

## **BENT KNEE PYLON FOR THE BELOW-KNEE AMPUTEE<sup>a</sup>**

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### **ABSTRACT**

Seventy-five patients with below-knee amputations have used a device called a bent knee pylon for immediate and continued ambulation prior to permanent prosthetic fitting. The advantages and disadvantages of the bent knee pylon have been described. In seven patients with knee flexion contractures, range of motion was increased with the use of the bent knee pylon.

Immediate postsurgical prosthetic fitting with ambulation one or two days postamputation was first described by Berlemont in the late 1950's (1). The results and advantages of this concept have been described by many authors in the past several years (1-5). At Fitzsimons General Hospital, this concept has been followed with minor variations. A method of early ambulation utilizing a bent knee pylon device for the below-knee amputee has been developed and used at this hospital with good results.

Most of the patients with amputations treated at the hospital sustained multiple traumatic injuries from fragment wounds. The patients arrive via medical air evacuation from the Republic of Vietnam usually 1 to 6 weeks post-injury, depending on the extent of their other injuries. While in the evacuation chain from the battlefield to the stateside hospital, the patients' stumps are left open to decrease post-injury infection; frequently skin traction is applied to minimize the retraction of skin and soft tissue from the end of the stump.

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## AMPUTEE PROGRAM

When a patient arrives at Fitzsimons, a plaster patellar-tendon-bearing socket is applied to his open stump. A pylon extension with SACH foot is fitted to the socket and the patient then walks with partial weight-bearing on the amputated side.

The patient continues ambulation and increases weight-bearing to tolerance as the healing process allows. When the stump is healed and stump maturation has occurred, permanent prosthetic fitting is carried out. Further stump revision may be necessary before permanent prosthetic fitting can be accomplished if problems result from stump length or distal scar tissue.

Following revision, the stump is placed in a rigid plaster dressing for approximately 2 weeks and the patient walks with crutches without bearing weight. The rigid plaster dressing is changed as needed during that time. Once the sutures are removed, a pylon extension is added to the plaster dressing and weight-bearing is begun again.

In some cases, split-thickness skin grafts are required as a result of open wounds and soft tissue loss of the stump. Following skin grafting, rigid dressings or pylons may not be tolerated.

## EXPERIENCE WITH BENT KNEE PYLON

When a below-knee amputee is unable to use a plaster patellar-tendon-bearing socket with pylon extension and SACH foot because of localized pressure over open wounds, adhered scar, or split-thickness skin grafts, a method for continued ambulation is needed to keep the remaining musculature of the involved extremity active.

This need has been met by a bent knee pylon which was improvised from a heavy duty Lofstrand metal cane crutch (Fig. 1).<sup>c</sup> Although this was the initial method used, the use of stock aluminum has been found to be less expensive.

With the use of the bent knee pylon for ambulation, the muscles of the hip, the quadriceps, and the hamstrings are active. Weight-bearing greatly aids balance and reciprocal action of the hip and its musculature during the walking motion. Electromyographic studies of the quadriceps and hamstrings have shown that those muscles are active during the phases of gait, similar to those of the normal extremity. If the patient is able to become full weight-bearing, his hands are free from crutches. This is a great morale factor, particularly when the patient goes home on convalescent leave before permanent prosthetic fitting.

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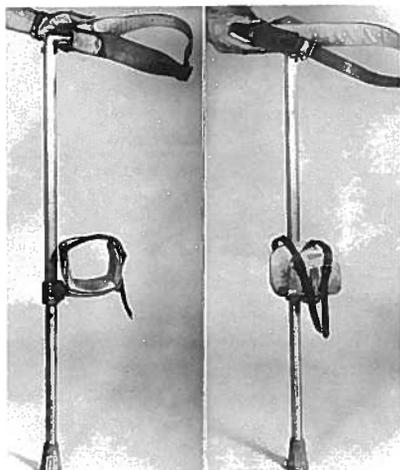


FIGURE 1.—Bent knee pylon.

From October 1969 through October 1971, 75 patients have used bent knee pylons; 64 of these patients were full weight-bearing and 11 were partial weight-bearing. There were 43 unilateral below-knee amputees; 11 bilateral below-knee amputees (Fig. 2); four below-knee, above-knee amputees; and 17 below-knee amputees with the opposite extremity also involved (such as with fracture, fused knee and soft tissue loss) (Fig. 3).

Full weight-bearing was considered as ambulation without crutches, with only one crutch or cane, or with two crutches when the opposite extremity was involved. Partial weight-bearing was considered as ambulation in the parallel bars only or with two crutches.

Initially, weight-bearing and continued ambulation were the main objectives; however, in a number of patients who had limitation of knee motion, an increase in joint motion occurred with the use of the bent knee pylon. The bent knee pylon has been used by nine patients for the specific purpose of gaining range of motion of the knee. The following brief case presentations illustrate some of the results of the use of the bent knee pylon.

*Case A.*—D.B. was injured in October 1969, sustaining multiple fragment wounds producing bilateral below-knee amputations and laceration of the right femoral artery. He arrived at Fitzsimons 6 weeks post-injury and began treatment in the physical therapy clinic 1 week later. The patient had very short stumps and bilateral knee flexion contractures of 25 deg. Although manual stretching and active exercises were used, the contractures did not decrease, probably because of the short stumps. Two weeks after treatment was begun in the clinic, the patient began to walk with crutches and bilateral bent knee pylons. After 2½ weeks of ambulation, he had normal knee extension bilaterally.



FIGURE 2.—Bilateral below-knee amputee ambulating with full weight-bearing on crutches.



FIGURE 3.—Unilateral below-knee amputee with a fracture of the opposite distal tibia and fibula. He is ambulating with full weight-bearing on crutches.

*Case B.*—F.H. was a 42-year-old retired sergeant, with a history of thromboangitis obliterans dating from 1960. In 1966, he underwent a left above-knee amputation and, in May 1971, a right below-knee amputation. In July 1971, a revision was necessary to shorten the right stump 5 cm. because of distal necrosis; the stump was then placed in skin traction. Five days later, delayed primary closure was performed and the stump was placed in a rigid plaster dressing. At that time a 15-deg. knee flexion contracture was present. Six weeks post-revision, active range of motion of the right knee had decreased to a range of 40 to 135 deg. despite the use of active and active assistive range-of-motion and quadriceps strengthening exercises. Ambulation with crutches was begun with a bent knee pylon on the right and the use of his above-knee prosthesis on the left. Two and one-half weeks later, active range of motion of the right knee was 15 to 130 deg. The patient has maintained a 15-deg. knee flexion contracture with continued ambulation and active range of motion exercises.

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*Case C.*—T.J. had a 20-deg. knee flexion contracture and increased his range of extension only 5 deg. with the use of the bent knee pylon. He maintained a 15-deg. knee flexion contracture until time of prosthetic fitting.

*Case D.*—A.B. had a 15-deg. knee flexion contracture and could flex the knee to 75 deg. After 3 weeks of ambulation on the bent knee pylon, extension was unchanged but knee flexion increased 10 deg.

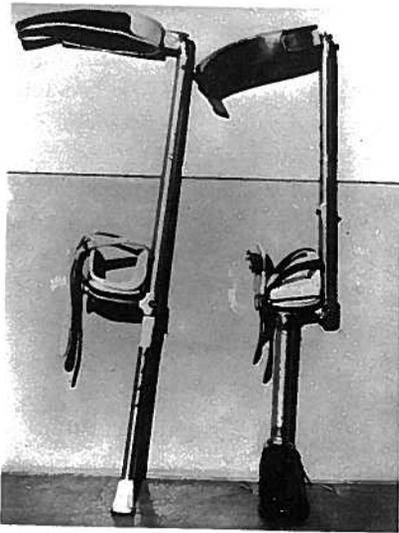
*Case E.*—D.S., one of two patients whose knee motion decreased during treatment, sustained multiple fragment wounds resulting in a right below-knee amputation, open comminuted supracondylar fractures of both femurs, open comminuted fracture of the left distal tibia and fibula, and left incomplete sciatic nerve palsy. Eight months post-injury, a split-thickness skin graft was performed to the right below-knee stump. Four weeks after skin grafting, the patient was issued a bent knee pylon. Active range of motion of the right knee at that time was 15 to 95 deg. He was full weight-bearing without the aid of crutches and went home the next day on convalescent leave. He returned to the clinic 19 days later and active range of motion of the right knee was 20 to 95 deg. The patient stated the bent knee pylon made his knee feel "tight and stiff." The right supracondylar fracture was believed to have played a major role in the decreased range of motion. The patient continued to use the bent knee pylon periodically when he wanted to carry objects that required the use of his hands.

*Case F.*—A.I., the second patient showing decreased knee range of motion, sustained multiple fragment wounds resulting in a right below-knee amputation, a left knee disarticulation, fractured right ulna, and right hemopneumothorax. Length of the right below-knee stump was 7.6 cm., and severe posterior scarring was present up into the popliteal region. Three split-thickness skin grafts were performed to the right below-knee stump and, 3½ months post-injury, active range of motion of the right knee was 30 to 95 deg. Ambulation on the bent knee pylon or plaster sockets, depending on the stump condition, was carried out along with active range of motion and passive stretching of the right knee. Five and one-half months post-injury, the patient had a 60-deg. right knee flexion contracture. Six and one-half months post-injury, a posterior knee arthrotomy with excision of torn medial meniscus, a posterior capsulotomy, and hamstring release were performed. Postoperatively, problems of skin coverage occurred and, subsequently, the patient developed septic arthritis which resulted in a right above-knee amputation 7 months post-injury. In this particular case, decrease in knee range of motion was attributed to the short stump with poor skin coverage, scar tissue posteriorly, and the torn medial meniscus.

**COMMENTS**

It should be noted that range of motion was decreased in only two out of 75 patients who ambulated on the bent knee pylon. Of nine patients who used the bent knee pylon specifically to gain range of motion of the knee, six gained both extension and flexion, and one gained flexion while extension was unchanged. Range of motion decreased in two patients noted previously who had actual knee joint injury.

Other Army hospitals have adopted the use of the bent knee pylon. In one hospital, the original form was altered by placing the distal portion of the bent knee pylon directly under the knee platform and adding a SACH foot (Fig. 4).



**FIGURE 4.**—Construction variations of the bent knee pylon.

The main disadvantage of the bent knee pylon has been the cosmetic appearance. The patient is unable to wear the bent knee pylon under his clothing. Problems also arise when the patient is sitting, since the bent knee pylon protrudes. Because of the absence of a knee hinge, the patient may have to remove the pylon when getting into a car. A few of the patients have stated that minor skin irritation occurred initially from the pelvic band over the ilium; however, this lasted only a few days and no actual skin breakdowns developed. Other patients have stated that the end of the bent knee pylon sinks in soft soil.

The bent knee pylon has been used at Fitzsimons as a temporary means of ambulation for the below-knee amputee during his period of rehabilitation. It has been used when other methods of continued ambulation

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are contraindicated. The knee can be exercised, and range of motion is not hindered. The construction is simple and economical. Excellent results have been gained and the patient's morale has been increased as a result of ambulation.

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