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Orthopaedic and Rehabilitation Department, Chaim Sheba Medical Center, Tel-Hashomer, Tel-Aviv University Medical School, Tel-Aviv, Israel.

FIBULECTOMY AND RESECTION OF THE PERONEAL NERVE FOR "SHORT TIBIA STUMPS"

E. SPIRA & T. STEINBACH

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The preservation of even a short tibia stump is of great functional importance to the amputee. The proprioceptive sense of the stump for a proper forward thrust of the leg is self-evident.

The ideal length of a below knee amputation is 12½–17½ cm (Alldredge & Murphy 1968, Gillis 1954, *inter alios*). In very short stumps these authors advise leaving at least the head of the fibula to key the stump in the socket. But in amputations shorter than 7½–8¾ cm below the knee joint, Alldredge & Murphy (1968) advise removing the fibula completely. In such cases, the peroneal nerve should be pulled down and resected so that it retracts above the knee.

Such a short tibia stump has peculiar problems for a successful fitting of a modern below knee prosthesis. They are: The stump presents a sloping surface and tends to slip in and out of the socket, causing rubbing and friction. The areas for weight distribution are limited to the medial tibial surface below the condyle, the patellar tendon and the very limited area anterior to the head of fibula on the lateral surface of the stump.

The stump end is of no significant value for weight bearing and the anterior crest of the tibia is very sensitive to pressure.

The popliteal area adds to the difficulties. Limitation of flexion to 70°–80° is permissible, if the stump should rest safely in the socket. The tender areas of the hamstring muscles add to the difficulties.

METHOD

Taking into account all these problems connected with a short tibia stump, we set before us two principles: We have to create a stump with the greatest length possible and with no tender areas for weight transmission, in order to put our limb

fitting on a sound biomechanical base and to create a pain-free stump for our patients.

The first observation was a twenty-year-old man with a congenital postaxial meromelia of the left leg with considerable shortening and deformation of the foot. After amputation of the leg, a patellar tendon-bearing prosthesis was fitted without any difficulties; on the contrary, the wide area on the lateral tibia below the condyle was very convenient for just this purpose.

Surgical technique

The existing scar is excised and the fibula exposed by elongating the incision proximally. The head of the fibula and the shaft are sub-periostally excised, the peroneal nerve exposed, pulled down and severed most proximally. The periost and capsula are closed and if necessary the muscle belly of the triceps is attached to the tibia. The skin is closed with adequate excision of all scars.

A polyethylene tube is used as a drain for 48 hours with a separate stab incision in the middle of the posterior flap. A well-padded plaster cast finishes the procedure.

RESULTS

We operated on 23 patients aged 20–35 years. Eighteen patients had an amputation performed after extensive destruction of the foot and leg, 3 patients due to sepsis after an open fracture and 2 patients because of congenital post axial meromelias of the leg. The tibia stumps varied in length between 4½ and 12 cm. All patients had previous unsuccessful trial fittings with different types of prostheses.

We wish to illustrate this procedure by some of these patients' reports.

1. L.E.: Below knee amputation after mine explosion and destruction of the left leg. Length of tibia after amputation 8 cm, length of fibula 3 cm. The popliteal region was covered with an extensive skin graft. The patient was fitted with a P.T.B. prosthesis with a thigh corset, but could not wear the prosthesis because of pains in the stump end and on the head of the fibula (Figure 1 a).

The fibula was resected, together with the peroneal nerve. There was no difficulty fitting a Munster type of P.T.B. prosthesis (Figures 1 b–c). The patient is so pleased with his prosthesis that he sometimes plays a game of soccer.

2. S.I.: A neuro-vascular injury of the left leg and open fracture of both bones in the upper third of the same leg prompted an amputation below the fracture line. Both bones healed with an angulation, leaving a stump of 5 cm length, with adherent scars on the anterior aspect of the remaining tibia and an extremely prominent fibular head. A trial

Figure 1 a. Traumatic amputation after mine destruction. Length of tibia 8 cm, of fibula 3 cm (male, aged 31 years).

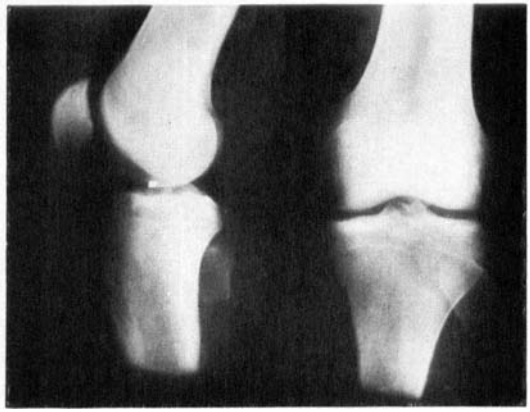


Figure 1 b. After fibulectomy and neurectomy.

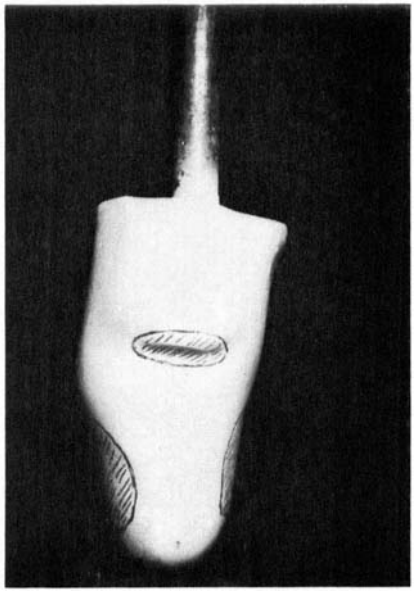
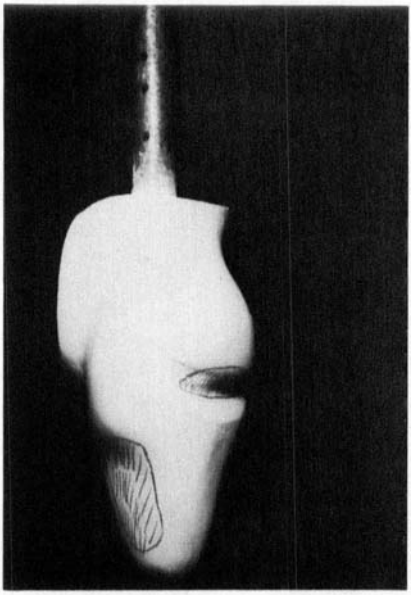


Figure 1 c. Patellar lig., medial and lateral areas of weight-bearing.

Figure 2 a. Amputation after open fracture with loss of bone and neurovascular injury. Length of tibia 5 cm, fibula 3 cm (male, aged 23 years).

Figure 2 b. After fibulectomy and neurectomy.



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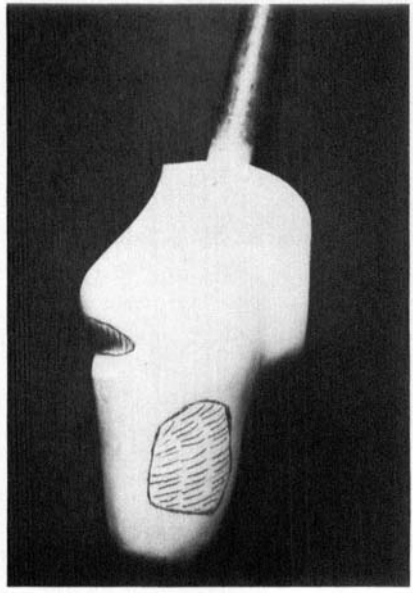

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Figures 2 c, 2 d. Patellar lig., medial and lateral areas of weight-bearing.

fitting was unsuccessful because of the pain on the fibular head, and skin abrasions on the tibia (Figure 2 a).

The fibula was excised together with the peroneal nerve. The scar could be partially excised. The patient was fitted with a P.T.B. prosthesis and walks without any difficulties (Figures 2 b–c).

3. S.E.: An open double fracture of both bones of the right leg had to be amputated below the upper fracture because of vascular impairment and sepsis. A great defect in the posterior part of the calf was covered with an extensive skin graft. The 8 cm tibial stump was very sensitive to touch and two neuromata could be palpated, which were adherent to the skin graft. A fitting with a P.T.B. prosthesis was tried, but was unbearable to the patient because of the pains in the skin-covered area over the fibula.

The scar was excised, the fibula and the peroneal nerve and neuroma were resected. The skin could be closed without difficulty. The patient was fitted with a P.T.B. prosthesis and has no difficulty in walking.

4. T.B. Below knee amputation because of vascular impairment after open fracture of right leg in 1962. He walked poorly with a conventional prosthesis with a thigh corset, because of pain in the stump and over the fibula. In 1969 he suffered a fracture of the patella of the same leg. The patella was excised. A prosthetic fitting was unsuccessful. The stump was 10 cm long, the tibia covered by tender skin, the fibula protruding and the extension of the knee was incomplete. The triceps muscle was not attached to the bone.

After fibulectomy, resection of peroneal nerve, attachment of the triceps to the bone, the patient was very satisfactorily fitted with a P.T.B. prosthesis.

In exceptional situations, even the hamstrings may be severed in order to gain additional length of the stump. We have tried this step as well, but have not had enough experience in order to express an opinion.

DISCUSSION

The static and dynamic alignment of the prosthesis for a "short tibia stump" is dictated by the forces acting upon the stump. These forces have been extensively studied by Radcliff (1970), and we follow his description.

There are two kinds of forces in action:

1. The body weight acts through the gravity line.
2. The floor reaction forces act upon the stump through its socket in vertical and lateral directions.

In mid-stance position, in the frontal plane, the floor reaction has a medial, oblique and upward thrust, causing a lateral inertia force. The horizontal component of this oblique force, acting in medial direction, generates an inertia force which is opposed to it.

If we assume the point of application of all vertical forces on the stump as a balance point—at equilibrium—the inertia effect plus the lateral force must be equal to the body weight.

In other words, equilibrium must be created between the body weight and the distribution of all the forces, acting upon the stump.

In a short stump the lateral force acts on a small weight-bearing surface. In order to decrease its effect the foot must be laterally placed, thus increasing the resulting inertia force. At the same time it results in an upward displacement of the lateral stabilizing force, into the sensible region of the head of fibula.

In a sagittal plane at heel strike, the floor reaction force acts in front of the knee, causing an extension of the joint. This tendency is controlled by the action of the hamstrings. Special attention must be paid in construction of the socket in order to free the tendons of these muscles. In the following phases of foot contact, the reaction force passes behind the knee, determining flexion in the joint. This tendency is resisted by the quadriceps pull. In this plane the forces between stump and socket act on three areas: patellar tendon area, the end of tibia and the popliteal region. It follows that in the short stump, the posterior brim of the socket must be high to ensure a larger surface of contact and to limit the extent of flexion.

After excision of the head of the fibula, other weight-bearing areas are presented. The small lateral area in front of the fibula is now a similar weight-bearing area, as on the medial site. The only difference in these two areas is that the lateral area begins below the tibial crest, which is quite prominent, while the medial area starts 1–1½ cm more proximally and is more sloping. Together with the area of the ligamentum patellae, three well-defined areas for weight-bearing are presented in front of the stump. In the popliteal region, the socket must reach as high as possible in order to prevent the bearer of the prosthesis from flexing the knee over 70–80°. This precaution ensures the fit in flexion and prevents the stump from slipping. The posterior borders are well defined in the plaster of paris positive (Figures 1 c, 2 c, 2 d).

The importance of a functioning knee joint and the preservation of even a short below knee stump are evident. The proprioceptive sensation transmitted through the stump is very important for good walking. Even if the forward thrust of the short tibia lever is limited, the below knee stump is to be preferred to amputation at a higher level.

A tibia stump shorter than 7½–8¾ cm in length is our main concern here. This stump is painful, with pressure areas over the head of fibula and most parts of the tibia. Such a stump rubs inside the socket and tends to slip out and in. There is a need to grasp such a stump more securely inside the socket and to prevent excessive points of pressure. If one takes into account the insertion of the hamstring muscles in the back of the knee, the difficulties for a snug fitting are even greater. It seems to us that the term "short stump" is more an expression of stability and fit of a stump than of its length.

The excision of the fibula and the resection of the nervus peroneus have, in our hands, given us the chance to solve this very difficult problem, as was reported by Erlacher (1917), Horworth (1952), Kirk (1963), Thomsen (1967, Alldredge & Murphy (1968), Murdoch (1970) and Loon (1970). In many of these patients we could improve the quality of the skin scars by adequate excision of skin available after fibulectomy.

The fitting of a prosthesis after this procedure did not cause any difficulties. We never observed rotation of the socket around such a stump, as was mentioned by Gillis (1954), Mercer & Duthie (1967) and Dederich (1970), as reason for opposing the excision of the fibula. All our patients are men and we have had no experience with such a stump in women, where a badly configurated knee could cause problems for fitting.

All these patients have been fitted before this procedure with different types of prostheses, even with conventional ones and several were fitted abroad, before we proceeded with our plan. This therefore presents a solution for short below knee stumps, if a previous trial fitting was unsuccessful.

SUMMARY

1. The term "short tibia stump" is characterized by length and form of the stump.
2. These stumps present fitting problems, because of the insufficient areas for weight-bearing and the protrusion of the head of fibula.

3. After fibulectomy and neurectomy of the peroneal nerve, the weight-bearing areas are considerably increased.
4. The fitting of a patellar tendon bearing (P.T.B.) prosthesis could be performed without difficulties after this operation.
5. Twenty-three patients have been submitted to this procedure, after attemps to fit them failed prior to operation.
6. All patients are walking well with patellar tendon bearing prostheses after this procedure.

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Correspondence to:

E. Spira
Orthopaedic and Rehabilitation Department
Chaim Sheba Medical Center
Tel-Hashomer
Tel-Aviv University Medical School
Tel-Aviv, Israel