SURGICAL REHABILITATION

George R. Vito, D.P.M.

The importance of proper rehabilitation is best illustrated by comparing cases in which physical therapy was utilized with patients where these therapeutic techniques were withheld.[1] Common symptoms which may develop following foot and ankle surgery include, flexion contracture of the gastrocnemius-soleus complex, muscle weakness, and disuse atrophy of the larger muscle groups of the extremity.[2] One of the more common postoperative complications in foot surgery is that of hallux limitus following hallux valgus repair.

Physical therapy should be initiated within the first few days following surgery, provided the procedure allows one to take this approach. The goals of physical therapy are as follows:

1) To resolve inflammation and promote removal of inflammatory products, thereby reducing pain and swelling.
2) To restore joint mobility and proprioception.
3) To restore muscle strength, power, endurance, and extensibility.
4) To maintain general fitness

The physician must set realistic goals for the patient, monitor the progress, provide feedback, and make necessary adjustments in the therapy program to maximize the patient's effort.[3] The surgical patient must be viewed as a "sum of the parts", meaning that surgery not only affects the physiology of that specific area, but also the patient's cardiovascular/respiratory fitness, the level of coordination and timing, overall muscular strength, power, and overall endurance and flexibility. Also the patient's self-image during the period of rehabilitation is a very important consideration. The rehabilitation can be as complex as the surgical procedure required to repair the injured limb or joint. Frequently, the surgeon does not take into consideration the final state of fitness of the individual.[3] Once the injured extremity has achieved an appropriate level of function, program goals should be adjusted to achieve a state of fitness equivalent to the pre-injured state.

The majority of patients undergoing foot or ankle surgery require some degree of immobilization. The effects of bed rest vary according to duration, the prior state of conditioning, and the degree of activity permitted during bed rest (i.e., isometric or isotonic exercises, bathroom privileges). Physiologic changes due to bed rest may occur within 3 days or less. Alterations in plasma volume, fluids and electrolytes, and venous compliance are all involved. With prolonged bed rest, the detrimental effects become more numerous and pronounced, possibly including losses in body weight, calcium, muscle strength, and maximum oxygen consumption. Maximum oxygen consumption is the best measure of aerobic fitness. Also, one must be concerned with the potential for development of constipation, atelectasis, orthostatic hypotension, and osteoporosis.

Even minimal activity such as sitting in a chair or performing mild isotonic or isometric exercise can reduce the adverse effects of bed rest.[4] Resumption of normal activities will eventually reverse most of the problems detailed above. Obviously, the less time a person is subjected to bed rest or reduced activity, the less time it takes to return to an appropriate fitness level. Individuals with a higher state of fitness, such as trained athletes, lose a greater percentage of their maximum oxygen consumption during periods of inactivity than the average sedentary individual. A rehabilitation program will be necessary for the more athletic individual to attain the same relative state of fitness.[5]

For more complex therapy programs it may be best to have the physician and therapist orient and evaluate the patient preoperatively to obtain baseline values for range of motion and strength. The patient may also be gait trained with crutches or a walker prior to surgery when it is easier to learn different gait patterns.

Preoperative muscle testing is best tested isokinetically. Isokinetics can be defined as a varied resistance against the extremity throughout the entire range of motion (hip, knee, or ankle). Cybex and the Orthotron were the first of many isokinetic exercise machines to measure strength in this manner.

The patient who is in good physical condition prior to surgery also has the advantage of a faster postoperative recovery. Therefore, if possible, a general conditioning

program should be performed prior to the surgery. However, alternatives may be sought in cases where degenerative joint changes are evident, or pain is present. For example, if a patient is to have a bunion procedure performed within a months time, a walking program can be started in conjunction with mild resistance exercises. However, if a ankle arthrodesis is to be performed for significant arthrosis, the patient may still be able to ride a stationary bike or benefit from a swimming program without exacerbating existing symptoms. Swimming allows for those patients who have difficulty ambulating to still attain a high level of fitness. The patient is also taught isometric exercises prior to surgery, so that disuse may be kept to a minimum if prolonged bed rest is required.[6] Following surgery, controlled exercise assists in the healing process by reducing edema and minimizing scar tissue.

Rehabilitation of the patient must be started as soon as possible. Disuse will result in atrophy, muscle contracture, inflexibility, and delays in healing due to circulatory impairment.[4]

In most instances of foot, ankle, and leg surgery a period of immobilization of the extremity is necessary. However, no matter what the period of inactivity the basic rehabilitation process is essentially the same. If the patient is to be at complete bed rest for a period of days, an isometric exercise program can be instituted. Isometrics refers to muscle contraction when the ends of the muscles are fixed. The activity is evidenced by an increase in tension without a change in length. This type of exercise (isometrics) not only develops power and strength, but also reconditions injured muscles. No special equipment is necessary to perform isometric exercises, making it ideal for bedridden patients and for patients with limited weight bearing. Isometric exercises do not involve joint motion, therefore they can be used for muscle groups that are enclosed in a cast and joints that are painful and swollen due to surgery.[7] Isometrics are of greater value when performed in several different periods, rather than once a day.

These exercises are good for the entire body. Cross education of body parts with the contralateral muscles performing the same contractions is very important in sustaining muscle tone and strength. While executing these exercises, one must maintain each position for 6 seconds and follow with 6 seconds of rest.[4] Each maneuver is repeated six to seven times. When completed, the patient flexes and extends the extremity if it is not immobilized.

Isometric exercises can be performed for any muscle group of the body, but specifically do well in the lower extremities.[8] All that is required is a stationary object, either the cast, the bed or wall, or any object that will not give to moderate pressure. All of these exercises can be performed in bed with minimal movement being involved. Once the patient is allowed out of bed more active exercises can be performed, such as isotonic, isokinetic, and stretching.

Whenever possible, range of motion exercises should be instituted soon after surgery. This mobility benefits the patient in the same ways as other exercises and also minimizes the tendency for joint fibrosis and limitation of motion. Range of motion exercise can be either passive or active. Passive motion is performed by the therapist or a machine without active muscular contraction. Passive range of motion is used to re-establish normal joint mobility.[9] In addition, healing of cartilage, tendons, and ligaments, is promoted. This has not been shown to interfere with the healing of incisional areas over the joint.[9] Passive range of motion is an important phase of the rehabilitation process. Indications for immediate postoperative ROM (Range of Motion) include the following:

1) Open reduction and internal fixation of intra-articular fractures involving the foot, ankle, and leg.
2) Open reduction and rigid internal fixation of diaphyseal fractures and metaphyseal fractures involving the foot, ankle and leg.
3) Capsulotomy and arthroplasties for posttraumatic arthritis with restriction of motion of the foot, ankle and leg.
4) Synovectomy for rheumatoid arthritis and hemophilic arthropathy.
5) Arthrotomy and drainage of acute septic arthritis.
6) Surgical release of extra articular contracture or adhesions.
7) Metaphyseal osteotomy with rigid internal fixation of the foot, ankle and leg.[6]

The use of immediate postoperative range of motion exercise has been known to reduce pain. It is proposed that the continuous generation of proprioceptive impulses from the joint may block the transmission of pain impulses.[10] Passive range of motion continues until a full range of motion is possible for the affected joint. Patients that must be immobilized due to periarticular soft tissue repair may undergo range of motion exercises with joints above or below the affected area. For example, if a closing base wedge osteotomy is performed on the first metatarsal, the cast should allow movement of the 1st metatarsophalangeal joint. This may be accomplished by extending the cast beyond the hallux plantarly, but not covering the hallux dorsally. Therefore, the cast provides support for the 1st ray, but allows adequate movement for pain control and joint function.[11]

Active range of motion exercises involve voluntary muscle contraction by the patient against gravity to increase muscle strength and function. Simple movements should be attempted initially, followed by more complex circular movements, and then finally "spelling". For complex movements of the ankle, have the patient sit on a table with the knee straight and only the ankle extended over the end of the table. Using the hallux, have them print in capital letters the entire alphabet, performing movements with the entire foot and ankle.[10] Theses exercises should be performed with the full extent of the joint. Resistive exercises to restore muscular strength, power, and endurance can then be performed. These exercises fall into three categories, isometric, isotonic, and isokinetic.

As previously discussed, isometric or static exercise implies that a muscle contracts without a change in its length. Isotonic exercise describes the type of contraction during which the muscle shortens as tension is developed. Two forms of isotonic exercise can be performed, concentric and eccentric. Concentric exercise is resistance with weight while the muscle is shortening. Eccentric exercise is resistance with weight while the muscle is lengthening. Strength (maximal amount of force with one attempt) can be increased significantly with eccentric contractions. While power (the amount of force generated per unit of time) and endurance (amount of force generated with repetitions till exhaustion is reached) can best be developed with concentric exercises. Strength, power, and endurance need to be achieved. Strengthening should be the first priority with concentrated deliberate full range of motion exercises with weight resistance.[7] This allows for a control of joint function without the danger of overloading the muscles and ligamentous tissues of the joint. Power is then achieved when the joint can fully accept force for a period of time throughout the range of motion without pain.[11] Endurance is the final step to be achieved in total reconditioning, and is attained with low resistance, yet with maximal amounts of contraction.

Isokinetic exercise is characterized by shortening of the muscle as tension develops through the range of motion, with the speed of motion being held constant by the internal mechanics of the equipment used. Any effort applied by the patient encounters an equal counter-force, or what is often termed "accommodating resistance". With isotonic exercise, a constant amount of weight is applied throughout the entire range of motion, yet with a varied amount of force and speed. Therefore, it is the author's opinion that isokinetic motion is a much safer means of rehabilitation where the resistance, speed, and the range of motion can be controlled without the fear of injury to the patient. Free weights and universal gym machines are both isotonic in nature, and can be very harmful to the patient if too much weight is used. However, Nautilus, Cybex, and Orotron rehabilitation machines are all isokinetic in nature and provide the patient with safety features not found in isotonic measures.

There is no specific time period in which one progresses from one stage of exercise to another. The only time constraints are the desires of the patient to return to normal preoperative function. Other modalities such as cryotherapy, moist heat, hydrotherapy, a stationary bike, pain control modalities (transcutaneous electrical stimulation), and ultrasound may be used to enhance the rehabilitation with the aid of a physical therapist.[11]

The final stage of rehabilitation consists of walking and running unassisted in a linear fashion, then with angular movements forward and backwards. This can be performed with the aid of a swimming pool. The water acts to break the force of impact on the involved foot or ankle, and also provides resistance, thus helping to regain strength, power, and endurance.

One must remember to be explicit in prescribing therapeutic exercises for patients:

1) State exactly how to perform the exercises.
2) Demonstrate the exercise to the patient.
3) State the exact amount of repetitions, sets (number of repetitions), and frequency.
4) Tell when to increase the repetitions or to adjust resistance weights.
5) Explain the muscles and the joints that are involved, therefore signifying the purpose of the exercise.
6) Give a specific test of the exercises to be performed.

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