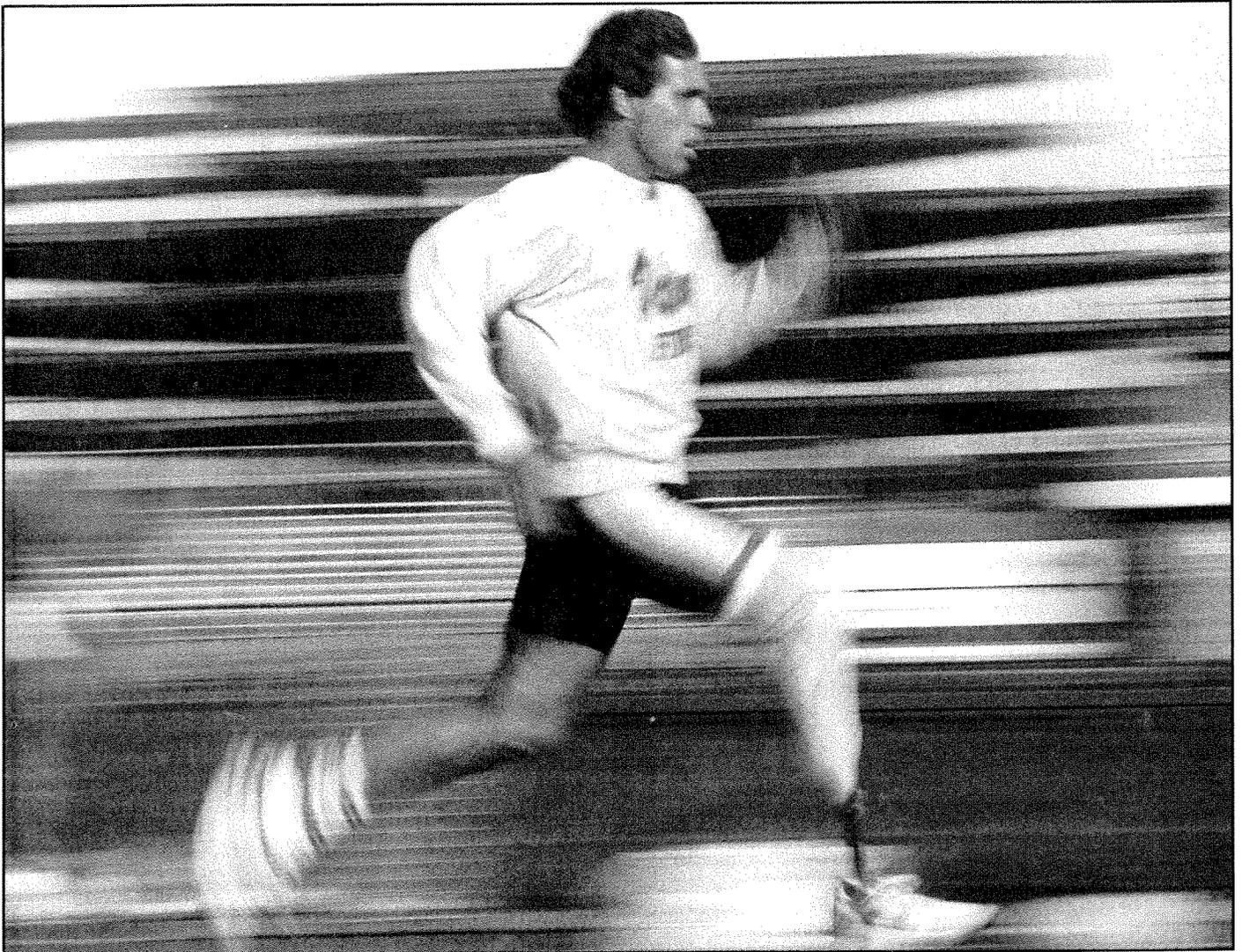


PART TWO

**CONDITIONING
EXERCISES**



NEWSDAY/J. CONRAD WILLIAMS, JR.

4

INTRODUCTION

The physical conditioning routines included in this book offer possibilities for individuals with lower limb amputation. We begin with calisthenics and stretches to improve flexibility and range of motion, followed by exercises to develop strength and muscular endurance in specific muscle groups for the arms, shoulders, legs, abdomen, chest, and back.

The conditioning exercises are performed with equipment such as Nautilus, available in most health clubs. An individual with a lower limb amputation can usually work the same muscle groups on the same equipment as can a nondisabled person, but not always in the same manner.

Special adaptations or modifications that will help to make these exercises safe and effective are noted in the corresponding descriptions. In many cases, the prosthesis alone provides the necessary support for the movements required. Exercises that will help strengthen the muscles of the residual limb are also indicated in the descriptions. Many of the exercises in Part Two are performed while the participant is seated; this allows the participant to concentrate on the exercises and weights without having to worry about maintaining balance while standing.

Variations for some of the exercises depend on the level of amputation. Range of motion and balance may not be the same for a person with an AK amputation as they are for someone with a BK amputation. Besides level of amputation, other variables include the surgical history, previous train-

ing, and type of prosthesis used. The prosthetist, therapist, and exercise instructor can help identify the best opportunities for exercise based on these variables.

The exercises illustrated in this book are performed by athletes who train on a regular basis. All are in excellent physical condition and demonstrate exercises that require a range of skill and practice. Beginners should not attempt to perform any of the exercises without first consulting a physician.

CAUTION

People with back injury should avoid lifting heavy weights in their exercise programs. To develop strength and endurance, they should do more repetitions with light weights rather than increasing the resistance.

Any exercise has the potential to cause injury to the back, whether or not one has had previous back injury. In particular, this would include sit-ups and other exercises involving hyperextension of the back, as noted in Chapter 10, Abdominals. Leg exercises requiring special caution, as noted in their descriptions, are squats and dead lift. Exercises that make the lower back vulnerable to injury are noted in Chapter 12, Back Exercises.

It is important that persons entering an aerobic exercise program obtain medical clearance prior to outlining the exercise regime. This precaution is repeatedly stressed throughout this text. Individuals

who have hypertension, for example, are particularly at risk in weight training as well as aerobic programs. Coronary artery insufficiency is another example of a risk factor in undertaking an aerobic exercise program. These risks apply for the nonamputee as well as the amputee. Medical clearance at all ages is absolutely necessary.

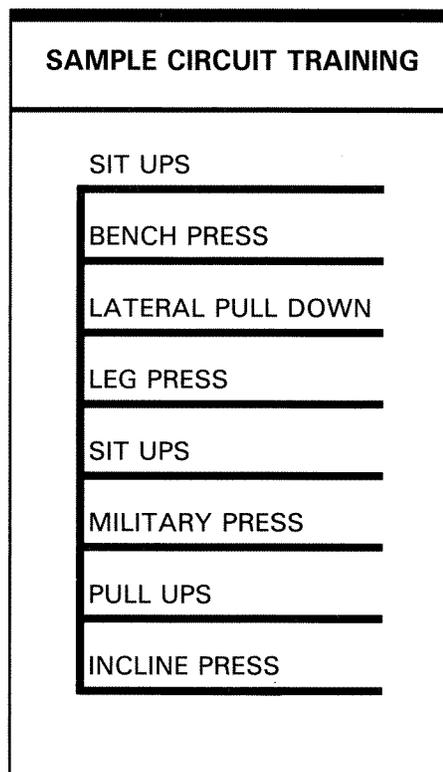
MONITORING THE INTENSITY OF AEROBIC EXERCISE

In order for exercise to promote optimum aerobic benefit, it must cause the heart to work at an accelerated rate and in a steady state for a period of time. Monitoring the heart rate during exercise is the best way to determine whether the routine is providing the desired aerobic benefits while ensuring that the heart is not being overworked. It is done by establishing a target heart rate and monitoring the beats per minute immediately after the conditioning exercise routine is completed. The goal is to maintain the target heart rate throughout the exercise period (warm-up and cool-down are not part of this period).

Establishing a Target Heart Rate Range

A target heart rate range for exercise can be predicted as follows: 1) a person's age in years is subtracted from 220 to give the maximum predicted heart rate (beats per minute); 2) the range is determined by figuring the percentage of the maximum rate that the person must work during exercise in order to achieve his/her target goal (70 to 85 percent is the range which is considered to be the most effective for receiving adequate aerobic benefits). For example, a 35-year-old person will have a maximum predicted heart rate of 185 (220 minus 35). If this person begins an exercise regimen with a goal of maintaining a 78 percent target heart rate, his/her target will be 144 heartbeats per minute (0.78 times 185).

Exercise at the targeted rate should last from 15 to 30 minutes. During this time the heart rate is monitored. Immediately after the routine is completed, the pulse should be taken to determine the heart rate. Most people take a 10-second, rather than a full minute, pulse count. The 10-second count is then multiplied by 6. Any irregularity in heart rate, including rapid variations, calls for



discontinuing the exercise immediately and consulting a physician.

A Target Heart Rate Range for Moderate Exercise

Certain individuals may not be able to exercise as strenuously as others. A 60 to 65 percent of maximum heart rate is a safe and still effective target range, especially for an older person. An even lower rate may be necessary for some individuals; therefore, when the intensity is lower, the exercise period should be extended from 30 to 50 minutes.

Indications of overuse include fatigue, poor sleeping patterns, and discomfort for extended periods of time following exercise. If it is difficult to reach a heart rate of at least 60 percent of maximum, a lower rate will give adequate aerobic benefits if the number of repetitions of each exercise is increased.

RELATIONSHIP OF MUSCULAR CONDITIONING TO HEALTH

Muscular conditioning is vital to overall fitness. Most body movements rely on the relationship between the muscular and skeletal systems. Weight training can reduce the resting heart rate and is effective for relieving stress. With the proper diet, body fat can also be reduced while muscle mass is being increased.

Exercising properly with weights is the most effective way to build strength and muscular endurance. Heavy weight resistance with a low number of repetitions builds strength, while light weight resistance with a high number of repetitions builds endurance.

Cardiovascular Benefits

Weight training is essentially anaerobic exercise. While it does not develop the cardiovascular system as well as running, swimming, or bicycling, weight-resistant exercise will develop strength and endurance in the muscles of the legs and upper body so that those muscles do not tire before the cardiovascular system can be improved.

If the intensity level of weight training is kept high, it can have a positive effect on the cardiovascular system. To do this, the exercises must be performed in such a manner as to maintain between 60-90 percent of maximum heart rate. One way to achieve this is to do each set of exercises in a con-

tinuous circuit, eliminating rest periods between each set. A high number of repetitions and light weights are usually recommended for this type of training.

A sample of circuit training follows:

The pulse should be checked periodically while exercising to confirm that it is in the target zone. In time, the exerciser will be able to tell by his or her breathing rate whether he/she is in the target zone and will only need to monitor pulse rate after completing the circuit. The weights used can be adjusted to help control the heart rate, but heavy weights should not be used for aerobic conditioning. Running or jumping rope for 30 seconds between sets is another option for maintaining circuit training.

Muscular Benefits

Whether or not one participates in sports and recreational activities, muscular conditioning is important for good physical fitness. Toning, strengthening, flexing, and stretching muscles through a regular program of progressive weight resistance exercises will aid in developing good posture, help prevent injury, increase endurance for daily tasks, create higher energy levels, improve circulation, and add to a person's total self-image. Muscular conditioning is also basic for successful participation in sports that require strength and endurance, and should always supplement aerobic training programs.

Conditioning through weights results in increased muscular strength and size (hypertrophy) that cannot be attained in any other way. Circulation through the muscles increases, and the number and density of capillaries within muscle fiber may also increase. Muscle enzyme levels rise along with blood volume and hemoglobin. Weight training strengthens bones, as well as ligaments and tendons that connect muscles to bones. Some physiologists contend that weight training aids in digestion and can improve elimination.

Applications to Physical Rehabilitation

Progressive resistive exercise (PRE) as a physical rehabilitation technique was the result of medical experiments performed by an orthopedist, Thomas L. DeLorme, MD, following World War II.* Mus-

* T.L. DeLorme, "Restoration of Muscle Power by Heavy Resistance Exercises," *Journal of Bone and Joint Surgery*, 4-B, 1945, pp. 645-667.

GUIDELINES FOR TRAINING WITH WEIGHTS

GENERAL DO'S AND DON'TS

Start with light weights and lift weights progressively. Never start with the heaviest set first: the muscles and tendons are not prepared for sudden exertion.

Do not continue lifting the weights to your maximum ability on the first set of repetitions.

Increase the size of the weights by 5 to 10 pounds after you are able to perform 10 repetitions per set with ease.

Always work the larger muscles of the body first. Small muscles are needed for lifting heavier weights but they become fatigued more quickly than larger muscles. For example, the smaller muscles of the arms often become fatigued before the large muscle groups of the chest or back can be effectively worked.

Learn and always use the correct form for lifting the weights.

FREQUENCY AND DURATION

Frequency and duration depend on personal goals. Maintain a minimum commitment of time in order to keep the body in good physical condition.

An exercise workout 3 times a week is usually needed to gain significant results. Workout sessions should last from 30 to 90 minutes with a rest day in between, which allows the exercised muscles to recover and grow stronger.

A schedule should be established and maintained. Nothing should interfere with your workout time. If you do miss a workout session, get back on schedule as soon as possible.

A competitive body builder or power lifter may train as many as 5 or 6 times a week. Even in this type of routine, each muscle group is usually given a day of rest between workouts.

INCREASING THE NUMBER OF REPETITIONS

The following are Nautilus recommended guidelines for increasing the number of repetitions when training with weights. (These guidelines will be repeated in the introduction of each chapter presenting weight-training exercises.)

Always do warm-up exercises before lifting weights.

Start with a minimum of 8 repetitions with a given weight. If a minimum of 8 repetitions cannot be completed, the weight is too heavy for you and the resistance should be lowered until 8 repetitions can be completed.

When 12 repetitions can be successfully completed, the weight should be increased by 5-10 pounds. When 12 repetitions can be completed with the increase in pounds, the weight may be increased again.

Work up to 15-20 repetitions per set for muscle maintenance, endurance, and tone.

When performing exercises with free weights, it is recommended that 2-6 sets for each particular muscle group be used.

CAUTION

Beginners are encouraged to have a spotter present when using free weights. Certain exercises will require a spotter regardless of skill level (e.g., squats).

GUIDELINES FOR TRAINING WITH WEIGHTS

LEVEL OF DIFFICULTY AND INTENSITY

A general level of difficulty is rated for each of the conditioning exercises in this book. You can vary the level of intensity by adjusting the amount of weight.

Do not lift to your maximum ability on the first few sets of repetitions. In this way you will not experience excess fatigue, which could keep you from finishing the workout.

Work at your own pace. Do not compare your own progress with the abilities of others. Always maintain proper form.

As you improve, you may add more exercises, increase the number of sets, add more weight, and shorten rest periods.

BREATHING

Do not hold your breath while lifting. This could stop the flow of oxygen to the brain, which might result in fainting. Holding your breath while lifting can also close off the escape of air through the glottis, causing a sudden increase in thoracic pressure. For this reason, many physicians do not recommend weight training for postcoronary patients.

Breathe in a rhythmic pattern. Some people find it best to exhale while lifting a weight or moving against resistance and inhale as the weight is lowered or resistance removed. Others find it better to reverse the breathing for certain kinds of exercises, such as those involving movements above the head or in chest expansion workouts.

PROGRESS

Keep a record of the number of sets and repetitions for each exercise in your workout in order to monitor your progress and increase the resistance of the weights in a regulated fashion.

If your goal is to gain or lose weight, gain muscle mass or lose bulk, you may wish to keep a record of your body weight and measurements on a regular basis for future comparison and a record of progress. Photos with front, back, and side views are also helpful.

cular conditioning through PRE is now used in pre- and postoperative care, chronic orthopedic conditions, asthmatic and cardiac conditions, postural problems, postpolio care, neurological conditions, motor coordination, and other postinjury therapy.

Training with weights not only helps one look and feel better, it can also improve self-image. For the disabled individual, increasing muscle size, strength, and endurance can help to restore self-confidence. Feeling strong results in feeling well and healthy. Muscular conditioning can help people with disabilities feel more positive about their bodies by emphasizing areas of the body which still have function and by working to rehabilitate weakened areas.

The results of regular muscular conditioning will be beneficial to the young or old, disabled or nondisabled. Whatever the goal, there is a program that can be tailored to the current physical condition of anyone in reasonably good health. A physician should be consulted before any type of program of muscular conditioning is undertaken.

Principles of Training

Physical fitness programs for rehabilitation, strength conditioning, body building, and toning have different routines. Guidelines are needed to safely and effectively begin any of these programs. In time, individuals usually discover what kind of routine and which exercises are best for their particular needs. An experienced trainer and a rehabilitation team should work with the person with lower limb amputation in designing such a program.

A basic training principle is that each muscle group should be worked every other day, not on consecutive days; thereby giving the muscles a chance to recover from the stresses of exercise. Exceptions to this are the calf and abdomen muscles, which may be exercised every day because they are used in daily activities.

A program should start with a light routine performed three times a week with a day of rest between each session. The program will usually consist of three sets of exercise for muscle groups of each part of the body, with 10 repetitions per set. Each body segment should be worked using one or two different exercises. In the beginning, there should be a 60-second rest period in order to let the muscles recover. Once a routine is established and successfully performed, one can increase the intensity of the workout by gradually reducing the rest

time to 30 seconds. For very heavy weight sets, longer rest periods are acceptable.

In the first week, only one set per muscle group should be performed in order that the movements of each exercise may be learned and the muscles allowed to adjust to the new stresses. Two sets may be performed during the second week and three sets during the third week. This routine should be continued for a total of 8 weeks. When the eighth week is completed, the program should be evaluated. If this routine is suitable, the exerciser may continue increasing the number of sets and weights each week. Intermediate and advanced conditioning programs require increasing weight repetitions and sets, as well as adding new exercises.

WARM-UP AND COOL-DOWN EXERCISE

Flexibility and range of motion are developed and maintained by calisthenics and stretching exercises before and after the strengthening routine.

A good warm-up prepares the muscles, ligaments, and tendons for action. It steps up blood circulation, raises the body temperature, and enhances flexibility of the joints. By limbering the muscles and joints, these exercises can prevent many injuries. Warming up before strenuous or active exercise is especially important in cold weather.

The warm-up should consist of some calisthenics, stretching exercises, and light resistance exercises. It should take from 10 to 20 minutes. Each body part should be moved through a full range of motion, first without resistance, then with light resistance. (Most experienced weightlifters use a light first set of their resistant exercises as a part of their warm-up.) Bicycling and running in place are also good forms of warming up for weight-resistant exercises.

Cooling down after completing the entire exercise routine is very important. It helps the body make the transition from high-intensity activity to a normal level. Stretching and low-grade calisthenics are best for the cool-down. Cool-down stretches can help prevent muscle soreness. A light jog or bike ride is also a useful means of cooling down. At least 10 to 20 minutes should be allowed for cool-down exercises.

Many weightlifters cool down individual body parts as they complete sets of exercises by doing 8 to 10 repetitions using a lighter weight than that used in the routine.

BASIC BEGINNING WORKOUT PROGRAM		
Warm-up Exercises; repeat for Cool-down Exercises		
Title	Chapter	Page
3-5 minutes: calisthenics		
Jumping Jacks	5	40
Neck Rolls	5	41
Trunk Twists	5	45
Supine Leg Raise	10	120
Push-ups	11	144-148
3-5 minutes: stretches		
Overhead Bent-Arm Stretch	6	53
Shoulder/Arm Stretch	6	54
Quadriceps Stretch	6	63-64
Hamstring Stretch	6	65
* Include any additional calisthenics or stretches you feel are appropriate.		
* 3-5 minutes of stationary bicycling (see Chapter 18) or jogging (see Chapter 15) also may be used for warm-up and cool-down exercises.		

BASIC BEGINNING WORKOUT PROGRAM				
<i>Resistance Exercises</i>				
Repetitions	Sets	Title	Chapter	Page
8-12 or 15-20	3	Nautilus Abdominal Chair	10	129
8-12 or 15-20	2-3	Single Knee Extension	9	93
8-12 or 15-20	2-3	Leg Curl	9	109
8-12 or 15-20	2-3	Push-ups	11	144-148
8-12 or 15-20	2-3	Nautilus Bench Press	11	152
8-12 or 15-20	3	Overhead Press	8	82
8-12 or 15-20	3	Nautilus Lat. Pull-down	12	169
8-12 or 15-20	3	Triceps Curl	7	71, 74
8-12 or 15-20	3	Seated Arm Curl	7	76

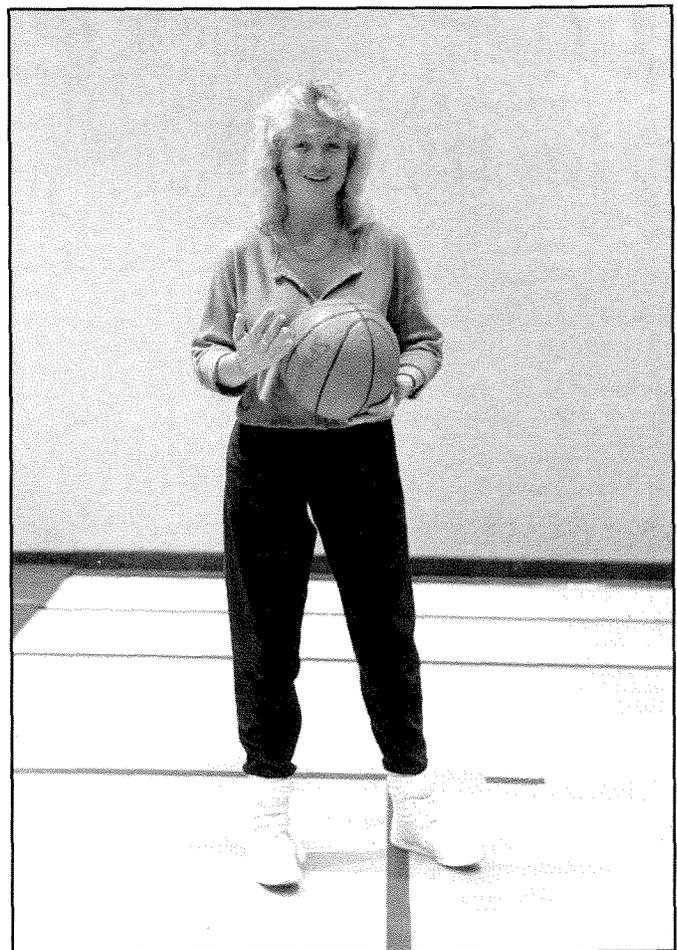
PROFILES OF THE EXERCISERS

Samantha Ellis

Samantha Ellis is an exceptional person. She is missing both limbs above the knee, but the ability to bear weight on the end of one of her residual limbs has given her an advantage in being able to develop her remarkable skills in physical activities.

The prostheses Ms. Ellis uses for most activities are Endolites with Contoured Adducted Trochanteric/Contained Alignment Method (CAT/CAM) Flexible Sockets made with a polyethylene inner socket and polypropylene outer frame socket. She also uses a Mauch Swing Phase Hydraulik™ Knee Unit for increased knee stability, along with the Endolite Stabilized StanceFlex Knee.

Ms. Ellis swims to stay in good physical condition and also plays golf. She discovered the benefits of health club equipment for strength conditioning and has taken up downhill skiing for recreation. Born and raised in England, Ms. Ellis now works part of the year in the United States at a.f.i. Endolite in Hialeah, Florida as a customer relations representative.

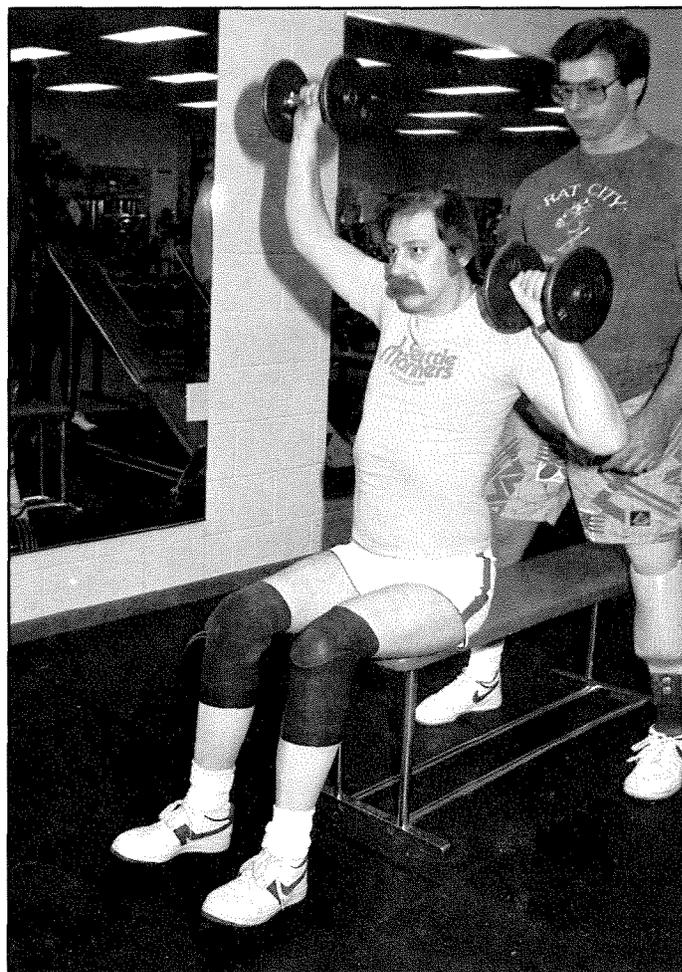


John Everett

John Everett is a Vietnam veteran who has bilateral below-knee amputations. He works out regularly with the same prostheses that he uses for his daily activities. He rides a stationary bicycle and walks for aerobic exercise. In the winter months, he enjoys downhill skiing. He feels that exercise enables him to be an active participant in recreational sports, as well as helping him to have more energy in his everyday routine.

His prostheses are exoskeletal in design with Seattle Feet, pelite liners, silicone end pads, New Skin cosmetic finishing, USMC's Adjustable Leak Rate Small Suction Socket Valves, and the ActivSleeve Suspension System. Although the ActivSleeve System produces a suction-type suspension, the addition of the small suction valve helps to purge any extra air from the socket (a 3-ply socket fit with a DAW Sheath underneath), which ensures true atmospheric suspension. When working out in the gym, Mr. Everett sometimes adds an extra ply sock and interchanges his pelite liner with the PM liner, which helps absorb the extra forces placed on his residual limbs.

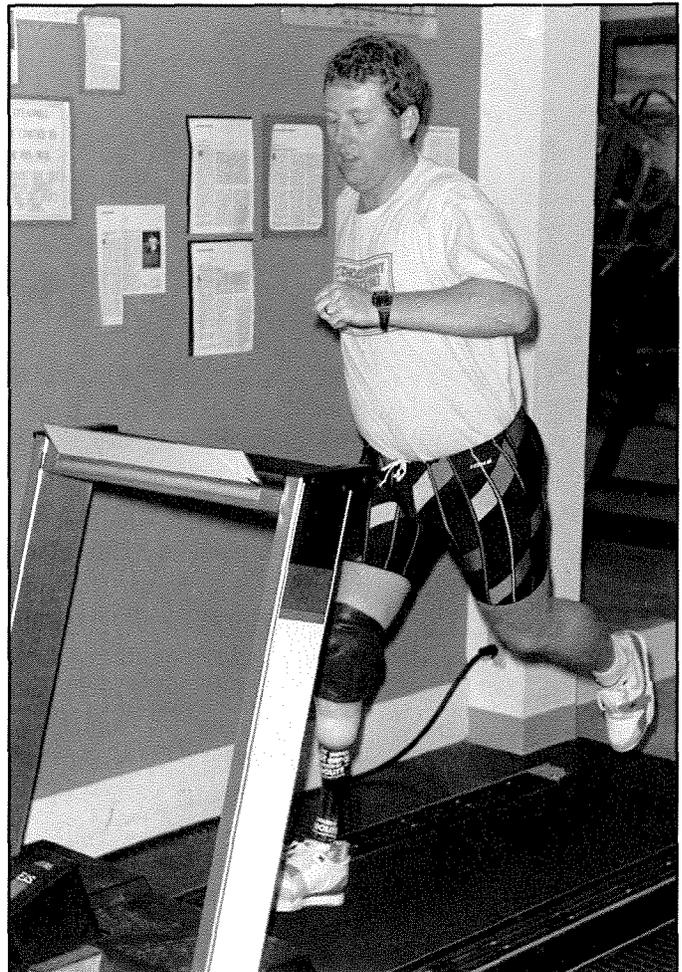
Mr. Everett counsels people with drug addictions, does peer counseling in amputee support groups at Harborview Hospital and other locations in the Seattle area, and is a volunteer at the Prosthetics Research Study, a firm in Seattle.



Richard Hughes

Richard Hughes has a below-knee amputation. He enjoys a variety of sports and stays in good physical condition by sculling in his own boat. He competes in triathalons, which requires him to maintain several types of prostheses for several sports activities. Mr. Hughes is chief of the Technical Marketing Department for a.f.i. Endolite in Hialeah, Florida. He has also worked as a clinical prosthetist.

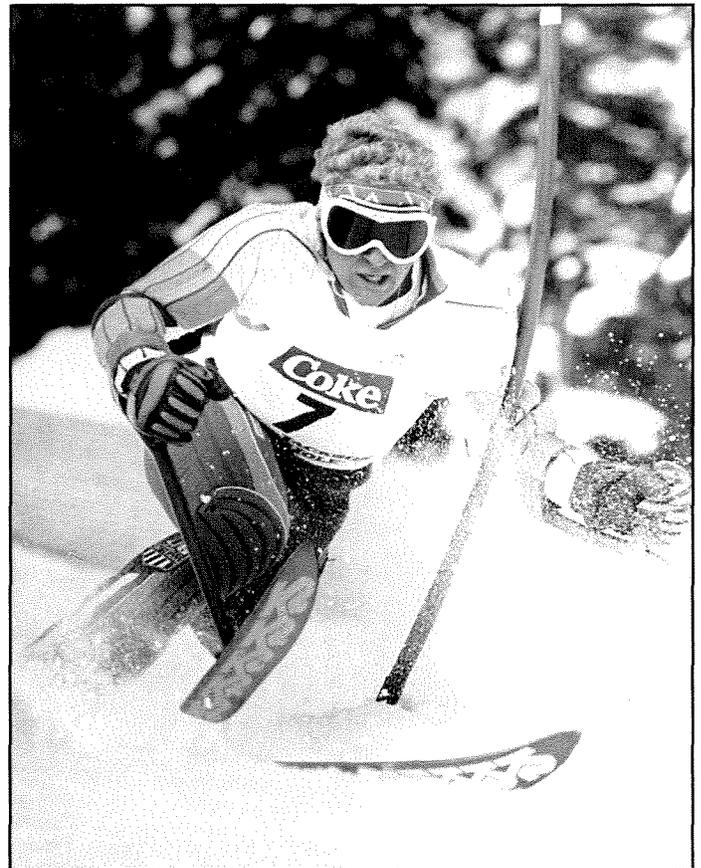
The artificial limb Mr. Hughes uses most frequently consists of a skin-fit suction below-knee prosthesis with a flexible wall polyethylene inner socket and a polypropylene outer frame socket, which is cut out over relief areas for increased comfort and lighter weight. An Endolite prosthesis is also incorporated into the design with an adapted Seattle Foot and the ActivSleeve Suspension System.



Greg Mannino

If Greg Mannino looks familiar to you it is because he is a highly visible professional amputee athlete. He trains year-round to maintain his ranking as one of the top downhill three-track skiers in the world. When he is not race training in Vail, Colorado, or traveling to a ski race, he is working on staying in good physical condition by lifting weights regularly. He also enjoys bicycling, running, cross-country skiing, and horseback riding.

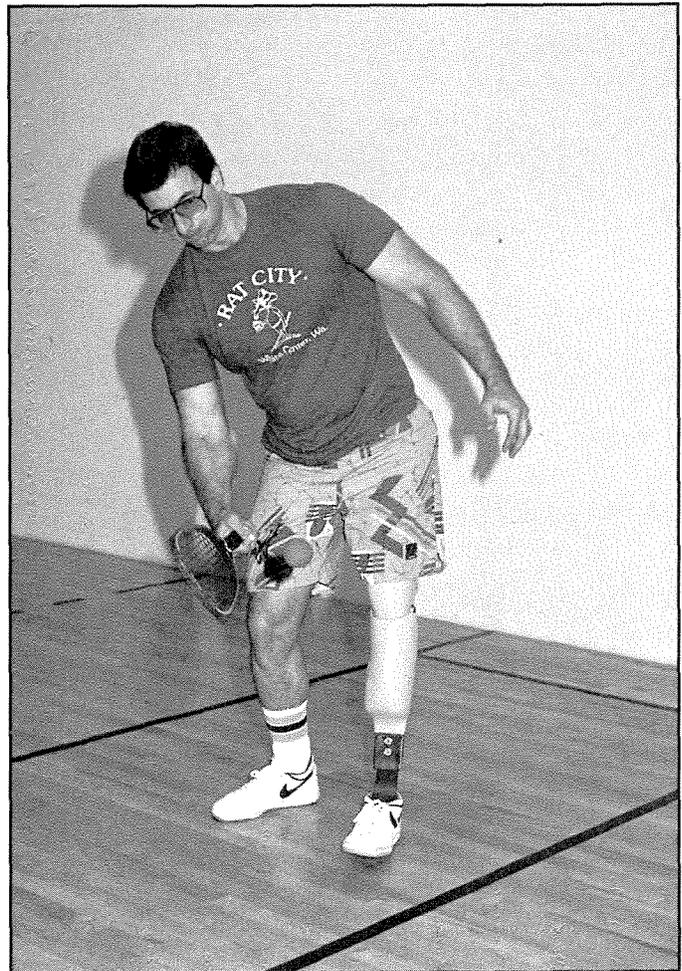
Mr. Mannino, who has an above-knee amputation, wears an Endolite prosthesis with the Stabilized StanceFlex (Bouncy) Knee, with the Mauch Swing Phase Hydraulik Knee Unit. He feels that the comfort of his CAT/CAM flexible walled socket has contributed to his ability to achieve a high level of performance.



Mike Nitz

Mike Nitz was a competitive power lifter before losing his leg above the knee. He has since returned to the gym and has designed a program that accommodates for his limb loss and prosthesis and still allows him to maintain a high level of intensity during workouts. The only exercises he has not continued are standing squats and the dead lift.

Mr. Nitz was back at work soon after receiving his first prosthesis. Because his job as a sanitation engineer is physically demanding, he feels it is not only important for him to stay in good physical condition but also to have a prosthesis that can perform adequately. He uses a Narrow ML Flexible Brim Socket with a Mauch Swing and Stance Phase Knee Control Unit (Mauch SNS Knee Unit) and the Flex-Foot.

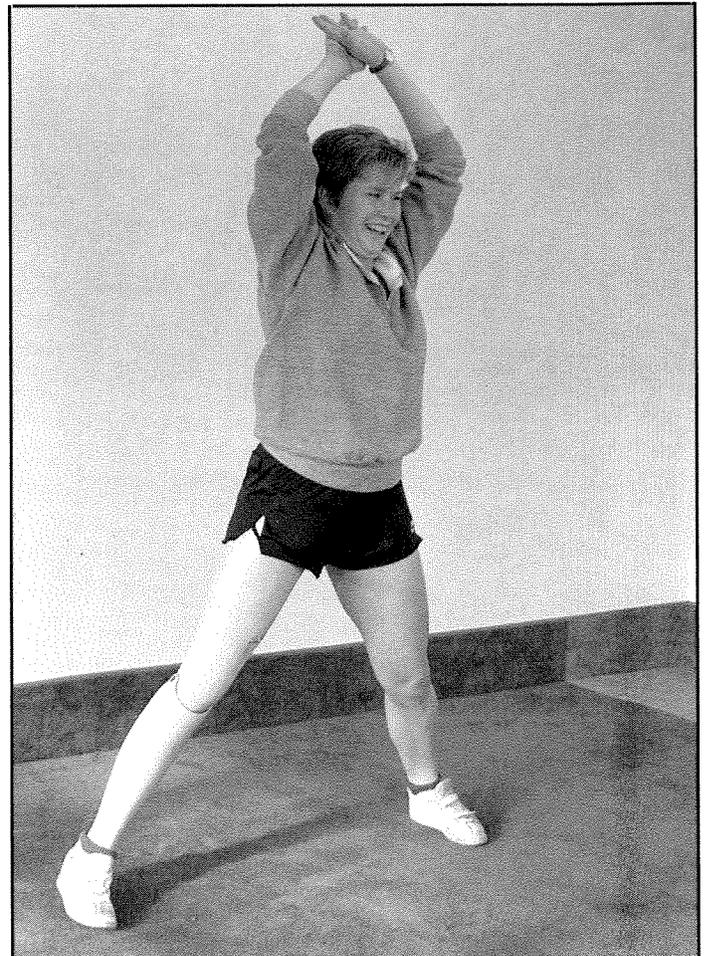


Linda Pedersen

Linda Pedersen works out on Nautilus equipment at least three times a week. She enjoys snow skiing in the winter and has competed in regional ski races sponsored by the National Handicapped Sports and Recreation Association (NHSRA). She plays tennis, water skis, and has played several seasons of crutch soccer as co-captain of a Seattle, Washington team. A former track star in high school prior to losing her leg above the knee, Ms. Pedersen is an excellent foot-over-foot runner.

She uses an everyday walking prosthesis for most of her activities. It consists of a quadrilateral suction socket, Mauch SNS Knee Unit, and Otto Bock SACH Foot. This exoskeletal prosthesis is simple in design and requires very little maintenance. For running, she often wears the Terry Fox Spring Shank and the Seattle Foot.

Ms. Pedersen is an administrative assistant in the Property Department of the Johnson and Higgins Insurance Brokerage firm in Seattle and does volunteer work at the Seattle Prosthetic Research Study.



Albert Rappoport

Albert Rappoport, one of the authors of this book, had been athletic prior to losing his leg below the knee and has worked to regain his abilities. He enjoys weight training, swimming, and skiing for fitness and plays tennis and racquetball.

Mr. Rappoport wears primarily one prosthesis for his everyday activities, as well as for the weightlifting exercises shown in this book. The below-knee exoskeletal prosthesis uses a pelite liner, silicone end pad, wool sock and sheath, ActivSleeve Suspension System, and Seattle Light Foot. Mr. Rappoport also wears a Flex-Foot prosthesis fabricated with a graphite epoxy socket for activities that involve running. The socket is a duplicate of that used with his regular prosthesis and utilizes the same liner. Stationary rowing photos show him using an endoskeletal prosthesis with Otto Bock components, ActivAnkle, and the Carbon Copy II Symes Foot.

Mr. Rappoport is a prosthetist in private practice and director of the Performance Prosthetic-Orthotic Center, Santa Monica, California. Previously, he was chief research prosthetist at the Prosthetics Research Study, Seattle, Washington. He also has worked as a Nautilus instructor and has taught courses in physical conditioning at the University of Southern California.

