

# An Alternative to Amputation for Complicated Fracture of the Tibia

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Despite the extensive use of antibiotics and the development of new techniques of open reduction and internal fixation, fractures of the tibia continue to present a challenge to the medical profession. A significant number of these severe injuries result in non-union despite repeated bone grafts and others result in useless extremities because of various degrees of osteomyelitis. Historically, in order to permit rehabilitation of individuals with these unusually complicated fractures, the surgeon has resorted to amputation in order to permit satisfactory fitting of a prosthesis. In many of these cases, however, the only restriction in function is that of weight-bearing. Surgical ablation is accepted by the patient reluctantly for cosmetic and psychological factors as well as the cost and worry of undergoing an operative procedure. A patient recently treated by us clearly illustrates these points. We believe that our solution for him may avoid amputation in carefully selected similar cases.

## Case Report

A 31-year-old Coast Guardsman was injured in an automobile accident on 1/21/57. He sustained a closed fracture of the upper one-third of the left tibia and fibula, fractures of the transverse processes of L 4 and L 5 on the right, and multiple fractures of the pelvis. He also sustained head injuries and was unconscious for approximately three weeks. Open reduction and plate fixation of the tibial fracture was performed. On 10/18/57 the screw and plate were removed because of delayed union and a heavy cortical bone graft from the right tibia was applied. He progressed to crutch walking with partial weight-bearing, but non-union persisted and a fracture across the bone graft occurred. On May 8, 1959, a repeat open reduction of the fracture of the tibia with a Lottes intramedullary nail and bone graft from the ilium was done. Seven months later the intramedullary nail was removed because of drainage about the upper nail site. Osteomyelitis persisted and on 3/24/60, incision, drainage and debridement of the fracture site was performed. Subsequently, several operative procedures were carried out for the management of the osteomyelitis and by 7/28/60, infection had clinically subsided and the patient was placed in an ischial weight-bearing brace. Non-union persisted and on 2/6/61 open reduction with iliac and fibular bone

grafts were performed with wide resection of the non-union site. He was maintained in a long leg cast, but no union occurred.

On several occasions during the later stages of his therapy, amputation was recommended by several physicians. The patient was adamant in wishing to retain his leg, holding a somewhat forlorn hope of eventual union. It was the unanimous opinion of several surgeons that no further attempts at bone grafts or operative procedures for promoting bony union were justified. Two standard braces proved inadequate.

Figure 1 shows an x-ray of his tibia.

Our dilemma was to fit the patient with a prosthetic device without surgical removal of the flail and useless portions of his lower extremity. This device must allow no weight bearing on the heel but permit wearing a conventional shoe in such a manner as to provide a satisfactory cosmetic appearance. It was necessary to have good support and immobilization of the fracture site, to avoid trauma to the thin and atrophic skin over the areas of the multiple operations and to compensate for the 3" of shortening. It was desirable also to permit an increasing range of motion of the knee. By application of the Patellar-Tendon-Bearing principle, it seemed possible to achieve the desired results in keeping with the physical conditions and medical requirements.

We developed the device shown in Figure 2. Technically, this is an orthosis, but is used by the patient as a prosthesis, and it incorporates principles ordinarily utilized only in a prosthesis. We prefer to consider the device in its functional capacity, and refer to it as a prosthesis.

When the patient improved his quadriceps strength, the thigh corset was removed and a supracondylar strap added (Figure 3.)

At present, the patient has found the prosthesis most satisfactory and has resumed a surprisingly active life.

### *Prosthetic Considerations*

To satisfy the above-mentioned requirements, the prescription included:

- (1) modified PTB Plastic Socket
- (2) brace bars
- (3) uprights with drop locks and thigh corset removable
- (4) foot plate for shoe
- (5) adjustable stirrup extension

### *Design*

The extended PTB Socket was bivalved in the medio-lateral or frontal plane just posterior to the side bars following optimum antero-posterior alignment of the anterior shell as shown in Figure 2.

The popliteal and posterior pad was made adjustable by the use of velcro closure.

The three velcro straps were extended on the lateral side and riveted to the anterior shell, to serve the purpose of a flexible hinged opening.

The side bars were molded to the PTB shell without ankle joints (to minimize the existing limited ankle motion) but with an adjustable stirrup for height adjustment. The steel foot plate with instep and heel straps were included to stabilize the shoe in the correct anatomical position. (Details are shown in Figure 3.)

The uprights and thigh corset were incorporated with drop locks for stability.

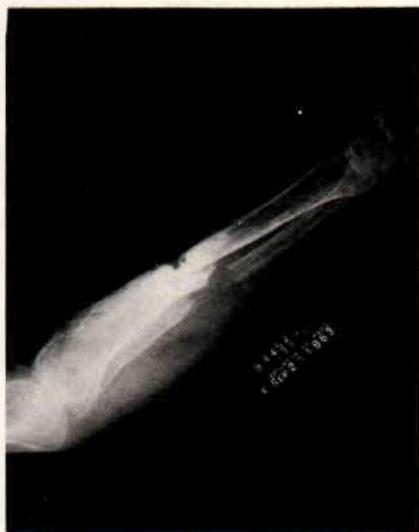


Figure 1: Lateral x-ray view of tibia and fibula showing non-union after multiple operative procedures.

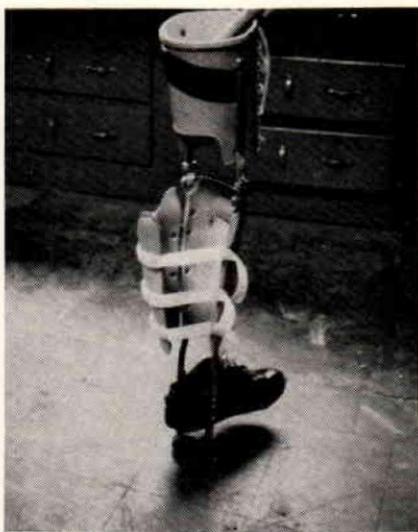


Figure 2: Original prosthesis. Note ease of application and adjustability afforded by the hinged posterior shell using velcro closure.



Figure 3: Patient wearing modification with supracondylar strap. The foot plate is adjusted to avoid weight bearing.



Figure 4: Patient's leg after wearing prosthesis a short time. Note the evidence of proper weight bearing over the patellar tendon.

### *Fabrication*

In casting, the PTB technique was employed with the cast extended to include the lower shaft of the tibia (for good immobilization of the fracture site).

In modifying the cast, extra buildup was applied to relieve the thin and atrophic skin over the affected areas.

The PTB Socket was fabricated in the usual manner. The side braces were molded to the PTB shell and set up with screws.

The foot plate was set up temporarily. At the time of initial fitting, the overall height was obtained by use of the adjustable stirrup type extension. After weight bearing was achieved at the knee and thigh area, the foot plate was adjusted for non-weight bearing.

The velcro closures not only served as a hinge for the posterior shell, but permitted finer adjustment for atrophy. They are easily installed and replaced. Shortly, the drop locks were discontinued. When the supracondylar cuff was installed (Figure 3), it was necessary to modify the posterior pad and velcro closure to minimize tissue pistoning.

Figure 4 shows the weight-bearing area to be similar to that of a patellar-tendon-bearing prosthesis.

Prosthetically, the foreshortened knee-center to floor length in this case was advantageous for non weight bearing (at heel) and roll over and it was not necessary to put a lift on the opposite shoe.

#### *Discussion*

The principle involved in this prosthesis might be applied appropriately in other conditions with slight modification. For example, in certain cases it may be more desirable than a Hessing brace for partial union of fractures of the tibia. In many fractures about the foot and ankle, in various arthritides of the ankle, or in almost any condition where only partial immobilization and/or non-weight bearing is required, this prosthesis may permit earlier and more satisfactory ambulation.

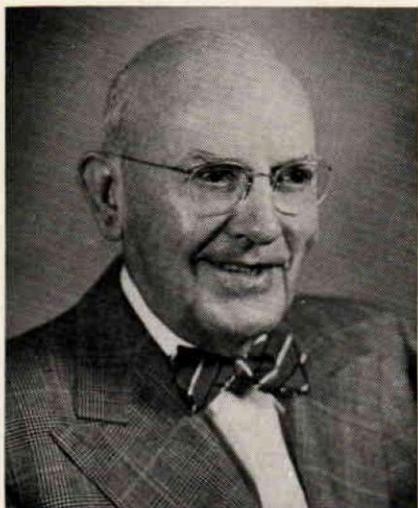
#### *Summary*

The application of the patellar-tendon-bearing principle in an orthosis has been found most suitable for a case of complicated fracture of the tibia, where amputation might otherwise have been performed. More extensive utilization of this principle for other type cases shows great promise.

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## In Memoriam

### LUCIUS L. CARR



A TRIBUTE FROM GEORGE LAMBERT, C.P.O.:  
"This man was a true friend of the Limb & Brace Profession. He helped a great many of our people and will never be forgotten."

Lucius L. Carr, field representative for S. H. Camp & Co. for 25 years, passed away June 17, 1964, at his home in Brightwaters, L. I., New York.

Mr. Carr had been actively engaged in the surgical garment field since he was eighteen. He traveled for the Camp Company in Texas, Oklahoma, Arkansas, Tennessee, Louisiana, Mississippi and Alabama. He was regarded as a dear friend by the AOPA members in his area.

Mr. Forrest I. Yeakey, President of Camp, spoke of the many years of service Lucius had given the company, and how greatly he would be missed by all his associates and acquaintances.

Funeral services were conducted from the Episcopal Chapel in Brightwaters and attended by representatives of the Camp Company.