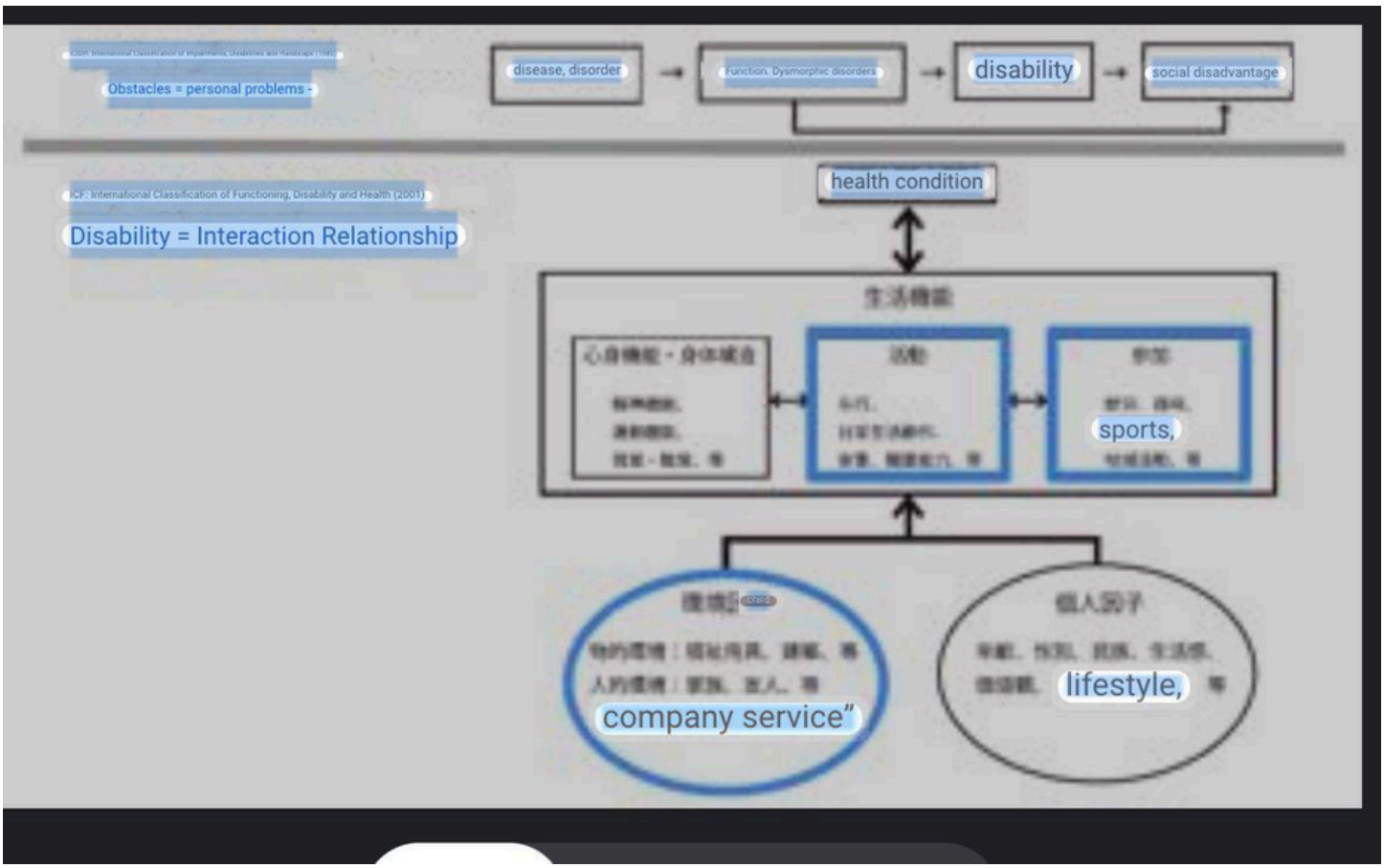
The International Classification of Functioning, Disability and Health (ICF), adopted by the World Health Organization (WHO) in May 2001, is a "'common language' that represents the 'whole picture of living.'" The ICF comprises the following elements: health status, life functions (physical and mental functions, physical structure, activities, and participation), and background factors (environmental and personal factors), and the combination of these elements results in a classification of about 1500 items. According to the concept of the ICF, each element is not unidirectional but comprises interactions.

2-However, the International Classification of Impairments, Disabilities and Handicaps (ICIDH, 1980), the predecessor of the ICF, had a one-way approach to disability. In other words, it was structured in such a way that it assumed that a person born with a disability, such as a disease or modulation, would have functional and morphological impairments that would lead to disabilities and social disadvantages called handicaps. This model was groundbreaking in that it presented a "hierarchy of disability" that divided disability into three levels: functional and morphological disability, ability disability, and social disadvantage, but it focused on the idea of classifying the negative aspects of disability. The ICF, which replaced the ICIDH, was a major change in that it shifted the perspective to look at life functions from the positive side and added the perspective of "environmental factors" as influencing factors.

An "environmental factor" is defined as "the facilitating or inhibiting influence of features of the environment, such as the physical and social environment and people's social attitudes." According to the ICF (2002), examples include "social attitudes," "the structure of buildings," "legal and social structures," "climate," and "topography. The human, physical, and material environment includes "climate" and "topography." The positive aspects of environmental factors are defined as "facilitating factors" and the negative aspects as "inhibiting factors. In other words, it has been officially stated that people's "overall picture of living" can be better or worse depending on environmental factors.

3-Nagi's model comprises four categories: pathology, impairment, functional limitations, and

disability. The new ICF model includes three domains of human function: body functions and structures, activities, and participation.



The joint movement

Dr-Fawzi Hammadi

Terminology

The different types of movement that are permitted at each joint are :

1-Flexion – bending a joint. This occurs when the angle of a joint decreases. For example, the elbow flexes when performing a biceps curl.

2-Extension – straightening a joint. This occurs when the angle of a joint increases, for example, at the elbow when putting a shot.

3-Abduction – movement away from the midline of the body. This occurs at the hip and shoulder joints during a jumping jack movement.

4-Adduction – movement towards the midline of the body. This occurs at the hip and shoulder, returning the arms and legs back to their original position from a jumping jack movement.

5-Rotation – this is where the limb moves in a circular movement around a fixed joint towards or away from the midline of the body. This occurs in the hip in golf while performing a drive shot.

6-Plantar flexion – pointing the toes – this movement only occurs at the ankle, for example, pointing the toes in ballet.

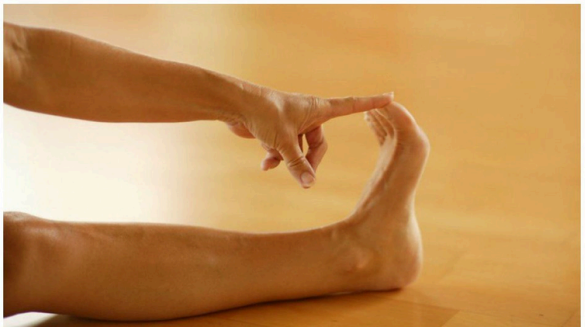
7-Dorsiflexion – the foot moves towards the shin as if you are pulling your toes up. This movement only occurs at the ankle.

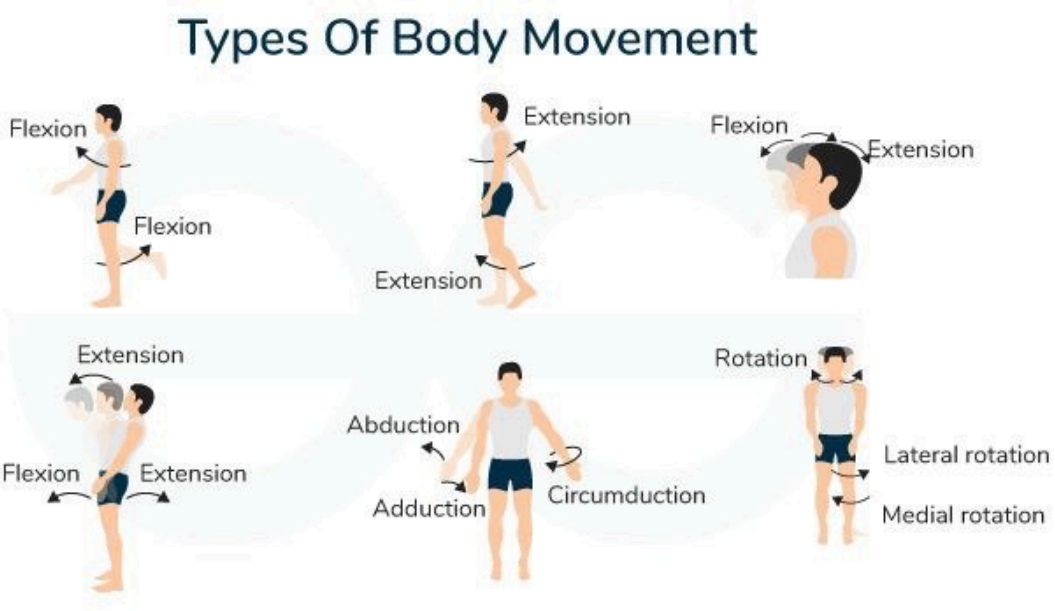
The table summarises the body locations and types of movements associated with each type of joint.

Type of joint	Ball and socket
Body location	Hip, shoulder
Types of movement	Flexion/extension, rotation, abduction, adduction, circumduction

Type of joint	Hinge
Body location	Knee, elbow
Types of movement	Flexion/extension

Dorsiflexion – the foot moves towards the shin as if you are pulling your toes up. This movement only occurs at the ankle.





Range of motion (ROM)

is a term used to describe how far you can move a joint or muscle in various directions.

What is normal range of motion?

Normal range of motion is the range of movement around a joint that is considered normal. The normal range of motion varies among joints.

What are the 3 types of range of motion?

There are three types of range of motion exercises. Passive range of motion is achieved by the help of an outside force,

while active range of motion occurs without. Active-assistive range of motion exercises are performed by an individual with manual assistance.

Classification of Joints on the Basis of Function

The functional classification divides joints into three categories: synarthroses, amphiarthroses, and diarthroses. A synarthrosis is a joint that is immovable. This includes sutures, . Amphiarthroses are joints that allow slight movement, like symphyses. Diarthrosesare joints that allow for free movement of the joint, as in synovial joints.

Movement at Synovial Joints

The wide range of movement allowed by synovial joints produces different types of movements. The movement of synovial joints can be classified as one of four different types: gliding, angular, rotational, or special movement.

Gliding Movement

Gliding movementsoccur as relatively flat bone surfaces move past each other. Gliding movements produce very little rotation or angular movement of the bones. The joints of the carpal and tarsal bones are examples of joints that produce gliding movements.

Angular Movement

Angular movements are produced when the angle between the bones of a joint changes. There are several different types of angular movements, including flexion, extension, hyperextension, abduction, adduction, and circumduction

Axes and planes:

All body movements occur in different planes and around different axes.

A plane is an imaginary flat surface running through the body.

An axis is an imaginary line at right angles to the plane, about which the body rotates or spins.

Planes of movement

There are three planes of movement:

Sagittal plane - a vertical plane that divides the body into left and right sides. Flexion and extension types of movement occur in this plane, eg kicking a football, chest pass in netball, walking, jumping, squatting.

Frontal plane - passes from side to side and divides the body into the front and back. Abduction and adduction movements occur in this plane, eg jumping jack exercises, raising and lowering arms and legs sideways, cartwheel.

Transverse plane - passes through the middle of the body and divides the body horizontally in an upper and lower half. Rotation types of movement occur in this plane, eg hip rotation in a golf swing, twisting in a discus throw, pivoting in netball, spinning in skating.

Movements are parallel to the plane in which they take place.

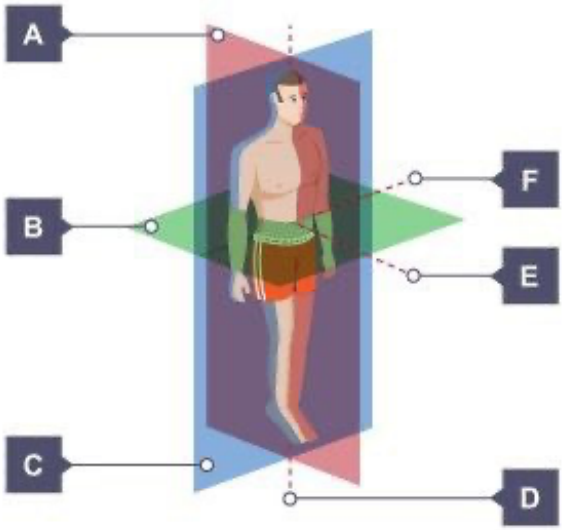
Axes of movement

There are three axes of movement around which the body or body parts rotate:

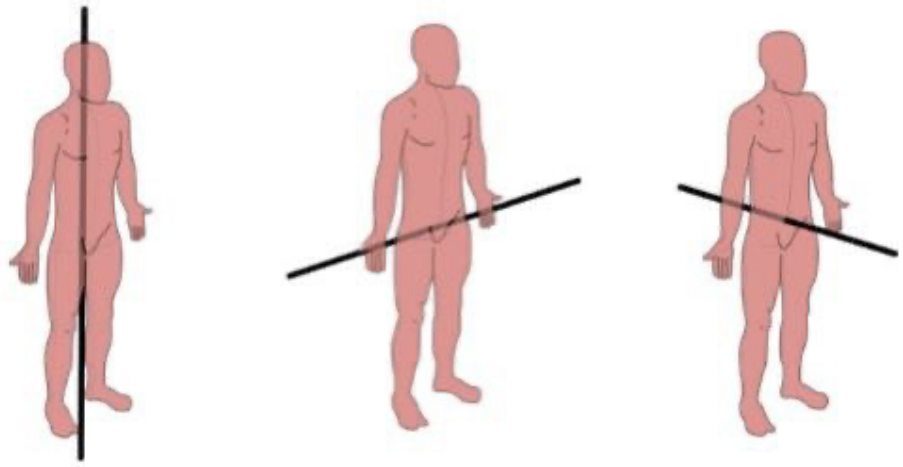
Frontal axis - this line runs from left to right through the centre of the body. For example, when a person performs a somersault they rotate around this axis.

Sagittal (also known as the antero-posterior) axis - this line runs from front to back through the centre of the body. For example, when a person performs a cartwheel they are rotating about the sagittal axis.

Vertical axis - this line runs from top to bottom through the centre of the body. For example, when a skater performs a spin they are rotating around the vertical axis.



A	Sagittal plane
B	Transverse plane
C	Frontal plane
D	Vertical axis
E	Sagittal axis
F	Frontal axis



Longitudinal Transverse Sagittal

Physiology of exercise effect on musculoskeletal system:

Dr.Fawzi Hammadi

Exercise involves a series of sustained muscle contractions of either long or short duration depending on the nature of the physical activity.

1-Short-Term Effects

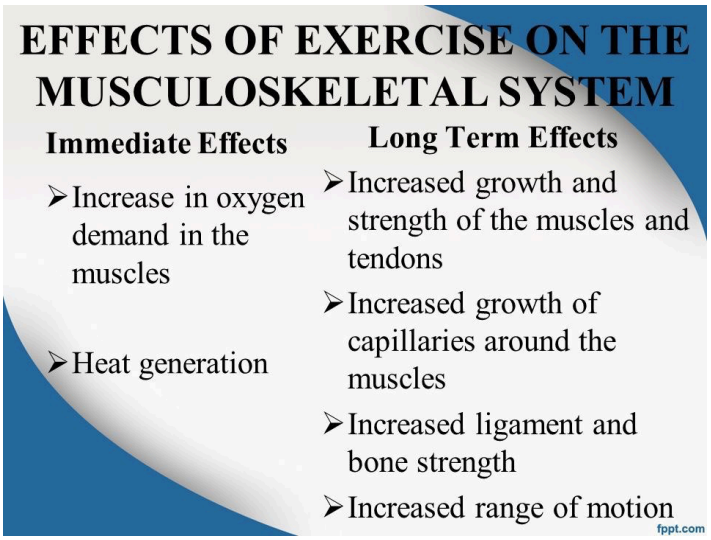
In the short term muscle can become fatigued and sore for reasons like impaired blood flow, ion imbalance within the muscle, nervous fatigue, loss of desire to continue exercising, and most importantly, the accumulation of lactic acid in the muscle.

Muscle soreness, once thought to be due to lactic acid accumulation, has more recently been attributed to small tearing, or micro-trauma, of the muscles fibers caused by eccentric contraction. With repeated cycles of eccentric contraction this soreness will be reduced.

2-Long-term Effects

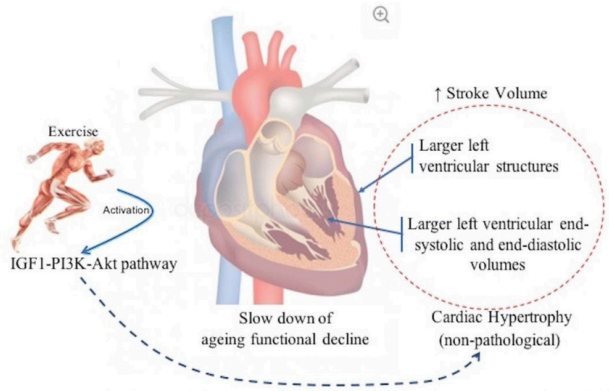
Muscle hypertrophy, or the increase in muscle mass due to exercise, particularly weight training, is a noticeable long-term effect of exercise. Exercise of specific muscles can often result in hypertrophy in the opposite muscles as well, a phenomenon known as cross education.

Increases in muscle mass are not the only long-term effect of exercise. With sufficient training the metabolic capacity of a muscle can change, delaying the onset of muscle fatigue. Muscle specified for high intensity anaerobic exercise will synthesize more glycolytic enzymes, whereas muscle for long endurance aerobic exercise will develop more capillaries and mitochondria. Additionally, with exercise improvements to the circulatory and respiratory systems can facilitate better delivery of oxygen and glucose to the muscle.



the effects of exercise on the circulatory system

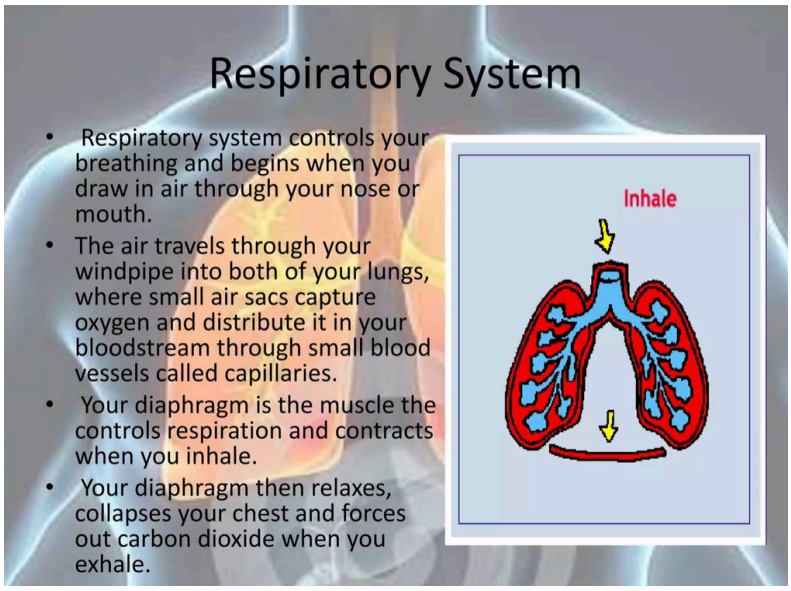
Exercise causes the heart to pump blood into thecirculation more efficiently as a result of more forceful and efficient myocardial contractions, increased perfusion of tissues and organs with blood, and increased oxygen delivery. Aerobicexercise trains the heart to become more efficient.



Abbreviations: insulin-growth factor 1 – IGF1, phosphoinositide 3 kinase – PI3K, and protein kinase b – Akt.

Exercise Strengthen the Lungs

When you are physically active, your heart and lungs work harder to supply the additional oxygen your muscles demand. Just like regular exercise makes your muscles stronger, it also makes your lungs and heart stronger. As your physical fitness improves, your body becomes more efficient at getting oxygen into the bloodstream and transporting it to the working muscles. That's one of the reasons that you are less likely to become short of breath during exercise over time. Some types of exercise can also strengthen the muscles of the neck and chest, including the diaphragm and muscles between the ribs that work together to power inhaling and exhaling.



the short-term effects of exercise on the neuromuscular system :

that one would typically experience during a good session at the gym.

1. Increased blood flow to working muscles
Blood is redirected to the muscles that have a greater demand for oxygen and nutrients. For example, if we are training our legs, then we will get an increase in blood flow to our legs. Often referred to as a muscle pump!

2. Increase in temperature
Blood also carries heat so the working muscles become warmer.

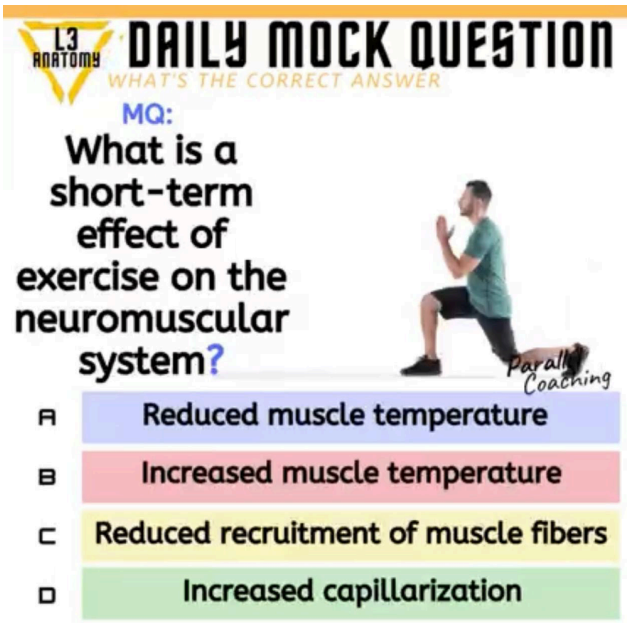
3. Increase in pliability
Muscles are a bit like blue tack! If you stretch blue tack when it is cold, it just tears. However, if we warm the blue tack in our hands, then we can stretch it really well. When the temperature of our muscles increases so does our ability to stretch them.

4. Increased nerve to muscle connection
When we become active, our nervous system wakes up and starts connecting and recruiting muscle fibres. This leads to greater power output from our muscles.

Long term effects of exercises on the neuro muscular system:

- **Increased muscular endurance**

- **Improved ability to repeatedly overcome a resistance. i.e Running, jumping, swimming, climbing, rowing.**
- **Increased muscular strength**
- **An increase in recruitment of motor units leads to greater force production.**
- **Increased muscle size (hypertrophy)**
- **An increase in our contractile protein actin and myosin increase the overall size of the muscle.**
- **Increased energy stores**
- **An increase in glycogen and creatine phosphate storage.**
- **Increased basal metabolic rate**
- **A increase in the ability to burn calories at rest.**
- **Improved posture**
- **Improved muscle symmetry and strength of core muscles.**
- **Increase in capillaries and mitochondria**
- **An increase in the size and number of capillaries and mitochondria.**
- **Increased neuromuscular connections**
- **Improvement in motor fitness i.e coordination, balance, reaction time, agility, power, and speed.**



Active exercises

Dr-Fawzi Hammadi

Definition:

Active movements are the movements that an individual performs voluntarily in his/her routine to accomplish the tasks.

Definition of Voluntary Movement

- Movements are **performed or controlled** by the **voluntary action** of muscles, working in opposition to an external force.

Classification

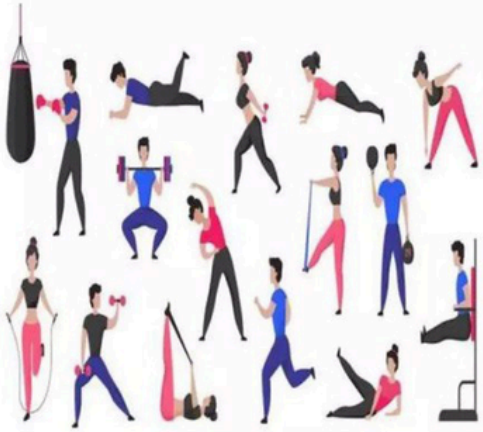
FREE EXERCISE — The working muscles are subject only to the forces gravity acting upon the part moved or stabilised.

ASSISTED EXERCISE — When muscle strength or co-ordination is inadequate to perform a movement an external force is applied to compensate for the deficiency.

ASSITED-RESISTED EXERCISE — Muscles may be strong enough to work against resistance in part of the range and not in others

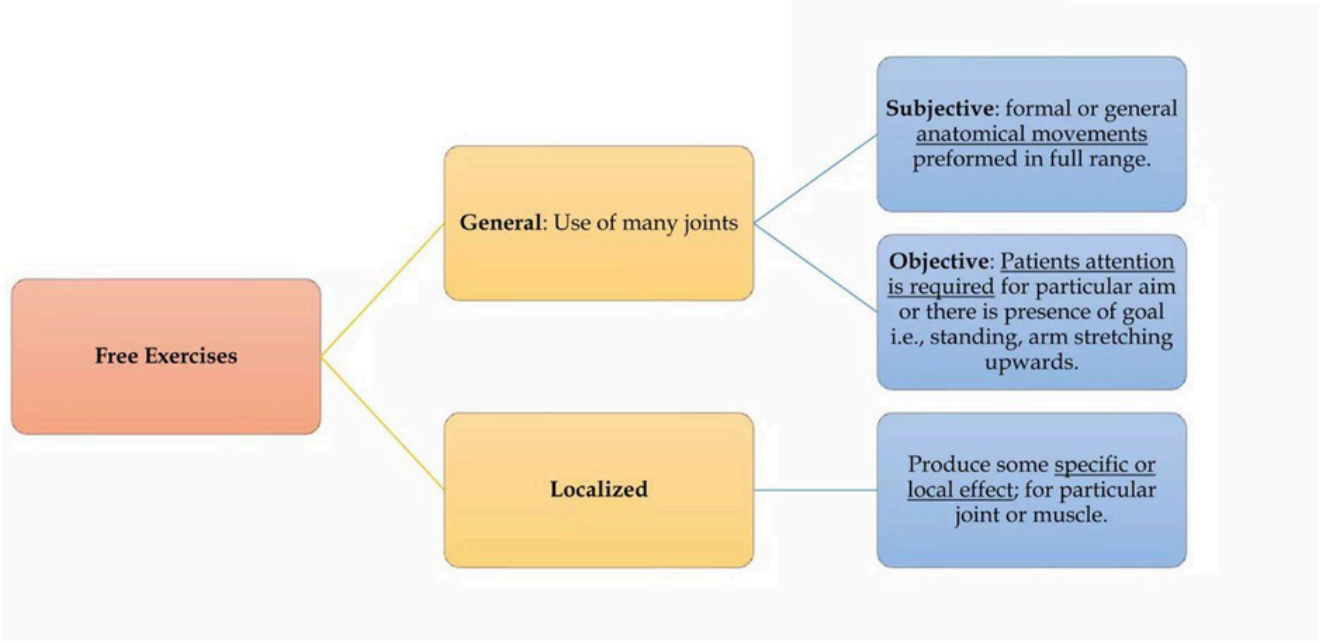
RESISTED EXERCISE — The forces of resistance offered to the action of the working muscles and artificially and systematically increased to develop the power and endurance of the muscles.

FREE EXERCISE



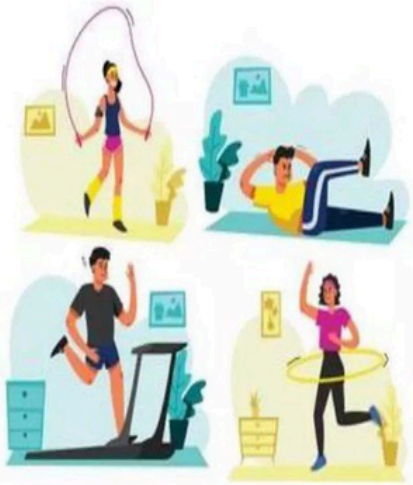
- Free exercises are those which are **performed by patient's own muscular efforts** without the assistance or resistance of any external force, other than gravity.
- Vary in character and effect; due to *nature*, *extent*, and *manner* in which the movement is performed.

Classification of Free Exercises



Effects and Uses

1. Provides **relaxation**; example: hypertonic muscle- free exercise or pendular exercise will help in normalizing tone.
2. Increases the **joint mobility** as well as ROM
3. **Increases** the **muscle power and endurance**
4. Improves **neuro-muscular coordination**
5. Increases **confidence**
6. Improves **respiratory capacity, local body and lymphatic circulation**



Advantages and Disadvantages

Advantages

- Patient can perform without depending on anybody.
- Can be advised as home exercise.

Disadvantages

- There is possibility to perform improper movement in case of muscle insufficiency/ trick movement.

Precautions

- Proper **supervision**
- Proper **guidance** to the patient

- Free exercises are used to obtain :

1. Relaxation because of rhythmical or pendular nature of exercise
2. Muscle tone maintenance
3. Power is increased according to speed, leverage and duration of exercise and the relationship of the part moved to gravity
4. Coordinates natural pattern
5. Confidence to perform and control movement pattern

Position is assumed by the body and take movement to come in a equilibrium.

Posture follows movements like a shadow.

Movement- Every movement begin with posture and end with posture.

Posture- Posture is an attitude either with support or without support.

The posture from which movement is initiated are known as standing position.

The movement may be either by active or passive.

STARTING POSITION- The movement either active or passive which comes our body in equilibrium with attitude and with less effort then the position is known as starting position.

There are five types of starting position that is known as Fundamental position. These are:-

Standing

Kneeling

Sitting

Lying

Hanging

This PPT helps the students to learn the different type of postures which are needed to treat the patient. Easy to understand the importance of Starting positions. Easily to understand the muscle effects in different fundamental positions and their benefits

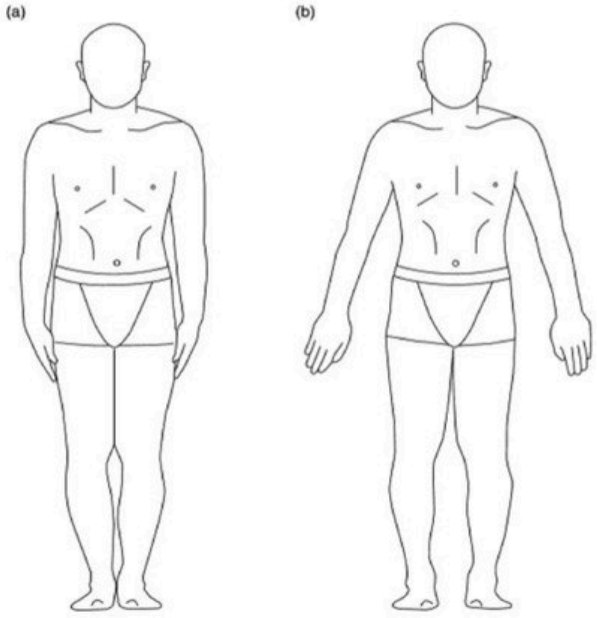
IMPORTANCE OF STARTING POSITION

1. **Equilibrium and Stability** is maintained in these positions by a balance of force acting upon it.

2. When our body use the force of muscular contraction, the fundamental position initiate the **contraction of isometric**.

3. Strength and distribution of contraction of muscles is normally controlled by the postural reflex.

STANDING



STANDING- This is the most difficult fundamental position to maintain the whole body, balanced and stabilized in a correct alignment with small Base of Support(BOS) by the co-ordination work of many muscles.
The position may be described as (from lower limb to upper limb).

1. Heels are together and on the same line , toes slightly apart (the angle between feet does not exceed from 45 degree).
2. The knees are together and straight.
3. The hips are extended and laterally rotated slightly.
4. Pelvis is balanced on the femoral head.
5. Spine is stretched to its maximum length (erect).

6. The ears are in level and eyes should be straight look forwar
7. Shoulder are down and back.
8. Arms hangs loosely in the side and palm facing inwards (towards the body).

NOTE:- Modify the position of the legs in which heels are slightly apart and the inner border of the feet are parallel.
This natural position propel the body forward.

MUSCLE WORK IN THIS POSITION-

1. **Intrinsic muscle of the foot-** stabilization
2. **Dorsi flexors of the ankle-** counter balance plantar flexors and support the medial longitudinal arch.

3. **Plantar flexors of the ankle:-** balance the lower leg.
4. **The evertors:-** counter balance the inverter and peroneus longus to press the ball of the greater toe and to press the greater toe to the ground.
5. **Flexors of the interphalangeal joint:-** press the toes to the ground.
6. **Extensors of the knee**
7. **Extensors of the hip**
8. **Extensors of the spine:-** upright the trunk and maintain the curvatures of the spine.
9. **Flexors of lumbar spine:-** maintain the angle of the pelvic tilt and support the abdominal viscera.
10. **Pre-vertebral neck muscle:-** control the extension of the neck and strengthen the cervical spine.
11. **Flexors and extensor of the atlantooccipital joint:-** balance the head.

12. Retractor of scapula:- back the shoulder.
13. Lateral rotator of the shoulder:- relax the arm in the correct position.

Effect and Uses

•Relatively small base
•High COG
•State of equilibrium- less stable
•A tending and holding the posture with minimal muscle work, reduce fatigue and also postural reflex.
•Position of alternate.
•Association with feeling of joy and efficiency.

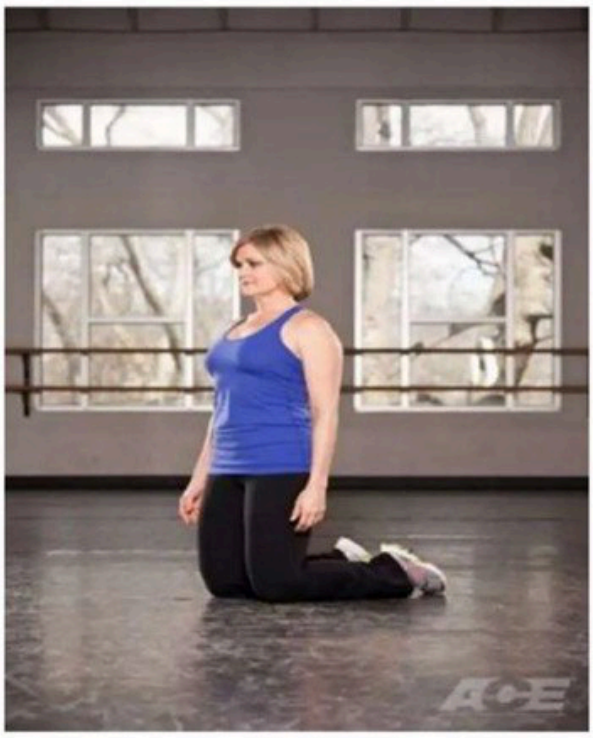
Purpose

- To increase and decrease the size and stability of the base.
- To raise or lower COG.
- To ensure maximum local and general relaxation.
- To control and fix the particular body part.
- To increase and decrease the muscle work.
- To increase and decrease the leverage.
- To provide convenient position to start exercise.

By alternating position of the arm

- Wing standing (butterfly standing)
- Low wing standing (pocket hand standing)
- Bend standing
- Reach standing
- Yard standing
- Stretch standing

KNEELING



KNEELING- The body is supported on knees which may be together or slightly apart. The lower leg rest on the floor with the feet plantar flexed or if a plinth is used the feet may be in the mid position over the edge.
The rest of the body is held in standing.

MUSCLE WORK

- **Flexor and extensor of knee-** to balance knee
- **Extensors of hip-** maintain the correct angle of pelvic.
- **Lumbar flexion of spine-** maintain the pelvic tilt
- **Lumbar flexion of spine-** decrease the angle of pelvic tilt and increase the extensor of spine.
- **Rectus femoris-** maintain the position of thigh.

Effects and Uses

- The COG of the body is relatively lower than in standing position.
- It is more slightly stable but is uncomfortable for most people.
- It is used as a starting position for backward movement in sagittal plane.
- To train the control of the hip joint and lower trunks in preparation for the standing position by which the feet press the flex by the extensor of the knee and dorsiflexors.
- By this position lower leg act as a bracket{}.

Derived position from kneeling

•**Half kneeling** (trunk bending, stretching, knee, and hip muscles stretch)
•**Kneel sitting** (stretching, hip and knee muscles strengthening)
•**Prone kneeling** (cat and camel ex., head control ex.)
•**Inclined prone kneeling**
•**Kneeling roll out exercise (by ball)**
•**Kneeling calf stretch.**

SITTING

SITTING- In this position the body rests on the tuberosity of t ischium but the back of the thigh should also be supported and the feet should rest upon the floor. The hip, knee and ankle joint should all for right angle (90degree).

Derived position of Sitting

- **Long sitting** (quads isometric, calf stretching toe pump exercise)
- **Crook sitting** (hip flex, knee flex and ankle in neutral position)
- **Stride sitting** (horse riding, bike riding)
- **Cross sitting** (leg cross one another)
- **Side sitting** (both legs at one side)
- **Foot sitting** (squat position)
- **One leg extension sitting**

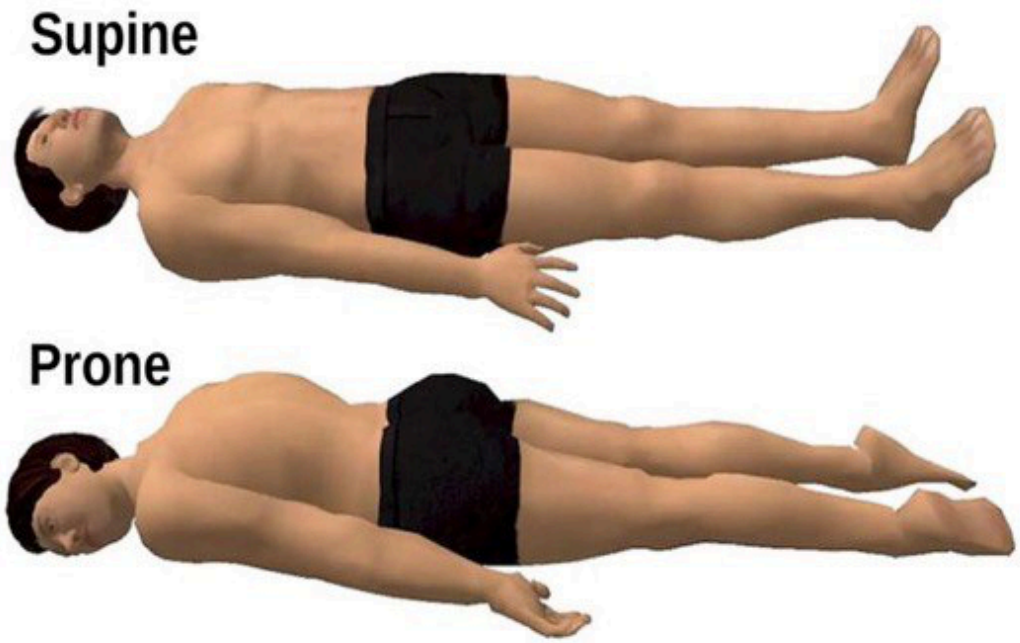
MUSCLE WORK

This position does not need much of work to be done by the legs to hold on to the position.

Flexors of hip work to maintain a right angle and prevent the tendency of slump (forward bend).

Effects and Uses

- Most comfortable and stable position.
- Rotation of the spine is limited.
- More suitable position for no weight bearing exercises.
- More suitable posture for correct alignment of spine.



LYING-

•Lying is the most easiest fundamental position.
•Most of us spend few hours as in sleeping or relaxing.
•It is as stable as possible.
•In this position the whole body is in contact with the mattress or hard surface.

MUSCLE WORK

•At lying position minimum muscle work.
•No much movement present.
•Soft mattress give way to contours of body but hard surface, head can roll to either side.
•Head rotators- to stabilize the head.
•Extensors of hip and flexors of lumbar spine- to hollow the back.
•Medial rotators of hip- keep legs in neutral position.

Effects and Uses

•It provide maximum relaxation to spine.

•Because of it, it is more preferably position for all type of exercise.

•It is more comfortable position to correct the spinal deformity but unsuitable for respiratory as well as cardiac patient due to increased abdomen pressure.

Derived lying position

•Supine lying

•Prone lying

•Half lying

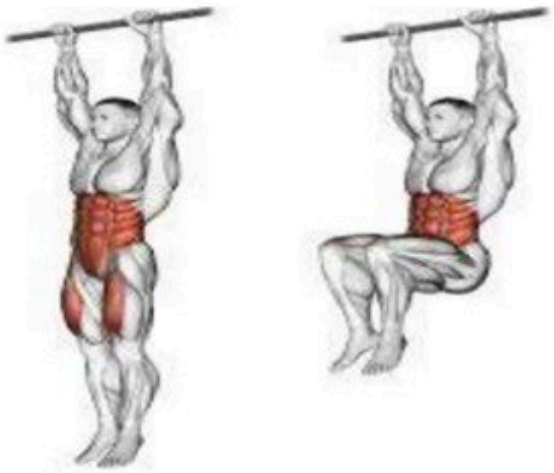
•Side lying

•Crook lying

•Leg prone lying

•Sit lying

HANGING



Hanging –

The body is suspended by grasping over a horizontal bar. The forearm being frontal. The arm straight and shoulder atleast width apart. Head is held by high and scapula are drawn down. Neck appears as long, trunk and legs straight, foot plantar flexed.

MUSCLE WORK

- **Flexors of finger-** to grasp strongly.
- **All the muscle of wrist-** to act as synergist and fixators.
- **Flexor of elbow-** to reduce the strain.
- **Lattismus dorsi and pectoralis major-** help to lift the body.
- **Depressors of scapula and medial rotators-** fix the scapula.
- **Flexors of lumbar spine and extensors of hip-**to maintain the posture and help to balance the back.
- **Adductors of hip-**to keep the leg together.
- **Extensors of knee-** maintain the knee in extension.
- **Plantar flexion of ankle-** to maintain the ankle and foot in neutral position.

Effects and Uses

As the muscle work of the arm and upper back is extensive and strong. The position is only suitable for those person whose muscular strength and body weight are well balanced.

- Spine and legs are elongated.
- This posture is unsuitable for weak person.
- Difficulty in breathing is increased at this posture.
- These posture is used by gymnastics.

manual muscle testing

Dr-Fawzi Hammadi

Defintion: is when resistance is applied to the body part at the end of the available range of motion. It's called the break test because when a therapist provides resistance the objective for the patient is to not allow the therapist to "break" the muscle hold

MMT is an attempt to assess the maximum force a muscle is capable of generating. However, this is not always the case. Given normal innervation, maximum force generated is to a great degree a function of the size of the muscle.

While there are many methods of assessing muscle strength, there are three key approaches described in the literature and used clinically isokinetic, isotonic, and isometric testing.

Isometric testing

typically involves a maximal voluntary contraction performed at a specified joint angle against an unyielding resistance

Iso tonic testing

Performance tests using isotonic muscle actions. They usually involve dynamometers that, in addition to measuring absolute strength, may also measure acceleration, peak velocity, work, and power of isotonic muscle actions at various preset loads

Isokinetic testing

is a strength test for the muscles around a joint, for example your knee. The test uses specially designed equipment to measure the muscle contractions and resistance around your joint

The technique:

1-Trace muscle activation, such as a twitch, without achieving full range of motion.

2-Muscle activation with gravity eliminated, achieving full range of motion.

3-Muscle activation against gravity, full range of motion.

4-Muscle activation against some resistance, full range of motion.

Manual Muscle Testing Grading System

Grading Scale Range: 0 to 5		
0	• None	No visible or palpable contraction
1	• Trace	Visible or palpable contraction with no motion (a 1)
2	• Poor	Full ROM gravity eliminated
3	• Fair	Full ROM against gravity
4	• Good	Full ROM against gravity, moderate resistance
5	• Normal	Full ROM against gravity, maximul resistance

0		0	No visible or palpable contraction
Trace	**I**	**1**	**Visible or palpable contraction (No ROM)**
Poor$^-$		2$^-$	Partial ROM, gravity eliminated
Poor	**II**	**2**	**Full ROM, gravity eliminated**
Poor$^+$		2$^+$	Gravity eliminated/slight resistance or < 1/2 range against gravity
Fair$^-$		3$^-$	> 1/2 but < Full ROM, against gravity
Fair	**III**	**3**	**Full ROM against gravity**
Fair$^+$		3$^+$	Full ROM against gravity, slight resistance
Good$^-$		4$^-$	Full ROM against gravity, mild resistance
Good	**IV**	**4**	**Full ROM against gravity, moderate resistance**
Good$^+$		4$^+$	Full ROM against gravity, almost full resistance
Normal	**V**		**Normal, maximal resistance**

MANUAL MUSCLE TESTING PROCEDURES

Key to Muscle Grading

	Function of the Muscle	Grade		
No Movement	No contractions felt in the muscle	0	0	Zero
	Tendon becomes prominent or feeble contraction felt in the muscle, but no visible movement of the part	T	1	Trace
Test Movement	**MOVEMENT IN HORIZONTAL PLANE**			
	Moves through partial range of motion	1	2-	Poor-
	Moves through complete range of motion	2	2	Poor
	ANTIGRAVITY POSITION	3	2+	
	Moves through partial range of motion			
Test Position	*Gradual* release from test position	4	3-	Fair-
	Holds test position (no added pressure)	5	3	Fair
	Holds test position against slight pressure	6	3+	Fair+
	Holds test position against slight to moderate pressure	7	4-	Good-
	Holds test position against moderate pressure	8	4	Good
	Holds test position against moderate to strong pressure	9	4+	Good+
	Holds test position against strong pressure	10	5	Normal

Preferred Testing Order of Muscle Groups.

This table provides a preferred order to the testing of muscle groups for manual muscle testing. Generally, for bilateral muscle testing, each muscle group is first tested on the right and then the left, prior to proceeding to the next muscle group in the list. Some muscle groups are listed here with anti-gravity testing, but for a weaker patient, these would be tested in a sidelying or supine position, per the table below (Testing Positions); the re-test for a weaker patient is indicated in gray scale. The ankle plantar flexors are first tested in prone, and then retested in standing for scoring purposes. Abbreviations: G.E., gravity eliminated.

POSITION	ORDER OF TESTING
SITTING	
Trapezius (shoulder elevators)	**1**
Deltoid middle (shoulder abductors)	**2**
Biceps brachii (elbow flexors)	**3**
Wrist extensors (extensor carpi ulnaris/radialis)	**4**
Wrist flexors (flexor carpi radialis/ulnaris)	**5**
Iliopsoas (hip flexors)	**6**
Qudriceps femoris (knee extensors)	**7**
Ankle dorsiflexors (tibialis anterior)	**8**
SUPINE	
Neck flexors (scalenes, sternocleidomastoid)	**9**
Trapezius (*G.E. test if needed*)	-
Deltoid middle (*G.E. test if needed*)	-
Gluteus medius (*G.E. test if needed*)	-
SIDELYING (lying on left side-right muscles tested)	
Gluteus medius (hip abductors)	**10**
Iliopsoas (*G.E. test if needed*)	-
Gluteus maximus (*G.E. test if needed*)	-
Hamstrings (*G.E. test if needed*)	-
Biceps brachii (*G.E. test if needed*)	-
Neck flexors (*G.E. test if needed*)	-
Neck extensors (*G.E. test if needed*)	-
PRONE	
Neck extensors (longissimus, semispinalis, illiocostaliis, splenius cervicis)	**11**
Gluteus maximus (hip extensors)	**12**
Hamstrings (knee flexors)	**13**
Ankle plantarflexors (*initial test;* gastrocnemius)	**14**
SIDELYING (lying on right side-left muscles tested)	
Gluteus medius (hip abductors)	**15**
Iliopsoas (*G.E. test if needed*)	-
Quadriceps *(G.E. test if needed)*	-
Gluteus maximus *(G.E. test if needed*)	-
Hamstrings *(G.E. test if needed*)	-
Biceps brachii *(G.E. test if needed*)	-
Ankle dorsiflexors *(G.E. test if needed)*	-
STANDING	
Ankle plantarflexors (*second test if needed*)	**16**

TESTING POSITIONS

Muscle Groups	Anti-Gravity	Gravity Eliminated
Trapezius (shoulder elevators)	Sitting	Supine
Deltoid middle (shoulder abductors)	Sitting	Supine
Biceps brachii (elbow flexors)	Sitting	Sidelying
Wrist extensors	Sitting (pronation)	Sitting (neutral)
Wrist flexors	Sitting (supination)	Sitting (neutral)
Iliopsoas (hip flexors)	Sitting	Sidelying
Quadriceps femoris (knee extensors)	Sitting	Sidelying
Ankle dorsiflexors	Sitting	Sidelying
Neck flexors	Supine	Sidelying
Gluteus medius (hip abductors)	Sidelying	Supine
Neck extensors	Prone	Sidelying
Gluteus maximus (hip extensors)	Prone	Sidelying
Hamstrings (knee flexors)	Prone	Sidelying
Ankle plantarflexors	Prone/Standing	Sidelying

MMT Considerations to Promote Reliability

MMT Grades (0 – 10 scale)	Comments
0 – T	Palpation skill may confound the distinction between the "0" and "T" score; use trained and experienced clinicians.
1 – 2	Adjust range of motion criterion to accommodate for muscle contractures.
3	This grade can only be assigned to muscles tested in the standard (against gravity) testing position.
4	Gradual descent from testing position to resting position should last at least 3 seconds
5	Test position should be held for 3 seconds
3 – 5	MMT grades in this range should be re-tested for the next highest grade after 60 seconds of recovery time.
6 – 10	MMT grades in this range are heavily influenced by the stature of the subject and tester. Attempt to use back-up testers of a similar stature to the primary tester. All MMT in this range should involve a force application time of 3 seconds.