Lengthening a short femoral amputation stump

A case of tissue expander and endoprosthesis

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A patient's function with prosthesis after leg amputation depends on the length of the stump. A stable suspension of the socket and the effective lever arm for its motion both relate to the length. The residual muscle mass finally is less in a shorter stump. For transfemoral amputations, especially the lack of adductor muscle force is critical. In above-knee amputees hip strength increases linearly with stump length (James 1973) and a short below-knee stump takes twice the energy expenditure of a normal-length stump (Gonzalez 1974).

With an above-knee amputation for a bone tumor in the distal femur, the resultant bone length of the amputation stump sometimes has to be made too short for good function. Plenk et al. in 1978 used a ceramic elongation prosthesis to add length to the femur within redundant soft tissues. If soft tissues also have been sacrificed, however, a stump elongation must include bone, muscles, fascia and skin. This has been achieved by lengthening osteotomies (Havan et al. 1990), by callous distraction, according to Ilizarov (Keier et al. 1988), or by a custom tissue expander, replaced by a custom elongation prosthesis, as in this case.

The patient

A woman was amputated in 1978, at age 14, for osteosarcoma of the distal femur. She had thoracotomy 3 times for pulmonary metastases during 2 years after amputation, and she has since been free of recurrences. The residual femoral bone length from the top of the trochanter to the end of femur was only 10 cm. In 1984 a polyethylene cylinder attached to a metallic stem was implanted distally, lengthening the femur 6 cm. Function was somewhat improved, the patient could walk with 1 stick and a prosthesis. To lengthen the stump further, soft tissue expansion was necessary. In April 1988 the first elongating endoprosthesis was extracted, and a tissue expander (McGahn, St. Barbara, U.S.A.) designed by us was implanted subfascially from the distal end of the femur. 3 weeks later injections of 100 mL saline every week were started and they continued for 10 weeks until a volume of 1 L was reached (Figure 1). In August 1988, 3 weeks after the last injection, the expander was removed from its submuscular and subfascial location and replaced by a custom-made elongator with a metallic stem and a polyethylene bulbous body distal to the bone (Mitab, Sjöbo); the implant lengthened the femur by 12 cm and was fixed to the medullary canal by bone cement. Muscles, fascia and skin were closed to cover. During 3 years the patient now had improved stability and strength with good skin coverage. Radiographs at 4 years showed loosening around the femoral cement. Therefore, the prosthesis was exchanged with a new cementation around a stem of the same length but with a 2 cm shorter polyethylene elongator. After 12 months now this is satisfactory. The patient works as a telephone operator and had her first child last year. She uses a prosthesis with a semirigid suction socket and a non-locking knee walking with 1 cane outdoor.

Discussion

The described type of lengthening of skin, fascia and muscles by use of tissue expander has not been reported before. It is a curiosity, however, that Ilizarov's first case of callus distraction in 1960 was in a below-knee amputee. Compared to callous distraction, our technique has the disadvantage of introducing a permanent foreign body, but the advantage of less risk of infection during the process as skin is not kept perforated by pins. The long-lasting results of artificial hips using similar materials make it reasonable to expect a lasting function. With expander and elongator prosthesis, the bone stump can be lengthened to twice its original length and given a rounded end. In well-

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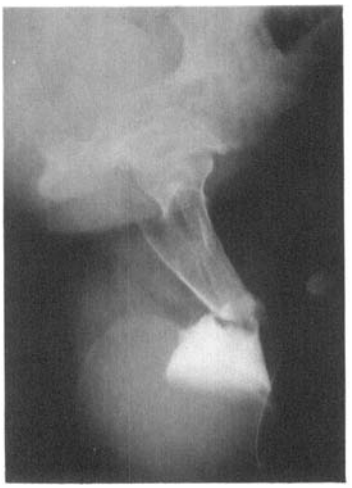
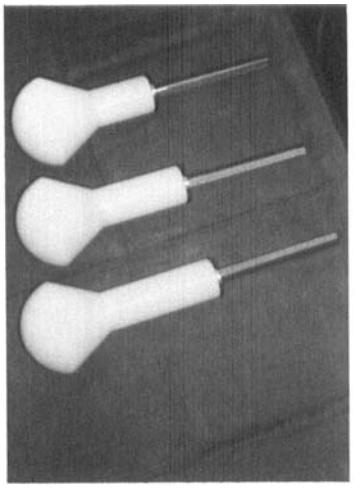
Figure 1. Elongation of a short above-knee amputation stump.



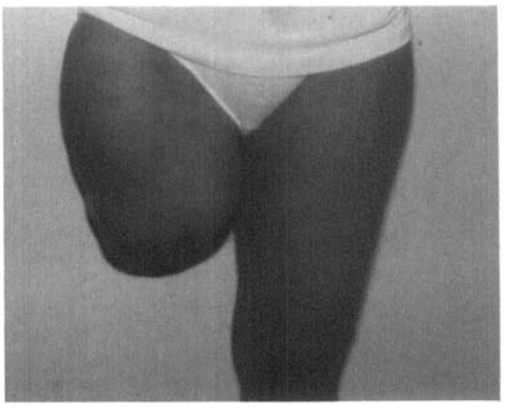
Short right transfemoral amputation stump with tissue expander filled with 1000 cc saline in place during elongation.



3 sizes of custom-made stump elongators to create a bulbous end simulating a joint disarticulation stump.

Transfemoral amputation stump after implantation of stump elongator with bone cement.

selected cases this new technique should be considered for improved function, apart from the new possibilities of using tissue expander to improve skin coverage on stumps (Rees et al. 1986, May and Sheppard 1987, Berg and Jonsson 1992). The distal bony end of an amputation stump often is tender (Persson and Liedberg 1982), and several designs to cover and round off the end have been presented (Swanson 1969). The elongation prostheses presented here combine lengthening with rounding off the end.



Patient with completed stump elongation.

References

Berg A, Jonsson C E. Tissue expansion to cover amputation stumps. Acta Orthop Scand 1992; 63 (5): 566–7.

Gonzales E G, Corcoran P J, Reyes R L. Energy expenditure in below-knee amputees: correlation with stump length. Arch Phys Med Rehabil 1974; 55 (3): 111–9.

Havan G, Benichou M, Chiesa G, Lefevre B, Menage D. Stump lengthenings. Intern Soc Prost Orthot Abstr, Kobe 1990: 80.

James U. Maximal isometric muscle strength in healthy active male unilateral above-knee amputees, with special regard to the hip joint. Scand J Rehabil Med 1973; 5 (2): 55–66.

Keier A, Rozhkov A, Shafilov O. The management of short stumps. In: Amputation Surgery and Prosthetics (Ed. Murdock F) Blackwell Publ, London 1988: 327–31.

May J W Jr, Sheppard J. Reconstruction of the stump after below-the-knee amputation. Soft tissue expansion and local muscle rotation flaps: a case report. J Bone Joint Surg (Am) 1987; 69 (8): 1240–5.

Persson B M, Liedberg E. Measurement of maximal end weight-bearing in lower limb amputees. Prosthet Orthot Int 1982; 6 (3): 147–51.

Plenk H Jr, Salzer M, Locke H, Stark N, Punzet G, Zweymüller K. Extracortical attachment of bioceramic endoprostheses to long bones without bone cement. Clin Orthop 1978; 132: 252–65.

Rees R S, Nanney L B, Fleming P, Cary A. Tissue expansion: its role in traumatic below-knee amputations. Plast Reconstr Surg 1986; 77 (1): 133–7.

Swanson A. Improving the end-bearing characteristics of lower extremity amputation stumps by the use of silicone rubber implants. Thesis, Amer Orthop Assoc 1969.