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Lecture Title

Kinesiology

Introduction

Man is a living organism that has inherited not only a systematic structure but also, motor behavior patter with the understanding of these patterns, we can classify each motor act, identify the basic similarities and variations that occur in a specific situation. To achieve this we have to use information from other fields i.e. from physics/mechanics explanation for operating forces; from anatomy and neuromuscular physiology explanation for joint actions. The human body is a very complex system which is subject to both mechanical and biological laws and principles. How effectively and efficiently it performs, depends upon both its mechanical and biological aspects and functions as they are directly related to physical performance.

Brief history of kinesiology

The subject of kinesiology is almost as old as recorded history. Aristotle, one of the greatest scientists of ancient Greek, is often termed the father of kinesiology, because he was the first person on record to study, to teach, and to write about mechanical principle relating to human performance. He is credited as cone whose work on mechanics started the chain of thought that has led us to our present approach to mechanical analysis. Aristotle demonstrated remarkable understanding of the centre of gravity in the human body, laws of gravity and motion, and principles of leverage.

Another great Greek, scientist Archimedes, developed principles of fluid mechanics which govern floating bodies in water. By means of a pulley arrangement, he launched a ship that many men were unable to move. To further emphasize the usefulness of mechanical advantage, he started that “give me a place to stand on and I can move the earth”.

Claudicus galen (103-201 A.D.), a Roman physician for the gladiators, is considered the first athletic-team physician. He had an opportunity to observe and study the parts of human body laid open in mortal combat, and he developed a substantial knowledge of the human anatomy and physiology which underlie kinesiology study. Through the ages of time many other scientists have added bits of valuable knowledge which helps to form the subject we now call kinesiology.

Meaning of definition of kinesiology

The word 'kinesiology is derived from the Greek terms kinesis, meaning "motion", and logos, meaning "word of knowledge", to discourse" or "to study". Kinesiology, then, was originally defined as "the study of motion".

The subject of kinesiology contains an organized and systematized body of knowledge, and therefore, it is referred to as a science. Because it deals with motion involved in human performance. It is precisely defined as "the study of the science of human motion.

Kinesiology, to-day is related to, and draws from four well-known fields of knowledge:-

- Anatomy
- Physiology
- Physics
- Mathematics

From above mentioned fields. It takes only facts which are directly related to human performance. Therefore, it, may be said that kinesiology is based specifically on bio-mechanics, musculoskeletal anatomy, and neuromuscular physiology.

The human body, which is very complex, is subject to both mechanical and biological laws and principles. How effectively it (human body) performs is dependent upon both its mechanical and biological functions.

Kinesiology stresses upon the mechanical aspects, but by necessity it also includes biological functions as they are directly related to performance. Hence, kinesiology deals with biological, mechanical, structure and movements of body.

No doubt many sports performances involve movements of the body and its parts. But also there are sports performances that involves the manipulation of implements such as balls, bats, rackets, iron shot, discus, javelin, hammer, etc. The use we make of these implements and how we handle them influence performance. Therefore, kinesiology also deals with factors affecting the use of implements, such as force, friction, motion, leverage, elasticity, projections, angles of release etc.

in brief, then, kinesiology includes a study of human movement and of implements or objects used in performance and factors affecting use of implements. Further We study kinesiology to learn how to analyze performance and factors affecting the use of implements. Moreover, we study kinesiology to learn how to analyze performance better and how to apply underlying principles to improve performance.

Although kinesiology is based on highly standardized fields of knowledge. Yet it has remained dynamic in nature. The human being in motor performance is a complex and interesting phenomenon. The study of human motion has attracted some of our best thinkers, who have discovered additional knowledge of better methods of teaching, how to apply basic laws and principles of performance, and how to use new devices such as radar guns, mini computers, pocket calculators, timing apparatus, tension-meters, dynamometers, strain gauges, force platforms, high speed photography, television replay, the electro-gonio-meter, and the electromygraph to analyze performance more effectively. This flow of new knowledge has helped to develop kinesiology into a highly, useful subjects. Further development o the subject continues how to apply underlying principles to improve performance.

Scope of kinesiology in games, sports and physical education

For the best performance in sports, kinesiology is an effective, systematic and scientific subject. It is also included in the curriculum of physical education and coaching.

The knowledge is very important in the field of sports and games and in daily living:-

1. Kinesiology provides knowledge to understand and analyze movements of the human body and to discover their underlying principles.
2. It helps in understanding the basis of basis of motor skills and how to carryout efficient movements.
3. Kinesiology helps to understand the interlink between human structure and function.
4. Kinesiology provides knowledge regarding mechanical basis of human motion.
5. Kinesiology provides knowledge regarding basic principles required to receive impact and avoid injuries.
6. Kinesiology provides knowledge regarding efficient movements as a part of daily living in order to achieve optimum quality of function.

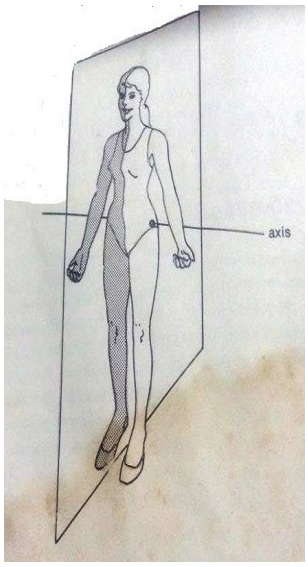
Planes

In common usage, there are three classes of planes:

- Sagittal plane
- Lateral plane
- Transverse plane

One plane of each class that passes through the human body's centre of gravity is referred to a as a primary plane, and all other planes which are parallel to the primary plane but which do not pass through the center of gravity are known as secondary planes. The three primary planes all intersect at right angles at the centre of gravity of a person standing in the anatomic position, that is, in an erect stance with palms facing forward.

The sagittal palne and lateral axis

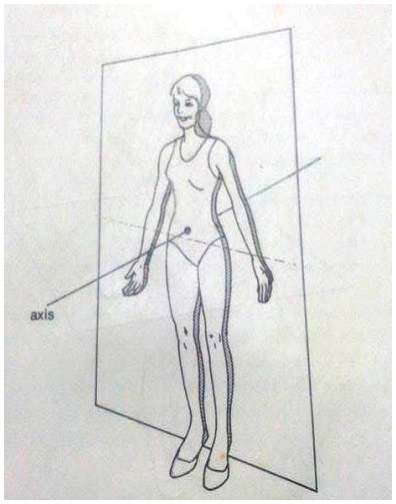


The sagittal plane divides the erect body into right and left halves. All flexion, extension, and hyperextension movements made by a person standing in the sagittal plane. Examples of movements made in this palne are a forward or backward roll, a nodding of the head, a punt, and a bow from the waist, running, a backbend, and a barebell curl.

The lateral plane divides the erect human body into front and rear halves. All abduction movements in the lateral plane are cartwheels, straddle hops, and side bends.

The transverse plane divides the erect body into equal-mass sections above and below the centre of gravity. Such rotational movements as a jump-turn, inward rotation of the humerus, and turning of the head left or right are all done in this plane.

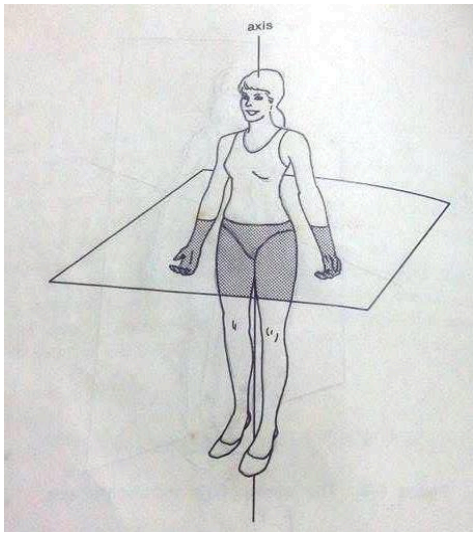
The lateral plane and sagittal axis



Axes

Angular motion is defined as a motion around an axis. All of the movements that were just described are of an angular nature and so must take place around some axis which is perpendicular to the particular plane. When the plane is primary, it and the axis for the movement will pass through the centre of gravity of the body. This is best illustrated by the rotation of air-borne bodies; as such rotations always occur around an axis which passes through the mass centre. When the plane is secondary, the axis will be found passing through the centre of the joint involved.

The transverse plane and longitudinal axis



Movements made in a sagittal plane occur around a lateral axis. Those made in a lateral plane turn around a sagittal axis. Movements which are in the transverse plane will have a longitudinal axis.

It should be noted that the names gives here for the planes and axes, while fairly common, are not standardized and the reader will find various other used in other texts. Some frequently used synonyms are;

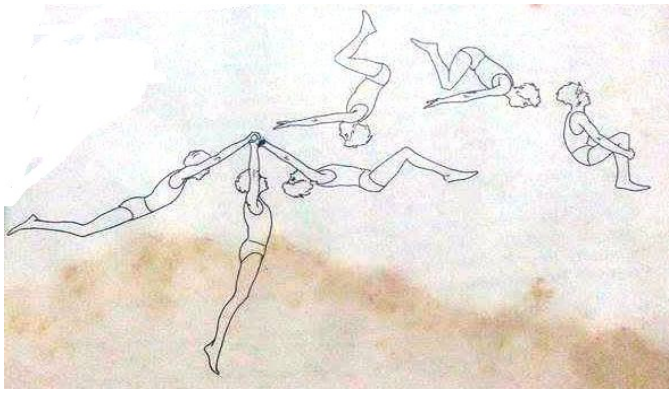
- For sagittal: antero-posterior
- For lateral: frontal, coronal
- For transverse: horizontal
- For longitudinal: vertical

When determining the plane and axis for any movement that is being analyzed, imagine the subject to be standing in the anatomic position.

Then, regardless of the performer's actual position in space, the plane and axis for the whole body or for any segment can be more readily identified.

A gymnast doing giant swings on a horizontal bar is moving in a sagittal palne around a lateral axis, the bar. If the gymnast does a somersault dismount, he will continue to rotate in the sagittal plane, but his lateral axis change from the bar to an axis which now passes through his centre of gravity. This is because the axis for rotation of any object in space must pass through the object's centre of gravity.

While the gymnast is swinging, the bar serves as the axis for rotation, but during somersault dismount, the gymnast rotated around his centre of gravity



In delivering a ball, a bowler's arm moves in a secondary sagittal plane around a lateral axis which passes through the centre of the shoulder joint. Until it is released, the ball may be considered a fixed part of the arm, but after release it will move in its own plane and around a new axis of rotation.

These examples are admittedly rather easy to analyze because the plane is obvious. In practicing the analysis of more complex sports movements, the student will soon detect that this system has

some severe limitations and cannot easily be used to describe all of the vast range of possible movements. But it is a starting point and does have some value in motion analysis and in the communication of information.

Type of Muscular Contraction

Concentric and eccentric contraction

Concentric and eccentric differentiate between shortening and lengthening type of contraction. Concentric contraction is the production of force while the muscle is shortening. In eccentric contraction, a muscle produces force that is less than the opposing external force although the muscle tries to shorten it is actually lengthened during contraction phase.

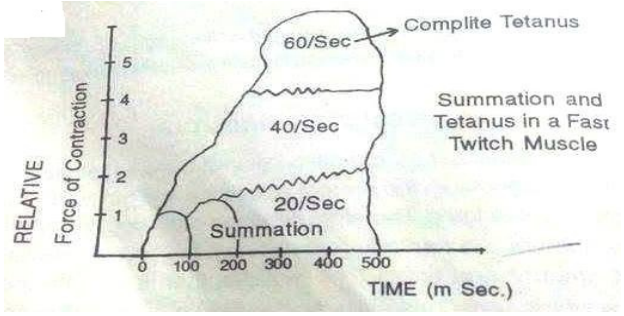
Isometric contraction

In this type of contraction the length of muscle does not change only tension change e.g. pushing a wall. It is also called "static contraction" involves producing tension without movement or the joint of shortening of the muscle fiber.

Contraction-variations in the strength of contraction pattern of stimulation and all or none law

Muscle shows an all or none response. If a stimulus exceed a certain threshold, a given motor unit (the group of muscle fibers supplied by single motor neuron) always contracts, when a motor unit contracts then all the muscles fibers of that motor units contracts otherwise none. The intensity of response if increased by any further threshold, there is further recruitment of motor units thus increase in the strength of muscle contraction, but also can be modified by a local operating conditions such as:

- Temperature
- Fatigue
- Initial fiber length etc.



If a second suprathreshold stimulus is applied within a few seconds of the first and if there is no additional response, the muscle fiber is said to be in a “refractory state” however it is possible to select a slightly longer stimulus interval, or to stimulate an adjacent fiber so that the second response is enhanced by the after effect of the initial contraction.

This reflects the fact that series of elastic elements are already under twitch. If a series of suparathreshold stimuli are applied in close succession, a tetanus contraction or subtetanus contraction is seen, if the interval is further reduced, fusion of the individual twitches becomes more complete. Until at a frequency of 60 stimuli/sec.

Titanic contraction is frequently used in performance of normal physical activities. That is recruitment of motor units more and more to increase the contraction force to overcome greater resistance or to develop speed in activity i.e. strength developed by a muscle but the size or number of muscle fiber within each motor unit is also important.

Reciprocal inhibition

Neuromuscular co-ordination or skill is the act of causing each movement to occur in the correct sequence and timing and with just the right amount of force. Therefore, when co-ordinate movement occurs, it is because amount and times. The muscles then cause the movement patterns which constitute skilled movements of performance.

The concept known as reciprocal inhibition means that motor neurons carry exciting impulses to agonistic and inhibitory impulses are carried to the muscles which are antagonistic to this movements, this prevent them from contracting. Which would detract from the speed and force of the desired movements e.g. when maximum speed or force is required complete inhibition of the antagonistic muscles is required.

Muscle angle of pull

The angle of pull is used to describe the angle of any muscle and the bone to which it's attached. Orthopedists and physical therapists use this term.

Although the term "angle of pull" was originally created and used by medical professionals, weight lifters and body builders use this term frequently when they are describing a specific technique. Orthopedists use this term when they are describing a person's range of motion. When orthopedists consider a patient's limited mobility, they use angle of pull to determine the percentage of muscle disability. Physical therapists use this to measure a patient's rehabilitation progress over time.

Two joints of muscles

Muscles do not have a mind of their own and only respond to the amount of weight that they must overcome in each exercise. The muscles are considered as objects to be worked so that they become bigger and stronger.

To a limited extent, thinking of the muscles as dumb can be considered accurate. When a resistance must be overcome, the muscles will respond by giving you the strength to move the weight.

The reason for this is that muscles do not work on their own, but instead function in close coordination with the nervous system. The nervous system as we know is the center of our intelligence, mental thinking and motor commands. It controls when a muscle will contract, with what intensity it will contract, how many muscle fibers will be recruited, what the frequency of their contraction will be and the simultaneous integration of other muscles in a coordinated manner.

It is important to understand that there is a high degree of intramuscular coordination between the various muscles that have the same action. For example, in the biceps curl, the brachialis does most of the work in the initial movement (when starting with straight arms) and the biceps takes over in the middle range. The brachioradialis comes into play only when needed, i.e., when the resistance is sufficiently great and if there is additional supination **or** pronation.

There is also intermuscular coordination with other muscles that are involved in a complex exercise. For example, when rising up from a squat there is coordination between the quadriceps, hamstrings and gluteus maximus in their concentric contractions and the erector spinae of the back and the side hip muscles in their isometric contractions.

It is usually impossible to have only one muscle involved in an activity. Most often there are a multitude of muscles working in a very complex, but integrated manner.

Even more complex are the two-jointed muscles. These muscles cross two joints (as for example, the hamstrings which cross the knee and hip) and have an action at each of the joints. The hamstring muscle is a good example of the typical two-jointed muscle. At the lower insertion end the hamstrings are involved in the leg curl (knee flexion) which develops mainly the mid to lower hamstring. At the upper end (which is attached to the pelvis) the upper hamstrings are involved in hip extension, which is seen in straight leg pulldowns on a pulley or with Active Cords in the pawback. The hamstring muscles have a powerful action at both joints.

Other two-joint muscles such as the biceps muscle of the arm and gastrocnemius muscle of the shin have a very strong action at one end, and a less powerful action at the other end. For example, the biceps is most powerful in elbow flexion as in the bicep curl exercise and is an assistant in shoulder joint flexion. The gastrocnemius is most powerful in ankle extension and a strong assistor in the leg curl exercise.

Because of their dual actions many of these muscles are not as powerful as most single-joint muscles, i.e., where the muscle crosses only one joint. Examples of this are the vastus muscles of the thigh quadriceps and the brachialis muscle of the upper arm. These single joint muscles can be considered the true workhorses of most joints.