Clinical Experiences with Triple Amputees

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INTRODUCTION

This paper explores the possibilities of rehabilitation for patients with multiple amputations. Three cases are presented involving bilateral above knee amputations with unilateral above elbow amputations. The cooperative effort of the patients who participated in this project demonstrates that the avenue to rehabilitation may be difficult, but that anything is possible with perseverance and desire.

The difficult task of providing prosthetic care for the bilateral above knee amputee is seldom underestimated. The additional insult of an above elbow amputation enhances the problems and ultimate abilities for the return of the patient to independent living. The entire rehabilitative process must be carefully evaluated and planned if hope for success is anticipated. The patient must be highly motivated. It is important not to have preconceived ideas of what the abilities of individual patients may be in spite of the extent or number of amputations.

An aggressive positive approach to the prosthetic fitting and component selection may be crucial to the success of the triple amputee. Clinical experience has shown that no physical experience the amputee goes through is comparable to actual walking on full length prostheses. To spend time and energy working on a less than satisfactory end such as "stubbies," results in and leads to only more energy expenditure and emotional stress of the patient when the next echelon prostheses are fitted. It seems to be far more successful to give the greater challenge to the patient from the beginning and pull back to more conservative choices if, after a reasonable period of trying, the patient cannot achieve the primary goal of walking with full length prostheses. By coupling the initial strong efforts of the patient with prosthetic components that offer the best chance for function and progress the patient can know that everything that can be done is being done. It must never be "too much work or effort." Extra assistance from physical therapists, more than one prosthetist or trained assistants may be necessary to cast, fit, stand and walk the patient and to protect him during all stages of walking.

Rising to a standing position and sitting from a standing position position may require more "feel" than understanding for the patient. It is most helpful when the patient can see the tasks being performed. Possibly the photo sequences in this paper may be of some assistance to that end. When standing or sitting many functions must be performed without error. Rather than dwelling on instructions of how to do tasks it may be better to gather around the patient, protect him from falling and to fully assist the patient in the tasks until he establishes the coordination and strength for the maneuvers.

A fine balance of aggressive training with an acute sensitivity to the physical and mental endurance of the patient is essential. Do not accept negative attitudes. Realize however, that each appointment is extremely stressful to the multiple amputee. The first time the patient is assisted to the standing position he is filled with anticipation, fear and some pain. Concentrate on solving one or two problems with each standing effort. Try to direct the patient to concentrate with you on the problem solving effort. It is important to direct the fitting process, particularly when the patient may stand for only a few minutes. Determine, quickly and accurately, what must be done to improve fit and alignment. Then focus on the patient to question him about the comfort and kinesthetic or positional feelings he is experiencing. If the patient can remember and recall the balanced feeling experience when standing, it can be practiced mentally and improve his performance. Do not overwork the patient during the early fitting stages; thirty to forty-five minutes will be exhausting for most patients at first. Dizzyness and heavy perspiring are not uncommon reactions when the patient stands for the first time.

When assisting the bilateral above knee/ unilateral above elbow from the seated position to the standing position two or even three people may be needed to assist. Care must be taken to keep the patient from sliding away from the chair or from allowing the knee mechanisms to flex. As the patient sits the same assistance must be intensified as loss of balance will quickly increase falling velocity and force when balance control is lost. As the patient gains strength and coordination, assistance is only gradually reduced. Generally, even experienced patients are protected while trials are being performed between parallel bars.

CASE PRESENTATION NO. 1: J.B.

The following case studies present a number of prosthetic and physical techniques that have been utilized to allow the triple amputee to sit, stand, walk, fall and rise from a fall.

Patient J. B. is a congenital amputee (Fig. 1) with a right hip disarticulation, left proximal femoral focal deficiency, a right above elbow amputation and pincer deformity of the left upper extremity. He was fitted bilaterally with Kolman safety knees (Fig. 2) with an essentially standard left

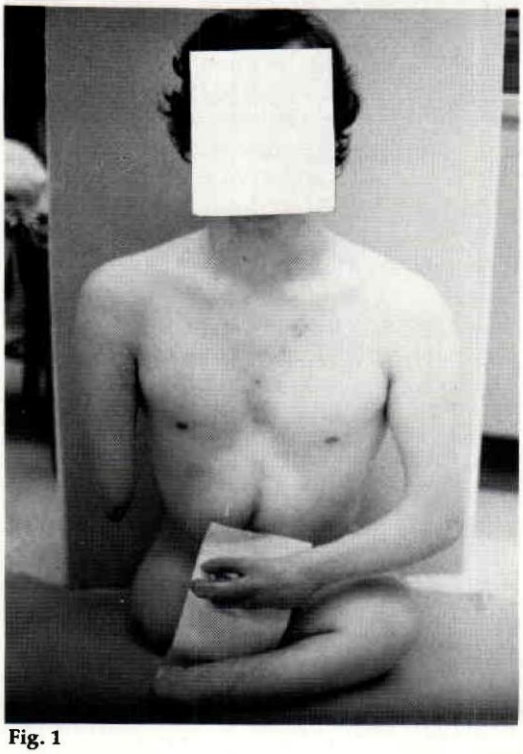

Fig. 1

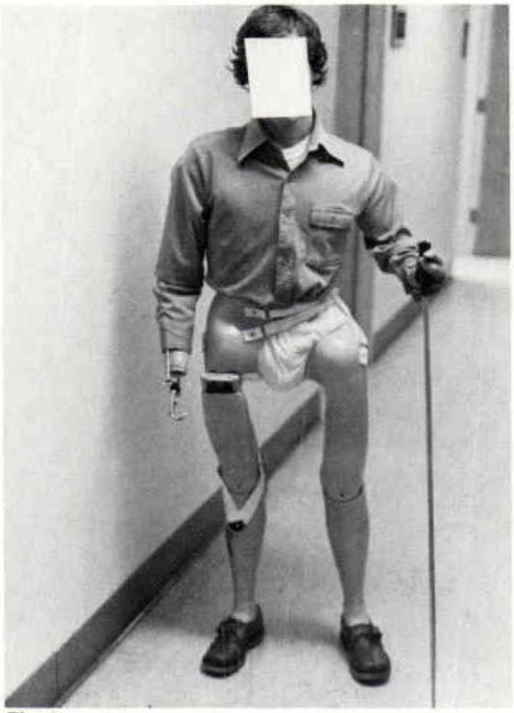

Fig. 2

hip disarticulation prosthesis, a non-standard right above knee prosthesis, both lower extremity prostheses used S.A.C.H. feet. His right above elbow is fitted with a standard above elbow prosthesis. The lower extremity prostheses (Figs. 3 and 4) required auxilliary suspension systems consisting of light weight velcro closures. These straps aid suspension of the prostheses and prevent rotation during the swing phase of the gait cycle. The hip disarticulation prosthesis required a flexible belt rather than a rigid structure so as not to interfere with the P.F.F.D. above knee side. Hip extension assist straps are seen in figure 5, to prevent excessive hip flexion on the hip disarticulation prosthesis.

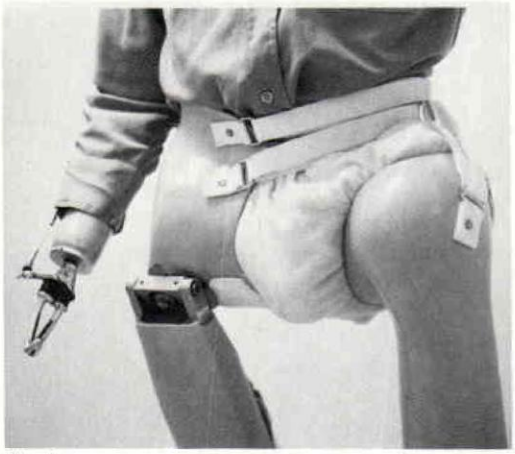

Fig. 3

Rising From A Seated Position

To rise from the seated position the subject necessarily utilized his above elbow amputation prosthesis locked in extension to act as the primary power to raise himself up. His "sound arm" elbow did not possess enough strength to assist. As weight was born on to the Kolman locking knees the weight actuated the locking mechanisms thereby affording stability and safety in standing. Forward steps are initiated (Fig. 6) by rocking to the hip disarticulation side and extending the right P.F.F.D. side forward with a flipping motion. The hip disarticulation forward step (Fig. 7) follows with a transfer of weight to the P.F.F.D. side and noticeable lateral trunk bending

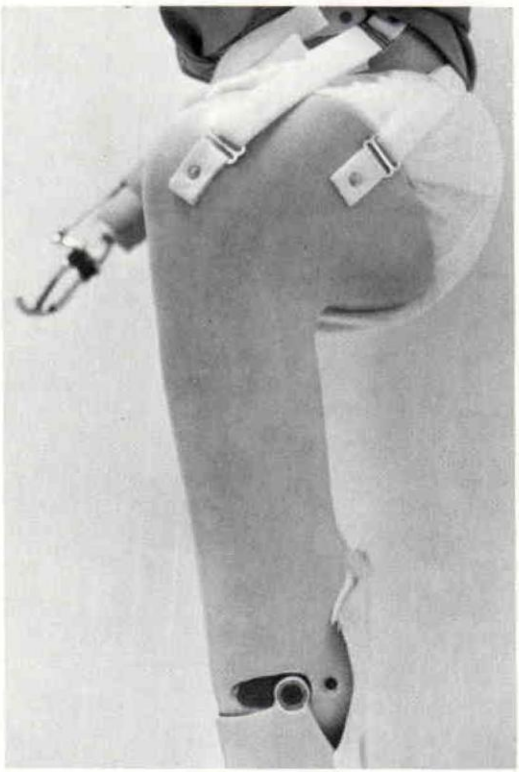

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

to that side. To sit J. B. rocks forward over the toes of the prosthesis while reaching for the chair with the locked and extended above elbow prosthesis. He then rolls around that arm until locating on the chair seat. Because the knee units are weight actuated locks, the prostheses will not unlock until he is fully seated. J. B. is shown in street clothes (Fig. 8) on his departure from the laboratory. Acceptable cosmesis was achieved. With the extent of his disabilities the wide base gait was not considered inappropriate.

CASE HISTORY NO. 2: R.H.

R. H. is a recent bilateral above knee and unilateral left above elbow amputee as a result of a power line accident. Figure 9 shows the socket designs that were fitted to this patient. Notice that the medial brims are less than ½'' wide and are carefully smoothed and rolled. The posterior medial corners of the sockets have been reduced and rounded to prevent pinching should the sockets be applied in external rotation or a misstep be taken.

R. H. was fitted with Hydra-Cadence hydraulic knee mechanisms with quadrilateral total contact plastic suction sockets. The plaid pattern was chosen by the patient for a final lamination finish. The polyester plaid material was laminated using clear acrylic resin with one or two layers of white nylon stockinette as backing.

Fig. 9

To rise from the seated position R. H. places his hand at the back of a supported chair (Fig. 10). The prostheses are placed about 18" apart. As he extends his arm he simultaneously forces his knees into extension (Fig. 11). He then pushes himself into a balanced standing position. The Hydra-Cadence knee units provide plantar flexion in the ankles allowing the knee centers to be easily maintained in a stable position during standing. As a balance point is reached (Fig. 12) R. H. takes a small forward step with the left prosthesis to bring both feet together. R. H. uses a cane for added support particularly when walking down inclines and rough surfaces. R. H. is presently the owner-manager of a machine shop working full time wearing his prostheses. For very active chores in the shop and at home "stubbies" were fabricated after the walking techniques on the full length Hydra-Cadence prostheses had been mastered. Figure 13 shows that the basic alignment of the stubbies can be duplicated from the full length prostheses. Wood blocks (Fig. 14) were laminated to the socket and ground to shape and alignment. Vibram soles from hiking boots were epoxied and nailed to the distal ends to prolong wear.

CASE HISTORY NO. 3: K.K.

The third patient K. K. is a bilateral above knee and unilateral left above elbow amputee. He is presently wearing bilateral quadrilateral total contact sockets, one suction, one partial suction with a light silesin belt. He is fitted with the Hydra-Cadence knee mechanisms. His basic alignment is no different than that of a unilateral above knee amputee (Fig. 15). A plumb line dropped from the ischial tuberosity falls with the foot slightly outset. The base of his gate measured between the heels is approximately 3½'' to 4''. Figure 16 illustrates the A-P foot position is essentially normal with the plumb bob position falling about 1'' anterior to the breast of the heel.

Fig. 10

Fig. 11

Fig. 12

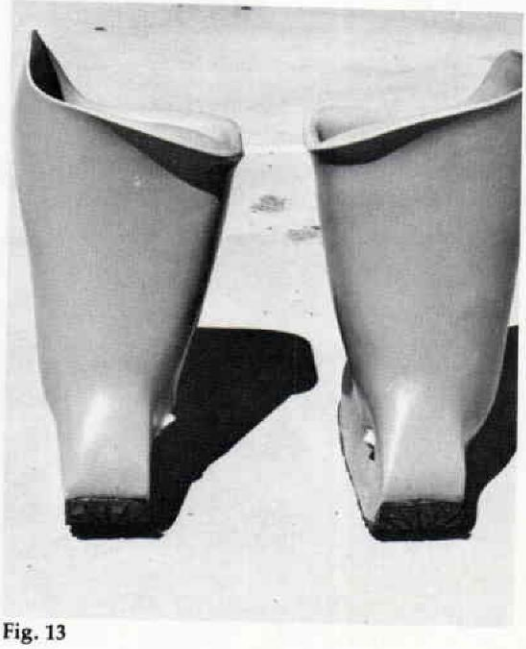

Fig. 13

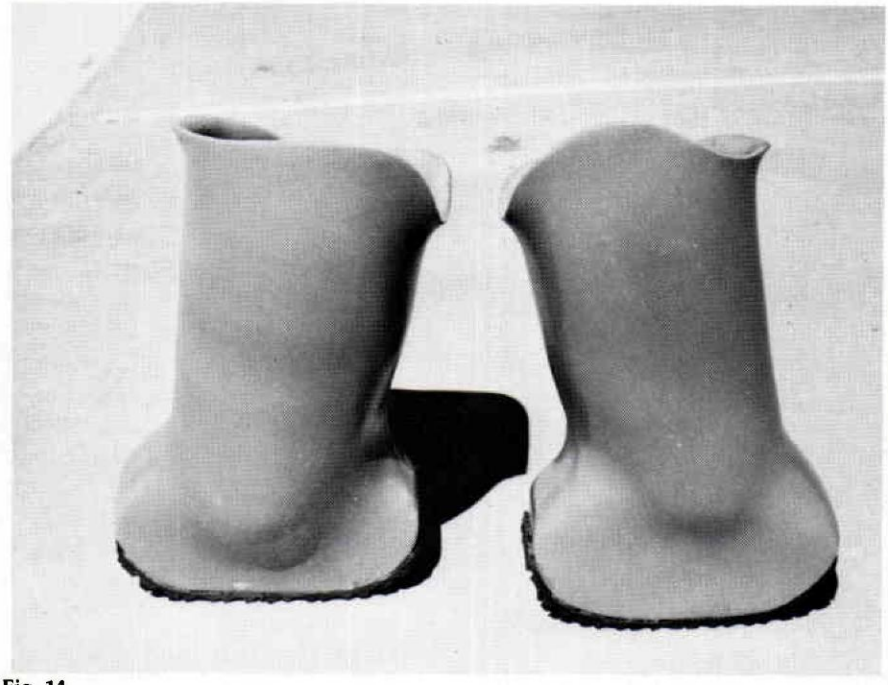

Fig. 14

Fig. 15

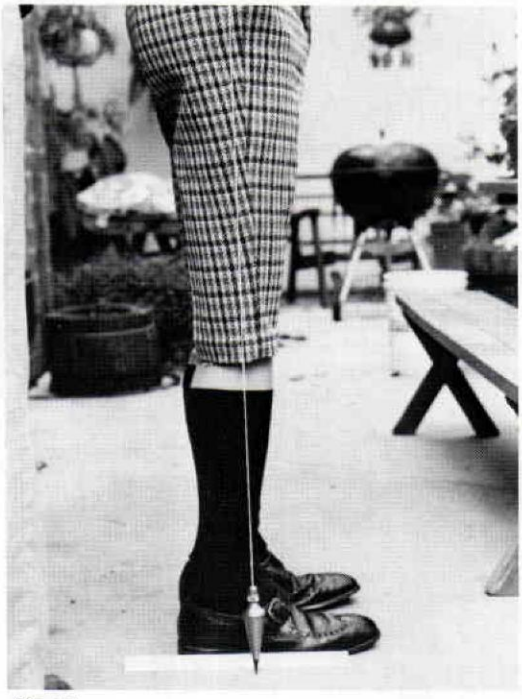

Fig. 16

Sitting Technique

Figure 17 begins a sequence of photographs of a sitting technique called the "roll and sit" technique. The patient approaches the chair face forward and places a hand on the side of the chair that it will be on when he is seated. Notice that the Hydra-Cadence units are in full extension and that the right leg is slightly forward of the left leg. In Figure 18 K. K. swings the left leg behind him crossing the right side and thereby aligning his feet in front of the chair. This is done while rolling to the lateral side of the right foot. Both knees are still extended. In Figure 19 the weight of his body transfers to the contact arm and is counter balanced by the still extended right prosthesis. The left prosthesis begins to flex, offering some guidance and positioning control by the fact that the unit's foot is on it's medial border. By extending the left residual limb against the force of the bending knee some support is afforded. This support is rather instantaneous. By pivoting his arm K. K. can lower himself safely to the seated position in Figure 20. Exceptional arm strength is required to perform this sitting sequence in a controlled manner.

A second sitting technique is used more often by bilateral above knee amputees.

Fig. 18

Fig. 17

Fig. 19

The patient positions himself in front of the chair but facing away from the chair. He is turned so that his good arm is closer to the chair. K.K. suggests pointing the hand at the chair and carefully judging its position. As he puts it "you only have to miss the chair once to understand why it is important to know its location." The hand is placed firmly on the chair (Fig. 21). By leaning slightly backwards the stability of this system now has three points.

Notice that the above elbow amputation aids in counterbalancing the weight of the body as it begins to lead towards the chair (Fig. 22). The right Hydra-Cadence unit is carefully flexed, leaving the full body

Fig. 20

Fig. 21

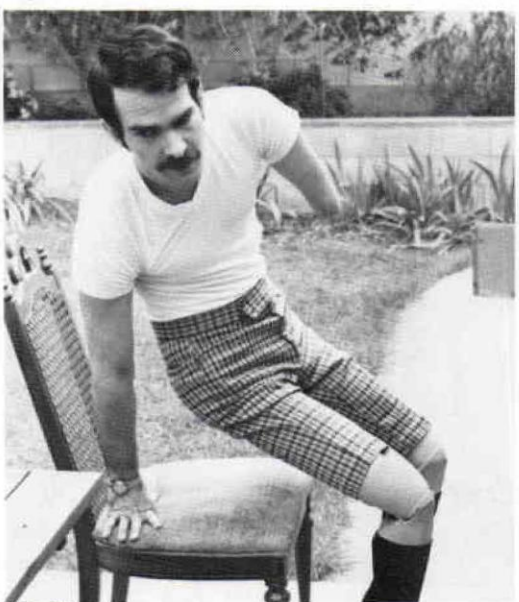

Fig. 22

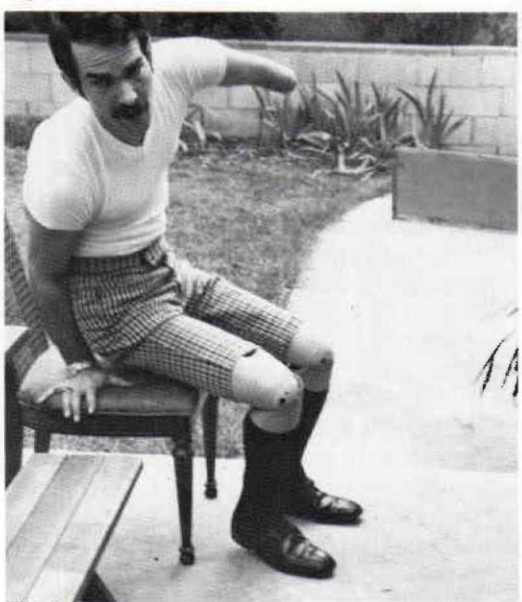

Fig. 23

weight on the left and the arm. When all weight is shifted to the arm and the right knee is flexed, the body system will quickly settle to the chair surface. A majority of body weight shifts to the arm. Notice the distance the torso is from the arm. Arm position and grip is crucial as the body descends. At this point neither Hydra-Cadence can aid in guiding the body to the chair. Any attempt to do so might shift the body weight forward thus throwing the subject to the floor. The buttocks swing to contact the arm and then slides down the wrist until contact is made with the chair seat (Fig. 23).

Rising From Seated Position

Careful positioning of the body is important to rise from the seated position in a chair that is not backed up against a solid wall or object. Force must be directed down through the chair rather than in a manner that would cause the chair to slide.

To rise from the chair, the hand is positioned directly behind the buttocks (Fig. 24). Once the body is lifted it is crucial that the position be such that an aborted standing to sitting can be safely completed. By extending the hips (Fig. 25) at the same time as the body is lifted, the knee units can be locked into extension, first the left side (Fig. 26) followed by the right side (Fig. 27). When the left side knee unit is locked into extension the safety of this standing sequence is greatly enhanced. When both units are in full extension the fingers are extended to push the torso forward balancing the body over the prostheses. K. K. now stands erect (Fig. 28) and takes a short step forward to counteract against the momentum generated during standing.

Controlled Falling

Falling to the ground can be a most devastating mishap to the bilateral above knee patient. For the triple amputee a fall presents even more of an intensified problem. It is important that the patient learn how to fall and how to rise to the standing position.

Fig. 24

Fig. 25

Fig. 26

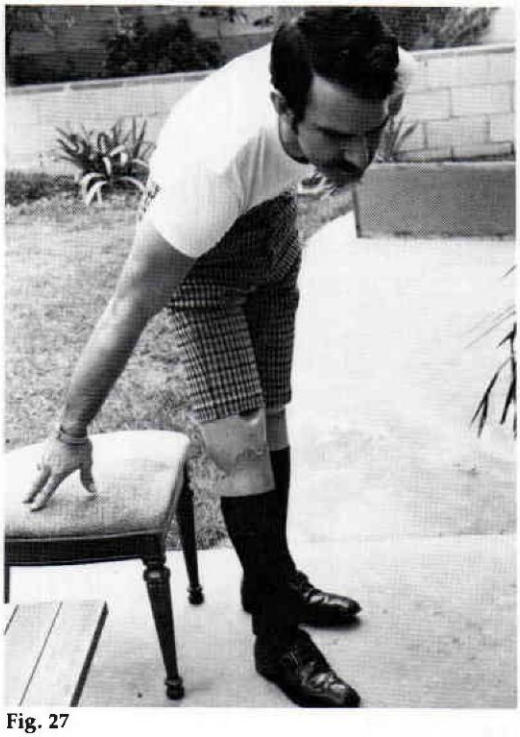

Fig. 27

Fig. 28

A demonstration of controlled falling begins by placing the right foot in front of the left (Fig. 29). As he begins to topple to the ground he bends forward at the hips to reach for his landing position with the sound arm (Fig. 30). The left knee unit is popped into flexion. By falling to the side the chances of being hurt are lessened as are the possibilities of damaging the prostheses. As the fall continues (Fig. 31) and downward velocity increases K. K. rolls around backwards so that the shock of the fall is absorbed by the buttocks and slowed appreciably by the shock absorbing action of the arm catching the fall and gradually bending at the elbow in a controlled manner (Fig. 32). It may not always be possible to control a fall. If a fall begins and any control is available at all, an attempt to twist or roll to the side should be made rather than straight down or backwards falling.

Rising From The Ground

Once on the ground or the floor, a far greater problem is how to rise to a stand-

Fig. 29

Fig. 30

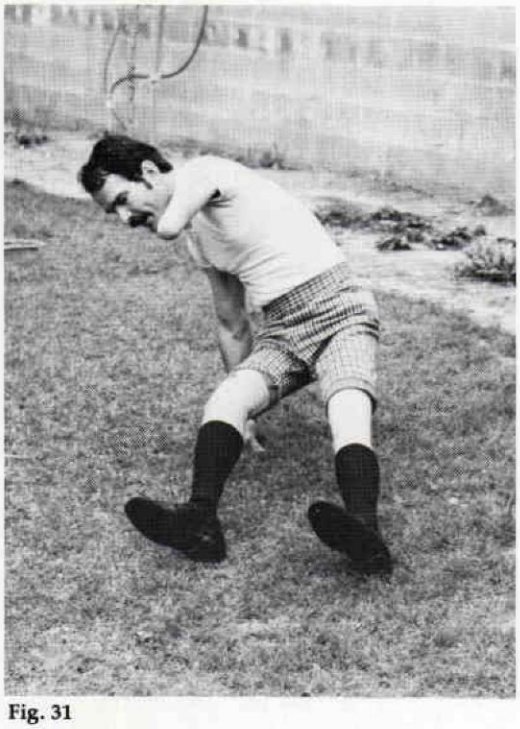

Fig. 31

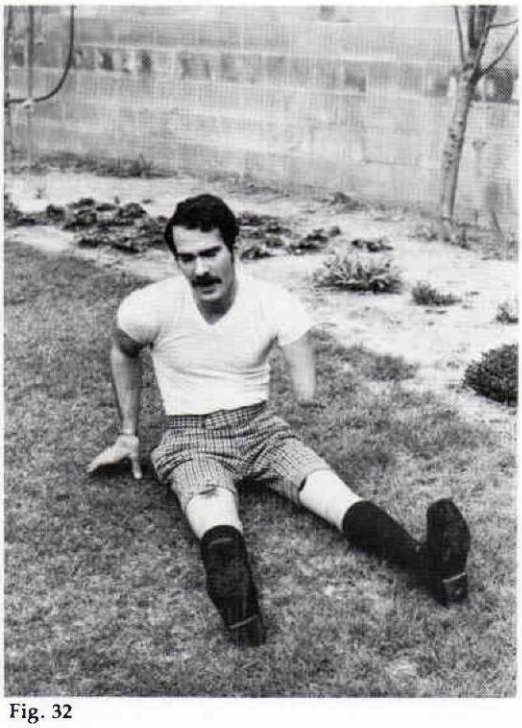

Fig. 32

Fig. 33

ing position unaided. The starting position is taken by spreading the prostheses about three feet apart. The arm is held next to the body and the elbow is bent (Fig. 33). The torso raised slightly off the ground. The pelvis is rolled to the side so that the Hydra-Cadence units are on their sides and are stable regardless of whether or not they are extended. The pelvis is now raised 1½ to 2 feet off the ground.

Fig. 34

By using a rocking, hoisting, bouncing, body english motion, K. K. hops his hand 10 to 12 inches closer to the feet position (Fig. 34). this motion is repeated and the torso is now flexed fully at the hips. By pushing forcefully but in a controlled manner the balance position over the center of gravity is achieved (Fig. 35). K. K. then returns to the upright standing position (Fig. 36). In this short sequence of photo-

Fig. 35

Fig. 36

Fig. 37

Fig. 38

Fig. 39

graphs it is easy to appreciate the agility, coordination and practice it takes to develop this technique.

An alternate technique to rise from the ground is also available to the triple amputee. First, roll on to the stomach (Fig. 37). By performing a "one-arm push-up" while forcing the body weight down through the prostheses the entire body can be raised without the knees buckling. K. K. leans forward then backward raising his buttocks higher in the air and hops his hand to a new position (Fig. 38). The process may be repeated one more time so that he is able to rock into the standing position (Figs. 39 and 40).

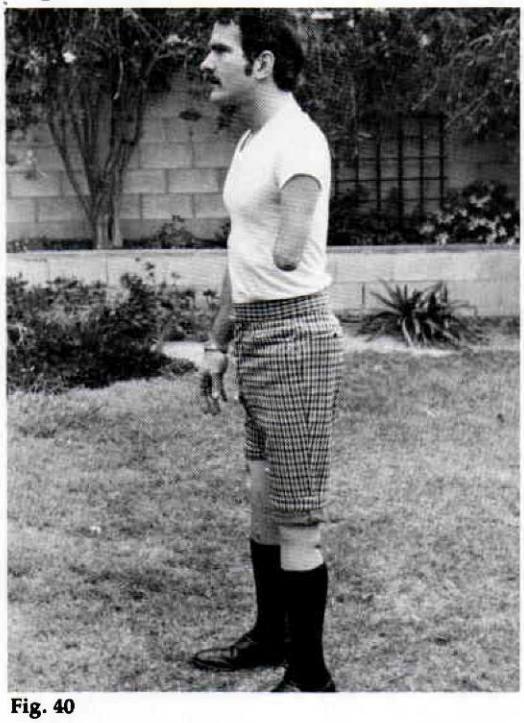

Fig. 40

Ascending and Descending Steps

Step climbing can be accomplished by the bilateral above knee amputee, unilateral above elbow only with great difficulty.

Begin by placing one foot on the step with the front of the heel catching the leading edge of the step (Fig. 41) by grasping the door jamb and pulling the body weight forward (Fig. 42) he is able to climb

the step to the position shown in Figure 43. A similar procedure is used to descend a single step (Fig. 44). K. K. grasps the door and lowers his left extended prosthesis to the lower level.

While it is not usually recommended for the bilateral above knee to descend stairs "step over step" K. K. has perfected a technique for descending at least curb height obstacles (Figs. 45 and 46). This sort of maneuver must only be attempted when tremendous confidence, not only in one's own physical abilities, but also when the knowledge and understanding of the functional capabilities of the knee mechanisms has been mastered.

The choice in this case of the Hydra-Cadence knee units required careful consideration and discussion with the patient. There are advantages and disadvantages to every knee unit. The patient must accept the facts about certain aspects of his prosthesis so that an understanding of problems and situations can be handled judiciously.

While the Hydra-Cadence is somewhat

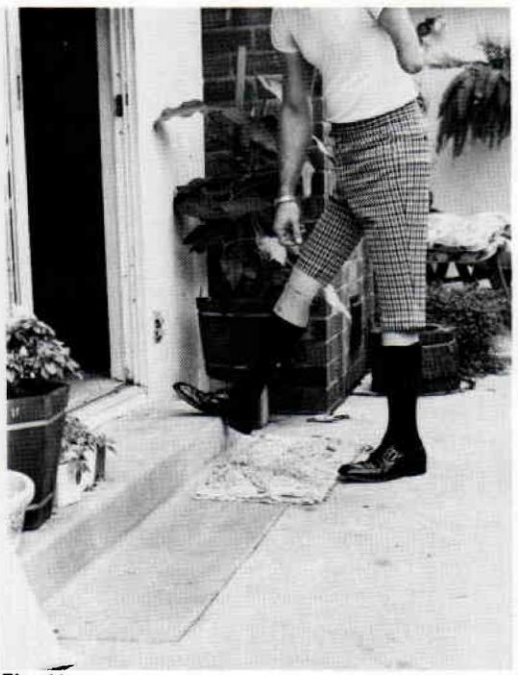

Fig. 41

Fig. 42

Fig. 43

Fig. 44

Fig. 45

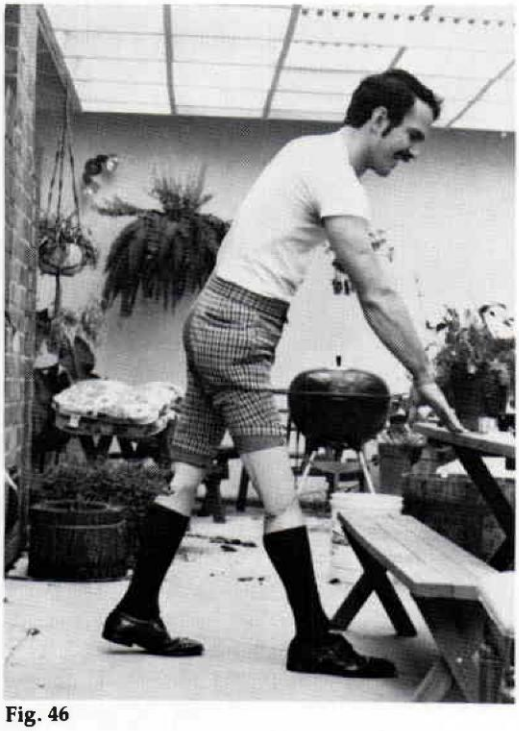

Fig. 46

heavier than other knee units, it is more sophisticated in the functional capabilities it provides to the patient. Many improvements have been made to the Hydra-Cadence knee mechanism but is a relatively complex system. As with any complicated system a certain amount of servicing may be necessary. The patient must be aware that servicing is normal. Most patients are willing to accept the trade-offs of weight, function, service and complexity because they are able to live more normally when well fitted.

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