Chapter I

INTRODUCTION

Fitness is an essential component in the concept of wellness which might be defined as persistent endeavor to achieve highest probability for total well-being. The basic concern is human movement, primarily in the sense of larger movements rather than the more minutes or finer movements of body. More specifically, physical education is concerned with the relation between human movement and other areas of education that is, with the relationship of the body’s physical development to the mind and soul as they are being developed. This concern for the effect of physical development and other areas contributes to the uniqueness broad scope of physical development for the broadest possible view of that field.

A well-balanced athlete has good coordination and control when performing sports actions. When a player absorbs a hit in football or hockey, it is clear that maintaining balance is difficult. Air resistance, friction, and gravity also affect how well an athlete can maintain balance. The way in which an athlete resists and handles these outside forces is called stability. The better and more sports persons specifically athletes’ train their bodies, the more balance and stable they will be during sports performance. And in the recent years the term that is very much related to balance is proprioception.

Hockey

Chris Moore has defined Hockey, a sport which emerged in the 19th century, has seen huge changes in the latter part of the 20th century. As we move towards the start of the 21st century even more changes can be expected. “It will be, through more evolution than revolution, and that is how it should be.” Hockey is a dynamic team game played by both sex requiring high level of skill, excellent conditioning and well co-ordinated team effort. Modern Hockey demands that all the players should be adapted to all the situations whether defending or attacking. Hockey is a game which calls for strenuous, continuous, thrilling action and therefore attracts the youth all over the world. The skills involved are simple, natural and yet are highly stimulating and satisfying to any child. These skills are dribbling, pushing, flicking, scooping, tackling and dodging the
opponent. Hockey is rated as one of the most popular team games in the world. With the involvement of Dhayan Chand, and Dung Dung from India, this sport is getting a dimensional popularity in India, Asian countries and in other European countries as well.

**National Game**

The game hockey was played in certain areas like Punjab even before colonial role came into existence. It was known as “Khido Kunti” by them. When the Britishers introduced modern hockey, in an organized manner the game became very popular and reached the forcorners of the country. The standard of the game reached dizzy heights and on its maiden appearance at the Olympics saw India retain its position as number one in the World.

**Origin and Development of the Game Hockey in India**

Though there is no definite origin of the game, a beginning has to be made to the primitive instincts of man hitting an object with something. About 500 years ago the Persians are known to have played from the horse backs a game like Polo. The young ones imitated the game with short sticks and stones or pebbles. A bas relief unearthed (514-449 BC) shows some Athenians at play, two of whom actually engaged in a Hockey bully.

Ron Hendrinks has asserted that the roots of hockey are buried deep in antiquity. Crude sketches found on the walls of prehistoric caves may lend substantial information on the fanciful notion that the caveman knocked at a stone with a primitive club for his amusement when he was not locked in mortal combat with his deadly enemy, the Iguanodon. Historical records show that rudimentary form of the game was played in Egypt 400 years ago and in Ethiopia around 1000B.C. It was the only team game practiced by the Greek in the epoch of Themistocles (525-449). The ancient Azteus of South America and the Red Indian tribes of North America played a savage stick-and ball-game several centuries before Columbus discovered the New World.

The British pride is that they originated the game and gave it to the world. With reference to the English Historians Hockey is a development of other games. In the pre-
Christian era, a stick and ball game had been in practice in the British Islands. Later it came to be known in Ireland as Hurley, in Scotland as Shinty and in England and Wales as Bendy, as these games seem to have been played with ball and stick teaming resemblance to the modern one. From England the French people borrowed this game and spread to the whole of the continent.

Modern hockey was introduced to India by an Englishman, than the rulers of India in the early years of the 15th century. The credit of starting Hockey in India first goes to Calcutta. The people there played a leading role in popularizing the game in India. In India the game takes the pride of place and it is considered as our National game and it occupies a significant place. The game became popular in other countries and its popularity in the world can be judged in terms of Federation International De Hockey (F.I.H), this now comprises of more than 130 National Federations as its member. By the time when India represented in the Olympic Games for the first time Amsterdam in 1928, they overshadowed the pioneers of the game such as England. India emerged as Olympic Hockey champions in their debut in 1928 and maintained their supremacy till 1960. In 1980 Moscow Olympic, India regained the gold.

Field Hockey, or Hockey, is a team sport in which a team of players attempts to score goals by hitting, pushing or flicking a ball into an opposing team's goal using sticks. It is most commonly known simply as "hockey". A hockey training program must meet the demands of a very physically challenging, multi-sprint sport. Played on a similar sized pitch with the same number of players and for a similar duration, physiologically field hockey is a close match in many ways to soccer. While intermittent in nature, players must perform continuously for 70 minutes with just one 5-10 minute interval. This places a high demand on the aerobic system and good aerobic endurance is required to support repetitive bouts of high intensity exercise.

Anaerobic power and anaerobic endurance is high in elite hockey players. Although the majority of the game is spent in low-level activity such as walking and light jogging, repeated back-to-back sprints make speed and tolerance to lactic acid an important characteristic in players. Strength is also central to a hockey training program. Although players aren't required to hold off physical challenges (when compared to other multi-sprint sports) power is required for acceleration, speed and
quick changes in direction. Upper body strength allows players to shoot more powerfully and pass over a greater range of distances. The unique demands of the sport mean that strength and endurance are just as crucial as explosive power. Careful planning is required to ensure that both muscular power and muscular endurance can be effectively developed alongside each other without leading to over-training and fatigue. Hockey conditioning also plays a crucial role in injury prevention.

As the sport is played on a synthetic surface, this places different strains on the body compared to grass. While the principle of specificity would dictate that a hockey training program should mirror the game as closely as possible, in this case there may be good cause to argue against training exclusively an artificial turf. There is a greater injury risk inherent in playing on synthetic surfaces, in particular with respect to spinal shrinkage. Again, correct training can help to minimize any risk. www.planetfieldhockey.com

It is unique sport that can improve overall fitness and confidence for players of all ages. It requires upper body strength, flexibility, agility, and incredible running skills. Improving field hockey fitness can be achieved by attending team practices, but for those who want to stay fit on their own or need extra practice, there are many easy exercises to give a play an edge. A player trying to improve field hockey fitness should first work on running. The majority of field hockey game is spent in motion, especially for forward players. An hour or more of running can be very rough on players who are out of shape. Even those who can run for a long time may not be very fast. Running is easy to do on one's own, and can improve overall field hockey fitness. To get maximum benefits, an athlete should mix in both long-distance running for endurance and sprinting for speed and quickness. It is important to have excellent endurance when running, and to be able to push one's body to great speeds. When running for field hockey, it is important to vary speed and to change one's path sporadically.

Flexibility and agility are also importance for a player’s field hockey fitness. Field hockey players need to be able to change directions quickly and maneuver themselves around other players. Drills that require quick and precise
movements, such as doing grapevines or ladder drills, can improve these skills. Also, having the speed and strength needed to perform field hockey moves us worth very little on the field if they cannot be performed skillfully. In this case, field hockey fitness is all about practicing a move in order to make it physical rather than mental knowledge, like an automatic reaction.

A field hockey player also needs upper body strength to help with drives and to power through opponents. While being quick and smart can help maneuver a ball out of a skirmish with an opposing play, being able to simply push the ball out from the other player's stick is valuable as well. Weight training can help add muscle to the upper body in a way that is sometimes not satisfied by normal field hockey drills. Working with weights can also be used to strengthen the rest of the body. Some players find that weights help strengthen parts of the body, such as certain back muscles, that are not typically used vigorously during the day. When a person routinely plays field hockey, it becomes apparent which muscles need extra practice in order to work well during a game. Paying attention to one's own body and coming up with a plan that fits on weaknesses can be the best way to improve field hockey fitness. (www.wisegeekcom)

Hockey is the dynamic game which involves speed endurance, agility and strength. And the hockey field is one of the main sources to reduce the strength of players. Without muscle strength it is not possible able to play in the ground. It involves more skills, movements, and tactics.

Anatomy involved in Hockey

Hockey relies heavily on both upper and lower body musculoskeletal anatomy, as well aerobic and cardiovascular endurance.
Among the most critical muscles used in both field and ice hockey are:

- Abdominal muscles
- Oblique muscles
- Erector spinae muscles and associated back muscles
- Hip extensors including the gluteal and hamstring muscles
- Hip flexors and quadriceps muscles

Muscles of the core are particularly critical for hockey. Core muscles include the abdominal muscles (such as the rectus abdominus and more importantly, the transverse abdominus), and the internal and external oblique muscles. A strengthened core permits greater power, increasing speed and precision, reducing the risk of injury. The hockey slap shot for example requires the contraction of core muscles, which assist in stabilizing the body. The slap shot follow-through also requires force largely generated in the core musculature.

Calf muscles are essential to support and stabilize the ice skater, while quadriceps and gluteal muscles, particularly the gluteus maximus are relied on for skating power. Large muscles in the legs generate enormous power for the hockey player but must be supplied with large amounts of oxygen when they are being worked. The gluteus maximus, critical in forceful skating, is the largest muscle in the body, used to extend the leg at the hip. Muscular growth or hypertrophy results from this muscle being extensively worked by the athlete.

Quadriceps muscles in the thighs also play an important role in skating. Their action is to extend the knee as well as acting to hold the knee in a static flexed position. Muscles of the inner and outer thigh act to adduct the leg, moving it away from the body's center, during the pushing phase of the skater's stride. The inner thigh muscles are used in abduction - pulling the leg inward during the recovery portion of the stride. Among upper body muscles, the anterior and middle deltoids and biceps muscles are most heavily used.
Motor control

It is the study of the neuro-physiological and behavioral processes affecting the control of skilled movements. Researchers in motor control are interested in the processes underlying the learning and performance of motor skills, such as how nervous system works with the muscular system to produce and coordinate movement and how cognitive processes are involved in the learning and execution of motor skills. In the 1960’s Franklin Henry published a paper on the “memory drum theory which discussed the role of cognitive activity motor learning.

Information processing model:

Many theories have been advanced to explain the process by which motor skills are learned and controlled. One popular model to described motor skill acquisition and performance is the information-processing model. In its simplest form, the information-processing model comprises four components or processes: input, decision making, output and feedback. Input is the process of obtaining information from the environment. This information is obtained through the senses. Visual, auditory, kinesthetic and other sensory information is transmitted through which the process of decision making occurs. So senses play a critical role in motor learning and performance. (Thomas JR., 2005)
The human system is continually inundated with sensory information from a variety of environmental inputs as well as from movement, touch, awareness of the body in space, sight, sound, and smell. In all higher order motor behaviors, the brain must correlate sensory inputs with motor outputs to accurately assess and control the body’s interaction with the environment.

Sensory integration is the ability of the brain to organize, interpret, and use sensory information. This integration provides an internal representation of the environment that informs and guides motor responses. These sensory representations provide the foundation on which motor programs for purposeful movements are planned, coordinated, and implemented. Ayers defined sensory integration as “the neurological process that organizes sensation from one’s own body and from the environment and makes it possible to use the body effectively within the environment. In an intact system, sensory integration occurs automatically without conscious effort.

**Sensory integration process**

The forces which move the supporting framework of the body are unleashed within skeletal muscles on receipt of signals by way of their motor nerves. In the absence of such signals, the muscles normally are relaxed movement is almost the combined action of a group of muscles which pull in somewhat different directions, so the control of movement involves a distribution of signals within the central nervous system to appropriate motor nerves with precise timing and in appropriate number. In order for movements to be useful in making adjustments to external situations, it is necessary for the central nervous system to be appraised of these situations, it is necessary for the central nervous system to be appraised of these situations which are continually changing.

**Sensation and movement**

Motor learning and motor performance are inextricably linked to sensation. As a motor task is practiced, the individual learns to anticipate and correct or modify movements based on sensory input organized and integrated by the central nervous system (CNS). The CNS uses this information to influence movement by both feedback and feed forward control. Feedback control uses sensory information received during the movement to monitor and adjust output. Feed forward control is a proactive strategy
that uses sensory information obtained from experience. Signals area sent in advance of movement allowing for anticipatory adjustments in postural control or movement. The primary role of sensation in movement is to guide selection of motor responses for effective interaction with the environment and adapt movements and shape motor programs through feedback for corrective action. (Susin B. O Sullivan 2007)

Success in field hockey is often associated with speed, but balance and quick feet, or agility, are the most important physical attributes to possess. Little can do to improve your innate sprint speed, but balance and foot agility can be improved significantly through practice. Proper body balance is controlled by the head, feet, and hands with the stick. When these extremities are in balance your body is ready to move quickly and skillfully. It is essential to have control of the body, feet, and stick before attempting to perform skills rapidly. Rushing your execution of hockey techniques will only promote mistakes, which reflect a lack of emotional balance as well as a lack of balance. Quickness is specific to the hockey skill being performed. The successful hockey player must seed a point of balance in her relationship to the ball with every offensive and defensive technique.

Like the golfer who attempts to prefer her body posture before swinging the club, the field hockey player must also prepare the body for performing skills, unlike the golfer who has plenty of time to position her feet, head and hands before striking the ball, a hockey player usually moving or running when performing a skill, whether you are passing, receiving, dribbling or tackling. The body must be momentarily in control before any skill can be performed successfully. Balance is closely related to footwork, which is basic to all fundamental hockey skills. Effective footwork allows starting, stopping and changing direction with quickness and balance. The footwork also prepares the body to perform skills. Good footwork is important to all the attack roles and defense roles in Hockey. (Elizabeth Andrews and Sue Myers, 2003)

Balance is improved with proprioceptive feedback. Proprioception is an automatic sensitivity mechanism in the body that sends messages through the central nervous system. The CNS then relays information to rest of the body about how to react and with what amount of tension. Human beings “train” for proprioception in the quest for efficient everyday movements. Proprioception is unconscious initially, but can be
enhanced with training. According to Greg Niederlander, an exercise physiologist, specialized sensory receptors in the muscles, joints, and connective tissues enable the body to process information from a variety of stimuli, and turn that information into action. (Greg Niederlander)

**Proprioceptors**

Students of motor activity and posture find the proprioceptors of special interest, for these are the receptors that receive impulses that occur because of body movements or positions. They are located in the muscles, tendons, and joints, including the surrounding and protective tissues such as capsules, ligaments, and other fibrous membranes and in the labyrinth of the inner ear. The proprioceptors are stimulated by motions of the body and in turn are responsible for transmitting a constant flow of information from these structures to the central nervous system. This information involves the appropriateness of the response in regard to the degree, direction, and rate of change of body movements. Without these sensory reports, effective coordination in motor patterns would not occur. Information from the receptors is directed both to the conscious and unconscious levels and, in addition to giving us a sense of awareness of body and limb positions, provides us with automatic reflexes. Proprioceptors are classified as muscle proprioceptors (muscle spindles and Golgi tendon organs), joint and skin proprioceptors (Ruffini endings and Pacinian corpuscles), and labyrinthine and neck proprioceptors.

**Muscle proprioceptors**

An abundance of two types of receptors are located within muscles and tendons are responsive to stretch tension. The muscle spindle detects relative muscle length and the Golgi tendon organ detects muscle tension and active contraction.

**Muscle spindles**

The muscle spindles are scattered throughout the muscle but predominate in the belly of the muscle, lying between the muscle fibers and parallel with them. More spindles are located in muscles controlling precise movements than are located in postural muscles. When the spindle is stretched, a sensory nerve located in its center sends impulses to the CNS, which in turn activates the motor neurons innervating the
muscle, thus causing it to contract. The muscle spindle is responsive to both length (tonic response) and rate of change in length (phasic response). A single spindle is a tiny capsule (about 1mm long), filled with fluid and containing some specialized muscle fibers known as intrafusal (fusimotor) fibers, to distinguish them from the extrafusal (skeletomotor) or “regular” muscle fibers. There are two kinds of intrafusal fibers, nuclear bag fibers and nuclear chain fibers. They are similar in that they both have central noncontractile areas in which the nuclei are situated, and both have polar ends that are contractile. They differ in size and in the arrangement of the nuclei. The nuclear bag fiber is the larger of the two, and the nuclei appear crowded into the baglike central area, which gives the fiber its name. The small nuclear chain fiber is named for the single line, chainlike arrangement of the nuclei in its slim, noncontractile central portion. There are differences also in the intricate system of innervations. Each spindle is supplied with a type I afferent neuron that has a characteristic ending known as the primary, or annulospiral ending. This ending is divided into as many branches as there are intrafusal fibers, and each branch is coiled around the noncontractile midsection of the intrafusal fiber. The annulospiral ending is highly sensitive to the velocity of changes in fiber length (phasic response), but only while the change is occurring. It also reacts to static (tonic) or length responses but with a sharp decline in frequency of impulse.

Most muscle spindles have and one to five sensory endings that, because of their appearance and flow spray endings. Each FS ending has its own sensory (typeII) fiber. The FS endings (also called secondary endings) are found at either end of the noncontractile midsection of the intrafusal fibers. They are believed to register static muscular length only (tonic response). The impulses transmitted by the FS endings increase almost directly in proportion to the amount of stretch and continue for a prolonged period of time. The FS endings are less sensitive to muscle stretch that the AS endings and therefore require a greater stimulus before responding. Because both the AS and FS ending’s activate the nuclear chain fibers, it is assumed that these fibers are responsible for the static response of both AS and FS endings. In contrast, only the AS endings activate the nuclear bag fibers. These fibers, then, must be responsible for the strong phasic response of the AS endings. (Gowitzke and Milner 1988: Park, Toole, and Lee 1999).
Muscle spindles are also supplied with their own small efferent fibers. To differentiate these fibers from the motor neurons of the “regular” muscle fibers, they are termed gamma fibers, in contrast to the “regular” motor neurons whose axons are termed alpha fibers as a group, the gamma fibers form a gamma fiber system. Approximately one-third of the fibers in the peripheral nerve are gamma fibers. Impulses conveyed by gamma fibers cause the intramuscular muscle fibers to contract. This shortening of the spindle muscle fibers stretches their central noncontractile region where the AS endings are situated, and this stimulates them, causing their rate of firing to increase. Hence the effect of the gamma system is to control the sensitivity of the spindle afferents. The “AS endings can be caused to fire, not only by passive stretch of the muscle as a whole, but also in the absence of such stretch by the function of the gamma system.

An exaggerated but familiar example of a simple adjustment of this nature is seen when picking up an object that is thought to be heavy. When the opposite proves to be the case, the correction in muscular effort is almost instantaneous. Less spectacular examples of this kind of coordination occur in all movements all the time. The gamma system provides a means of maintaining a position regardless of the tension put on it and enables smooth rather than jerky muscle response.

**Golgi Tendon Organ**

In contrast to the muscle spindle, the golgi tendon organ, when stretched, sends signals to the central nervous system and causes the muscle to relax rather than contract. It consists of a mass of nerve endings, which are enclosed within a connective tissue capsule and embedded in a muscle tendon. It is situated close to the junction of the tendon with the fleshy part of the muscle in such a way that it has an end-to-end relationship with the muscle fibers. It is said to be “in series “with the muscle fibers. As the muscle shortens in contraction, the tension in the tendon increases and the golgi tendon organs are stretched and activated. They are much less sensitive to stretch than spindles and require a stronger stretch to be activated. When the stress is greater that the golgi tendon organ stretch threshold, the reflex contraction that is due to spindle stimulation is overridden and the muscle relaxes.
Joint and Skin Proprioceptors

Two important receptors located in the joints or skins are the pacinian corpuscles and the ruffini endings. Pacinian corpuscles are found beneath the skin, concentrated in regions around the joint capsules, ligaments, and tendon sheaths. They are large end organs consisting of a tip of nerve fiber surrounded by many concentric layers of capsule. They are activated by rapid joint angle changes and by pressure that compresses and distorts the capsule, but only for a very brief period of time. Consequently, they are important for detecting rapid changes in pressure but useless for constant pressure awareness. In running, the information provided by the pacinian corpuscles allows the nervous system to predict where the feet will be at any time so that appropriate adjustments in limb position can be anticipated and effected as needed.

Reflex Movement

Reflexes are integrated at various levels of the nervous system. A reflex movement is a specific pattern of response that occurs without volition and without the need of direction from the cerebrum. The anatomical basis for a reflex act is the reflex arc. This consists of an afferent neuron that comes from a receptor organ, enters the spinal cord, and there makes a synaptic connection either directly with the dendrites and the cell body of an efferent neuron or indirectly through one or more connector neurons. The axon of the efferent neuron extends from the cord to the muscle, where its distal branches terminate in muscle fibers. The point of contact between an axon and a muscle fiber is known as a myoneural junction, or motor endplate. The number of reflex arcs and the number of motor units involved depend both on the nature of the reflex and on the extent of muscular activity needed. Automatic reflex motions accompany all normal voluntary motion. Indeed, very few muscles in most movement patterns are under conscious control.

Exteroceptive Reflexes

Although some overlap occurs, as could be inferred from the discussion of receptors, two main classes of reflexes are related to skeletal movements namely, exteroceptive and proprioceptive. Many of the exteroceptor reflexes exhibited by animals and human beings are familiar to us. A horse will twitch its skin when flies
alight on it, a dog will scratch when its skin is irritated by a flea, or perhaps tickled by a person; a human jump upon hearing a sudden loud noise. A person also blinks when a foreign body strikes the eyeball, or even threatens to strike it. Three exteroceptive reflexes that may be of special interest are the extensor thrust, flexor, and crossed extensor reflexes.

**Extensor Thrust Reflex**

Pressure against the sole of the foot stimulates the pacinian corpuscles in the subcutaneous tissue and solicits the reflex contraction of the extensor muscles of the lower extremity. When the weight is supported by the feet, the pressure of the floor is sufficient to bring about his reaction. As the weight is shifted to the balls of the foot in preparation for a jump, or to the palms of the hand in preparation for a handspring the pressure results in the extensor thrust reflex facilitating the contractions of the extensor muscles of the legs or arms, respectively, thus assisting the pus-off from the floor. (Deutsch 1997 and Gowitzke and Milner 1988)

Similarly in archery, the pacinian corpuscles in the bow hand are stimulated, and facilitation of the extensor muscles of the bow are occurs. However, in this instance, the arches must counteract this reflex action and prevent full extension at the elbow or suffer a painful lesson of being whipped by the released strings. Exteroceptors and interceptors, the latter being subdivided into visceral receptors and proprioceptors.

**Proprioceptive Reflexes**

Proprioceptive reflexes are generally described as those reflexes that occur in response to stimulation of receptors located in the skeletal muscles, tendons, joints, and labyrinths of the inner ear. According to this interpretation, the proprioceptive reflexes are those interoceptors related to motions and positions of the body. The stretch, or myotatic, reflex is always included among these. Some classifications also include the extensor thrust, the labyrinth and neck, and the tendon organ reflex.
**Stretch Reflex**

The stretch reflex is so named because stretch on the muscle stimulates the muscle spindle, resulting in the reflex contraction of the stretched muscle and its synergists and relaxation of its antagonists. The muscle spindle picks up the stretch stimulus and transmits it by way of the afferent neuron to the spinal cord. There the central terminal branches of the sensory neuron synapse directly with the dendrites of the motor neuron, which activates the same muscle fibers that were stretched. These fibers then contract. This two-neuron reflex arc is the simplest type of reflex arc, consisting of a single sensory neuron and single motor neuron which may involve one or more synapses. The important characteristic of this type of reflex arc is that it does not make use of connector neurons in the spinal cord.

There are two responses to the stretch reflex—phasic or tonic—depending on the velocity at which the stretch occurs. The frequency of discharge from the primary endings of the muscle spindle is directly related to the velocity at which the muscle fibers are being stretched. The greater the frequency of these impulses, the greater will be the resulting muscle fiber contraction. The phasic type includes familiar clinical tests, such as the knee jerk. Reflexes of this type are extremely rapid and the contraction is of brief duration. It is true that the cause of the stimulus in this instance is exteroceptive in nature (a rubber-headed hammer or the edge of the hand) it is nevertheless classed as a proprioceptive reflex. If the stretch is sudden and sufficiently strong, the stretched muscle contracts quickly and forcefully because of the response of the primary endings of the muscle spindles.

A slow stretch, such as is elicited in postural sway, will result in a tonic response. Another demonstration of this reflex may be observed when a weight is placed in the hand, with the forearm in 90 degrees of flexion at the elbow joint. The result is likely to be a subtle depression of the hand and forearm immediately followed by a return movement to compensate. Movements that put muscles on a stretch in the backswing or preparatory phase can take advantage of the stretch reflex. If the desired outcome is a strong application of force, the preparatory movement should be rapid, to benefit from the phasic increase in spindle discharge, and long, to increase the tonic response. The backswing in forceful striking and throwing patterns, the crouch before a
vertical jump and the stretch before a tuck dive are all examples. If, however, the desired outcome is accuracy, as in a badminton low serve or a golf putt, the backswing should be short and slow, with a pause before the force application. This approach allows the phasic frequencies of the primary endings to slow down to tonic level. (Gowitzke and Milner 1988)

In the static type of stretch reflex, the muscle is stretched slowly. This causes primary and secondary endings of several spindles to be stimulated and results in a more sustained muscular contraction. The importance of the static stretch is that it causes muscle contraction as long as a muscle is put on excessive stretch. When such a reflex is elicited by the stretch caused by the tendency of weight-bearing joints to flex, the response of the extensor muscles is commonly referred to as the antigravity reflex. Some also use this term to include the response of lower extremity and trunk muscles to the involuntary forward backward swing that usually occurs when a person stands in one position for as long time. (Hamilton, Nancy, 2001)

Importance of Proprioceptive Training

Proprioception taking a balanced approach to sport, when it comes to sport performance, power, strength and endurance can only take you so far. Whether a footballer dribbling the ball, a gymnast on the bars, or a rugby player diving for the line while fending off tackles, balance is critical for performance. Balance in sport involves a complex interplay between numerous factors. A number of these are conscious – such as deciding to move a limb to prevent you falling at the same time as performing a skill e.g. a basketball shoots – while many more are unconscious play. The unconscious element involves the ‘use’ of in-built sensory mechanisms and programmed responses. This is known as proprioception. Proprioception has been called the sixth sense and is a mechanism that keeps track and control of muscle tensions and movement in the body.
The Proprioception Process

The Central Nervous System, is a broadcasting powerhouse of all sensory stimuli received from outside. As soon as joints, muscles and ligaments acquire an external impulse, the message is sent through the CNS, which relays this information to the rest of the body, giving it “instructions” on how to react. The brain receives some of these messages and acts on these messages unconsciously. The spinal cord also receives some of these messages and automatically responds to them. This is how proprioception is achieved.

The nerve endings that are found in muscles, joints and ligaments are sensory “feelers” called pro-prioceptors. Reacting to force, tension and stretch, these feelers act as key determinants in kick starting the ‘stretch/reflex’. Stretch/reflex is a common term used in sports to describe what happens when a body attempts to stretch a muscle to its breaking point. The muscle sends a message through the pro-prioceptors, which is passed along to the CNS. A reply is sent back instructing the body to start up the stretch/reflex mechanism, preventing the muscle from stretching any further.

Manipulation of the postural muscles is also the domain of the stretch/reflex mechanism. Postural muscles control the body’s equilibrium against the effects of gravity. Even if not immediately perceived, the stretch/reflex mechanism works to adjust the muscles’ reaction to stimuli. For instance, adding an object to a set of weights already held in the palm of one hand will cause the hand and forearm muscles to tense to accommodate the additional weight. The stretch/reflex causes this automatic adjustment by “informing” all the muscles involved in the carrying action. This makes the stretch/reflex mechanism both an overall and specific muscle manager.

Proprioception in Sports

Basketball forwards evading offense, soccer goalies guarding the net, gymnasts on the double bars. These athletes utilize a fair amount of skill, energy, and stamina to stay on the top of their game. The brute forces involved in athletics are essential, but so
is maintaining balance while playing a sport. Sports and specialist health writer, John Shepard investigates the role that balance plays in optimizing athletic skill.

Balance is a complex and many-faceted element that governs our everyday lives. It is especially essential for athletes whose exceptional sense of balance and equilibrium allows them to excel in their respective sports. Balance can be seen in the way a basketball centre drives toward the basket and makes a leaping shot to score for his team. In many ways, balance is also unconscious, relying on an internal sensory structure in which pre-programmed responses react to various external stimuli. This type of unconscious balance is called ‘pro-prioception’, more commonly known as the “sixth sense.” It is largely responsible for awareness of muscle tension and movement control.

Muscles, ligaments, and joints have their own “thought processes”. Conscious movement made by a body or motions caused by external forces, prompt them to react according to information they receive from nerve endings. These reactions stem from mechanisms referred to as the sensory-motor process, and scientific research continues to investigate how the body’s senses consciously and unconsciously interact with one another in controlling response to external stimuli. Sports scientists are working on the premise that athletes can actually heighten their pro-prioception and sensory-motor sensitivity by disciplined cultivation of certain habits.

Although not so readily apparent, the stretch/reflex also provides control over other functions e.g. your postural muscles, which maintain the balance of the body against gravity. This makes it a global as well as specific site muscle mechanism. An example of this is if you were holding a weight in your outstretched hand and then had more added, the stretch/reflex would attempt to make the adjustments necessary to allow you to continue to hold the added load by ‘weakling’ all the supporting muscles and influencing your posture.

Proprioception related to Insular Cortex, any type of mental exercise increase brain’s power. Proprioception ability is related with insular cortex activity and this part of the brain represents an important neural connections hub. So training of insular
cortex is reflecting in the brain’s ability to control attention networks, especially neutral attention network. Movement is natural by making it conscious there is a high risk of making it robotic. Most of movement awareness activities can be addressed daily as part of structured warm-up. Structured in the sense that the thought and planning should be put into the sequence and timing of the activities, not the step by step orchestration or choreographing of the movement. The later would defeat the purpose. The goal is to create an environment where the athlete can cultivate as rich a repertoire of motor skills to draw upon as a foundation for specific sport skill. “Rigorously defining proper form and the use of mechanical stabilization and anti cheating aids excessively constrain athletes exploration and problem solving movements, and bear little resemblance to what occurs in athletic performance.” (Ives and Shelley, 2006)

Objectives

1. To determine the impacts of proprioceptive training on field hockey players’ motor fitness and skill performance variables.

2. To compare experimental group and control group on motor fitness and performance variables of field hockey players due to proprioceptive training.

Statement of the problem

The purpose of the study was to investigate the effect of proprioceptive training on selected motor fitness and skill performance variables of hockey players.

Hypotheses

Taking into the account of theoretical considerations, revived literatures, discussions with experts in the field of proprioception, the following hypotheses were formulated.

1. Proprioceptive training would bring significant improvement on motor fitness and performance variables of hockey players.

2. There would be significant difference between control and experimental groups for trained and novice players after administration of proprioceptive training.
Delimitations

1. The study was delimited to 58 field Hockey players from Pondicherry region they were divided into four groups.
2. Proprioceptive training was assigned for experimental groups for a period of 3 days per week for 12 weeks (1 session = 60 min)
3. The age of the subjects ranged between 13 and 19 years.
4. The entire field tests were taken only in the turf ground.
5. Selected motor fitness and skill performance variables were assessed by the standardized testing procedure.

Limitations

1. The regular work outs and training of the hockey players is considered as one of the limitations of the study.
2. Individual difference and their ability to adjust to the training on the new equipment. (Balance board)
3. The subject’s social, economic, and cultural background will not be taken into consideration
4. The subject’s food habits will not be taken into consideration.
5. Methodological variation such as air temperature, atmospheric pressure and relative influence on the result of the study were recognized as limitation for the study.

Definition of terms

Hockey

It is defined as hockey is a dynamic game played by both sex, requiring high level of skills, excellent conditioning and well co-ordinated team effort. (Horst wein, 1981).

Field hockey is played with 11 players on each team uses their hooked hockey stick to control, dribble and hit the ball. The object is to score goals by putting the ball in the opposing team’s goal. The team to score the most goals wins the match.

(www.sportsdefinitions.com)
Novice Player

It is defined as a player is new to this hockey game/skills or activity and he has not played any competition. (www.brainyquote.com/words/)

Trained Player

It can be defined as a player, who is experienced in the field hockey game. They were participated regularly and won many tournaments (www.thefreedictionary.com)

Proprioception

It is a feedback system of our body that allows us to sense where our head and limbs are situated in space and in relation to the body, whether they are moving or still. (Harish, 2006)

Motor Fitness

Motor fitness refers to the ability of an athlete to perform successfully at their sport (Herbert and Terry, 1994, 30)

Muscular Strength

The extent to which muscles can exert force by contracting against resistance. (e.g. holding or restraining an object or person)

The ability of the muscles to exert an external force or to lift a heavy weight. A fit person can do work or play that involves exerting force, such as lifting or controlling one’s own body weight. (Charles R.Carbin, 1994)

Explosive Power

The ability to exert maximum muscular contraction instantly in an explosive burst of movements. The two components of power are strength and speed. (e.g. jumping or a sprint start) (Charles R.Carbin, 1994)
Agility

The ability to perform a series of explosive power movements in rapid succession in opposing directions (e.g. Zigzag running or cutting movements)

The ability to rapidly and accurately change the direction of the movement of the entire body in space (Charles R.Carbin, 1994).

Balance

The ability to control the body's position, either stationary (e.g. a handstand) or while moving. (e.g. a gymnastics stunt) (Charles R.Carbin, 1994).

Balance is typically defined as the ability to sustain or return the body’s center of gravity (COG) over its base of support. (Scott Lucett, 2009).

Flexibility

The ability to achieve an extended range of motion without being impeded by excess tissue, i.e. fat or muscle. (e.g. executing a leg split)

The range of motion is available in a joint. It is affected by muscle length, joint structure, and other factors. A fit person can move the body joints through a full range of motion is work and in play. (Charles R.Carbin, 1994).

Co-ordination

The ability to use the senses with the body parts to perform motor tasks smoothly and accurately. (Charles R.Carbin, 1994).

Coordinative abilities are relatively stabilized and generalized patterns of motor control and regulation processes that enable a sportsperson to do a group of movements with better quality and effect. (Singh, 1991)
Reaction time

The time interval between the presentation of stimulus and the initiation of response running.

The time elapsed between stimulation and the beginning of reaction to that stimulation. *(Charles R.Carbin (1994)).

Skill Performance Variables

Performance

Hockey playing ability may be defined as the exertion of fundamental skills in the game situation. The playing ability would include like dribbling, pushing hitting scoping and stopping etc.

Accuracy Hitting (Hitting to the target)

Hitting is to strike the stationary or the moving ball with the flat side of the stick to determine a destination at certain speed and also abiding by the rules of the game of hockey (i.e.) fault side or face of the stick only used for playing the ball.

Driving the Ball

It means a player has rolled the ball with an ultimate speed with control as well as accuracy.

Control the Ball

This is one of the advanced skills which should always apply in the game in all field sports. The player after received the ball, should control in a same position whether give perfect pass or dodge the opponent.

Trapping

Trapping is a technique used to stop the ball coming from one place by the flat side of the stick or the reverse stick also abiding by the rules of the game of hockey.
Dribbling

Dribbling is defined as to proceed further having full control over the ball in a required speed towards the desired directions preferably towards the opponent’s goal.

It is one of the primary skills for controlling the ball by the players stick for use dribbling.

Significance of the Study

1. Proprioceptive training plays a major role in conditioning the sensory receptors to be more responsive to length and tension in the muscles and tendons. It also helps the skin, palms of the hands, soles of the feet and other senses to communicate with the brain about muscle tension, weights shifts, load and range of motion.

2. This type of exercise involves integration of the mind and body, combining balance, strength and quickness.

3. This exercises control the unconscious movement of the player.

4. This exercise would increase the power of the lower extremities.

5. This exercise helps coaches to influence the player’s cognitive sense for decision making process and skill coordination.