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**AN APPROACH FOR THE PHYSICAL  
THERAPY MANAGEMENT OF THE  
INDIVIDUAL WITH C6 QUADRIPLÉGIA**



by

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## I. INTRODUCTION

The information presented in this paper is an overview of an approach to the physical therapy management of a patient with complete C6 motor level quadriplegia. The ideas and techniques discussed have been learned over a five year period from the staff and patients at two major spinal cord injury centers: Craig Rehabilitation Hospital in Englewood, Colorado and The Institute for Rehabilitation and Research (TIRR) in Houston, Texas.

The program described is based on the characteristics of a "typical" patient with a spinal cord injury which results in paralysis of motor functions below the C6 spinal segment during his first admission at The Institute for Rehabilitation and Research. The ideas and techniques presented can be applied in various settings dealing with spinal cord injured patients. General progressions in the areas of functional training, psychosocial support and discharge planning are discussed. General treatment goals are suggested and specific techniques for performing various functional tasks are stated. The emphasis of this approach is on the patient's learning of functional movement patterns, problem-solving skills and providing opportunities for the patient to demonstrate self-responsibility that he should be able to apply in his home environment. Experiential learning is the major technique. The program is progressed gradually by the physical therapist at a pace suited to the patient.

## II. PHILOSOPHY

The result of a severe spinal cord injury in man is an extensive loss of motor, sensory, and autonomic functions. But, he\* has potential for regaining sufficient independence to function effectively within his environment. To do that, the individual must adapt to those radical changes in his body. Time and emotional support are needed while he acquires knowledge about his altered status, regains a positive self-image, accepts responsibility for himself, and develops skill in activities that promote independence. A person with a spinal cord injury has the capacity to learn new skills and behaviors. The health professionals specializing in rehabilitation have developed some of the knowledge, techniques, and specialized equipment needed to enhance the individual's progression from dependency to independence. Together, the patient and the rehabilitation expert can tailor a therapeutic program designed to achieve a level of independence consistent with his life situation.

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\* A point of clarification: throughout the discussion which follows, the masculine pronouns he and him will be used when referring to the patient or the therapist. That simplifies writing and should be understood to include female patients and physical therapists when appropriate.

### III. GOALS OF A PHYSICAL THERAPY PROGRAM FOR A PATIENT WITH C6 MOTOR LEVEL SPINAL CORD INJURY

Below are specific physical therapy goals for the first admission to TIRR for a "typical" patient whose spinal cord injury has spared the sixth cervical segment and segments above. Various factors may limit the patient's achievement of goals in different areas. For example, some limitations to meeting functional goals could be spasticity, limitation of joint motion, or chronic fatigue. Limitations to meeting the psychological goals could be pre-existing emotional or social difficulties. The patient's ability to integrate information from the knowledge base provided to him could be impaired due to learning disability, poor memory, or a high anxiety level. These goals are intended to provide guidelines for planning a treatment program. Each physical therapist must modify them to meet the individual needs of the patient in the context of the home environment.

#### A. PHYSICAL GOALS

1. GENERAL (to be achieved by the patient by the end of the first admission)
  - a. *Upper extremity strength, with emphasis on shoulder girdle depression, elbow flexion, and wrist extension*
  - b. *Pain-free, mobile upper extremities and neck*
  - c. *"Functional" long-sitting range (approximately 60 degrees of trunk forward flexion; see Fig. 1)*
  - d. *Balance and coordination*
  - e. *Awareness of body and movement sense*
  - f. *Ability to analyze and solve practical problems of movement and mobility*
2. FUNCTIONAL (to be achieved by the patient by the end of the first or second admission to TIRR)
  - a. *Independent or minimally assisted transfers from the wheelchair to bed and car*
  - b. *Moderately assisted transfers from the wheelchair to a bathbench and commode seat*
  - c. *Dependent transfers to and from sofa, floor and bathtub*
  - d. *Independent wheelchair skills which include self-positioning, weight shifts; wheelchair propulsion over long distances with quad pegs and brake extensions*
  - e. *Dependent wheelchair skills which include placement of wheelchair cushion; negotiation of curbs, stairs, and very rough terrain*
  - f. *Minimally assisted bed mobility with equipment: supine to sitting, rolling and scooting*
  - g. *Spontaneous gesturing in the wheelchair*

#### B. PSYCHOLOGICAL GOALS

**To enhance positive attitudes of the patient with respect to:**

1. The ability to problem-solve (e.g., planning for home modifications, equipment, attendants, daily activities)
2. Self-image
3. General adjustment to injury
4. Self-determination in a situation of physical dependence (physical dependence need not mean psycho-social dependence)

### **C. PATIENT KNOWLEDGE**

**To increase the patient's knowledge and participation in the following areas:**

1. **SKIN CARE**  
Awareness of the importance of timely weight-shifts, and of protecting the skin from noxious agents
2. **RESPIRATORY CARE**  
The ability to instruct others in assisting him to cough
3. **PHYSICAL THERAPY PROGRAM RATIONALES**  
Knowledge of the importance of various treatment procedures and how they relate to the overall rehabilitation process
4. **HOME EXERCISE PROGRAM**  
The ability to instruct others in his program of strengthening exercises and range of motion
5. **FUNCTIONAL SKILLS**  
The ability to instruct others in all of his positioning, transfers and assisted wheelchair activities
6. **EQUIPMENT**  
Knowledge of the use of equipment the patient possesses and knowledge of available brands and vendors for equipment the patient requires
7. **HOME MODIFICATIONS**  
The ability to identify various possibilities for increasing home accessibility; familiarity with information on home modifications
8. **COMMUNITY RESOURCES**  
Knowledge of community resources available after discharge from the rehabilitation center and the ability to utilize those resources (e.g., New Options, Coalition for Barrier Free Living); the awareness of possibilities available in travel, education/vocation, attendant care and choice of lifestyle

### **D. TRAINING OTHERS TO ASSIST WITH CARE**

**To prepare those who will be working with the patient to assist effectively and efficiently in his care, including:**

1. **SKILLS**  
The ability to perform any activities or exercises requiring assistance, following the patient's verbal cues and using good body mechanics
2. **KNOWLEDGE**  
The ability to understand concepts taught to the patient, as well as to understand necessary specifics in the areas of equipment, home modifications and the home exercise program
3. **AWARENESS**  
An understanding of the patient's need for self-responsibility and the need for opportunities that require him to perform partially or completely any functional activities of which he is capable
4. **PRIORITIES**  
The ability to differentiate the essential from the desirable activities in organizing a home routine that will maintain the health, strength, safety and psychological well-being of the patient and those assisting him

#### IV. THE PRINCIPLES OF FUNCTION FOR THE PATIENT WITH C6 QUADRIPLÉGIA

The movement patterns necessary to maximize mobility for a patient with C6 quadriplegia are different from the movement patterns he used as an able-bodied person. Paralysis decreases the quantity and quality of movements available to him. To maximize the remaining movements he must utilize various principles of biomechanics which emphasize the body as a system of mechanical levers. Successful application of those principles can greatly expand his movement repertoire and his function.

##### A. VOLUNTARY MOVEMENTS PRESERVED

An individual with damage to a particular spinal segment loses the voluntary function of muscle fibers innervated by neurons originating in that segment as well as those below the segment. However, many muscles receive innervation from two or more adjacent spinal segments, so some functional innervation may remain in muscles supplied by segments near the area of damage. In classifying the level of a spinal cord injury, the anatomical region and number of the lowest normally functioning nerve root segment are specified. Thus, a patient with C6 quadriplegia has neurons entering and leaving the sixth cervical segment capable of transmitting information between the pertinent muscles and the brain, but the nerve roots of the seventh cervical segment and below are separated from the brain by the injury. Spinal cord injuries vary in severity. An injury in which all motor and sensory pathways are blocked at the area of damage is called "complete". This is the type of injury discussed in this paper. An injury that has some preserved pathways, either sensory or motor, is called an "incomplete" or "partial" spinal cord injury. Incomplete injuries can differ greatly in their amount of residual impairment.

The movements listed below are present in patients with a C6 level of motor function. The strength exhibited in this musculature during the first admission at a rehabilitation center is usually within the Fair plus to Good plus range (grading scale used in manual muscle testing).

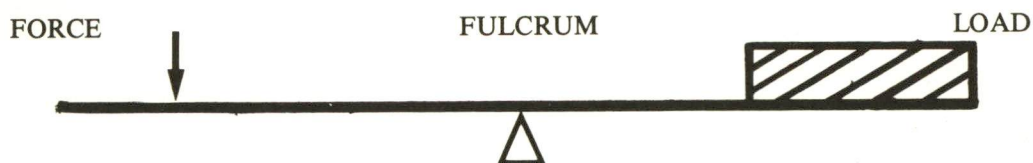
1. **SHOULDER GIRDLE STABILIZATION**  
Each muscle having an attachment to the scapula assists in this activity during some movements.
2. **SHOULDER GIRDLE DEPRESSION**  
The major muscles assisting in this action are trapezius lower fibers (C3-4), latissimus dorsi (C6-8), pectoralis major middle fibers (C5-T1).
3. **SHOULDER FLEXION AND EXTENSION**  
Major muscles: deltoid (C5-6), biceps (C5-6), latissimus dorsi (C6-8), subscapularis (C5-6), teres major (C5-6).
4. **SHOULDER ADDUCTION AND ABDUCTION**  
Major muscles: pectoralis major, deltoid, supraspinatus (C5-6), latissimus dorsi, teres major.
5. **SHOULDER ROTATION**  
Major muscles: infraspinatus (C5-6), subscapularis (C5-6), pectoralis major, latissimus dorsi, deltoid, teres minor (C5-6).
6. **ELBOW FLEXION**  
Major muscles: biceps, brachialis (C5-6), brachioradialis (C5-6)
7. **FOREARM SUPINATION AND PRONATION**  
Major muscles: supinator (C5-6), pronator teres (C6-7)
8. **WRIST EXTENSION**  
Major muscles: extensor carpi radialis (C6-7)

## B. KEY BIOMECHANICAL FACTORS TO BE UTILIZED

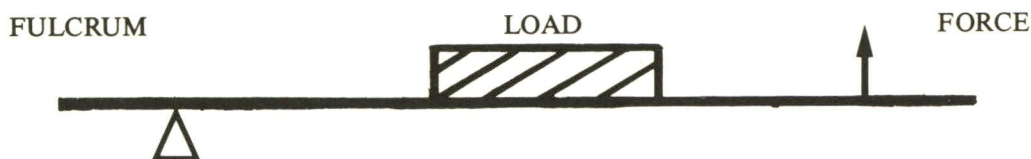
### 1. LEVERAGE

To maximize the effect of the force available from the motor units which can be activated voluntarily, the use of levers is necessary. Levers are divided into three categories in which:

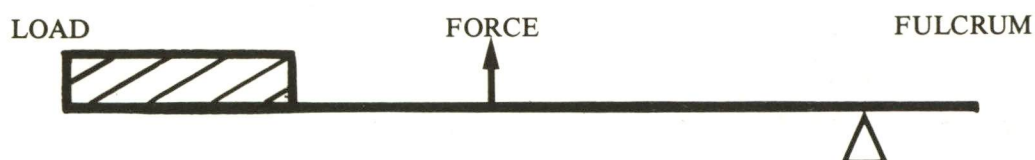
- a. *the force is separated from the load by the fulcrum:*



- b. *the force is separated from the fulcrum by the load:*



- c. *the load is separated from the fulcrum by the force:*



The fulcrum is a stationary point around which the movement takes place. The load is the weight to be moved, e.g., an arm, leg, or body. The force is the muscle contraction used to accomplish the task. In each of the lever systems, a given load can be moved with less force if the distance between the load and the fulcrum can be shortened or if the distance between the force and the fulcrum can be lengthened.

An example of lever utilization: to lift the left thigh while sitting in the wheelchair, the patient may hook his left arm around the left push-handle and secure his right hand under his left thigh. Using this method to lift the thigh into the air requires considerable effort. The fulcrum is at the shoulder, the elbow flexors provide the force and the load is the weight of the leg. To improve the mechanical advantage of the lever system, the patient can rest his right elbow on his right knee. This changes the fulcrum to the elbow, thus shortening the distance between the weight and the fulcrum. This arrangement now requires less muscle force to accomplish the same task.

### 2. FORCE VECTORS

To maximize the effect of the available force, the direction of the component vectors is important. For example, for a patient to learn to scoot sideways in a long-sitting position, appropriate trunk and hand positioning are needed. The patient must position himself so that the line of force has a greater horizontal component than vertical component. If the vertical component is too great, as will occur when the person is sitting up too straight, he will push down into the mat but initiate no resultant sideways movement (Fig. 1). With correct hand placement as illustrated in Fig. 2, the combination of forces produced by contraction of the innervated musculature and the momentum of a swing of the head can develop sufficient kinetic energy to move the body sideways a few centimeters on a smooth surface.

### 3. MOMENTUM

Another technique for maximizing the available force is the utilization of momentum. The increased momentum gained by swinging movements of the head, shoulders, and/or arms assists the patient in functional activities. Using this momentum, he can accomplish tasks not otherwise possible for him such as positioning his hands behind him while long-sitting, and increasing the force needed for scooting, rolling or trunk movement. These actions may appear insignificant by themselves, but they play a very important role in increasing the number of functional activities that may be accomplished independently.

### 4. TIMING

Frequently, in movement patterns useful to quadriplegic patients, two movement skills must be performed simultaneously to achieve the maximum force desired. For example, to move the buttocks forward on a mat, the downward push of the hands must be simultaneous with the upswing of the head. To lift a leg onto a bed using a footstrap, both arms must flex simultaneously with the upswing of the head, thus three movements must be properly synchronized. Without this form of coordination, the patient will lose movement force otherwise available to him.

### 5. REVERSE ACTION OF MUSCLE PULL

The patient can expand his movement possibilities by utilizing the reverse pulling action of his muscle, i.e., stabilizing the distal point of muscle attachment, and moving the proximal point of muscle attachment. This technique can partially substitute for motions now limited by paralyzed musculature. For example, by anchoring his wrists in the wheelchair armrests (with the elbows flexed, forearms pronated, wrists extended) and pulling with his elbow flexors, the patient can pull his trunk towards his hands (See Fig. 3); by stabilizing his hands near his hips in a long-sitting position, he can lift his buttocks off the mat by depressing his shoulders (with the shoulders externally rotated, elbows extended, forearms supinated, and the fingers pointing away from the feet: "basic shoulder depression position") (See Fig. 4); by stabilizing his hands under his thighs in a long-sitting position with the elbows flexed, forearms pronated, wrists extended, he can pull his head down toward his legs, thus stretching his hamstrings and back.

Since the movement patterns available for a patient with quadriplegia are so different from those used by the individual before the injury, he requires much practice to develop the experiential base necessary to change his "movement lifestyle". A method for providing this experience is to relate all movement activities to function. This not only illustrates the biomechanical principles, but also orients the patient to the skills he will need following discharge from the rehabilitation center. Repeated practice, involving expenditure of considerable amounts of time and energy, is usually required to change these movement patterns from a deliberate step-by-step process to a smoothly integrated sequence performed automatically and efficiently. Success for the patient depends on the ability of both the patient and the therapist to view functional activities as sequences of components, to master each sequence through repetition and to re-integrate them into functional skills.

### C. BASIC "QUAD MOVEMENT PATTERNS" EMPHASIZED

**Below are listed the movement patterns that form the foundation of functional movements for a person with C6 quadriplegia. These utilize the biomechanical factors stated previously.**

1. Use of head/shoulder swing and arm swing (for momentum)
2. Use of shoulder girdle depression with locked elbows or with the elbows on the wheelchair armrests (for relieving pressure from the buttocks or for moving the buttocks) as illustrated in Fig. 4
3. Use of arms in an unloaded position (to assist in maintaining balance) as illustrated in Fig. 5
4. Use of elbow flexors with the hand anchored (to pull the trunk toward the hand)
5. Use of the arm hooked around the ipsilateral push-handle (to maintain balance in the wheelchair or to return to a vertical sitting position from side-leaning or forward-leaning) as illustrated in Fig. 6

6. Use of shoulder internal and external rotation for moving the arms in any desired direction
7. Use of hand position with fingers pointing away from the feet while supporting the trunk with the arms, to maintain elbow extension without the triceps as illustrated in Fig. 7

Emphasis on "quad movement patterns" can be integrated into the physical therapy program from initial contact with the patient. No specific level of strength or range of motion is necessary to initiate this approach. If limiting factors are present, the exercise activity can be modified to accommodate patient need. Consider the following examples:

- a. *If a patient's wrists are too painful for shoulder depression on extended elbows, various other positions can be used to strengthen shoulder depression:*
  - long-sitting on the mat, with elbows flexed to 90 degrees as illustrated in Fig. 8
  - supine, pushing parallel to the mat into the physical therapist's hands
  - sitting, leaning sideways on the elbow as illustrated in Fig. 9
  - long-sitting on the mat with the patient's hands positioned in pronation with sand bags under the palms and the physical therapist supporting the elbows (elbows buckle easily when the forearms are pronated)
- b. *If a patient's hands are too sensitive for propelling his wheelchair with quad pegs, the physical therapist can apply palm mits ("wheelie mitts"), or continue with short periods of wheelchair propulsion interspersed with other activities.*

Persons with quadriplegia often have many factors limiting their physical therapy program during the course of their admission. If the physical therapist waits for each of them to be resolved before beginning a program with full functional emphasis, the patient will not have the opportunity to develop the experience base he needs to maximize his potential for function. However, in pursuing the program in the face of limitations, activities must be kept within the patient's mental and physical tolerance.

#### **D. KEY LIMITING FACTORS**

**The persistence of one or more of the following factors can interfere with the achievement of an expected level of functional independence:**

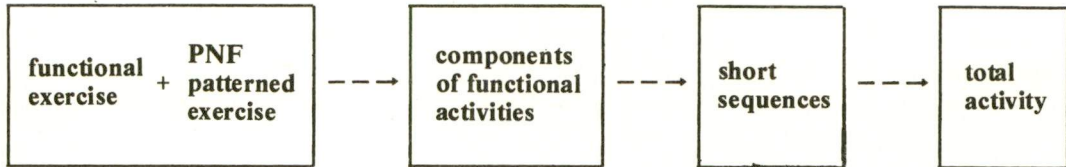
1. **BODY BUILD**  
For example, short arms, hypermobile hips, large buttocks, long torso
2. **LIMITATION OF MOTION**  
For example, limitations of elbow extension, hip flexion
3. **PAIN**
4. **POOR SENSE OF MOVEMENT**  
This is often a function of a patient's pre-injury life-style. For instance, athletes frequently learn movement patterns more quickly than those with a sedentary life-style.
5. **WEAKNESS**
6. **FEAR**
7. **POOR MOTIVATION**
8. **SPASTICITY**
9. **POOR ENDURANCE**

Several of these factors may be resolved and, if so, the patient may progress to a higher functional level during subsequent admissions.

#### **E. PROGRESSION RATE**

The progression of working on functional skills is tailored to the patient's tolerance. In the beginning, that depends on such factors as the patient's medical and surgical status, psychological and physiological adjustment, pain and endurance. At this point the progression

is slow to allow the patient time for adjustment to his environment and to his injury. Gradually, additional information, responsibility and activities are added to the program as the patient accommodates to new levels of stress. The body and the mind may accommodate at different rates. Therefore, the patient's response must be watched closely at both levels, and the program tailored accordingly. The following diagram clarifies the teaching progression used in a physical therapy program for a C6 quadriplegic patient:



Each of the above steps will be discussed in the following sections: "Progression of Skills on the Mat" and "Progression of Wheelchair Skills."

### 1. PROGRESSION OF SKILLS ON THE MAT

The exercises described below can be performed on a mat. They are the foundation of this physical therapy approach, and are usually continued to some degree throughout the first admission. They combine strengthening with experiential learning of necessary movement patterns. These "functional exercises" can be modified or expanded by the physical therapist, according to his creativity, and the needs of the patient.

#### a. *Functional Exercise in the Long-Sitting Position*

- 1) Shoulder Depressions – The patient leans forward in the "basic shoulder depression position" (See Fig. 4). The downward force comes from the shoulder. The physical therapist will need to assist with arm and trunk positioning in the beginning. He may also lift the patient's buttocks slightly with each push, as illustrated in Fig. 4, so the patient can get the "feel" of the desired motion.
- 2) Elbow Flexion – The patient leans back, with his arms "propping" his trunk up. The arms are positioned slightly behind the hips, with arms externally rotated, forearms supinated and elbows extended. Persons with short arms may be leaning back quite far. The patient flexes his elbows slightly, and pushes downward from the shoulders to return to the extended position. Since excessive flexion will cause the elbows to buckle when a load is placed on them, the physical therapist will need to assist with arm positioning, and support the patient at the elbows. This exercise can be done bilaterally and unilaterally.
- 3) Arm Catches – The first half of this activity is the "fall" backward. The patient begins in a forward-leaning position, over his legs. He then leans his head and shoulders back, throws his arms backward (using shoulder extension, abduction, and external rotation), attempting to catch himself with elbows extended. Since this usually requires moderate assistance in the beginning, the initial benefits of the exercise are in helping the patient to deal with the fear of falling, and in showing him that he can learn to "catch" himself in controlled situations.

The second half of this activity is returning to the initial forward-leaning position. This can be accomplished if the patient ducks his head forward and scoots his hands forward simultaneously, step by step, towards his hips. He then swings his arms and head forward, using the momentum to carry his entire trunk forward to the starting position over his legs.

- 4) Side-leaning Elbow Push-ups – This is another shoulder depression exercise. The patient begins by leaning to the side, bearing his weight on his forearm as shown in Fig. 9. He pushes his weight up by using shoulder depression, and then returns to a relaxed position, leaning on the forearm.
- 5) Elbow-to-Elbow – The patient begins in a forward-leaning position, over his legs. He positions his right forearm under his right thigh and eases over to bear weight on his left forearm while contracting the right biceps to slow his movement. He then balances in that position for a few moments. Next, he pulls harder with the right biceps and swings his head to the right to bring himself back to the initial position. There he pulls his right forearm out from under his thigh, and positions the left forearm under the left thigh and eases down to the side onto his right forearm. The physical therapist may need to assist with all stages of this exercise, especially with holding the patient's forearm under his thigh.

- 6) Forward Pulls – The patient begins in a forward-leaning position, over his legs. He positions both hands under his thighs, using his wrist extensors to maintain his hold. He then pulls himself forward by flexing his elbows, to stretch his hamstrings and back. If a patient is hypermobile at the hips, this exercise is not desirable. Fig. 4 illustrates the optimal long-sitting forward flexion position. The physical therapist may need to assist with maintaining the patient's hand position.
- 7) Balancing – The patient can learn to position himself, sitting in a position balanced between tipping backwards and tipping forwards (Fig. 5), by using slight movements of his arms and head. This activity will require much practice. The concept of balancing is similar to that of riding a bicycle. This dynamic balancing position will be different from the position in which the patient rests when he is leaning forward in a "functional long-sitting position" (Fig. 4). Once the patient can balance in this position, slow arm and/or trunk movements can be superimposed upon it.
- 8) Active Arm Exercises – While the patient is maintained in an upright position by the physical therapist or a back support, he can move his arms in any pattern or direction. Even if the patient has the strength to do all resistive exercises, this mobility exercise encourages ease and spontaneity in arm movement (Fig. 10).

#### *b. Functional Exercises in the Supine Position*

- 1) Biceps Pull-ups – In this exercise the physical therapist holds the patient's wrists securely, with his arms in the air, elbows slightly flexed and forearms supinated. The patient pulls himself off the mat as far as possible, and slowly lowers himself back down. The physical therapist must take care to stabilize his own arms on his knees as shown in Fig. 11, to avoid back strain. If a patient's biceps are too weak for him to pull to sitting from a supine position, the physical therapist may have him do small pull-ups in the same position or bring him to a partially reclined position and have him pull to vertical sitting (Fig. 12).
- 2) Active Arm Exercise – The patient can move his arms in any pattern or direction. An important motion to practice is moving the arms from a fully flexed position at the elbow to an extended position, using arm swing and shoulder internal rotation. The patient should also practice swinging the arms overhead using abduction and flexion, without allowing his hands to hit his head.
- 3) Rolling – The patient can attempt rolling with the physical therapist's assistance. The patient can provide much of the necessary momentum with forceful swinging of the arms and head. Again, he must learn to swing his arms low so he won't hit himself in the face. The patient should do two preliminary arm-swings before swinging to roll, following the physical therapist's verbal cues: "One--two--three and roll". The physical therapist assists rolling by flexing and adducting the hip and knee on the side opposite the rolling direction (Fig. 13). This still allows the patient to get the "feel" of rolling without excessive frustration.
- 4) Supine Elbow Push-ups – The physical therapist will need to position the patient in a weight-bearing position on his elbows. The patient then does shoulder depression as an exercise. This may be painful to sensitive shoulders in the beginning.
- 5) Elbows to Ceiling – In the beginning position, the patient is supine with his elbows fully flexed and pointing toward the ceiling overhead. He abducts his scapulae as far as possible, pushing his elbows toward the ceiling. He then returns to a position of scapular adduction, maintaining his elbow position.
- 6) Shoulder Extension – The patient pushes his upper arms into the mat, keeping the elbows flexed to 90 degrees. This can be done unilaterally or bilaterally. This motion may be combined with neck flexion or extension. The physical therapist will probably not need to assist with this exercise.

#### *c. Functional Exercises in the Prone Position*

- 1) Prone Elbow Push-ups – The physical therapist positions the patient in a prone position, weight-bearing on his elbows. The motion the patient uses is shoulder depression. He relaxes by allowing himself to "sag" at his shoulders. The physical therapist may need to assist in maintaining the elbow position.
- 2) Elbow Weight-Shifting – The physical therapist positions the patient prone in a weight-bearing position on his forearms. The patient shifts his weight from forearm to forearm by swinging his head, and using shoulder depression to push off each forearm.
- 3) Shoulder Extension – The physical therapist positions the patient prone with arms by his side with 2-3 pillows under his chest to allow for comfortable head positioning. The patient then lifts his elbows as high into the air as he can (shoulder extension). This can be combined with neck extension, if desired.

#### *d. Breathing Exercises*

- 1) Deep Breathing – The patient may be lying on a mat or sitting in his wheelchair for this exercise. He breathes in deeply, emphasizing contraction of the diaphragm, then breathes out slowly. The physical therapist may instruct the patient to follow a count of: "in--2--3--out--2--3--". The physical therapist will probably need to

count with the patient and give verbal cues regarding his diaphragm movement. Deep breathing exercises can increase vital capacity and help to maintain greater lung compliancy. Once the patient has gained proficiency in this exercise, the physical therapist can add resistance to the diaphragm by using his hand, or with a weight.

- 2) Arm Movements – Basic deep breathing exercise can be modified by adding arm movements, i.e., lifting the arms up on inspiration and lowering them on expiration.
- 3) Yelling – To increase forced expiratory volume, yelling or loud counting, is a useful technique.

e. PNF Patterned Exercise.

*Patterned resistive exercise is an important part of the initial physical therapy program. Usually, during the first two to three weeks of a program, the patient cannot tolerate a full hour of functional exercise. This may be due to pain, muscle fatigue, poor endurance or joint tightness. Therefore, an alternative system of strengthening exercise is necessary. I believe PNF or some modified patterned resistive exercise facilitates maximum strengthening to innervated musculature more effectively than exercise in which the emphasis is on movement at a single joint in a cardinal plane. Exercise in patterned movements is decreased gradually by the physical therapist as the patient can tolerate more intensive functional work. Since the total amount of time available to work with a given patient is limited, I choose to focus on functional activities rather than on even the best of progressive resistive exercise systems. In performing functional activities, a person is automatically using patterned movement, and resistance is added by the weight of body parts. Without this deliberate focus on function and functional exercise, the patient may gain much strength in certain muscles by the time of discharge, but may not necessarily be able to use them effectively in his daily activities.*

f. Breakdown of Functional Activities into Component Parts.

*To assist a patient in gaining expertise in a functional task, the task should be subdivided into its component skills. These components can be practiced separately in the beginning and gradually added together into short sequences. Eventually, the sequences can be combined until the patient is performing the task as a whole. Portions of the task may continue to require assistance at the time of discharge. But, once the patient understands the components and sequences on the intellectual and experiential levels, he can continue to work on these skills after discharge. He can also combine some of the components into new patterns in experimenting with potential solutions to the problem of accomplishing new functional maneuvers.*

*In the following descriptions, the major functional skills have been broken into their component parts. The components, of course, vary in difficulty. With experience, the physical therapist learns which components are easy for the patient initially and how to progress to the more difficult. As the patient learns the simple components, the physical therapist upgrades his program by teaching new components and by combining learned components into higher level skills. During this functional progression, an important point is to keep a "high success—low frustration" level for the patient. Learning these functional skills usually requires the whole period of hospitalization and improvement should be expected beyond discharge.*

*The order of the components within a functional activity is interchangeable, depending on what is most successful with a particular patient. The techniques discussed below are only suggestions and may not be applicable to all patients. The physical therapist and patient together must work out the appropriate methods for that patient.*

g. Components of a Basic Transfer

- 1) Position the wheelchair at a slight angle (30 degrees) to the bed, mat, or car. The caster wheels should be locked, if possible, or blocked, to keep the wheelchair from sliding.
- 2) Remove the armrest, and place it in the back armrest hole so that it is out of the way, but reachable (Fig. 14).
- 3) Position the sliding board under the thigh, angled toward the buttocks as shown in Fig. 15. A MED\* board can be positioned independently by the patient but other sliding boards will usually require assistance for placement.

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\*MED = Medical Equipment Distributors

This sliding board has a hinged peg on the under surface which can be placed in the forward armrest receptacle on the wheelchair frame to provide stabilization of the board.

- 4) Lift feet up onto the mat, bed or car, using a footstrap or forearm (Fig. 16). This technique is explained under "Progression of Wheelchair Skills: Components of Moving Legs from Footrests to Mat" on page 16.
- 5) Scoot buttocks forward to the front of the wheelchair wheel. This technique is explained under "Progression of Wheelchair Skills: Moving the Buttocks Forward in the Wheelchair Seat" on page 16.
- 6) Scoot sideways across the sliding board:
  - for scooting to the right, the patient must keep his trunk positioned forward and over his left thigh.
  - his left hand is his main "pushing" hand. Hand placement is variable, according to body proportions, and it is important to achieve the greatest leverage for a horizontal force. (See "Force Vectors," page 7, for further explanation.) Generally the hand placement is approximately 20 cm. (12 inches) outward from the greater trochanter.
  - his right hand is used for maintaining a rotated position of his shoulders and is positioned on the mat to allow full elbow extension and shoulder depression.
  - the sideways motion is accomplished by shoulder depression and head/shoulder swing. The proper timing is essential. The downward thrust of the hands must coincide with the end-swing of the head and shoulders (maximum shoulder rotation). Initially, the physical therapist can help the patient gain a "feel" for this movement by manually moving the patient to the side at the appropriate movement.
  - the patient repositions his hands and repeats the movement until he has scooted across the sliding board onto the mat, bed, or automobile seat (Fig. 17).
  - the hands will require a non-skid surface to keep from slipping sideways while pushing. "Wheeler mitts" (palm mitts), gloves or moistened hands provide a non-skid surface.
- 7) Move off the sliding board. The buttocks are moved by scooting sideways, using the same transfer technique described in item 6) above. The legs are moved, one by one, to the right by leaning on the right elbow and pulling them with the left forearm.
- 8) Pull the sliding board out. The patient can get a loose grip on the MED board peg by using wrist tenodesis action as shown in Fig. 14.

#### *h. Components of Moving Supine-to-Sitting-to-Supine*

- 1) This task is simplified for many patients by using "chain loops" (Fig. 18), which can be fabricated for individual patients. Attach the chain loops to the end of the bed, or if working on the mat, attach them to the wheelchair.
- 2) Position the loops so that they run parallel to the patient's body, and lie between his legs.
- 3) The patient places his strongest arm through the particular loop that will give him adequate leverage to lift his head and shoulders approximately 30 cm (1 foot) off the mat.
- 4) The opposite elbow is then placed next to his side, with the elbow flexed to 90 degrees. For this example, he is rolling onto the right forearm using the left forearm in the loop.
- 5) He pulls hard with the right elbow flexors and ducks his head forward and to the left, to initiate a swinging motion. Once he has lifted his trunk off the mat, he positions the left forearm into a balanced weight-bearing position (Fig. 19).
- 6) The patient balances on the left elbow while he changes loops with the right arm. With the next loop, he will have the leverage to pull to a sitting position.
- 7) To lie back down he can reverse the above process, or he can lower himself by using just one loop.
- 8) Alternate method for the patient to lower himself to the bed from sitting: The patient "props" himself on extended arms. He then flexes one elbow at a time, by slightly pronating his forearms. After falling backward on his forearms, the arms are abducted to lower the trunk to the mat. This method may traumatize the elbows, however, and should be evaluated accordingly.

#### *i. Components of Scooting Backward.*

- 1) The patient assumes the "basic shoulder depression position" with his trunk erect. Hand placement will be somewhat variable depending on body proportions, but a position slightly behind the hips is usually satisfactory.
- 2) Backward movement is accomplished by bilateral equal shoulder depression and head "ducking," i.e., fast downward swing. The hips will be dragged slightly toward the hands. However, the patient should not lean backwards excessively because this may cause loss of balance and leverage. The distance is covered with a series of small steps. The proper timing is essential. The downward thrust of the hands must coincide with

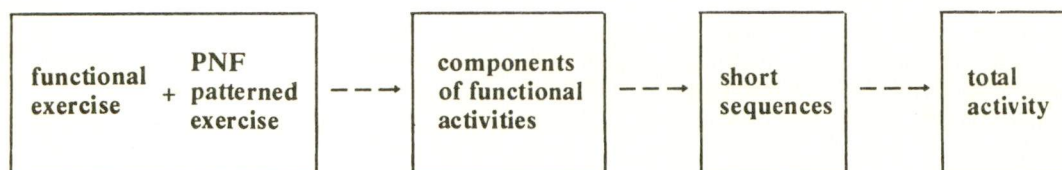
the end-swing of the head. Initially, the physical therapist can help the patient gain a "feel" for this movement by manually moving the patient backwards at the appropriate moment. Also, sliding on a smooth, large sliding board simplifies the activity by decreasing the surface resistance (Fig. 20).

- 3) If the above method is not successful, the hips can be moved one at a time with the side-scooting method discussed under "Components of a Basic Transfer" on page 12.

*j. Components of Scooting Forward.*

- 1) The patient positions himself in the "basic shoulder depression position" with his trunk erect. Hand placement will be variable, but placing them slightly ahead of the hips usually works well.
- 2) The forward movement is accomplished by bilateral, equal shoulder depression, upward head-swings and scapular adduction (to functionally extend the back). The hips will be scooted forward a few centimeters at a time. The downward thrust of the hands must coincide with the end-swing of the head. The feet will stay in one spot, and the legs will need periodic repositioning by the physical therapist or patient. Usually this is the most difficult direction for a patient to scoot and may not be mastered by the time of discharge. The physical therapist can again provide important cues by manually moving the patient forward at the appropriate moment.

## 2. PROGRESSION OF WHEELCHAIR SKILLS



The progression for wheelchair skills is the same as for mat skills. However, since the wheelchair activities are simpler and are comprised of shorter sequences than the mat activities, breaking them down completely may not be necessary. Following are suggestions for wheelchair orientation, functional wheelchair exercises, and the components of various wheelchair functional activities.

*a. Suggestions for Orientation of the Patient to Wheelchair Skills.*

*Learning wheelchair skills can begin as soon as the patient can tolerate sitting at 90 degrees.*

- 1) Work in front of a mirror the first few times. Frequently, the patient is in a halo vest or cervical collar which restricts his ability to see directly down. During this session, the physical therapist can identify wheelchair parts and their function. I believe it is important to remember that the wheelchair is foreign to the patient. He will need time to identify with it, and accept it as his primary mode of mobility. Therefore, discuss it as "the wheelchair" instead of "your wheelchair". The change in self-image and environmental orientation from a life-style based on walking to one based on a wheelchair is a learned response and takes time to be accepted.
- 2) As early as possible, have the patient practice "hooking" an arm around a push-handle. This provides him with a method of holding his balance and of controlling some movement at a time when he may feel that his ability to control his body is totally lost. If the patient is tilting in a reclining wheelchair, the back height will be too high, and the patient must wait until he has a wheelchair with a standard back height before he can use "hooking" for balance. Frequently, the patient's shoulders are too painful to hook an arm independently around a push-handle and the physical therapist will need to assist in this activity. Once this is accomplished, the next portion of this movement sequence consists of the patient leaning sideways in the wheelchair seat to the opposite side. The patient will probably require assistance in allowing the hooked arm to extend since patients usually do not trust the strength of their biceps. If the patient is fearful of the movement, the physical therapist can passively take him through the side-leaning. Such physical support helps the patient overcome fear of falling.
- 3) Another position to which the patient needs to become accustomed is full forward-leaning. This will be incorporated into functional activities at a later time, but it is used in the beginning to decrease fear of falling and to help the patient appreciate the availability of alternative body positions in space. The physical therapist can slowly lower the patient forward to a resting position on his knees (with the caster wheels forward and seat belt on). This position may be uncomfortable for the patient so it should not be maintained longer than necessary.

b. Functional Exercises for Wheelchair Skills.

*Functional exercises are done in the wheelchair by performing repetitions of the components of wheelchair functional skills. A few examples are listed below.*

- 1) Push-ups – The patient places his elbows on the armrest or hands on the tires and pushes downward using shoulder depression. He can hold this position for a few seconds and then return to a relaxed position with his arms still in place. A modified version of this exercise can be performed with the patient's hands on the brake extensions. He lowers his trunk toward his knees, then pushes into the brake extensions to return to a vertical sitting position.
- 2) Side-leaning Pull-ups – The patient hooks his left arm around the left push-handle and leans his trunk side-ways to the right armrest. He then pulls himself back to a vertical position using his left arm as illustrated in Fig. 6. The process can be repeated on the other side using the right arm.
- 3) Forward Pulls – The physical therapist stabilizes the patient's wrists in front of him. The patient pulls in with his elbow flexors to move his trunk forward towards his hands. He then relaxes his arms and leans back in the wheelchair seat. To get the proper leverage for this exercise, the physical therapist should pull the patient's buttocks forward in the wheelchair before beginning this exercise.
- 4) Balancing – With the buttocks positioned forward 5 to 10 cm., the patient can practice balancing in the wheelchair by bringing his trunk forward from the backrest and holding his arms out to the sides, or grasping the armrests with his forearms.
- 5) Leg-lifts – The technique for lifting a leg into the air is discussed on page 16 under "Components of Moving Legs from Footrests to Mat." This can be performed as an exercise, either with or without the footstrap, by repeating the lifting motion continuously several times.
- 6) Active Arm Exercises – While sitting in an erect position in the wheelchair, the patient can move his arms in any pattern or direction repetitively. Even if the patient has the strength to do all resistive exercises, this mobility exercise encourages ease and spontaneity in arm movement.

c. PNF Patterned Exercise.

*Patterned resistive exercise can be done while sitting in the wheelchair. The rationale for using patterned resistive exercise within the physical therapy approach being presented here is discussed on page 12 under the same heading in "Progression of Skills on the Mat".*

d. Breakdown of Functional Activities into Component Parts.

*The rationale for the breakdown of functional activities into component parts can be found on page 12. As previously stated, the techniques discussed below are only suggestions and may not be applicable to all patients. The physical therapist and patient together must work out the appropriate methods for that patient. An individual with C6 quadriplegia, whose impairments prevent him from being able to perform a transfer, may still master the skills required to adjust himself independently in the wheelchair.*

- 1) Moving the Buttocks Forward in the Wheelchair Seat
  - a) *The patient positions himself in an erect posture.*
  - b) *The forward movement is accomplished by any of the following methods:*
    - (1) Arching backwards against the back of the wheelchair, using a swinging motion of the head (extension) and arms (shoulder abduction and external rotation) for added force.
    - (2) Pushing downward on the armrests with the forearms, and swinging the head backward (scapulae adducted).
    - (3) Pushing downward on the tires or the wheelchair seat with the hands (shoulder depression, with elbow extension and forearm supination and swinging the head backward).
    - (4) Moving one hip forward at a time: to move the right hip forward, hook the left arm around the left push-handle, hook the right arm through the left armrest (holding the right wrist extended) and pull with both arms toward the left as illustrated in Fig. 21. Swinging the right arm forward and to the left (instead of hooking it through the armrest) may also provide the desired force. To move the left hip forward, repeat the above procedure to the opposite side. Moving far enough forward in the wheelchair seat using this method may require several "scoots".
- 2) Moving the Buttocks Backward in the Wheelchair Seat –
  - a) *The patient positions his hands on the locked brake extensions and leans forward as shown in Fig. 22.*
  - b) *The backward movement is accomplished by bilateral shoulder depression and external rotation, with extended elbows combined with head-shoulder swings from side to side. The patient must maintain a forward-*

leaning position to create the horizontal force necessary to move his buttocks backward. For a more complete explanation of the concept involved in this movement pattern, refer to page 13 under the heading: "Components of Scooting Backward".

- c) Another method is to hook the thumbs under the anterior horizontal struts of the armrests (Fig. 23) instead of positioning the hands on the brake extensions. The patient uses bilateral shoulder depression, combined with head/shoulder swing from side to side. Again, he must maintain the forward-leaning position to create the horizontal force necessary to move backward.
- 3) Moving the Buttocks Sideways in the Wheelchair Seat – By pulling his trunk forward and to the right, the patient can usually move his buttocks sideways to the left. Various methods may give him the leverage necessary for this maneuver.
  - a) He can hook his right arm around the right push-handle and push off the left tire or armrest with the left arm.
  - b) With the right arm hooked around the right push-handle, he can pull forward with his left forearm positioned under his right thigh or through the right armrest.
  - c) With the right arm hooked around the right push-handle, he can swing his left arm forward and to the right.
  - d) Simply hooking the right arm around the right push-handle and twisting to the right is sometimes all that is needed.
- 4) Components of a Forward Weight Shift –
  - a) Lock the caster wheels forward: the patient locks his wheelchair, hooks his left arm around the left push-handle and leans forward to lock his quad-release caster locks (the caster wheels need not be positioned yet). He pulls himself back to vertical sitting with his left arm. He unlocks his wheelchair and backs it up. This will bring the caster wheels forward and lock them. (This same procedure is used in preparation for transfer.)
  - b) He locks his wheelchair again, and leans fully forward, slowing his descent with his arms on the brake extensions. He rests in this forward position on his knees for 1-2 minutes.
  - c) He brings himself back to vertical sitting by pushing on his brake extensions (Fig. 22).
  - d) He then unlocks the caster locks using step (a) above.
- 5) Components of Moving the Legs from Footrests to Mat –
  - a) Using a Footstrap –
    - (1) The patient hooks the footstrap around his wrist by using wrist extension. To move his left leg onto the mat, he holds the footstrap on his left wrist and hooks his right arm around the right push-handle.
    - (2) He leans forward and loops the footstrap around the area of the metatarsal heads of his left foot (positioning the strap too proximal on the foot makes removal difficult; positioning it too distal tends to allow the footstrap to slip off). The foot may have to be moved slightly forward on the footplate to allow the footstrap to slide down into position.
    - (3) The upward movement of the leg is accomplished by pulling back with the right arm, swinging the head back and pulling hard with the left elbow flexors (Fig. 16). If the knee flexes excessively, the patient will need to keep his elbow straighter and pull up harder with his shoulder flexors.
    - (4) The sideward leg movement (to move the leg over to the mat) is accomplished by moving his left arm to the left and leaning his body to the left.
    - (5) Movement of the leg is accomplished by total body motion. The strength of the left arm alone usually is not adequate to perform the desired movements. If the patient has difficulty with this arm arrangement, he can try reversing his arms so he is holding the footstrap with the opposite wrist.
  - b) Without a Footstrap – This is a more advanced technique. The left leg is lifted onto the mat by reaching under the left calf with the right forearm. The left arm is hooked around the left push-handle. The patient pulls in with both arms, and places the leg on the mat. The procedure is repeated with the contralateral limbs to place the right leg on the mat. A similar procedure is used to move the legs onto the bed during a legs down transfer from the wheelchair (Fig. 24).
- e. Additional Wheelchair Skills:

*The following are fundamental wheelchair skills that should be mastered by a person with C6 quadriplegia by time of discharge from a rehabilitation center. The ability to perform these well will greatly decrease the individual's dependence on others while he is sitting in his wheelchair. They are presented separately since it is not necessary to break them down into their component parts.*

- 1) Patient ability to remove and replace the armrests (for ease of transfer, side-leaning weight-shifts and for enabling the patient to rest by leaning on the bed).

- 2) Patient ability to unlock the footrests, swing them to the side and relock them (for transfers or forward weight shifts).
- 3) Patient ability to move his arms in all directions without tipping over or being overcome by fear of falling (allows for spontaneity of arm movements and gestures, and for performing tasks while sitting in the wheelchair).
- 4) Patient ability to push up off the wheelchair tires (for partial relief of pressure on the ischium and for stretching the back and elbows).
- 5) Patient awareness of his usual spasticity patterns and ability to compensate for them as necessary by adjusting body positioning. Control may be provided by hooking an arm around a push-handle, trunk-leaning, anchoring an arm, or head-positioning.
- 6) Patient ability to hook either arm around a push-handle and lean his trunk to the opposite side and return to a vertical position (for partial pressure relief, back stretching, or position change).
- 7) Patient ability to propel his wheelchair:
  - a) *Using quad pegs to achieve independent propulsion of the wheelchair forward, backward and in a circle; on smooth surfaces and over carpet; in a reasonable amount of time.*
  - b) *Independent manipulation of brake extensions. Brake extensions can be of great assistance for the patient in turning corners, and slowing the wheelchair going down inclines. They also provide for greater ease of position change in the wheelchair, and ease of locking the brakes. The patient should be able to remove and replace the extensions independently, using loops attached through the rubber tips of the extensions.*
- 8) Patient ability to instruct others in all dependent wheelchair activities such as transferring up from the floor and negotiating curbs, steep ramps, stairs, and rough terrain.

## V. PSYCHO-SOCIAL ASPECTS

### A. PSYCHOLOGICAL FRAMEWORK FOR THE TREATMENT OF PATIENTS WITH SPINAL CORD INJURY

#### 1. SELF RESPONSIBILITY

During this first admission, the patient is progressing from a state of total reliance on others to a state of newly defined self-reliance. Since this new self-reliance will probably be a more delicate balance between dependency and independency than he has previously experienced, the patient needs to experiment with new behaviors to determine this balance for himself. The physical therapist can provide various opportunities for this experimentation, such as instructing family in functional skills and planning for home modifications.

#### 2. PROBLEM-SOLVING

Use of problem-solving skills is common in life experience. The C6 quadriplegic patient involved in a rehabilitation program must learn many new skills and ideas which he must integrate and use to influence his environment. He will encounter many unique problems created by his disability. Therefore, his problem-solving skills must be highly developed. The rehabilitation system can present the patient with the basic knowledge and skills he may need. He is responsible for developing these to a level necessary for meeting his own life goals. The more highly developed his problem-solving skills are, the more effective he will be in this process.

#### 3. EXPERIENCE SUCCESS

Following a spinal cord injury, the patient's physical progress is slow and his stress level is high. Therefore, a "low frustration-high success" level should be maintained by the physical therapist during physical therapy activities by simplifying and varying activities as necessary to accomplish this.

#### 4. FREEDOM OF EXPRESSION

The patient is trying to adapt to an incredible change in his body, social structure, income, and life-style. The physical therapist must permit the patient to express anger, silence, or depression, without judgment.

#### 5. HUMOR

The physical therapist should be sensitive to the patient's "smiling times" and add some humor to daily interactions. However, the physical therapist should be aware of his own need to avoid dealing with the patient's depression or fear and take action to reduce that avoidance behavior.

#### 6. POSITIVE SELF-IMAGE

The patient needs to know that he's "OK", even without his "normal" body. Therefore, he needs:

- a. *Increased patience in interactions*
- b. *Increased recognition provided by commendation for accomplishments; communication outside structured physical therapy time; acceptance of his emotional status*
- c. *Reinforcement that he is not an invalid or a child*
- d. *Opportunities to take responsibility for himself, such as, independently attending appointments or using a spotter when performing unsafe functional skills. Each independent activity should be followed by discussion with the physical therapist if unwise or unsafe choices are made.*
- e. *Opportunities to express his knowledge and experience in other areas.*

#### 7. HOME ENVIRONMENT

The physical therapist should maintain both his own and the patient's orientation toward the home environment. The admission at TIRR is only a short interval. Preparation for discharge must begin soon after admission and, in fact, may be initiated prior to admission.

#### 8. FOUNDATION FOR GREATER INDEPENDENCE

The patient should be aware that by developing his imagination, coordination, planning skills and health, he can provide a greater degree of physical independence for himself, as well as a more independent life-style.

## B. GENERAL TREATMENT PROGRESSION TOWARDS ACHIEVEMENT OF PSYCHO-SOCIAL GOALS

**The physical therapist:**

- Selects and progresses the physical therapy program.
- Is supportive and gentle in his approach with the patient.
- Is aware of the need to allow for the patient's immediate adjustment to injury.
- Pays careful attention to building a relationship of confidence and trust.

**ADMISSION**

**The physical therapist:**

- Gradually, but systematically, teaches the patient about the fundamentals of exercise, pertinent information regarding his treatment rationales, wheelchair living, and other pertinent topics.
- Begins teaching the patient how to instruct others in performing specific tasks associated with his care.
- Encourages the patient's expression of emotion.
- Reinforces the patient's feeling of self-worth.

**The physical therapist begins providing opportunities for the patient to assume responsibility for portions of his program.**

**The patient begins basic problem-solving in the areas of movement sequences, home modifications, accessibility problems, etc.**

**The physical therapist encourages full patient problem-solving in physical therapy.**

**The patient and the physical therapist discuss discharge plans and home functional activity sequences.**

**The patient chooses the activities in physical therapy on which he wants to focus.**

**The physical therapist shifts the responsibility for carrying out the physical therapy program from himself to the patient.**

**The physical therapist provides opportunities for the patient to instruct the nursing staff and family in how to assist him.**

**The patient and the physical therapist discuss community options.**

**The patient demonstrates competence in performing specific functional activities.**

**DISCHARGE**

## VI. PREPARATION OF THE PATIENT FOR DISCHARGE

The information presented in this section is a general framework for discharge planning for the patient with a spinal cord injury at the C6 motor level. It is organized within a 12-week first admission at TIRR. As always, exceptions will be necessary to accommodate the needs of the individual patient.

### A. INDIVIDUAL EVALUATION

This information can usually be obtained while the physical therapist is completing the initial assessment. A general discussion of the patient's family, job, accident, home and interests can be part of the initiation of the therapist-patient relationship. This can provide the physical therapist with important information for program planning. But, I do not recommend that the physical therapist go into much detail, at this time, regarding discharge expectations. Detailed information can be presented after a support relationship with the patient has been achieved and after he has had more time to accept his disability. In the meantime, determine the general:

1. Potential for wheelchair accessibility of the home environment.
2. Family structure and the relationship of the patient to other members of the family before the injury. This will provide useful clues about the most likely sources of physical and emotional assistance for the patient.
3. Sources of funding for equipment and services that are likely to be needed. This information can usually be obtained from the medical chart. Also contact the insurance rehabilitation nurse (if worker's compensation is involved) and any others who should be advised of the patient's long-range needs.

### B. FOUR TO SIX WEEKS AFTER ADMISSION

1. A usual treatment period (approximately one hour) can be utilized for detailed planning of necessary equipment and home modification.
  - a. *The physical therapist can draw a picture of the general home layout, the bathroom, and any other potential problem areas, with the patient verbally instructing him.*
  - b. *The physical therapist and patient can discuss the "wheelchair accessibility" of his home. This provides the patient with an opportunity to plan possible methods for performing his daily activities from a wheelchair. The physical therapist acquires the information necessary for recommending equipment purchases and possible home modifications. Focus should be on wheelchair access:*
    - 1) In and out of the house independently (ramp? door handles? emergency procedures?).
    - 2) To the car from the house (covered? smooth surface?).
    - 3) To the bed.
    - 4) To clothes, stereo, TV, telephone.
    - 5) To a sink and mirror for light hygiene activities, such as combing hair, brushing teeth, and washing face.
    - 6) To the shower or bathtub for bathing.
    - 7) To the toilet, if a bathroom bowel program is to be established.
    - 8) In the kitchen for simple food preparation and eating.
  - c. *The physical therapist and patient can discuss possible modifications. More exact measurements may be required from a family member.*
2. The physical therapist should make a home visit if the patient lives within commuting distance of the rehabilitation center. Besides assuring appropriate recommendations for home modification, a home visit gives the physical therapist much information regarding the social and physical environment to which the patient will be returning at discharge. That may assist with realistic program planning.

3. The physical therapist should discuss possible home modifications with the patient's family and make necessary recommendations to the family, appropriate staff members, TRC counselor, insurance nurse, or any others who may require such information.
4. The physical therapist should order any necessary equipment. The following is a list of equipment that is usually needed by a patient with C6 quadriplegia.

a. Sliding Board.

- The patient needs a plastic sliding board for immediate transfers on the nursing station.
- A MED board is useful for independent board placement by the patient. Progression to this type of board would probably be at the end of the first admission or perhaps during the second admission.
- A large sliding board is useful for a patient who requires a smooth, large surface for sliding. Such a sliding board is available from Craig Rehabilitation Hospital. This board usually cannot be positioned independently by the patient.

b. Bath Bench.

Before this is ordered, the physical therapist must evaluate the patient for ease of transfer, patient's ability to maintain balance while sitting on the bench, and the general stability of the patient and the bench in the bathtub. Spasticity is frequently a problem in safe bathing for a patient with such a high level of spinal cord injury. Bed baths are a realistic alternative, with an eventual progression to a roll-in shower, if possible.

c. Flexible Shower Hose.

With a hand-held shower head, the patient or the assistant has greater control of the water flow. Shower hoses can be fitted to a shower head or a bathtub nozzle. Faucets may require a handle attachment for independent patient control.

d. Everest and Jennings (E & J) Shower-Commode Chair with Quad Pegs or Teflon-Coated Rims (Optional).

This type of shower-commode chair is recommended if the patient plans to build a roll-in shower but is a very expensive piece of equipment to be used only for a bowel program. Frequently, a patient requests a commode chair or the purchase of a cheaper model. However, the E&J chair appears to be the most stable, best fitting, and easiest for the patient to propel.

e. Grab Bars (Optional).

These may be useful in transfers, even for a patient who has no functional grasp, if they are placed at a height that allows hand placement for shoulder depression.

f. Footstrap.

Used to assist the patient in elevating his legs to the bed or car.

g. Chain Loops.

Used to assist the patient in bed mobility, specifically in assuming a sitting position from supine.

h. Wheelchair Adaptive Equipment.

The use of these adaptive devices on the wheelchair increases the patient's potential functional level.

- 1) Brake extensions – Provide additional mechanical advantage so that each wheel can be braked with less effort. For more details see page 17.
- 2) Grade-aids – Prevent wheelchair from rolling backward when it is being propelled up an incline.
- 3) Pneumatic tires – ] Provide a smoother ride and better traction over rough terrain
- 4) Semi-pneumatic caster wheels – ]
- 5) Caster locks – Prevent the wheelchair from sliding sideways during transfers and provide a broader base of support for forward-leaning (when casters are locked forward).

- 6) Quad releases for armrests (these are not usually ordered at TIRR) – Assist in armrest removal by the patient.
- 7) Quad pegs (vertical projections decrease overall wheelchair width by 2 inches in comparison to oblique projections) – Pegs that project from the handrim and which permit propelling forces to be applied to the wheels of a wheelchair by a person who cannot grip the handrim.
- 8) Low wheelchair back – Facilitates upper extremity and trunk mobility and good sitting posture.

### **C. DURING THE LAST MONTH**

1. The physical therapist might have the patient review the steps of various functional skills to provide him with practice in instructing others, to increase his awareness for detail and to give him practice in assuming responsibility for functional activities. This can be done by requiring either verbal or verbal-physical responses. The physical therapist might say:
  - "Tell me how to assist you in moving from the wheelchair to your bed."
  - "Tell me how to place your cushion under you in the wheelchair."
  - "Tell me how to get you up from the floor."
2. The physical therapist can use functional sequences as problem-solving practice and preparation for discharge:
  - "Tell me how you will get from your bed through a complete shower."
  - "Tell me how you could prepare a sandwich and heat some soup."
  - "Tell me how you will get from the house into your car."
  - "Tell me how you will get from the front door into your bed."
  - "Tell me how you will set up your bedroom so you can dress yourself and do your morning hygiene without assistance."
3. Once the transfer technique is determined, the physical therapist and patient can practice "wet run" bathing two to three times. Include hair washing, if possible.
4. The physical therapist can describe various equipment options available and show illustrations in equipment catalogs, as well as discuss how the patient can follow-up on equipment in case his equipment has not arrived by the time of discharge.
5. The physical therapist can present various hypothetical situations which the patient might encounter after discharge:
  - "Tell me how you would plan for an airplane trip."
  - "Tell me what you would do if you fell out of your wheelchair while you were home alone."
  - "Tell me how you would get out of the house if there were a fire."
  - "Tell me what you would do if you needed to go up six steps and a group of people were 'hovering' around trying to help."
6. The physical therapist can present various community resources available after discharge:
  - Transitional living projects
  - Civic and political organizations for the disabled
  - University resources
7. The physical therapist can reinforce that the patient will probably improve in his ability to care for himself, even without neurological return, as he returns to his home environment. He will eat better, build up his activity level, adjust to his limitations and skills, sleep better, "continue with his life" and "hang out" with friends.

## VII. ADDITIONAL SUGGESTIONS FOR PATIENT SAFETY

- A. Joint stretching may trigger a dysreflexic response in the patient.
- B. With a dysreflexic response, i.e., blotching of the skin, sweating, headache, elevated blood pressure, the physical therapist should first check for a kinked catheter, then return the patient to the nursing station and notify the team leader.
- C. With a hypotensive response, i.e., dizziness, nausea, lightheadedness, the physical therapist can tilt the patient backward into a wheelie position, if he is sitting in a wheelchair, or lay him down, if he is on the mat. These maneuvers will usually be adequate to relieve the symptoms. If the patient faints or becomes severely nauseated, he should be returned to the nursing station. Dibenzylene may trigger a hypotensive response, even in an ambulating patient. Know the drugs a patient is taking.
- D. The physical therapist should be aware of all pressure sores or skin abrasions so that he can protect these areas appropriately during physical therapy activities.
- E. The physical therapist should check urinary drainage apparatus and the clothing around it to assure adequate drainage.
- F. The patient needs to have as safe an environment as possible in which to practice his functional skills. Even if the physical therapist is not directly holding onto the patient, he can protect the patient from harm. Balance is usually poor in this patient population due to lack of trunk musculature. To protect the patient, hard objects that the patient might hit against, e.g., footrests or bedrails, can be padded temporarily with a pillow. Also, the physical therapist can place himself between the patient and possible hazards, e.g., the edge of the mat or sharp objects. Equipment frequently changes position and the physical therapist must anticipate possible problems.

In conclusion, the information presented in this document is designed to stimulate the physical therapist to use critical thought processes in the area of physical therapy management for spinal-cord-injured patients. Each physical therapist must develop and improve his own understanding of what approach might best be used with an individual patient. The ideas discussed may be integrated into the physical therapist's own unique treatment approach.

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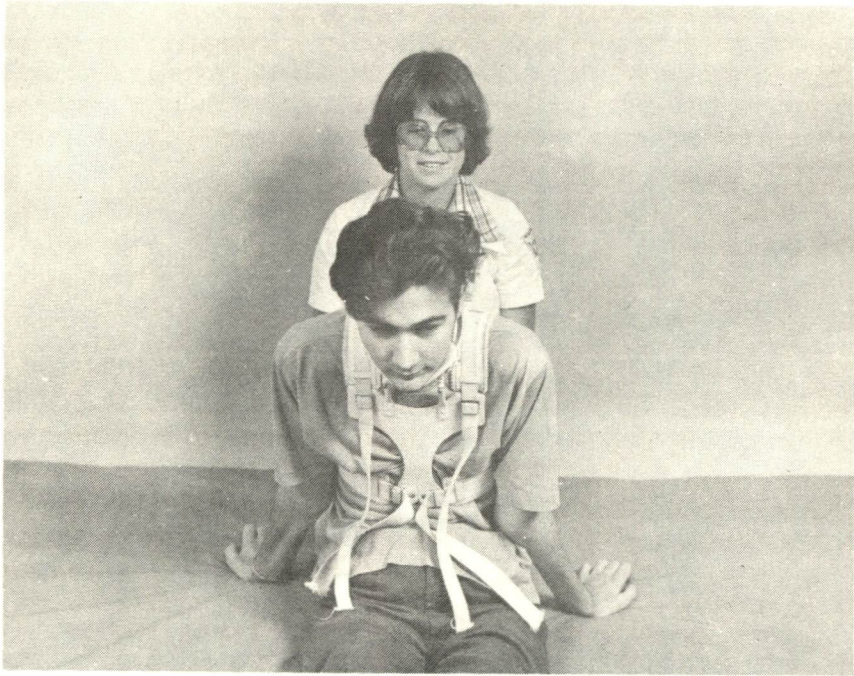


Fig. 1. Long-sitting Position.

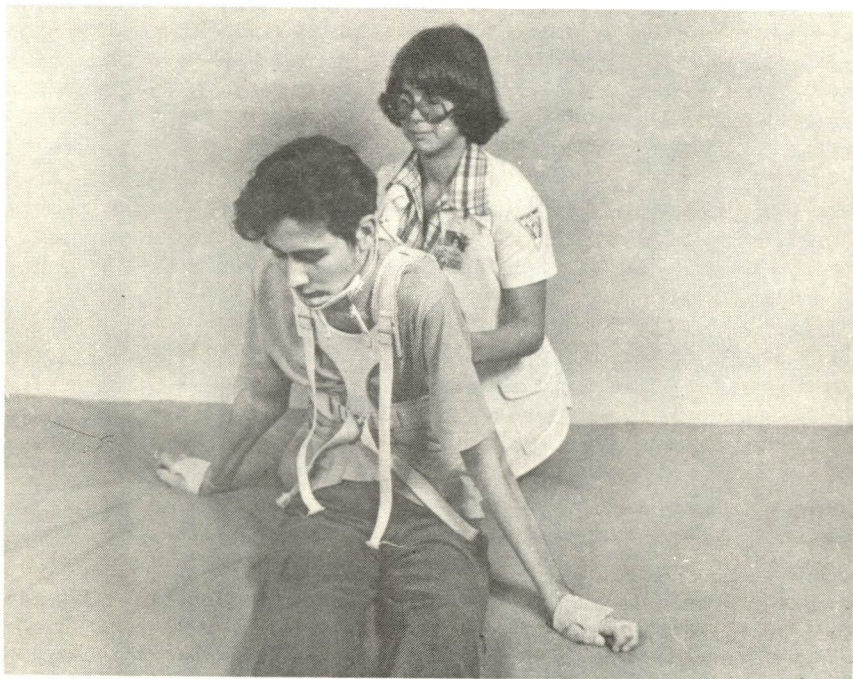


Fig. 2. Hand Placement for Scooting Sideways.



Fig. 3. Anchoring Wrists in Wheelchair Frame.



Fig. 4. Basic Shoulder Depression Position.

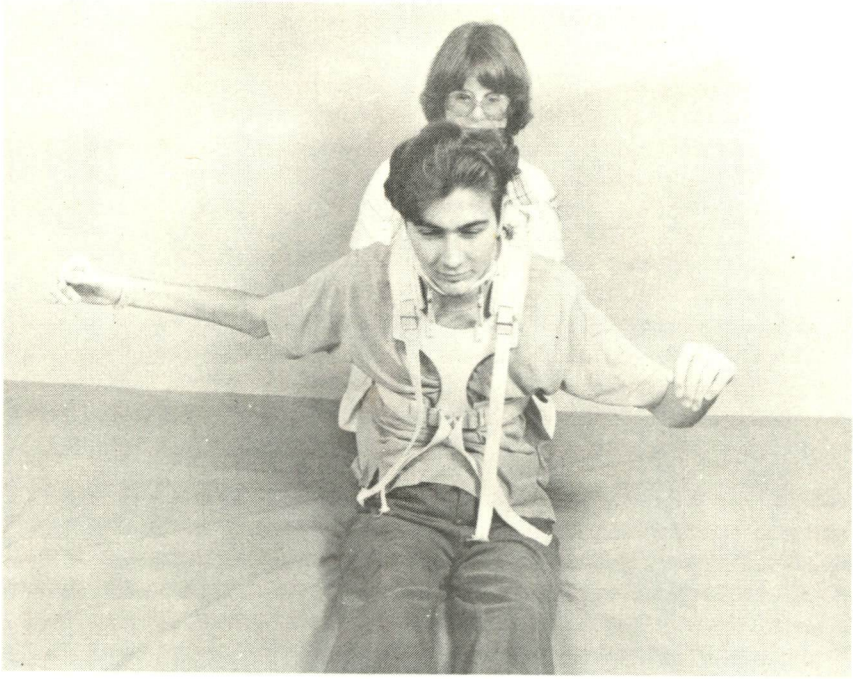


Fig. 5. Practicing Trunk Balance with Arms Free.



Fig. 6. Arm Hooked Around Push-handle.



Fig. 7. Maintaining Elbow Extension without Triceps Muscle.



Fig. 8. Shoulder Depression Exercise When Wrists are Painful.



Fig. 9. Another Variation of Shoulder Depression Exercise.

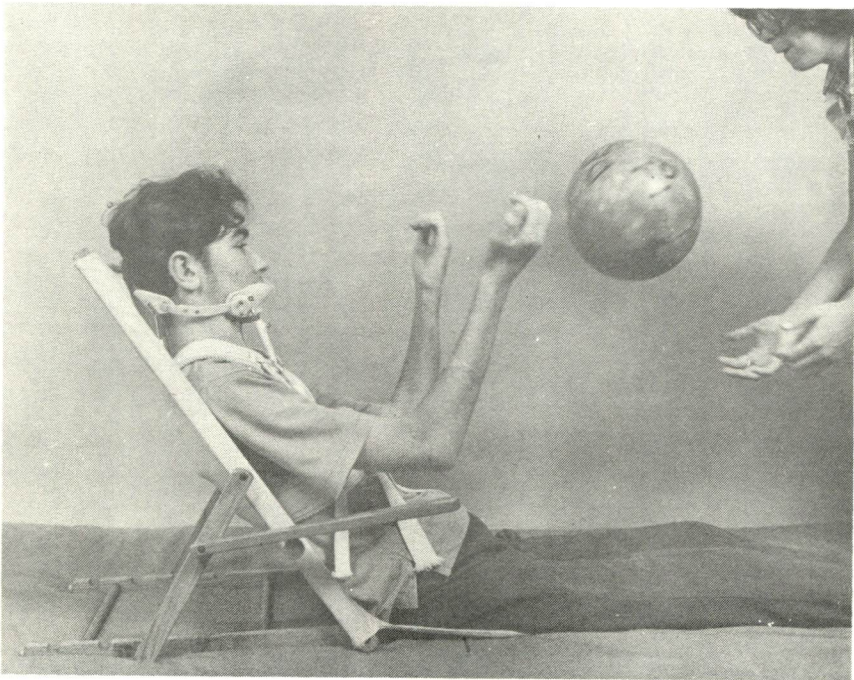


Fig. 10. Active Arm Exercise.

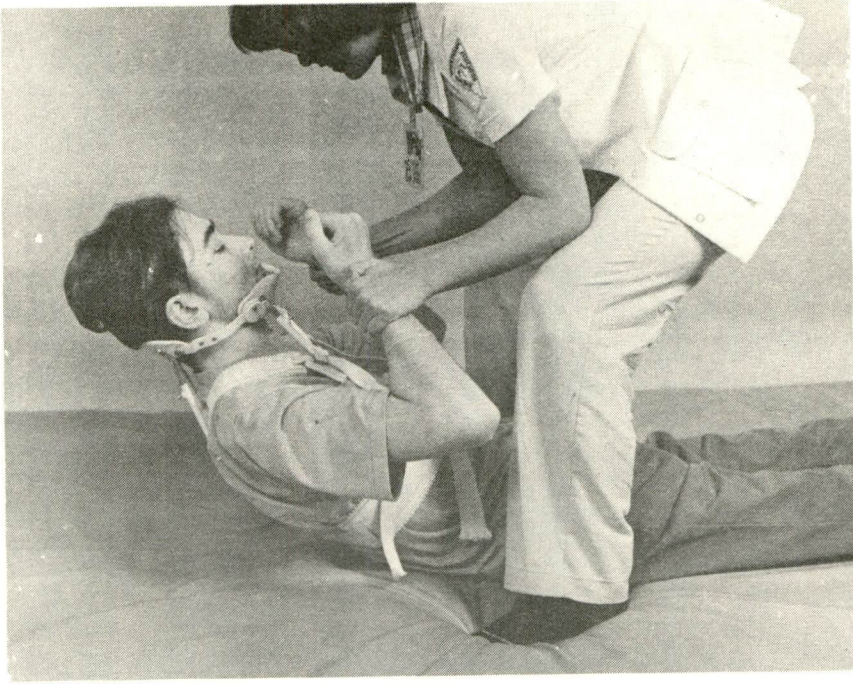


Fig. 11. Biceps Pull-up Exercise.



Fig. 12. Another Variation of Biceps Pull-up Exercise.



Fig. 13. Rolling with Assistance.

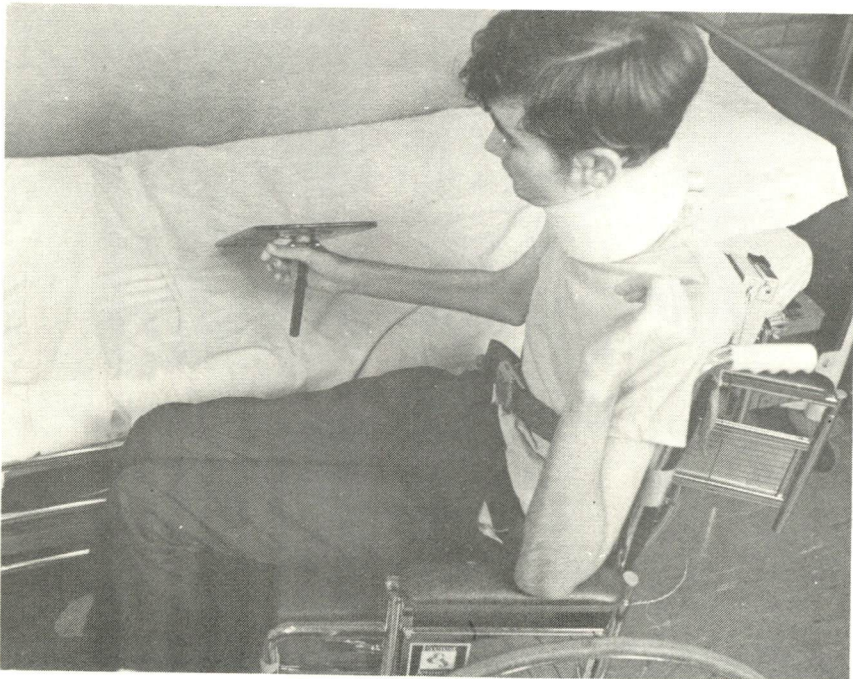


Fig. 14. Position of Wheelchair for Basic Transfer.



Fig. 15. Use of Sliding Board in Basic Transfer.



Fig. 16. Moving Legs with Forearm.

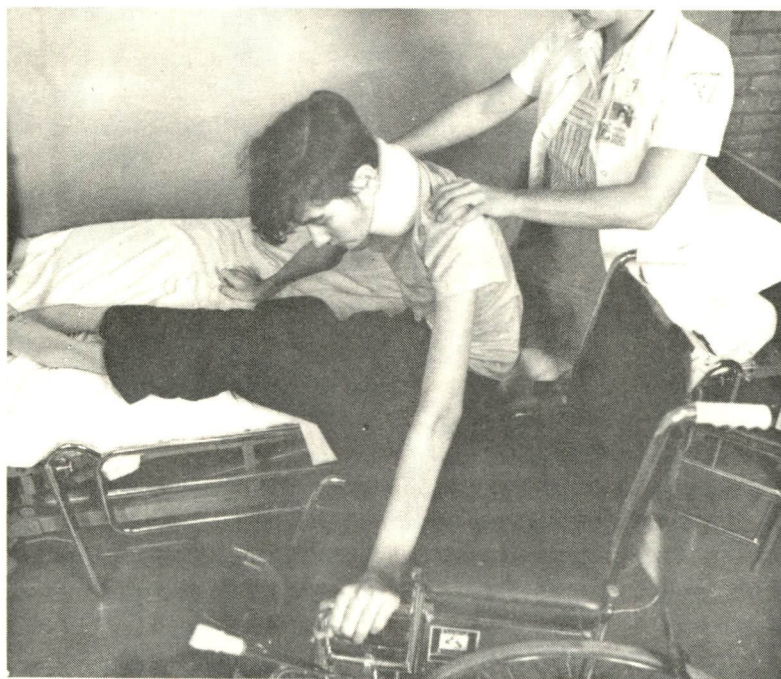


Fig. 17. Position of Hands for Scooting Across Sliding Board.

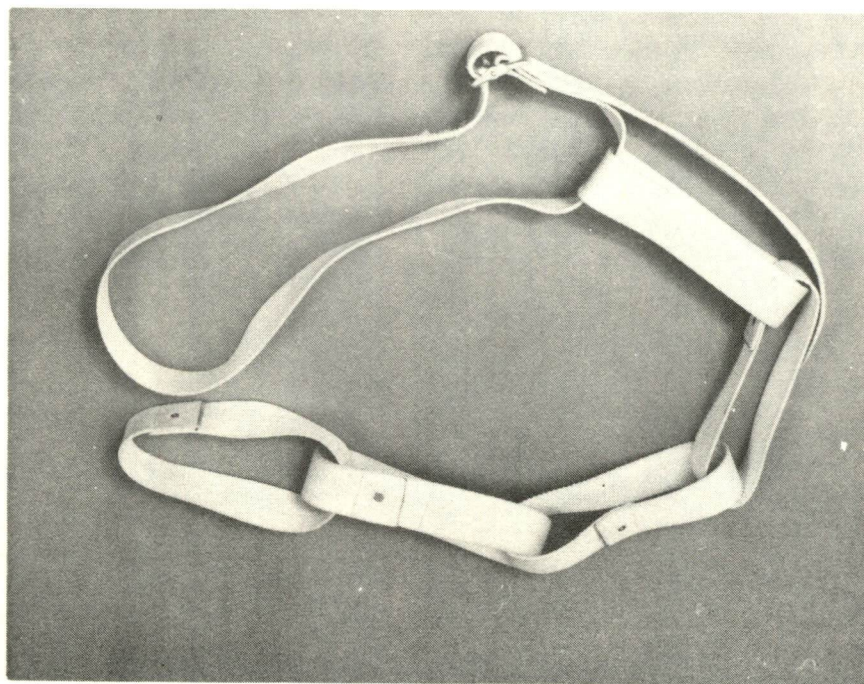


Fig. 18. Chain Loops.



Fig. 19. Use of Chain Loops.



Fig. 20. Scooting Backward on a Sliding Board.

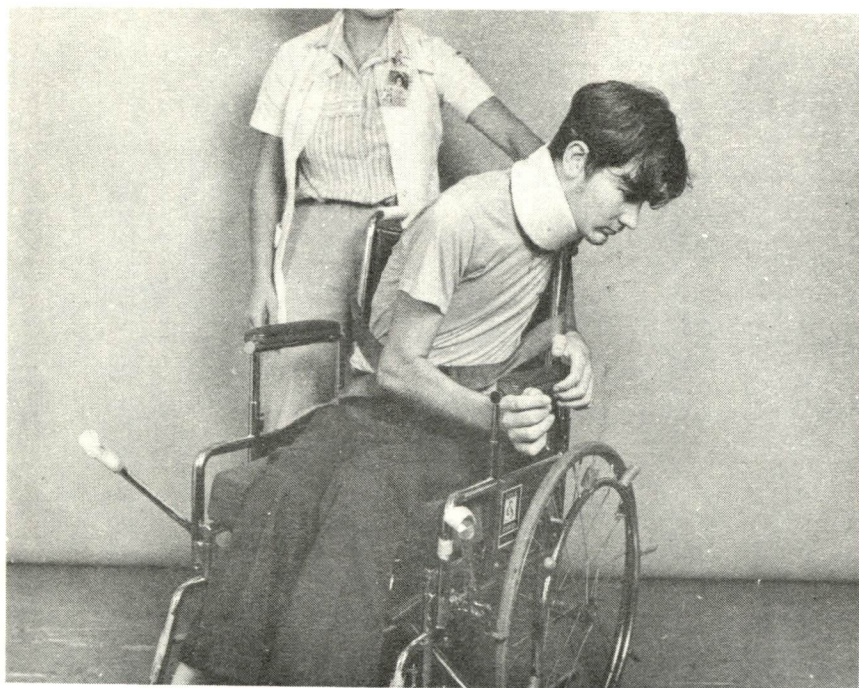


Fig. 21. Moving One Hip Forward at a Time.



Fig. 22. Leaning Forward on Brake Extensions.



Fig. 23. Pushing Against Anterior Struts of Armrest.

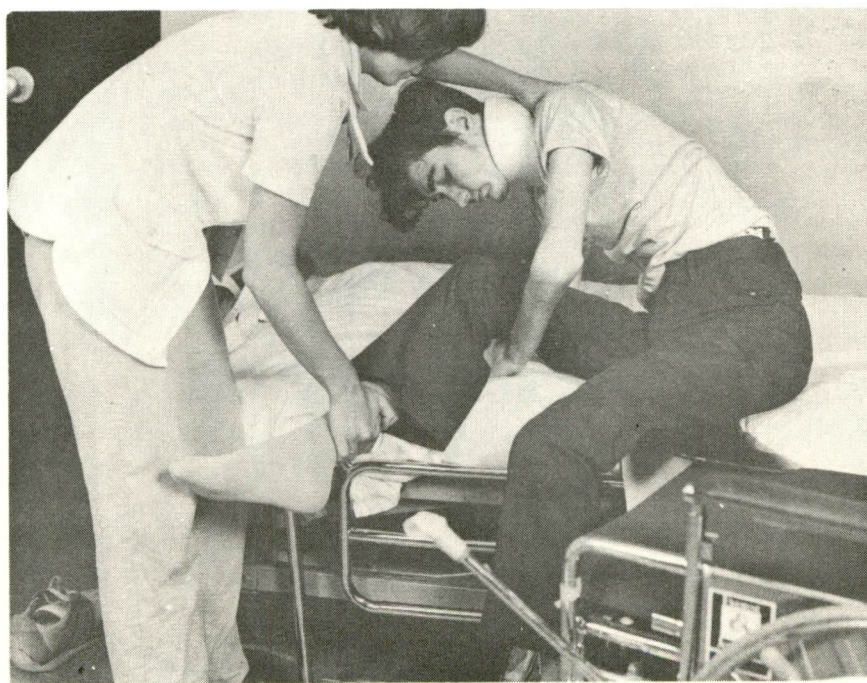


Fig. 24. Lifting Leg onto Bed with Arm.