

C14 M 6.1: Introduction and Classification of Therapeutic Exercise

Role	Name	Affiliation
Principal Investigator	Dr. Asis Goswami	Ramakrishna Mission Vivekananda University
Co-Principal Investigator	Dr. P.K. Nag	Ramakrishna Mission Vivekananda University
Paper Coordinator	Dr. A. G. K. Sinha	Punjabi University
Content Writer/Author	Dr. A. G. K. Sinha	Punjabi University
Content Reviewer	Dr. Asis Goswami	Ramakrishna Mission Vivekananda University
Language Editor	Mr. Jayanta Kumar Ghoshal	Free Lance Language Editor

Items	Description of Module
Subject Name	Physical Education, Sports and Health Education
Paper Name	Athlete Care and Rehabilitation
Module Name/Title Case Study	Introduction and classification of therapeutic exercise
Module Id	PESHE/RKMVU/14/6.21
Pre-Requisites	None
Objectives	After going through this module the reader will be able to <ol style="list-style-type: none">1. define therapeutic exercise2. understand the terminology of therapeutic exercise3. understand the basis of classification of therapeutic exercise4. enumerate and define various types of therapeutic exercises5. describe the role of therapeutic exercise in the management of sports injury
Keywords	Therapeutic exercise , classification, active exercise, passive exercise, rehabilitation

Table of content

Summary

Introduction

1. Meaning and Definition of Therapeutic Exercise
2. Classifications of Therapeutic Exercise
 - 2.1 According to force and nature of exercising movement
 - 2.2 According to objective
3. Scope of therapeutic exercise in sports injuries and rehabilitation
 - 3.1 Process of repair of sports injury
 - 3.2 Role of exercise in management of sports injury

Summary

Exercise is the repetition of movement(s) for a specific purpose. The exercise used for management of disease and injury is termed as therapeutic exercise. On the basis of the methods of execution of therapeutic exercises can be categorized in two broad groups - active exercise and passive exercise. In active exercise the movement is produced by the contraction of muscle whereas passive exercise uses some external force to produce the movement. Each of these two categories has various subgroups. Therapeutic exercises have such an important role in the management of sports injuries that it is often said that management of sports injuries is incomplete without the use of therapeutic exercises. At the same time it is also true that inappropriate use of exercise has the potential to inflict further damage and complicate the process of healing. Exercises are required to combat the complications of sports injuries. They also improve the quality of repair. No use or less use of exercises during management of sports injury produces a less pliable and weak repaired tissue that has poor ability to withstand stress and is more likely to be re-injured.

Introduction

The discipline of physical education deals with the use of exercise, physical activity and sports to keep a person fit, healthy and productive. In fact physical exercises are an inseparable part of physical education. However physical exercises are also used in the management of several diseases and injuries. When exercise is used for treatment purpose it is termed as therapeutic exercise. Use of physical exercise for treatment of various diseases and injuries and physical dysfunctions is a specialty area of physiotherapy. There are several types of therapeutic exercises each having specific goal. In this module we shall discuss definition, classification and scope of therapeutic exercise in the treatment and rehabilitation of sports injuries.

1. Meaning and Definition of Therapeutic Exercise

Exercise is the mainstay of physical education programme. We all understand the meaning of exercise but it is difficult to put it in words. Exercise is a movement, an activity. What distinguishes exercise from an ordinary activity or movement is repetition. When an activity or movement is repeated for a specific purpose it is termed as exercise. Physical exercise is the repetition of natural movements of the body. Straightening knee while sitting in a chair is a natural movement but when the same is repeated several times for the purpose of increasing strength of the quadriceps- the muscle that produces this movement – it becomes exercise. Similarly walking is an everyday activity. We walk daily to perform a variety of activities of daily living. But when walking is done in a systematic way controlling the speed and the duration for the purpose of reducing the cholesterol level, or increasing the cardiopulmonary endurance, it becomes an exercise.

Similarly if a mental activity is repeated it becomes a mental exercise. For example mental recitation of a poem several times contributes to memorization of the poem and enhances memory. Doing sums, solving complex puzzle items regularly are the known mental exercises that are commonly used to improve the mental abilities.

In the field of health and rehabilitation exercise plays a very important role. Use of physical exercise for treatment of disease and injury and physical dysfunctions, i.e. exercise therapy, is one of the core specialty areas of physiotherapy. Physical exercises are used for increasing strength, flexibility, balance and stamina and physical exercises help in keeping a person fit and healthy. Exercises are also used in the prevention and treatment of movement related ailments caused by diseases and injuries. Many diseases and injuries affect the organs of movement producing system - such as muscles, ligaments, nerves, bone etc. – and make movement production ability of a person inefficient. The inability to perform a given movement creates difficulty in smooth execution of activities of daily living, which in turn exerts negative effects on the social and economical aspects of life. For example a blunt blow to thigh may produce injury to the quadriceps muscle and make the movement of the knee difficult. Inability

to produce smooth movement in the knee produces difficulty in walking, floor sitting, and squatting, which affects the toilet activities and climbing stairs. If the person's office is situated on the 2nd floor, he may find it difficult to go there and may be forced to take leave.

In these situations of movement restriction exercise therapy promotes physical activities in an organized way. The ultimate aim of any injury management programme using exercises is to produce symptom-free and functional movement. Therapeutic exercises have been proved valuable in tackling the problems of stiffness of joints, weakness of muscles, and subsequent deformities of joints that may arise after injury or suffering from a disease. Exercise therapy is also used to combat non-coordination of movement and subsequent difficulty in independent execution of activities of daily living. In fact the main aim of the exercise therapy is to correct the movement dysfunction and make the person independent in execution of activities of daily living. In several neurological conditions therapeutic exercises are needed to maintain the physical and functional status of the patient.

Therapeutic exercises also bring about favourable changes in the structure and function of the locomotor system (bone, joint, muscle, ligament) and the central nervous system, and exerts long lasting positive impact on the functioning of the circulatory system, the respiratory system and the metabolic system. All these make physical exercise a powerful method of treatment of injuries and diseases. In recognition of the role of exercises in management of disorders the notion that **exercise is medicine** is gaining popularity both among health professionals and common public.

2. Classifications of Therapeutic Exercise

The therapeutic exercises can be classified in several ways. The most common basis of classifying exercise is the type of force used in the production of exercising movements. Therapeutic exercises can also be grouped according to the aims of exercises. Table 1 presents the classification of therapeutic exercises on the basis of the types of the force.

Table 1: Classification of therapeutic exercise on the basis of force required to produce movement

Type	Force required to produce movement
Active	Contraction of muscle
Passive	External force

2.1 Classification according to force and nature of exercising movement

Force is required to produce movement. For human motion this force may be generated by the contraction of muscles or by the external forces such as force of gravity, from another person or by machines. On the basis of the methods of execution, exercises can be categorized into two broad groups - active exercise and passive exercise. The movement produced by the contraction of muscle is called active movement whereas movement produced by external force is known as passive movement. The **active exercise** is the repetition of active movement which requires muscle contraction to produce and control any movement. Often the muscle contraction is voluntary, but many a time exercising movement can be produced by reflex contraction of the muscle. Contraction of muscle to produce movement is the essential feature of active exercise. On the other hand **passive exercise** does not require any muscle contraction to produce movement. In this type of exercise movement is produced by the application of some external force. Passive exercise is usually done by some other person or by machines. Sometimes the force of gravity is utilized to produce passive movement of a body part.

2.1.1 Passive Exercise

Passive exercises are directed towards the flexibility of body parts. Relaxed passive movement, forced passive movement and stretching are the subcategories of passive exercises. During Relaxed passive movement exercise, a joint is moved through the existing range of motion. Forced passive movements are localized quick movements where the joints are moved passively beyond the existing range. These are also referred to as manipulation. Both the exercises can be applied to physiological movement or accessory movement. Physiological movements are the movements which a person can produce voluntarily. Flexion, extension, abduction, adduction, rotation are the physiological movements available in human joints. Accessory movements are those movements that take place in a joint during normal movement but cannot be performed actively by an individual. They consist of spin, glide and slide of one joint surface over the other. Execution of accessory movement requires specialized knowledge of joint anatomy and biomechanics.

Stretching exercise refers to taking the joints to such position where a given muscle or a soft tissue is stretched to its maximum possible length. It is a therapeutic procedure that aims to elongate the soft tissue of the body. These are exercises which are usually directed towards the muscles. The muscle is elongated passively to its maximum length. Stretching exercise is also known as flexibility exercise. The external force for stretching is provided by the physiotherapist or by the patient or by mechanical means such as pulley or weights. Passive stretching, active stretching and ballistic stretching are the subcategories of stretching exercises. Passive stretching is performed by another person. Active stretching refers to the technique in which the patient does stretching himself. Here the force of stretching is generated by the contraction of the opposite muscle group or by the gravity. Fig 1 displays one

self-stretching exercise for the hamstring muscle. The person is doing an active contraction of the quadriceps muscle to stretch the hamstring muscle. On the other hand, in Fig 2, hamstring stretching is done passively by another person. Ballistic stretching is a form of active stretching characterized by the application of quick oscillations at the end range of the movement.



Fig 1– self stretching of hamstring muscle



Fig 2 – passive stretching of hamstring muscle

2.1.2 Active Exercise

Active exercises are categorized on the basis of the amount of assistance and resistance provided during execution of exercises and also on the basis of the types of muscular contraction required to produce movement. On the basis of amount of assistance or resistance during the execution of movement there are four main categories of active exercises - **Free exercise, Assisted exercise, Resisted exercise and Assisted - Resisted exercise**. On the basis of the types of muscular contraction the active exercises can be classified as **Isometric, Isotonic and Isokinetic exercises**. Isotonic exercises can be further categorized as isotonic concentric and isotonic eccentric exercises. Active

exercises can also be classified on the basis of number of muscles required to produce a movement. Exercises utilizing the movement produced by contraction of a single muscle can be termed as **Isolated muscle exercise** whereas exercise using the movement produced by several muscle groups can be termed as **Mass movement exercise**.

During free exercise when a person performs movements on his own without receiving any external assistance or resistance, the only force that acts on the body is the force of gravity which can be used to provide assistance or resistance of a given movement by adjusting the posture during exercise. Free exercise can be further classified as local exercise and general exercise. Local free exercises is focused on the movement of a single joint such as the exercises to improve the power of the thigh muscle or the exercises to increase the range of motion of the knee. In general, in free exercise several muscles contracts to produce movements of many joints at a given time. Walking, running, swimming etc. are the example of free general exercises.

Assisted exercises are utilized for very weak muscles whose fore of contraction is not sufficient to complete the movement and therefore, assistance of external force is needed to complete the movement. The external force of assistance is usually provided by another person. Sometimes mechanical devices are also used to assist the completion of the movement. Assistive exercise is used in the early stage of strengthening of very weak muscles.

Resisted exercise is performed against a force that tends to oppose the force of muscle contraction. In this type of exercise a force is applied to resist the active movement in order to make it difficult. Resisted exercises are used to increase the strength and the size of a muscle. Resisted exercise is also known as strength training.



Fig.3 Resisted exercise

Assisted-Resisted exercise is the combination of assistance and resistance during a single movement. In the weaker range of movement assistance is provided whereas in the stronger part of the range the resistance is provided to the movement. The force of assistance and resistance is usually provided manually by the physiotherapist. This type of exercise is the progression of assisted exercise to free exercise. The purpose is to give confidence to the patient and promote strengthening of muscle.

On the basis of the type of muscle contraction involvement in production or control of exercising movement the active exercises can be grouped as isometric, isotonic and isokinetic. During isometric contraction the length of the muscle does not change during force production. Exercise using isometric contraction is also known as static exercise as this exercise does not change the joint position. In isotonic contraction the force production is associated with the change of length of the muscle. When during force generation the muscle gets shortened, the contraction is termed as isotonic concentric whereas when during force generation muscle gets lengthened, it is called isotonic eccentric contraction. Isotonic exercises are also known as dynamic exercises as these exercises result in the movement of a joint. Isokinetic movement refers to that kind of activities where the speed of movement remains constant throughout the movement. On the basis of position of distal part of limb and its ability to move in space the exercise can be open kinetic chain exercise or close kinetic chain exercise. In open kinetic chain exercise the distal segment is free to move in space but in close kinetic chain exercise the distal segment is fixed and movement takes place in other joints. Straightening of knee, while sitting in a chair is the example of open kinetic chain exercise, whereas bending knee while standing on the feet is the example of close kinetic chain exercise. Close kinetic chain exercise is also known as weight bearing exercise whereas the term non-weight bearing exercise is often used for open kinetic chain exercise.



Figure 4a:



Figure 4b)



Figure 4c)

Fig 4: Open chain (4a & 4b) and Closed chain (4c) exercise

2.2 Classification of therapeutic exercise according to objective

On the basis of aims and objectives therapeutic exercise can be broadly categorized as

1. Strength exercise
2. Mobility/ flexibility exercise
3. Balance exercise
4. Breathing exercise
5. Endurance or cardiopulmonary exercise
6. Skill improvement exercise

The strengthening exercise is directed at increasing the muscular strength whereas the focus of mobility exercises is to increase or maintain the range of motion of joints and flexibility of body parts. Balance exercise works at improving the coordination of various muscle groups and enhance the ability to maintain equilibrium in the situation of reduced base of support. Breathing exercises are a special category of free exercise, and they are directed towards the respiratory muscles. These exercises alter the breathing pattern and increase the amount of oxygenation in the body. Endurance exercise works to enhance the oxygen delivery capacity of the circulatory system to working muscles. Endurance exercise is also known as aerobic exercise. Skill improvement exercise can also be called as functional exercise as it seeks to improve the performance of a given motor skill. Motor skill can be classified as gross motor skill and fine motor skill. Training of gross motor skills such as walking, standing or sitting plays

important roles in enhancing independence after injury or disability. The example of fine motor skills includes writing, painting, playing musical instruments etc.

3. Scope of Therapeutic Exercise in Rehabilitation of Sports Injuries

According to Kulund (1982) “rehabilitation of sports is although closely tied to the modalities of heat and cold but the most important modality is exercise which does more than ice or heat to restore muscle and joint function and prevent fibrosis.” This statement underscores the role of therapeutic exercise in the management of sports injuries. Therapeutic exercise also play an important role in prevention of sports injuries. It would not be an exaggeration to say that any phase of management of sports injuries is incomplete without the use of therapeutic exercises. At the same time it is also true that inappropriate use of exercise during healing process has the potential to inflict further damage and complicate the process. For the judicious use of therapeutic exercises in injury management process it is important to have familiarity with the various stages of biological process of healing of injury and the effect of exercises on healing process.

3.1 Process of Repair of Sports Injury

An Injury can be described as the disruption of the continuity of a structure of the body which may be gross or microscopic. Healing refers to a process in which the body attempts to restore the anatomic continuity of structure by laying down new tissues to bridge the gap. Depending on the type of the tissue injured the gap created by the injury may be bridged by the similar tissue or when it is not possible, the gap is bridged by non-specific connective tissues which are composed of collagen fibres. The end result of this process is scar formation. Scar is basically the replacement of lost tissue. The structural and functional integrity of the injured part and its susceptibility to further injury depends by and large on the quality and mechanical strength of the scar.

Irrespective of the cause of injury the biological processes related to repair of various tissues are strikingly similar and can be described under three distinct but overlapping phases i.e. acute inflammation, healing and remodelling. Inflammation is the immediate response of the body to injury. It is characterized by intense pain, swelling, loss of function. Carefully designed active isometric exercises help reduce swelling and prevent adhesion developed subsequently to injury. As the inflammatory responses recede in intensity the process of healing begins. The dead cells are replaced by either new cells of similar type or by fibre producing cells. These cells start building a haphazard network of collagen fibres. The purpose of this process is to bridge the gap by creating a connective tissue that resembles as closely as possible to the structure, function and strength of the original injured tissue. The tensile strength of the repaired tissue increases gradually during remodeling. The quality of repaired tissue is very much influenced by the movement. As a matter of fact the mechanical strength of any tissue depends on the number and orientation of collagen fibres which in turn are influenced by the physiological stress and motion. The collagen fibres orient

themselves parallel to the line of imposed stress, and the application of stress within acceptable limit increases the mechanical strength of the tissue. Carefully progressed movement enhances the mechanical strength of repair whereas prolonged lack of movement reduces it. Therefore carefully designed therapeutic exercise is essential to improve the quality of repair.

During repair of injury several complications may take place which sometimes become more problematic than the injury itself. The initial period of inflammation and immobilization leads to stiffness of joints, adhesion of soft tissues and weakness of muscles. All these complications can be the consistent source of long standing pain that persists even after the repair of injury. Reduced cardiopulmonary endurance and balance are the other complications of an injury that grossly reduces the functional capacity of a person and seriously interferes with the early return to sports.

3.2: Role of Exercise in Management of Sports Injury

The specific role of therapeutic exercise in the management and rehabilitation of sports injury is summarized in Table 2. Studies have demonstrated that management of injury using controlled early movement of the injured part (early mobilization protocol in medical terminology) has better physiological and functional outcomes. The quality of repaired tissue formed after early controlled mobilization - in terms of types and number of collagen fibres and the mechanical strength - is much better in terms of ability to withstand stress. Therefore it is less likely to be re-injured. On the other hand no movement or less use of exercise during management produces a less pliable and weak tissue that is more likely to be re-injured. It is to be understood that modalities and medicine are no alternative to therapeutic exercise. Without therapeutic exercise the relief obtained by the use of electrotherapeutic modalities and medicine will not last for long time.

Table 2: Role of Exercise in Injury Rehabilitation

- Reduce swelling
- Improve quality of repair
- Prevent and treat complications of stiffness, weakness and adhesion
- Maintain fitness
- Recondition injured parts to withstand higher load

During the phase of inflammation and early repair the part should be protected. In this phase exercise should always be used in conjunction with ice. Gentle isometric contraction of muscles of the injured segment is required to reduce the congestion and facilitate early healing. However, care should be taken so that stress is not imposed on the injured segment during exercise. During late healing and remodeling phase therapeutic exercise becomes the mainstay of

management. Therapeutic exercise is also required to deal with the complications of immobilization and also to influence the quality of repair.

In the management of sports injury the first goal of therapeutic exercise is to have pain free active control of the injured part by judicious use of isometric exercises and active exercises to increase joint range of motion. After the pain free range of motion is achieved the focus of exercise shifts towards increasing the strength of the surrounding muscles using active resisted exercises. The balance and coordination exercises are added to the programme when strength reaches to 70-80% of the normal. Practice of sports specific skills should be added in the latter part of rehabilitation programme.

During treatment phase of injury, an athlete is unable to take part in full training. Injury induced detraining has negative effects on the fitness of the athlete and it is important to blunt these effects by incorporating the principles of conditioning in overall injury management programme. The fitness of the athlete should be maintained as far as possible using the alternative regimen of training that uses those exercises which do not stress the injured part.

Reconditioning of the injured part is the last stage of injury management where the rediscovery of form of the athlete is the main consideration. This phase is mainly exercise oriented in which the injured tissue is subjected to gradual loading and the specific attention is paid to correct deficits in range, strength, proprioception, agility, aerobic and anaerobic fitness and restoration of sports specific skills. The aims are to maximize the loading tolerance of the repaired tissue and restore the fitness of the athlete to the pre-injury level prior to returning to the competitive sports situation.