

## CLINICAL APPRAISAL OF THE OTTO BOCK KNEE MECHANISM

By ROBERT G. THOMPSON, M.D. and  
CLINTON L. COMPERE, M.D.

Beginning approximately six years ago, a growing number of amputee veterans have requested the replacement of their standard knee mechanism with an Otto Bock knee. (Fig. 1) Their interest in the Bock knee mechanism had been aroused either by salesmanship in the prosthetic facility, or from the few amputees who were using the knee mechanism. The Veterans Administration Prosthetic Clinic Team was at first resistant against this external influence for several reasons. For a considerable time, the Bock knee was available only through one local distributor, the majority of our prosthetic shops not having the component on contract with the Veterans Administration. The charge for the exchange of this mechanism in a prosthesis for the standard knee was approximately \$125.00. Furthermore, many of the amputees making the request for the change presented no indication or need for the special functions of the Bock knee.

During the past several years, we have had increasing experience with this knee mechanism. At the present time, the increase in cost of a new prosthesis with the Bock knee is approximately \$50.00. For certain indications, it is superior at the present to any other commercially available standard knee. The principle of operation is simple, and we have often wondered why an improved version has not been developed and licensed for manufacture in the United States. Many thousands of these Bock knees have been imported from Germany, and in some facilities the use of this knee is becoming almost standard practice.

We felt an attempt should be made to clinically evaluate the effectiveness of the knee stabilizing mechanism (Fig. 1), by a survey of above-knee amputees from the Veterans Administration Chicago Regional Office Amputee Clinic, and a similar group of amputees from the Rehabilitation Institute of

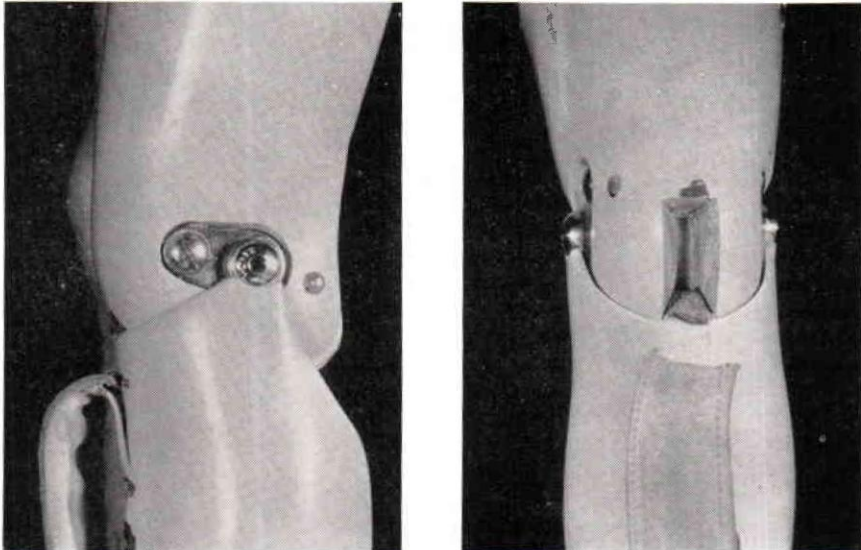


Figure 1

Chicago. The amputee patients were evaluated by questionnaire and/or direct observation. All of the Veterans Administration patients are males who have been fitted with the Bock knee within a period of the past two and one-half years, and have either mid-thigh or higher thigh amputations. All except one of the Rehabilitation Institute patients are males, and several are bilateral amputee patients. Early in the application of the Bock knee to the prescription for above-knee prostheses, our indications were limited to the following:

1. A short above-knee stump in the unilateral amputee;
2. Bilateral above-knee amputees;
3. Medium length stump in the older individual of the unilateral group;
4. Occupations where short ramps or rough ground was encountered;
5. Unilateral amputees with resistant flexion contractures of the hip.

It is our opinion that amputees with mid-thigh or longer stumps have adequate knee extension power and stability, secondary to a long stump lever arm, and normal hip extensor muscles.

Thirty-seven Veteran Administration patients and eighteen patients from the Rehabilitation Institute answered the questionnaires.

**Table I — Age Groups**

	<i>VA Patients</i>	<i>Rehabilitation Institute</i>
20 to 30 years of age .....	5	2
31 to 40 years of age .....	24	3
41 to 50 years of age .....	6	4
51 to 60 years of age .....	2	3
61 to 70 years of age .....	0	6
	—	—
	37	18

In the Veterans Administration group, all of the patients are employed with the exception of one: the occupations ranging from executives, mechanics, elevator operators, watchmen, prison guards, auto mechanics, salesmen, to students. The Rehabilitation Institute group of patients were primarily in the older age group and fourteen of this group were employed, whereas four were not employed. A predominant number of the Veterans Administration group have been using their Bock knee mechanism for at least a year, with individual experience ranging to thirty-six months. In the Rehabilitation Institute group, eleven of the eighteen patients have used a Bock knee for a year or more, whereas seven have used the mechanism less than twelve months.

In questioning the amputees as to the number of times the knee required repair or prosthetic shop adjustment, eighteen of the thirty-seven VA amputees reported that no repairs had been necessary. Three patients reported one necessary repair; eight patients noted two occasions on which repairs were needed; three patients reported necessary adjustments on three occasions; and five patients reported more than four adjustments or repairs. As to the type of repairs, seven patients reported that the knee mechanism required tightening on several occasions. Four patients reported a replacement of the leather facing material of the braking sleeves; one patient related that the front bumper had been replaced; and one patient indicated that the entire Bock knee mechanism required replacement because of defective wood in the proximal knee block. Most of the necessary repairs were minor, except for the one complete knee replacement.

Since the Rehabilitation Institute group were mainly the older, less active group, it was noted there were no significant repairs required in this group.

It is therefore evident that the Otto Bock knee stands up under considerable punishment, as our Veterans Administration group are primarily young, vigorous males in good health, who carry on a full day's activity.

The patients were requested to compare the number of falls incurred before and with the use of the Bock knee. Twenty-seven patients reported fewer falls with the Bock knee than before its application. Nine patients reported the amount of falling remained about the same with or before use of the Bock knee, and one patient reported that he had fallen on more occasions with his Bock knee, than before. The majority of the Rehabilitation Institute group are using the Bock knee as the first knee mechanism and thus have no basis for comparison.

**Table II**

	<i>VA Rehab.</i>		<i>VA Rehab.</i>	
	<i>Patients</i>	<i>Inst.</i>	<i>Patients</i>	<i>Inst.</i>
	YES		NO	
1. Do you feel that the Bock knee has slowed you down in your speed of walking? .....	6	5	31	4
2. Do you feel that you can walk faster with the Bock knee? .....	18	3	19	6
3. Does it take more effort to use this type of knee than the regular knee? .....	6	4	31	5
4. Does the Bock knee have more friction than the regular knee? .....	17	5	20	4
5. Are you satisfied with the appearance of the Bock knee as compared with the remainder of the leg? .....	32	8	5	1
6. Does the width of the knee take away from the over-all appearance of the leg? .....	5	2	32	7
7. Does it help you to go upstairs? .....	11	8	26	1
8. Does it help you to go downstairs? .....	23	9	14	0
9. Does it help you in climbing ramps? .....	24	8	18	1
10. Does it help you in going down ramps? .....	29	9	8	0
11. Does the knee appear to be wearing out? .....	3	0	34	9
12. Does the Bock knee make any objectionable noise? .....	10	4	27	5
13. Would you go back to using the standard type of knee mechanism? .....	4	0	33	9

In evaluating the answers to the specific questions as noted in Table II, only nine of the Rehabilitation Institute patients have had sufficient experience with the prosthesis from which to draw valid conclusions. The total number answering the questions reported in Table II is forty-six. It is noted that thirty-five patients of the total group indicate that the Bock knee has not slowed down their speed of walking; however, when extra speed was required, twenty-one of the entire group state that they can walk faster with the Bock knee than with the standard type of constant friction knee.

Because of the greater possibility of friction within this knee mechanism, it was thought that more effort would be required to use this type of knee than the standard knee mechanism. However, thirty-six patients indicated that no more effort was required, while only ten indicated that more effort was required to use the Bock knee. Twenty-two patients indicated the presence of more friction in the Bock knee than in the standard knee, whereas twenty-four believe that there is no increase in the amount of friction.

The general appearance of the knee as compared with the rest of the leg was stated to be satisfactory by forty of the patients of the group, whereas six patients considered the appearance unsatisfactory. The one woman patient indicated that she did not consider the knee mechanism as attractive as the standard type knee. This is primarily because the Bock knee mechanism comes in only one width size, and for those patients who require large sockets, the narrow width of the knee detracts from the overall appearance.

The patients are agreed that the Bock knee is a definite improvement over the standard knee mechanism. With regard to going up and down stairs, a majority feel that it is a definite aid going down stairs but that it is less advantageous in going up stairs. Performance on short ramps and inclined planes, however, is reversed, with thirty-two patients stating that the knee is a definite help in climbing ramps, whereas nineteen expressed a contrary opinion. In going down inclined planes, thirty-eight patients favor this mechanism, while eight do not.

Forty-three patients feel that the knee is satisfactorily durable. Objectionable noises were complained of by fourteen patients, versus thirty-two patients who have no complaint regarding noise.

The final question was answered overwhelmingly in favor of the Bock knee, with forty-two patients indicating no desire to change back to the constant friction knee; four patients make no choice between the Bock knee and the other.

### Summary

The Bock knee is a simple braking mechanism that will slow or prevent involuntary flexion of a prosthetic knee joint when the body weight is placed on a partially flexed above-knee prosthesis. This is providing, however, that the amount of initial knee flexion is between 130 and 160 degrees. If the weight is suddenly borne on a prosthetic leg in which the amount of knee flexion is beyond 160 degrees, then the braking mechanism ceases to be effective, and the knee will continue into further involuntary flexion and the patient may fall. Patients who have mid-thigh or shorter amputation stumps usually do not have sufficient strength in remaining musculature, or sufficient prosthetic stability available to hyper-extend their prosthesis and thus prevent falling. In this survey, the patients clearly expressed their opinion that the Otto Bock knee mechanism provided sufficient braking power to lessen the number of accidental falls. This survey also indicates that the mechanism wears well, as patients who have used it regularly for more than a year do not feel that it wears out any faster than the regular knee mechanism. It is further pointed out that walking down stairs, down short ramps, or inclined planes was definitely aided by the use of the Bock knee, but that it does not have much to offer in climbing stairs, ramps, or inclined planes.

The Bock knee mechanism has a very high amputee acceptance, as revealed by the answers to our questionnaire. It is an acceptable knee-braking mechanism when judiciously prescribed.