BELOW THE KNEE AMPUTATION FOR ISCHEMIC GANGRENE

Comparative Results of Conventional Operation and Immediate Postoperative Fitting Technique

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The most critical factor in rehabilitation of the geriatric lower-extremity amputee on a prosthesis is preservation of the knee joint. Several reported series have established that most amputations below the knee will heal despite extensive vascular occlusive disease [1-4]. Satisfactory healing appears to be a direct result of attention to atraumatic surgical detail, especially in the careful management of skin closure.

A new technique for the postoperative management of the amputee has recently been introduced. A temporary prosthesis is applied at the time of operation, which permits limited weight-bearing ambulation by the first or second postoperative day [5-14]. This method offers the...
amputee early mobility and accelerated rehabilitation. However, before recommending this technique for patients with occlusive vascular disease, it is necessary to determine whether a rigid dressing and immediate ambulation would tend to compromise wound healing in marginally vascularized tissue. There is no justification in risking failure of primary healing simply to accelerate rehabilitation; however, if the immediate postoperative prosthesis does not compromise healing, the advantages of early mobility and accelerated rehabilitation should encourage the use of this technique. In this study we evaluated both the standard below the knee amputation and amputation with immediate postoperative fitting of prosthesis (IPOP). We compared the results of these two types of treatment performed in a homogeneous population of veterans by a surgical staff who used identical criteria for selecting amputation at the below-knee level.

**MATERIAL AND METHODS**

*Group I.* From 1961 to 1966, 55 below the knee amputations were performed on 53 patients, using standard operative technique and postoperative management.

*Group II.* From 1966 to 1971, 53 below the knee amputations were performed on 47 patients with immediate application of a prosthesis and postoperative ambulation. The hospital records were analyzed to determine similarity of the two groups of patients and to compare the results of management.

*Age.* The average age of the patients in the standard amputation group was 63 years. The average age of the patients who received immediate postoperative prostheses was 59 years. A comparative analysis of age by decade is shown in Figure 1.

*Selection of Amputation Level.* All patients with ischemic gangrene who were not suitable for amputation of a toe or partial amputation of a foot were considered candidates for below the knee amputation. The only contraindication to below the knee amputation was gangrenous changes in the skin at the site of incision. No patient was excluded on the basis of oscillometry, absence of popliteal pulse, changes in temperature, loss of hair, or arteriography.

*Diabetes.* Figure 2 compares the incidence of diabetes in the two groups. The diabetic patients were further subdivided into those with and those without concomitant occlusive disease of large vessels (Fig. 3). Diabetic patients are considered better candidates for below the knee amputation since their major arterial supply is usually intact and the distal gangrene is often a result of localized, necrotizing infection. However, primary healing is less likely in diabetic patients with concomitant occlusive disease of large vessels. The incidence of diabetes
Figure 1.—An analysis of age by decade in the two amputation series shows a relatively equal distribution between the two groups.

Figure 2.—The incidence of diabetes mellitus was equal in the two amputation groups.
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DIABETICS WITH POPLITEAL OR PEDAL PULSES

- 29% 16 AMPUTATIONS
- 17% 9 AMPUTATIONS

DIABETICS WITH LARGE VESSEL DISEASE

- 27% 15 AMPUTATIONS
- 42% 22 AMPUTATIONS

Figure 3.—The incidence of large vessel occlusive disease with diabetes was twice as great in the immediate postoperative prosthesis group.

in the two groups was similar: 56 percent of the patients who had standard amputation had diabetes and 58 percent of the patients who had immediate postoperative fitting of the prosthesis had diabetes. However, when the diabetic patients were subdivided into those with concomitant disease of the large vessels, only 27 percent of the standard amputations were performed on diabetic patients with occlusive disease of large vessels, but 42 percent of below the knee amputations on patients with IPOP were performed on this higher risk group.

Pulses. The level of the most distal palpable pulse in the two groups is shown in Figure 4. Forty-two percent of the patients who had the standard amputation had palpable popliteal pulses, but only 23 percent of patients with IPOP had palpable popliteal pulses, suggesting that as a group, the patients who received IPOP had more extensive vascular disease.
LOWEST PALPABLE PULSE

TABLE

<table>
<thead>
<tr>
<th>Level</th>
<th>Standard</th>
<th>Immediate Postoperative Prosthesis</th>
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<tbody>
<tr>
<td>Aorta</td>
<td>4% 2 amputations</td>
<td>0%</td>
</tr>
<tr>
<td>Femoral</td>
<td>47% 26 amputations</td>
<td>68% 36 amputations</td>
</tr>
<tr>
<td>Popliteal</td>
<td>42% 23 amputations</td>
<td>23% 12 amputations</td>
</tr>
<tr>
<td>Pedal</td>
<td>7% 8 amputations</td>
<td>9% 9 amputations</td>
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Figure 4.—The incidence of palpable popliteal pulses in the standard amputation group was twice as great as that in the immediate postoperative prosthesis group.

Ambulatory Status. The patients' ambulatory status prior to the development of gangrene was evaluated, so that the rehabilitation rates in the two groups could accurately be compared. The pregangrenous ambulatory status is also of value in comparing the general debility of the two groups. The ambulatory status of the two groups was essentially equal (Fig. 5). An IPOP was applied in nonambulatory patients to take advantage of any benefit from the rigid dressing, but without the expectation of future ambulation.

Previous Vascular Surgery. As vascular surgeons, we are primarily interested in preventing amputation by arterial reconstruction, or, in the instance of irreversible ischemia, to improve the chance of healing a more distal amputation site by providing a better blood supply. Because of this approach, patients in both groups were evaluated with pan-extremity angiography. Major occlusive lesions in the aortoiliac system were bypassed with a prosthetic graft to provide revascularization of at least the profunda femoris artery. In some cases sympathectomy was also performed. When the arterial occlusion was distal to the pop-
The ambulatory status prior to the development of gangrene was essentially equal in the two groups.

The incidence of these various vascular operations in the two amputation groups is compared in Figure 6. Each vascular procedure was performed essentially the same number of times in the standard and in the IPOP group.

Figure 6.—Previous vascular surgery was performed equally in the two amputation groups.
OPERATIVE TECHNIQUE AND POSTOPERATIVE MANAGEMENT

The technique for standard below the knee amputation has been described previously [3]. A circular incision is made without skin flaps. The circular incision is developed through each tissue layer at successively proximal levels, so that bone division occurs 2 to 3 in. proximal to the skin incision. The fibula is divided so that it is ½ in. shorter than the tibia and a 60 deg. bevel is applied to the anterior tibial surface. The skin is closed in a transverse direction and the resulting dog ears at both ends of the incision are allowed to contract and mature with time. The closure is performed in a careful, atraumatic fashion. Tissue forceps are not used. The stumps are dressed with fluffs. A posterior plaster splint is applied to prevent knee flexion. After the wound heals the patient receives physiotherapy for shrinkage of the stump and is taught conditioning exercises in preparation for fitting of the prosthesis and subsequent gait training.

The surgical technique is modified somewhat in patients who receive an immediate postoperative prosthesis [12]. A total posterior flap, consisting of skin, subcutaneous tissue, and fascia, is constructed and no anterior flap is used. The anterior skin incision is made at the same level as the bone division. The fibula is divided so that it is ¼ in. shorter than the tibia. The anterior surface of the tibia is beveled at 60 deg. The total stump length ranges from 4 to 7 in. and the optimal length is 5 in.

In 34 of the 53 amputations the anterior tibial and gastrocnemius-soleus muscle groups were fixed to the tibia (tension myodesis) by passing mattress sutures through the muscle and into holes drilled on the anterolateral and posterior aspects of the tibia. Thirteen amputations were drained with a Hemovac® tube, brought out through the plaster cast; the remainder were closed without drainage. The skin and fascia were meticulously closed without the use of tissue forceps. The posterior flap was tailored to avoid dog ears. The dressing and immediate postoperative prosthesis were applied using the Burgess technique [6].

On the morning of the first postoperative day the patient stands with assistance. Thereafter, training in ambulation is continued in the department of physical medicine, at which time weight-bearing on the newly amputated side is limited to 5 or 10 lb. of compression. On the 10th postoperative day the cast is changed, the wound is inspected, and a new prosthesis applied. This is repeated on the 20th postoperative day, when the patient is fitted with either a permanent prosthesis or another plaster prosthesis, depending on the progress of wound healing.
RESULTS

Healing. The two techniques were compared with respect to primary healing, secondary healing, and failure of healing which required higher amputation (Fig. 7). In the patients who received an immediate postoperative prosthesis the primary healing rate was 85 percent, as compared to a primary healing rate of 58 percent with the standard procedure. Only 11 percent of the IPOP group required revision to a higher level, but in 24 percent of the standard group the wound failed to heal and a higher revision was required.

To compare the results of the two techniques of operation on patients with vascular disease of similar extent, subgroups arranged according to the level of the most distal palpable pulse were established. The number of patients with primary healing, secondary healing, or healing failure were compared in each pulse subgroup according to the two methods of therapy. The results are summarized in Table 1. When the femoral pulse was the most distal palpable pulse, the failure rate was 25 percent in the standard amputation group and only 16 percent in the IPOP group. When the popliteal artery was the most distal palpable pulse, the failure rate in the standard amputation group was 18 percent as compared to no failures in the IPOP group.

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<thead>
<tr>
<th></th>
<th>STANDARD</th>
<th>IMMEDIATE POSTOPERATIVE PROSTHESIS</th>
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<tr>
<td>1st HEALING</td>
<td>53%</td>
<td>28 AMPUTATIONS</td>
</tr>
<tr>
<td>2nd HEALING</td>
<td>23%</td>
<td>12 AMPUTATIONS</td>
</tr>
<tr>
<td>FAILURE REQ.</td>
<td>24%</td>
<td>13 AMPS</td>
</tr>
<tr>
<td>HIGHER AMP</td>
<td>11%</td>
<td>6 AMPS</td>
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Figure 7.—An analysis of healing revealed superior results with immediate postoperative prosthesis; the healing failure rate with IPOP was only 11 percent as compared to 24 percent in the standard amputation group.
<table>
<thead>
<tr>
<th>Lowest Palpable Pulse</th>
<th>Primary healing</th>
<th>Secondary healing</th>
<th>Healing failure</th>
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<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>IPOP</td>
<td>Standard</td>
</tr>
<tr>
<td>Aorta</td>
<td>15/24</td>
<td>62%</td>
<td>3/24</td>
</tr>
<tr>
<td>Femoral</td>
<td>24/36</td>
<td>81%</td>
<td>1/36</td>
</tr>
<tr>
<td>Popliteal</td>
<td>10/22</td>
<td>45%</td>
<td>8/22</td>
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<tr>
<td>Pedal</td>
<td>12/12</td>
<td>100%</td>
<td>0/22</td>
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<tr>
<td></td>
<td>5/4</td>
<td>75%</td>
<td>1/4</td>
</tr>
<tr>
<td></td>
<td>4/5</td>
<td>80%</td>
<td>1/5</td>
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Mortality. The 30 day mortality in the standard amputation series was 15 percent. There were no deaths in the IPOP group. The causes of postoperative death in the standard group were pneumonia (three patients), myocardial infarction (three patients), and miscellaneous causes (two patients).

Complications (Nonfatal). The postoperative complications in the two operative groups are compared in Table 2. Noteworthy is that the stump became infected in 14 percent of the patients in the standard amputation group as compared to 2 percent in the IPOP group. Pressure necrosis occurred in two patients in the IPOP group. In both patients pressure necrosis resulting from improperly applied Ace® bandages occurred after the plaster cast was removed. Healing eventually occurred in both patients, but their hospital stay was prolonged.

Rehabilitation. To assess rehabilitation rates in the two treatment groups, the total number in each group who were potentially available for prosthetic rehabilitation includes all those living, successfully healed patients who had been ambulatory prior to the onset of gangrene. Results of rehabilitation are analyzed in Figure 8. Ninety-one percent of the IPOP group had uninterrupted success in prosthetic rehabilitation as compared to 62 percent in the standard group. Nineteen percent of the standard group were finally rehabilitated after a short delay, usually due to second wound healing. Nineteen percent of the standard group could not be rehabilitated on a prosthesis and treatment was considered a failure. There were no rehabilitation failures in the IPOP group.

The average time from operation to placement of a permanent prosthesis was 125 days in the standard group. The average time for the IPOP group was 32 days.

COMMENTS

In a true experimental study both methods would have had to be performed concurrently and each patient randomly allocated for one or other techniques of amputation-rehabilitation. However, when we

<table>
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<th>Table 2.—Complications (Nonfatal)</th>
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<tr>
<td><strong>Complication</strong></td>
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<tr>
<td>Infection</td>
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<tr>
<td>Hematoma</td>
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<td>Pressure necrosis</td>
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<tr>
<td>Myocardial infarction</td>
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<td>Acute tubular necrosis</td>
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</table>
REHABILITATION
OF LIVING, SUCCESSFULLY HEALED BKS WHO WERE
AMBULATORY PRIOR TO NEED FOR AMPUTATION

SUCCESS 62% 22 PATIENTS
91% 32 PATIENTS

DELAYED SUCCESS 19% 7 PATIENTS
9% 3 PATIENTS

FAILURE 19% 7 PATIENTS
0%

STANDARD
IMMEDIATE POSTOPERATIVE PROSTHESIS

FIGURE 8.—There were no patients who failed to walk on a prosthesis in the immediate postoperative prosthesis group as compared to a 19 percent failure rate in the standard amputation group.

evaluated factors such as age, extent of vascular disease, presence of diabetes, and previous vascular reconstruction, we found that the two groups were remarkably similar and, for purposes of comparing the results of these nonconcurrent series, were well matched.

The obvious advantage of accelerated rehabilitation with an immediate postoperative prosthesis, when compared with the standard amputation technique, is not unexpected. However, the dramatic superiority of the immediate postoperative prosthesis is evidenced by a higher incidence of primary wound healing, a lower complication rate, and a reduction of postoperative mortality to zero which are all unexpected benefits and are actually of greater significance than is rapid rehabilitation.

In assessing the various factors that have contributed to improved healing in the IPOP group, the use of the long posterior flap must be considered. It has been appreciated that posterior skin, in addition to
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being skin of better quality at the below-knee level, also has a better blood supply. Thus there is a good argument for avoiding thin anterior skin and using instead the better quality posterior skin by constructing a longer posterior flap. Another factor favoring healing in the IPOP group is the use of a rigid dressing which prevents postoperative edema and improves healing in marginally vascularized tissue. The rigid dressing also immobilizes the wound and protects it from external trauma, both of which enhance healing. The rigid dressing provides a matrix for the incorporation of the immediate prosthesis. In medical centers that do not have a prosthetic service, the use of a long posterior flap and a rigid plaster dressing may improve the rate of wound healing. Ambulation on an immediate fitting prosthesis may further enhance wound healing by reducing edema through additional compression when the patient is standing. Another factor which may favor healing is improved blood flow in the stump when the patient is in the upright position because of the gravitational influence on the collateral circulation.

The reduction of postoperative mortality to zero in the IPOP group is attributed to the elimination of complications that might otherwise have occurred with bedrest if these patients had not been immediately ambulatory. This is in contrast to a 15 percent mortality in the standard group, which was probably due to pneumonia or thromboembolic complications. Although it might be assumed that physical therapy beginning on the first postoperative day would increase the incidence of postoperative myocardial infarction, this has not been the case. In fact, the incidence of postoperative myocardial infarction in the group with immediate fitting was less than that of patients with standard amputation.

The accelerated rate of rehabilitation is the expected result of an immediate postoperative prosthesis and this has been confirmed in the present series. An average of 125 days elapses in the standard amputation group before a permanent prosthesis is fitted, as compared with only 32 days in the immediate fitting group. This, combined with the incidence of prosthetic rehabilitation of 85 percent in the standard group as compared with 100 percent in the immediate fitting group, has obvious economic implications for the patient, his family, and the community.

SUMMARY

Two techniques of below the knee amputation-rehabilitation are presented. The results of a standard operative technique are compared with those of amputation with immediate postoperative fitting of a prosthesis. In every parameter of comparison the group receiving an
immediate postoperative prosthesis was superior as evidenced by a zero mortality compared to 15 percent in the standard group, an 85 percent primary healing rate compared to 53 percent, and 100 percent rehabilitation compared to 85 percent. The time from amputation to fitting of a permanent prosthesis was 32 days in the group with an immediate postoperative prosthesis as compared to 125 days in the standard amputation series. A combination of factors comprising the immediate postoperative prosthesis program, including a long posterior flap, rigid dressing, and immediate ambulation, seems to account for the improved results in this amputation series.

REFERENCES

Edward A. Stemmer (Long Beach, Calif.): Doctors Moore, Hall, and Lim have presented a well-analyzed study demonstrating remarkable success with the application of immediate postoperative prostheses. It appears that this technique enables successful below the knee amputations to be performed regardless of the level of temperature change, hair loss, sensation, or arterial pulsation. Even the absence of angiographically demonstrable major vessels or collaterals in the limb was not a contraindication to below the knee amputation.

Our own experience with lower-extremity amputations differs somewhat from that presented. In the past 4½ years, 85 above the knee amputations were performed for vascular insufficiency. The 14 percent operative mortality in the group is comparable to that observed in the authors' control group of below the knee amputations. Forty-one below the knee amputations were performed for vascular insufficiency, with one death from myocardial infarction (2.5 percent). Immediate postoperative prostheses were not employed. Four patients died of myocardial infarction, and six died of a variety of causes such as diabetic acidosis, sepsis from other sources, mesenteric occlusion, and gastrointestinal hemorrhage. Only three patients died from pneumonia, and one of these was admitted with far advanced pneumonia. Thus, from the standpoint of mortality it is difficult to understand how early ambulation on a temporary prosthesis would have improved matters very much even in our patients with above the knee amputation.

Admittedly, we are less liberal than the authors in our indications for below the knee amputation although, like the authors, we are strongly in favor of preserving the knee joint and do not hesitate to attempt a below the knee amputation in situations where the possibility of healing seems to exist.

Several years ago we participated for a short period in a national study on the use of immediate postoperative prostheses. The technique worked very well after amputations for tumors, trauma, or chronic infection. However, when we applied this technique in patients with ischemic gangrene, three of four patients required higher amputations shortly thereafter. After this unhappy but admittedly small experience we abandoned IPOP for vascular disease. Perhaps this is unfair, and on the basis of the present study we may have to revise our opinion. Mortality considerations aside, if immediate postoperative prosthesis has advantages in terms of ultimate rehabilitation, frequency of primary healing, and shortened hospital stay, the technique should be employed more widely.

I would like to ask the authors several questions: 1. How many above the knee amputations were performed and what was the mortality?
2. What are their indications for above the knee amputation? 3. What do they think their healing results would have been if long posterior flaps had been used in the control group as well? 4. How many of their patients fitted with permanent prostheses use their prostheses regularly? 5. What was the length of hospital stay in the two groups? 6. Did they proceed with below the knee amputation if there was minimal tissue bleeding at the site of below the knee amputation?

Leonard D. Rosenman (San Francisco, Calif.): This has been a superb presentation, consistent with everything Doctors Moore and Hall have done in this field.

I want to remind you that some patients who have below the knee amputation, who have a good blood supply at least to the extent of pulsatile popliteal arteries, could equally well have Syme's amputation. In other words, there is a choice other than amputation of the foot and below the knee, that is, amputation at the level of the ankle.

Three years ago I discussed our experience with Syme's amputation and Doctor McKeever challenged our results. When I reported 11 successes in 15 patients, he said further experience would reduce the percentage of success. He was correct.

In the intervening years at our hospital we have performed six Syme's amputations, four of which have failed. We have come to realize that the primary reason for failure is poor selection of patients who have ischemia which is too advanced.

Those patients whom I consider ill-advised for this procedure had high femoral arterial occlusions, inflow limited by partial iliac occlusion, and the like. One patient, for example, had undergone femoropopliteal endarterectomy which was successful for many years; then occlusion, thrombosis of the distal system, and acute advance of ischemia occurred. A bloodless Syme amputation flap meant failure.

Poor technique caused one failure. The surgeon, in making the flap, was not conscious of the need to preserve the remaining portion of the posterior tibial artery when dissecting behind the malleolus.

We have had no experience with immediate fitting of prostheses after Syme's amputation. I believe Doctor Moore's approach may be used in some patients.

Carleton Mathewson, Jr. (San Francisco, Calif.): I do not want to object to Doctor Moore's results because I think they are excellent. However, I do disagree very vehemently with him on trying to compare the result of a guillotine operation with those of a planned operation.

The operation he describes is the type of operation they undertake with an immediate postoperative prosthesis, which is exactly the operation we have been performing for years to preserve the blood supply to the below-knee stump. The guillotine operation, which they em-
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ployed routinely in patients in whom they did not apply a prosthesis, is certainly not comparable to the operation they have described.

I had the very unfortunate experience during World War II of visiting a number of hospitals to determine why there was so much difficulty with guillotine operations. This was a routine procedure. Someone looked up the definition of “guillotine” and it meant “to chop off.” The skin and subcutaneous tissue and the bone were chopped off all at one level, leaving a stump with bone sticking out peripherally, the muscles next, and the skin retracted. I simply want to emphasize to the younger members of the society that good results can be obtained with below the knee amputation without a postoperative prosthesis if the technique described for below the knee amputation is carried out.

There is one other point I would like to make. If a postoperative prosthesis is not to be used, a compression bandage must be applied to prevent edema and the knee joint must be immobilized to keep it from contracting.

Finally, if you amputate below the knee and find no blood supply at that level, then above the knee amputation is necessary.

F. William Blaisdell (San Francisco, Calif.): Since I was responsible for those guillotine amputations, and since I was trained by Doctor Mathewson, I thought I had better try to clarify the problem a little. The first series of operations were not guillotine operations, the word, guillotine, meaning to chop everything right through at one level. The attempt in this particular series of operations was to avoid flaps when possible. The reason is that when you create a flap, the portions of the skin on the margins have different degrees of blood supply. The use of a circular incision gets away from this problem.

I think the first series speaks for itself. The ratio of below-knee to above-knee amputations in that series was something like 2 to 1. If enlightened surgery is being done, the incidence of below the knee amputations should always exceed that of above the knee amputations. The incidence of successful below the knee amputations should essentially be the same as the incidence of successful above the knee amputations. A below-knee amputation requires good, meticulous technique. When one applies the technique used for standard orthopedic amputations, success will be negligible in limbs with marginal circulation. The advantages of a below-knee amputation, as the literature will document, is that the mortality is half that for above the knee amputations, and of course the rehabilitation rate is excellent with below the knee amputation as opposed to above the knee amputation.

Doctor Moore has demonstrated to my satisfaction that the posterior flap does have excellent circulation, and we use the posterior flap he advocates rather than the circular incision.
Doctor Moore, would you comment on the cost of an immediate prosthetic fitting? This seems to be the primary problem related to its universal application.

Francis M. McKeever (Los Angeles, Calif.): The two series of amputations, which Doctors Moore and Hall have presented, are indeed a contrast in morbidity and mortality. However, I do not believe that the great decrease in morbidity and mortality in the second series can be attributed entirely to the technique of “immediate prosthetic fitting.”

There is no question that the splintage and compression bandaging, which results from immediate prosthetic fitting, is physiologically favorable to healing. It effectively minimizes venous engorgement and edema of the flaps and promotes primary healing.

The results in any series of amputations are directly related to the skill and enthusiasm of the people involved in the program. I would credit the striking decrease in morbidity and mortality to good preparation of the patient, meticulous operative procedure, and vigilant aftercare rather than to the single item of immediate prosthetic fitting. Some of the appalling poor statistics in amputation series have been due to the fact that this procedure has been relegated to the intern and resident staff and has been devoid of continuity of care. The period required for rehabilitation to the effective use of a prosthesis is directly proportional to the enthusiasm of the prostheteist and physical therapist working with the amputee.

Immediate prosthetic fitting is a very valuable addition to amputation surgery but does not substitute for skilled surgery and continuous well-planned care. It is not a technique for the surgeon performing an occasional amputation.

I wish to congratulate the authors on their incorporation of immediate prosthetic fitting into a very well-managed amputation program.

Albert D. Hall (closing): We have found that when arteriosclerotic patients require amputation, most of them can be rehabilitated with a below the knee amputation. The above-knee/below-knee ratio has been more than reversed. Very frequently there is no popliteal pulse and virtually no bleeding of incised tissues other than that from skin edges. The high rate of healing can be attributed to the use of posterior flaps and to the rigid plaster dressing with the support and protection it provides the wound. Such a dressing also prevents knee flexion contracture and provides the mechanism for attaching the immediate fitting prosthesis. Standardization of the technique by participation of senior surgeons and prosthetists has been all important. In metropolitan areas, standardization can be provided through an amputation team made available to several surgeons. Those who are concerned with costs should note that in reducing the hospital stay by 50 percent, significant
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savings for total care have been effected. The patients who are discharged with a prosthesis in place have continued to use them unless there has been some progression of associated cardiovascular disease. In general, this has been a highly successful program. As vascular surgeons, we are participating in the continued care of patients who have not been suitable for revascularization and have succeeded in restoring them to an ambulatory status.

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aching the immediate fitting e by participation of senior tant. In metropolitan areas, an amputation team made 

are concerned with costs t by 50 percent, significant