Therapeutic Exercises and Its Role in Body Fitness

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Therapeutic exercise is defined by DeLateur as body movement designed to correct impairment, improve musculoskeletal function, or maintain a state of well-being.[1] It incorporate exercises performed to attain physical benefit, such as maintenance of the range of motion, strengthening of weakened muscles, increased joint flexibility, or improved cardiovascular and respiratory function. Therapeutic exercises may vary from highly selected activities restricted to specific muscles or parts of the body, to general and vigorous activities that can return a convalescing patient to the best of physical condition. Therapeutic exercises helps to enable ambulation, release contracted muscles, tendons, and fascia, mobilize joints, improve respiratory capacity, improve coordination, reduce rigidity, improve balance, promote relaxation, improve muscle strength and improve exercise performance and functional capacity (endurance). It Increases size and strength in musculotendinous tissue and tensile strength, Improves coordination and timing of muscular groups, Reduces atrophy, Improves reaction, recruitment and endurance, Reduces edema, Improves connective tissue strength and integrity, Promotes circulation to enhance soft tissue healing and metabolism, Increases bone density, reduces fatigue, and Improve range of motion of the spine and extremities.

Aim of Therapeutic Exercise:

The ultimate aim of therapeutic exercises is to achieve optimal level of Physical fitness. The improvement of muscle strength and improvement of exercise tolerance depicts an individual's overall physical fitness, a state characterized by good muscle strength combined with good endurance.

A therapeutic exercise, also known as corrective device applies to scientific use of bodily movement to restore normal function in diseased or injured tissues to maintain a state of well-being. As with any type of therapy, a therapeutic exercise program is designed to correct specific disabilities of the individual patient.

Periodic Evaluation of Services:

The program is evaluated periodically and modified as indicated by the patient's progress and response to the prescribed regimen. Exercises affect the body locally and systemically and bring about changes in the nervous, circulatory, and endocrine systems as well as the musculoskeletal system.

Role of Therapeutic Exercises:

Among the types of therapeutic exercise are those that (1) increase or maintain mobility of the joints and surrounding soft tissues, (2) develop coordination through control of individual muscles, (3) increase muscular strength and endurance, and (4) promote relaxation and relief of tension.

JOINT MOBILITY: In the absence of a disability that prohibits mobility, the regular day-to-day activities of living maintain the normal movements of the joints. If, however, motion is restricted for any reason, the soft tissues become dense and hard and adaptive shortening of the connective tissues takes place. These changes begin to develop within four days after a joint has been immobilized and are evident even in a normal joint that has been rendered immobile. It is for this reason that therapeutic exercises to prevent loss of joint motion are so important and should be begun as soon as possible after an injury has occurred or a disease process has begun.

Prevention of the loss of joint motion is much less costly and time-consuming than correction of tissue changes that seriously impair joint mobility. It is recommended that each joint should be put through its full range of motion three times at least twice daily. If the patient is not able to carry out these exercises, he is assisted by a therapist or member of the family who has been instructed in the exercises. Inflammation of the joint, as in arthritis, may cause some pain on motion, and so passive exercises are done slowly and gently with the joint as relaxed as possible. Procedures that stretch tight muscles to increase joint motion should be done only by a skilled therapist who understands the hazards of fracture and bleeding within the joint, which can occur if the exercises are done improperly or too strenuously.

MUSCLE TRAINING: Exercises of this type are taught to the patient who has lost some control over a major skeletal muscle. By learning precise and conscious control over a specific muscle, the patient is able to strengthen and coordinate its movement with normal motor patterns and thus enhance mobility. Muscle training or neuromuscular re-education demands full cooperation of the patient, who must be capable of understanding the purpose of the exercises, following directions, and giving full attention to the muscle isolated for retraining. The sessions are held in a quiet, comfortable atmosphere to facilitate concentration by the patient.

The development of conscious control over individual muscles is useful in the rehabilitation of patients with a variety of disorders, including physical trauma, diseases such as poliomyelitis that affect the motor neurons, and congenital disorders such as cerebral palsy. It involves a systematic program of sequential activities under the direction of a therapist knowledgeable in the technique. Although it requires much effort on the part of the patient and the therapist, the attainment of muscle control and coordination is a satisfying reward.

MUSCLE STRENGTH AND ENDURANCE: Improvement of muscle strength and endurance is particularly important in the rehabilitation of patients whose goal is to return to an active and productive life after a debilitating illness or disabling injury. The exercises are prescribed according to the individual needs of the patient and usually involve more than one group of muscles.

Strengthening (force increasing) exercises are prescribed after an examination has shown weakness in individual muscles or muscle groups. These exercises are usually administered with relatively high

resistance and few (3 to 10) repetitions. A group of exercises, called a *set*, is followed by a few minutes of rest. Three to 5 sets for a muscle or group constitute one bout of exercises. Strengthening exercises are often performed daily in early stages of rehabilitation, but less often later in treatment.

Types of therapeutic exercise:

Therapeutic exercises aim at achieving and maintaining physical fitness fall into the following major categories:

- Endurance training
- Resistance training
- Flexibility training

Endurance Training

An endurance training focuses on frequency, intensity, and duration.

- Frequency incorporates aerobic exercise 3-5 days per week
- Intensity of training depends on maximum heart rate (HR max), or maximum oxygen uptake reserve (VO_2 R) or heart rate reserve (HRR)
- Duration of training constitutes continuous or intermittent aerobic activity for 20-60 minutes (minimum of 10min bouts accumulated throughout the day)

Duration is dependent on the intensity of the activity; thus, lower-intensity activity should be conducted over a longer period of time (≥30min), and, conversely, individuals training at higher levels of intensity should train at least 20 minutes or longer. Moderate-intensity activity of longer duration is recommended for adults not training for athletic competition, because total fitness is more readily attained with exercise sessions of longer duration and because potential hazards and adherence problems are associated with high-intensity activity.

Exercises that use large muscle groups that can be maintained continuously and are aerobic in nature are recommended. These exercises include Walking, Running, Jogging, Dancing, Stair climbing, Cycling, Swimming, Rowing, Skating, Aerobic dance and exercise classes, Jumping rope and Cross-country skiing.

The HR max can be determined by the following: HR max = 220 – age. The exercise session should consist of the following:

- A warm-up period of approximately 10 minutes - This should combine calisthenic-type stretching exercises and progressive aerobic activity that should increase the heart rate close to the prescribed heart rate for the session
- Endurance training (20-60min)
- A cool-down period of 5-10 minutes

Application to patients:

It has always being believed that for patients, especially those with cardiac or respiratory disease, a less intense training regimen must be used, with the training heart rate not exceeding that attained at 50-60% of maximum O_2 uptake (VO_2 max).

It is prudent not to allow a patient to exceed a heart rate of 130 beats per minute (bpm). In elderly patients and patients at risk, the intensity, frequency, and duration of therapeutic exercise should be established for each patient individually through prior medical evaluation.

Using the following equation, the HRR method, otherwise known as the Karvonen method, should be employed to determine the target heart rate for the ill or elderly patient: Target HR = (220 - age - resting heart rate × % intensity selected) + resting HR.

Progression:

Progression must be a part of an exercise program to ensure continued results. With endurance training, progression can occur by increasing the duration or the intensity. Several factors contribute to the optimal rate of progression; current activity levels, exercise goals, age, and physiologic limitations should be considered. Most importantly, a rate of progression should be used that results in long-term participation. Being too aggressive with progression can lead to increased dropout rates as a result of injuries and/or perceived excessive discomfort.

Resistance Training:

Resistance training increases strength, walking speed, stair-climbing power, balance, and lean body mass and decreases regional and total fat mass. This type of exercise generally exists in 3 forms: isotonic, isometric, and isokinetic.

Resistance training has been shown to bring about favorable changes in risk factors for coronary artery disease, osteoporosis, diabetes mellitus, and cancer. For example, resistance training has been proven to lower systolic blood pressure, increase bone mineral density, increase mechanisms involved with blood glucose metabolism (glucose tolerance and insulin resistance), and increase bowel transit time, which decreases the risk of colon cancer in healthy men and women who are middle-aged or older. Back pain and work-related back injuries also have been shown to decrease with resistance training.

Isotonic exercise:

Isotonic exercise consists of dynamic exercise combining a constant load (the amount of weight used) with uncontrolled speed of movement. Movement is through a range as the muscle

shortens or lengthens. This type of exercise uses free weights and machines; it is what most people envision when they think of resistance training. DeLorme and Zinovieff were 2 of the first proponents of isotonic exercise.[4, 5]

DeLorme recommended gradually building up to the 10 repetition maximum (RM; the maximum amount of weight lifted with correct technique for 10 repetitions) for each exercise with percentages of the 10 RM (i.e, 50%, 75%, and then 100%). In contrast, Zinovieff's method, called the Oxford technique, starts at 10 RM and works down by a certain percentage (i.e, 100%, 75%, and then 50%).

Both methods are effective because when the RM is reached, the progressive recruitment of muscle fibers has occurred and the muscle is at high intensity. Today, reaching the RM is still a crucial part of a resistance training program. More variables to a resistance training program exist, as described below.[6]

Contraction:

The fundamental components of most resistance training programs are dynamic repetitions of concentric contraction (in which the muscle is shortened) and of eccentric contraction (in which the muscle is lengthened), with an isometric contraction stabilizing the movement.

Load and volume:

The load is the amount of weight used during the set and is the most important variable in program design. The load is best determined by the RM. Training volume is prescribed in terms of repetitions per set, number of sets per session, and number of training sessions per week. Resistance training programs designed for muscular strength and hypertrophy are best served by moderate to heavy loads (6-15 RM) and moderate volume (3-4 sets per exercise). The training load should be increased by 2-10% when the desired number of repetitions with the current load is surpassed by 1-2 repetitions.

Muscle groups and joints:

Larger muscle groups (i.e, thighs, back, chest) should be exercised before smaller muscle groups (i.e, shoulders, arms, calves), and multi joint exercises (i.e, squat, dead lift, bench press) should be performed before single-joint exercises (i.e, leg extensions, curl, arm extension).

These approaches are important for 2 reasons: (1) multi joint, large muscle–group exercises require high levels of energy for optimal performance, and (2) small muscles limit the load during exercises for large muscles. For example, a bench press requires more energy than an arm extension; plus, the triceps limit the pectorals during the bench press. With regard to specific exercise selection, multiple exercises are available for each muscle group. This allows patients to perform those that they most enjoy, increasing compliance.

Rest periods:

Rest periods are periods of time that are used for recovery between sets. The training goal, the training status of the individual, and the relative load lifted determine the rest period. Goal-specific rest periods are recommended as follows:

- For power (the ability to exert force at higher speeds) - 5-8 minutes
- For maximal strength (the greatest force that a muscle or muscle group can generate in a single maximum contraction) - 3-5 minutes
- For muscular hypertrophy - 1-2 minutes
- For muscular endurance - 30-60 seconds

Repetition velocity:

The criterion standard repetition velocity that should maximize muscle tension and that may result in greater strength and hypertrophic changes is 2:1:4 (2s, concentric; 1s, pause; 4s, eccentric). However, for the average individual, 3:3 (3s, eccentric; 3s, concentric) is sufficient.

Frequency:

Training frequency is the number of sessions during a given period of time (eg, 1/wk). Untrained individuals should perform a complete body workout 2-3 days per week. Changes in frequency to 3-4 days per week as training status increases may accompany program design changes (i.e, splitting workouts into upper- and lower-body routines). For advanced training, workouts can take place 4-6 days per week (using workouts that focus on 1-2 body parts).

Isometric exercise

Isometric exercise is static exercise with muscle contraction but no movement of the load, resulting in no change in the total length of the muscle. These exercises involve the exertion of force against an immovable object or the holding of an object in a static position. They are relatively easy to perform and require little time. Isometric exercises are very effective on postural muscles and are useful when joint motion is painful or contraindicated. As is true with isotonic exercise, the force should be sufficient to fatigue all of the muscle fibers.

The strength gained during static exercise may not transfer to dynamic activities. Another disadvantage of isometric exercise is that it requires great caution, because it raises heart rate (due to decreased vagal tone and increased discharge of cardiac sympathetic nerves). Within a few seconds of the start of isometric exercise, the systolic and diastolic blood pressures rise.

Isokinetic exercise:

In isokinetic exercise, movement is controlled so that it occurs through a range at a constant angular velocity as the muscle shortens or lengthens. However, the load or force exerted may be variable. Isokinetic exercise is performed using special equipment (eg, Cybex, Nautilus) that only permits movement at a preset angular velocity. This causes maximum tension at all angles.

The individual performing the exercises must be very motivated to recruit all of the muscle fibers, because the machine moves at the same rate no matter how much force is applied to it. Other disadvantages include the fact that strength gained at one particular velocity may not transfer to other velocities. In addition, the equipment is expensive and therefore is not readily available.

Flexibility Training:

Flexibility exercises can aid in improving and maintaining range of motion in a joint or a series of joints. They should be performed in a slow, controlled manner, with a gradual progression made to greater ranges of motion. The stretching techniques include: static, dynamic, Ballistic and PNF.

Static:

The muscle is stretched to a point of mild discomfort and then held at that position for an extended period of time (usually 15-30s). The static stretch is used most often. In static stretching, one stretches the particular muscle or a group of muscles by slowly moving the body part into position and then holding the stretch for a set time. The static stretch begins with a relaxed muscle and then applies the stretch slowly and therefore do not activate the stretch reflex like knee jerk. Activation of stretch reflex causes the stretched muscle to contract then instead of elongate. Static stretching can be done actively or passively. The characteristics of static flexibility exercise are as follows:

- Low injury risk
- Effective, with little time and assistance required
- Most commonly recommended method

Dynamic:

Momentum created by repetitive bouncing movements produces a muscle stretch. However, dynamic flexibility exercises can cause muscle soreness or injury. Dynamic stretching refers to the stretching that occurs while performing sport specific movements. Dynamic stretching is similar to ballistic stretching in that both use fast body movements to cause muscle stretch, but dynamic stretching does not employ bouncing or bobbing.

Dynamic stretching called “dynamic limb range of motion [1]”. It is achieved by moving a limb in a slow and controlled manner through its full available range of motion. As the dynamic motion is repeated, the speed of the movement increases, as does the available range of motion.

Ballistic:

Ballistic stretching uses muscle contractions to force muscle elongation through bobbing movements where there is no pause at any point in movement. Although the bobbing movement quickly elongates the muscle with each repetition, the bobbing also activates the stretch reflex or

knee jerk response. Since the stretch reflex stimulates the muscle to contract after the stretch is finished, ballistic stretching is usually discouraged.

Beaulieu[50] asserts that ballistic stretching creates more than twice the tension in the target muscle that a static stretch does. This increases the likelihood of tearing the muscle, because the external force lengthening the muscle opposes the internal shortening force produced by the stretch reflex, resulting in excessive tension in the muscle and tendons.

PNF:

PNF stretching refers to a stretching technique in which a fully contracted muscle is stretched by moving a limb through the joint's range of motion. After moving through the complete range of motion, the muscle is relaxed and rested before resuming the procedure. The combination of muscle contraction and stretching serves to relax the muscle used to maintain the muscle tone. This relaxation allows for increased flexibility by quieting the internal forces in both the muscles that assist and the ones that oppose the movement of the joint in desired direction. This involves the alternation of contraction and relaxation of agonists and antagonists through a designated series of motions. Characteristics of PNF are as follows:

- Produces the largest improvements in flexibility
- Typically causes some degree of muscle soreness
- Typically requires a partner trained in the technique and is time consuming

Stretching exercises:

Stretching exercises should be performed a minimum of 2-3 days per week. For each stretch, 2-4 repetitions should be performed: 15-30 seconds of static stretching, as well as a 6-second contraction followed by 10-30 seconds of assisted stretching for PNF. These exercises can be effectively included in the warm-up and/or cool-down periods that precede and follow the endurance training exercise programs. A warm-up period should precede stretching exercises in order to elevate muscle temperature.

A systematic review examined the effect of acute static stretch on maximal muscle performance during pre exercise routines. The authors found that stretch durations of less than 30 seconds (pooled estimate, -1.1% ± 1.8%) and 30-45 seconds (pooled estimate, -4.2% ± 2.7%) did not result in a meaningful reduction in muscular performance following these pre exercise routines. However, they did find a moderate detrimental effect (61%) on peak performance with stretch durations of more than 60 seconds.[7] Yoga, tai chi, and Pilates are techniques that can also be used to improve joint flexibility.

Active Assisted and Passive ROM Exercises:

AAROM:

Active assisted range-of-motion (AAROM) exercises are used when the patient has very weak muscles or when joint pain limits movement. During AAROM exercises, it is important to avoid forcing the joint and/or soft tissue beyond the point of pain.

PROM:

In patients who cannot exercise actively, passive range-of-motion (PROM) exercises, consisting of stretching immobile muscles and joint capsules to prevent joint stiffness and muscle contracture, are used. Joint flexibility is achieved by means of steady and slow manual stretching of large muscle groups and joint capsules or with the help of mechanical devices. As a preliminary exercise prior to endurance or resistance training, PROM should be performed during the first warm-up and the last cool-down phases.

Exercise in Specific Patient Populations:

Therapeutic exercise has numerous benefits for all patients. Therapeutic exercise programs should consist of endurance, resistance, and flexibility training. All 3 of these can be combined into 1 exercise session, or they can be divided up. The method that the patient will best comply with should be used.

Patients should be encouraged to progress with their exercise programs so that they can continue to benefit from them. When performing resistance training, patients should be encouraged to exercise the muscle group of interest until they reach their RM so that all of the muscle fibers in that group are recruited. In patients who are too debilitated to perform an independent therapeutic exercise program, AAROM and PROM should be performed by a therapist, a trained family member, or a caretaker.

Stroke:

Therapeutic exercise has been shown in several studies to benefit post stroke patients.[8, 9, 10] In one study, it improved function and the quality of life in patients with a subacute stroke, increasing their endurance, balance, and mobility.[11] In a similar study in the same patient population, therapeutic exercise improved depressive symptoms.

A large, systematic review revealed that progressive resistance exercise can improve strength and activity in patients with acute or chronic stroke without increasing spasticity.[12]

Peripheral arterial disease:

Therapeutic exercise can improve symptoms of pain with increased walking distance, referred to as intermittent claudication, as well as improve the quality of life in patients with peripheral arterial disease (PAD). This includes resistance and endurance training. Resistance training, consisting of both lower extremity exercises, has improved walking distance, quality of life, and pain associated with intermittent claudication.[13, 14, 15]

Endurance training, including low-intensity training,[16] interval training,[17] and upper extremity aerobic exercise,[18] also improves quality of life, walking distance, and pain.[14, 19, 20] In addition to improving symptoms, exercise can decrease cardiovascular morbidity and mortality in patients with PAD.[21] The exercise programs do not have to be supervised. Home-based therapeutic exercise programs have also been shown to improve walking and quality of life.[22, 23]

Multiple sclerosis:

Several studies have shown that endurance and resistance training can reduce fatigue in patients with multiple sclerosis (MS).[24, 25] Quality of life has been improved with endurance training. Studies have also shown improvements in VO_2 max and strength as a result of endurance and resistance training, respectively.[26]

To allow MS patients to exercise safely, certain precautions should be taken. Close supervision is recommended. In addition, exercise should be graded so that the intensity of the exercise is reduced in proportion to the degree of disability. For individuals with mild to moderate disability, endurance training should be performed 2-3 times weekly for 20-30 minutes, with 65-75% of the HR max.

For previously untrained individuals, resistance training should be performed twice weekly. The sessions should consist of 1-2 exercises per body part for major muscle groups (legs, chest, back) and 1 exercise for the smaller muscle groups (shoulders, biceps, triceps, abdominals). Either 2 or 3 sets should be performed, with about 15 repetitions per set.

Symptoms in some patients with MS worsen in response to higher ambient temperatures. Interval training and/or pre-cooling prior to the exercise session may be preferable for them.

Diabetes mellitus:

Exercise is important in diabetes prevention and management. Exercise has been shown to decrease glycosylated hemoglobin, blood pressure, and diabetic medication doses in people with type 2 diabetes.[27]

Exercise improves insulin sensitivity by acting directly on the muscle, causing autophosphorylation, glucose transporter 4 (GLUT-4) content, and glucose transport-phosphorylation to increase. Exercise reduces visceral obesity, which decreases free fatty acids. It also increases insulin-stimulated limb blood flow. Resistance training leads to muscular

hypertrophy, which improves glycemic control by increasing the storage size for glucose disposal.

Exercise has also been shown to slow the development of diabetic peripheral neuropathy.[28] The exact mechanism of this is unknown, but the authors of the study do propose some possible explanations. Exercise may cause cellular changes that result in increased endoneurial blood flow and greater oxygen delivery. Another mechanism could be an exercise-induced increase in the concentration of Na^+/K^+ –adenosine triphosphatase (ATPase) pumps. K-channel openers have been shown in experiments to improve nerve perfusion and function in patients with diabetic neuropathy.

Osteoporosis:

Multiple trials in postmenopausal women have shown improvements in bone-mineral density as a result of resistance training. These studies have also shown improvements in strength and muscle mass, which can help with functional activities.[29, 30, 31, 32, 33, 34, 35]

However, despite the importance of resistance training, a conservative approach should be taken when designing an exercise program. The exercise routines can be simple and should have no jarring motions or sudden changes in direction, which may result in a fall. Patients should start with a light weight that allows them to perform 8-12 repetitions in a specific muscle group without the assistance of other muscle groups. Erect trunk alignment with back and head support, along with proper positional alignment, is important. High loads through the vertebral bodies should be avoided because they can produce compression fractures.

Progression should occur gradually, with sets added before weight is increased. The exercises should be performed 3-4 times weekly. Over time, those exercises that increase strength in the spine and extremities will increase the patient’s sense of balance and stability, which may decrease the individual's risk of falling.

Parkinson disease:

Several studies have shown that therapeutic exercise can increase function and quality of life in people with Parkinson disease. Researchers found that an exercise program consisting of flexibility, endurance, and resistance training improved patients' perceptions of quality of life by increasing physical activity and social interaction.[36] Another study demonstrated that high-intensity resistance training could result in muscular hypertrophy; more important, it led to improvements in stair descent times and 6-minute walk distances.[37] High-intensity resistance training has also been shown to increase balance.[38] In another study, endurance training improved movement initiation times and increased VO_2 max.

Neuromuscular disease:

Strength can be increased in children with Duchenne muscular dystrophy and in adults with slowly progressive neuromuscular disease. The exercise needs to begin when the muscle groups have significantly more than simply antigravity strength. Exercising muscles that do not have

antigravity strength may cause them to become weaker. The exercises need to be performed on a routine basis because any discontinuation will result in a rapid decrease in the strength gained. They also need to be performed at a sub maximal level. There is no clinical evidence, however, that exercising muscles in individuals with neuromuscular disease will result in long-term improvements.

There have been only a few studies pertaining to endurance training and neuromuscular disease. Most of these have shown a positive effect from the training. Individuals have had variable responses to the training, probably in relation to their level of conditioning at the time their study participation began and to the effects of individual diseases. The cardiopulmonary adaptations to sub maximal training in persons with neuromuscular disease are similar qualitatively to those in individuals without this type of illness. Short-term adaptations may be made, but the long-term effect of the training is unknown and may be limited by loss of muscle mass.

Balance disorders:

Therapeutic exercise, including resistance training, flexibility training, multicomponent exercise, and tai chi, for the treatment of balance disorders and balance confidence has been studied extensively in older adults.[39, 40, 41, 42, 43, 44] Resistance and endurance training programs incorporating jumping and mini-trampoline exercise have also been shown to improve balance in elderly persons.[45, 46]

A meta-analysis of randomized, controlled trials on exercise and balance confidence in adults aged 60 years and older without a neurologic condition demonstrated low-significant effects for exercise and multifactorial interventions and medium-significant effects for tai chi.[47]

Recumbent and convalescing patients:

Recumbent and convalescing patients require maintenance by means of AAROM or PROM exercises, aided or performed by a therapist, to preserve full joint mobility and prevent joint stiffness and muscle contractures.

During or immediately after a patient's hospital stay, the patient should be referred to a physical training program. Otherwise, an individual therapeutic regimen appropriate to the patient's physical capacity should be designed in order to maintain and, whenever possible, improve his/her level of physical fitness. Thus, physical fitness maintenance or training can be performed either by means of an individual program carried out by the patient at home or by participation in a group training program.

Additional patient populations:

Therapeutic exercise can also be used in many diagnoses other than those specified above. See Table 1 (below) for more diagnoses and pertinent exercise recommendations.

Table 1. Some Therapeutic Exercise Routines for Specific Patient Populations:

Department	Disease	Therapeutic Exercise
Cardiac[12, 31]	• Ischemic heart disease (CAD) • Post-MI • Stable angina • Stable chronic heart failure (CHF) with sinus rhythm and ejection fraction of £ 40%	• AROM; endurance training (eg, after a 5min warm-up, exercise until the heart rate reaches that attained at 50% of VO_2 max) • Training muscle strength by resistance training, which must be carried out with great caution and adjusted to each patient's physical fitness level
Pulmonary	• Pneumonia • Chronic bronchitis • Bronchiectasis	• Postural drainage exercises
	• Asthma • Emphysema	• Breathing techniques • Relaxation techniques
	• Respiratory insufficiency • Restrictive lung disease	• Stretching exercises to mobilize respiratory muscles *Note:* The level of physical effort should be limited because exercise may provoke bronchospasm
Orthopedics	• Fractures • Osteoarthritis[48, 49] • Amputations	• Preoperative and postoperative exercises • Isometric exercises for joints with minimal ROM • ROM exercises to prevent contractures and heterotopic ossification
Burns		• Passive and active exercises assisted by therapists to prevent contractures
Rehabilitation	• Cervical, thoracic, and lumbar problems	• Training of the Swedish Back School* • Treatment of muscle contractures • Myofascial release • Flexibility training (stretching) to mobilize joints • Resistance (which may include isometric exercises) and PNF training of muscle strength in muscles that have become weakened, as well as in the back extensors and abdominal muscles • Graded fitness training

	• Ankylosing spondylitis	• Mobilization of spinal vertebrae • Extension exercises
Rheumatoid arthritis		• Flexibility training • Gentle fitness training
Gynecology and obstetrics	• Pregnancy and postdelivery	• Prenatal and postnatal exercises • Relaxation techniques
	• After mastectomy	• Training to reduce lymphedema
	• Urinary incontinence	• Isometric exercises to pelvic muscles

Mechanical aids in physical fitness:

Examples of mechanical aids used in physical fitness maintenance and training include the following:

- Electrically braked cycle ergometers
- Treadmills
- Rowing apparatuses
- Bed bicycles
- Arm cycles
- Pulleys
- Free weights
- Weight-training machines
- Indoor stair steppers
- Medicine balls
- Pools

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