Through knee amputation with gastrocnemius musculocutaneous flap

6 cases of tibial osteosarcoma followed for 3 (1–6) years

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6 cases of proximal tibial osteosarcoma were operated on by through knee amputation using a long dorsal gastrocnemius musculocutaneous flap; the usual anterior flap could not be used because of tumor size and the location of the biopsy tract. The only complication was one wound dehiscence which healed. The stump was of good quality in all patients. At follow-up, the patients walked without walking aids.

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Above knee amputation is usually performed for malignant tumors in the proximal tibia, when limb salvage procedures are not considered appropriate (Baumgartner 1979). Through knee amputation provides better function (Batch et al. 1954, Early 1968, Steen Jensen 1982, Pinzur et al. 1988, Murdoch et al. 1992). However, the long ventral flap often used with through knee amputation may not be suitable because of tumor size and location of a biopsy scar. This means that a relatively long marginally vascularized dorsal flap or side flaps is/are needed to close the defect. We have performed through knee amputation for proximal tibial sarcoma in 6 cases, using a long dorsal musculocutaneous gastrocnemius flap.

Patients and methods

Preoperative work-up

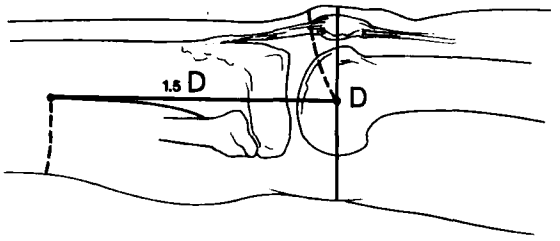
2 women and 4 men, aged 20 (12–47) years, had proximal tibial osteosarcoma Grade IIB, without evidence of metastasis. Clinical staging included MRI of the primary tumor, chest radiographs, bone scintigraphy and open biopsy at the anterior side of the tibia. MRI was used to rule out tumor infiltration into the knee joint and the gastrocnemius muscle. Tumor infiltration in the ligaments was no absolute contraindication for use of the procedure, because the joint capsule can be cut more proximally in this case. The patients were submitted to a pre- and postoperative chemotherpay protocol, according to the European Osteosarcoma Intergroup (E.O.R.T.C. 80831–80861 and 80862).

The operation (Figure 1)

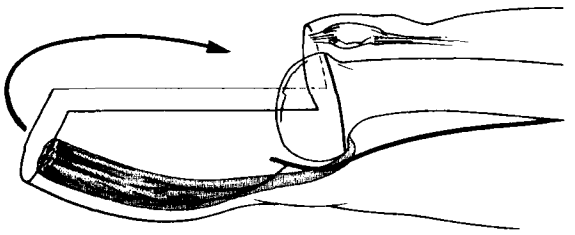
An anteroposterior fish mouth incision with a long dorsal half was drawn. The anterior part extended from just below the distal patellar edge to the upper third of both femoral condyles. The dorsal part started from both proximal ends of the ventral half of the fish mouth, and met distally. Length of the dorsal flap was determined as 1.5 times the anteroposterior height of the upper leg 10 cm above the knee joint, but not less. The incision was made according to the described line, taking cutis, subcutis and fascia in one layer. This flap and the gastrocnemius layer were kept intact. The gastrocnemius muscle and tibial plateau were inspected to confirm that they were free from tumor. Using the gastrocnemius muscle, a long posterior musculocutaneous flap was prepared. After that, a proximal division of the articular capsule and the ligaments of the knee was performed. Care was taken to keep clear of the tumor when handling nerves and vessels. Then the vascularization of the gastrocnemius was isolated and the vessels and tibial nerve distal to it were ligated and cut, followed by disarticulation. The hamstring and biceps muscles were reinserted in the femoral condyles. The fascia of the gastrocnemius muscle was inserted in the anterior capsule and patellar tendon and the skin was sutured at the anterior side of the amputation stump.

All patients were followed for a mean of 2.5 (1–6) years.

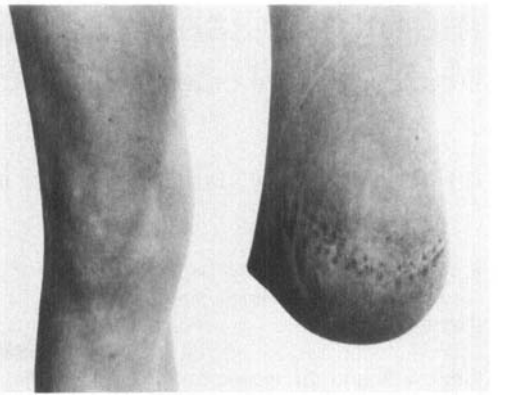
Figure 1. Through knee amputation with a gastrocnemius musculocutaneous flap.



Anteroposterior fish mouth incision with a short ventral flap just below patella and a long dorsal flap, from the middle of the femoral condyles, with a length 1.5 times the anteroposterior height at the level of the middle of the femoral condyles.



The long dorsal gastrocnemius musculocutaneous flap is sutured over the femoral condyles, resulting in a good coverage of the condylar cartilage.



Anterior view of the stump. Note the ventral localization of the scar.

Results

Case 2 had wound dehiscence during chemotherapy; complete spontaneous closure occurred. Case 6 had a superficial 1 × 2 cm ulcus on the lateral side of the stump because of pressure of the prosthesis after 6 months; a subcutaneous abscess was drained and the wound healed completely with chemotherapy. At the latest follow-up, no patient had a local recurrence, but 2 had metastases. All stumps healed without skin atrophy or neurinoma. All patients were walking with their prosthesis without additional walking aids, but with a full weight-bearing stump. Only the oldest patient, Case 1, used a crutch while walking long distances. In all cases, the maximal walking time was at least 1 hour. No patient complained of pain, either at rest or when walking. All patients practised swimming regularly and all, except Case 1, were riding a bicycle.

Discussion

Through knee amputation offers a better function than above knee amputation (Murdoch 1988) but the question of radicality has long prevented its use for high tibial tumors. CT and certainly MRI make it possible to assess preoperatively whether the knee joint and the gastrocnemius muscle are involved. When a through knee amputation is considered, and the diagnostic biopsy is taken from the ventral part of the tibia, only a short ventral flap is left for reconstruction. As alternative flaps, a posterior flap or side flaps may be used. These are relatively long with associated risk of delayed wound healing, which has to take place over cartilage. Also, the tumor size often excludes the use of side flaps. Therefore, the use of a posterior gastrocnemius musculocutaneous flap, seems advantageous. In below knee amputation, the dorsal musculocutaneous flap already has proved its value (Burges 1968, More et al. 1972). We had no difficulties in obtaining a sufficient margin. The gastrocnemius muscle is separated from the tibia in its most proximal part by the popliteus muscle and semimembranosus tendon. In the distal direction, this anatomical barrier increases in thickness by interposition of the soleus muscle. Further distally, the barrier formed by the popliteus muscle is replaced by the flexor digitorum longus and the tibialis posterior muscles (Figures 2 and 3). An advantage with the flap is the good coverage of the femoral condyles.

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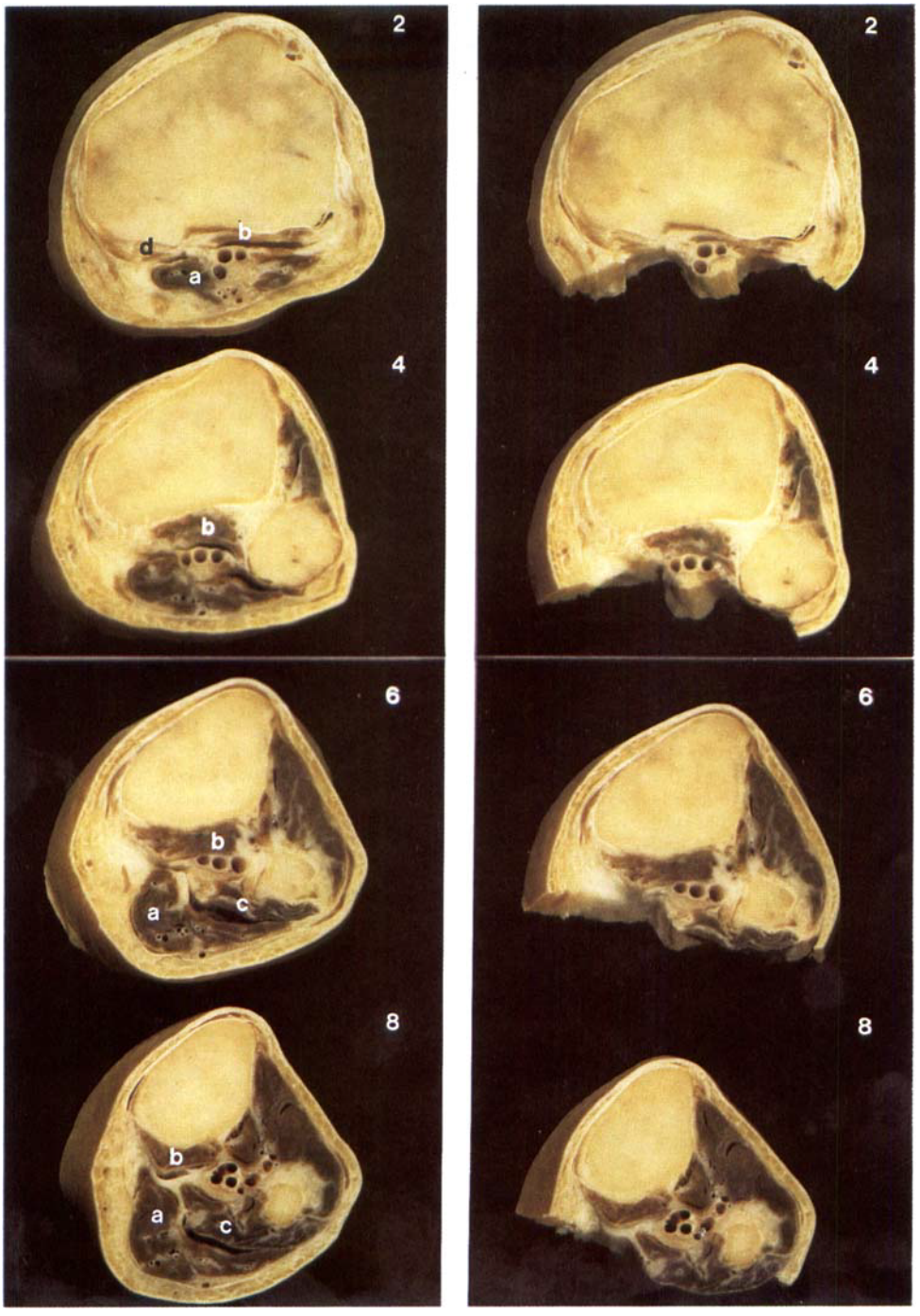

Figure 2. Lower leg from a human body, fixed by perfusion with formalin (Department of Anatomy, University of Amsterdam). Cross-sections made by a diamond band saw at 2, 4, 6, and 8 cm below the articular surface of the tibia. Left: the gastrocnemius muscle (a) is separated from the tibia by the popliteus muscle (b), the soleus muscle (c) and the semimembranosus tendon (d). Note the vascularization of the gastrocnemius muscle. Right: after removal of the gastrocnemius muscle and overlying skin and subcutis.

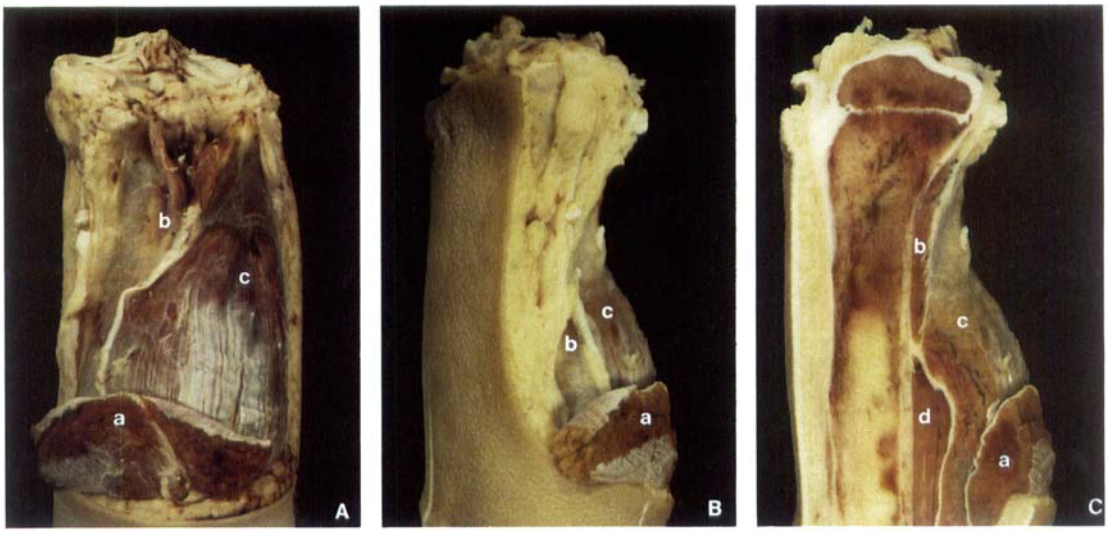

Figure 3. Proximal part of a through knee amputation specimen after preparing a gastrocnemius musculocutaneous flap with a length of 13 cm. Posterior (A), medial (B), and sagittal (C) sections through the tibia, made of the fresh, deep-frozen specimen (–80 °C) with a band saw (butcher saw). Specimen fixed in formalin. Colors refreshed with alcohol 70%. The tibia is covered by the popliteus muscle (b), the soleus muscle (c) and in the distal portion by the flexor digitorum longus muscle (d) and the remaining distal part of the gastrocnemius muscle (a).

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