Simple Imaging Technique for Fitting a Below the Knee First-Time Prosthesis

Atzmon Tsur MD[1], Norman Loberant MD[3] and Gershon Volpin MD[2]

Departments of [1]Rehabilitation and [2]Orthopedic Surgery, and [3]Institute of Radiology, Western Galilee Hospital, Nahariya, Israel
Affiliated to Technion Faculty of Medicine, Haifa, Israel

Key words: below-knee prosthesis, imaging technique, malalignment

IMAJ 2004;6:713–714

Comfort, fit, alignment, as well as appearance are criteria for an acceptable prosthesis for all amputees. The patellar-tendon-supracondylar-bearing prosthesis, including external and internal socket, appears to be the most useful below-knee prosthesis among our patients.

After completing the final prosthetic evaluation, a new below-knee amputee will require a period of gait training to learn how to function using the prosthesis. Physical therapy in a hospital may last from 10 days to 1 month. For the new amputee it may be appropriate to undergo the initial gait training while the prosthesis is still capable of being adjusted and aligned.

As the skin's ability to tolerate high pressure with weight bearing increases, the length of the prosthesis wearing-time is gradually increased. Socket comfort, which is related to socket fit, is one of the most important aspects of prosthetic acceptance and function. The most frequent problems in socket fit encountered during the rehabilitation period are due to changes in the limb contour that result from local edema or inappropriate stump bandage [1].

Prosthetic alignment is an important and commonly neglected contributor to abnormal pressure distribution at the residual limb-prosthetic socket interface [2]. Some patients with below-knee amputation hospitalized in our department after receiving their first prosthesis (generally PTS) suffered from skin breakdown in either the tibial tuberosity or the patellar tendon area. The lesion appears a few days after the beginning of gait training, and these patients complain of excessive pressure around the stump.

PTS = patellar-tendon-supracondylar

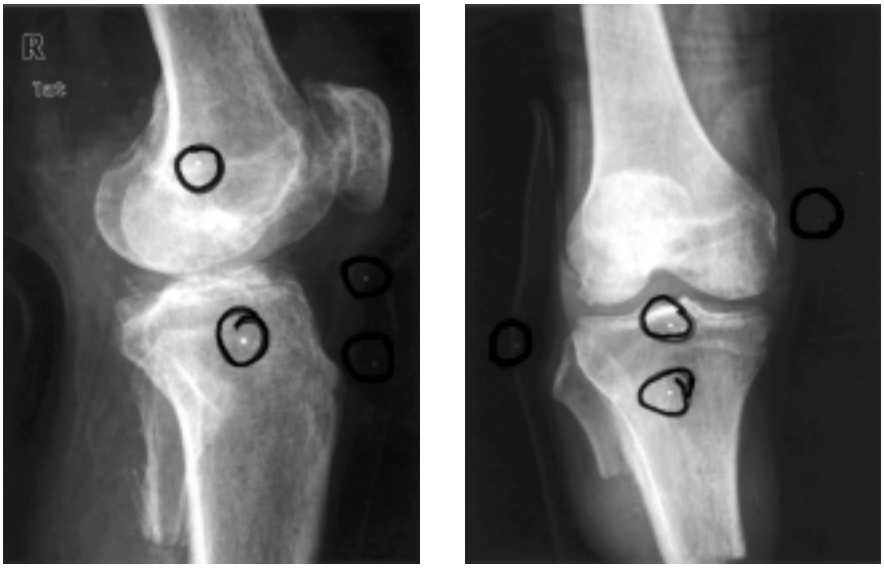

Figure 1. Good alignment of prosthesis; the weight-bearing points in the socket correspond to those of the stump.

The ability to visualize the alignment of the residual limb inside the prosthesis is an important step toward improving prosthetic fit assessment and preventing skin lesions. Volumetric imaging methods such as spiral X-ray computed tomography [3], magnetic resonance imaging and ultrasound [4] have been used to obtain residual limb shape information.

Methods

We developed a simple technique of imaging that permits us to evaluate the adaptation of the stump to the socket. Four small stickers with a metal radio-opaque point in the center are attached to the weight-bearing points around the internal socket of the prosthesis. These points are the internal and external femoral condyle, the tibial tuberosity and the patellar tendon. The patients were asked to don the prosthesis, and the X-rays – antero-posterior and lateral views – were performed in full weight bearing

Patient Descriptions

A 74 year old man with a right leg below-knee amputation was admitted to the rehabilitation department after receiving

Figure 2. Skin breakdown in the stump several days after fitting of prosthesis and gait training.

Figure 3. Malalignment of prosthesis; the weight-bearing points in the socket do not correspond to those of the stump.

his first prosthesis. The skin of the residual limb was completely preserved. Plain X-rays after 11 days of gait training demonstrated good alignment of the weight-bearing points in the stump to those in the socket [Figure 1]. A 68 year old man with a left leg below-knee amputation exhibited skin breakdown at the edge of the stump [Figure 2] one day after the prosthesis was fitted. Plain X-rays taken with the patient in a standing position 3 days after the beginning of gait training revealed that the stickers attached to the socket did not overlap the weight-bearing points of the stump [Figure 3], indicating that the prosthesis was most probably malaligned.

Comment

The presence of ongoing pain, skin breakdown, changes in the ability to don and doff the prosthesis, and changes in the number of sock plies indicate that the prosthesis needs to be modified. Erythema normally appears within a few minutes after removing the prosthesis and should subside quickly. Erythema that is present upon removing the prosthesis or that does not completely resolve within 20 minutes is particularly worrisome. The new visualization methods provide a feasible means of displaying lower extremity residual limb adaptation within the new prosthesis.

References

1. Davidson JH, Jones LE, Cornet J, Cittarellli T. Management of the multiple limb amputee. *Disabil Rehabil* 2002;24(13):688–99.
2. Czerniecki JM. Rehabilitation in limb deficiency. 1: Gait and motion analysis. *Arch Phys Med Rehabil* 1996;77(3 Suppl):S3–8.
3. Commeran PK, Brunsden BS, Smith KE, Vanier MW. Below-knee residual limb shape change measurements and visualization. *Arch Phys Med Rehabil* 1998;79(7):772–82.
4. Douglas T, Solomonidis S, Sandham W, Spence W. Ultrasound imaging in lower limb prosthesis. *IEEE: Trans Neural Syst Rehabil Eng* 2002;10(1):11–21.

Correspondence: Dr. A. Tsur, Chairman, Dept. of Rehabilitation, Western Galilee Hospital, P.O. Box 21, Nahariya 22100, Israel.
Phone/Fax: (972-4) 910-7726
email: azurgr@naharia.health.gov.il

Capsule

Gene silencing in leukemia?

About 15% of acute myeloid leukemia display a chromosomal translocation with high level expression of leukemogenic AML1-ETO fusion proteins. AML1-ETO contains a conserved TAF4-homology domain (TAFH) for which *in vivo* function is unknown, but which might be expected to complex with other transcription factors. Zhang and co-workers show that the TAFH domain AML1-ETO, and non-leukemic factor ETO, associate with HEB protein, a transcription factor of the E protein family. The domain by which ETO interacts with E protein coincides with the site targeted by p300/CBP histone acetyltransferase. The association of HEB and ETO may sterically block p300/CBP recruitment *in vivo* and allow recruitment of negative co-factors such as HDACs for gene silencing of HEB-responsive promoters in leukemic cells.

Science 2004:305:286

E. Israeli