

Long Term Functional Outcomes of the Capanna Technique for Pediatric Limb Salvage

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Background: Large intercalary bone defects have historically been reconstructed with massive cadaveric allograft, however this practice is associated with multiple complications including infection, fracture and nonunion (1-3). In contrast, the Capanna technique combines the use of large cadaveric allograft with an intermedullary vascularized fibular flap to allow for immediate rigid fixation of the allograft, but allow for the potential of accelerated bony union through the fibula flap (Fig. 1 and 2) (4).

Patients and methods: Between 1997- 2009, we operated the lower limb of 17 children with Capanna technique. Average age was 11.05 ± 4.02 years at the time of operation. All the patients were skeletally immature. We collected data retrospectively and our follow up ranged between 20 and 135 months (Mean 71.46 ± 37.14 months). All the patients' tumours were biopsied before the surgery and appropriate chemotherapy was started before limb salvage and continued 3 weeks after the surgery.

Results: 8 were femur (47%) and 9 were tibia (53%). According to the pathology reports, 45% of the tumors (8 patients) were osteosarcoma; 35% (6 patients) were Ewing's sarcoma and there was one adamantinoma, one chondrosarcoma and one osteofibrous dysplasia. Mean excised tumor volume was $120.62 \pm 205.05 \text{ cm}^3$. The mean bone defect was $14.34 \pm 4.71 \text{ cm}$. Mean length of harvested free fibula was 18.56 ± 3.69 . All the patients healed well except one patient whose graft was replaced by bone allograft 31 months after the limb salvage surgery. We excluded this patient and last two patients from union time analysis because their follow-up hasn't reached to one year. Mean union time for the allograft placed in femur was 12.41 ± 5.47 months and in tibia was 14.43 ± 6.5 months. Mean union time for the fibula flap placed in femur was 8.16 ± 2.48 months and in tibia was 6.56 ± 2.61 months. 2 of the patients had distant metastasis to lung, sphenoid bone and hand. 7 patients re-operated because of the allograft non-union. We did not encounter any wound or bone infection. All limbs were salvaged. At final follow-up, only two patients had more than 2cm of leg length discrepancy. Mankin score was excellent for 87% of patients and good for the rest.

Conclusions: Compared to other long bone reconstruction methods, the Capanna technique is a single step, effective and durable limb salvage surgery that has earlier bone union time.

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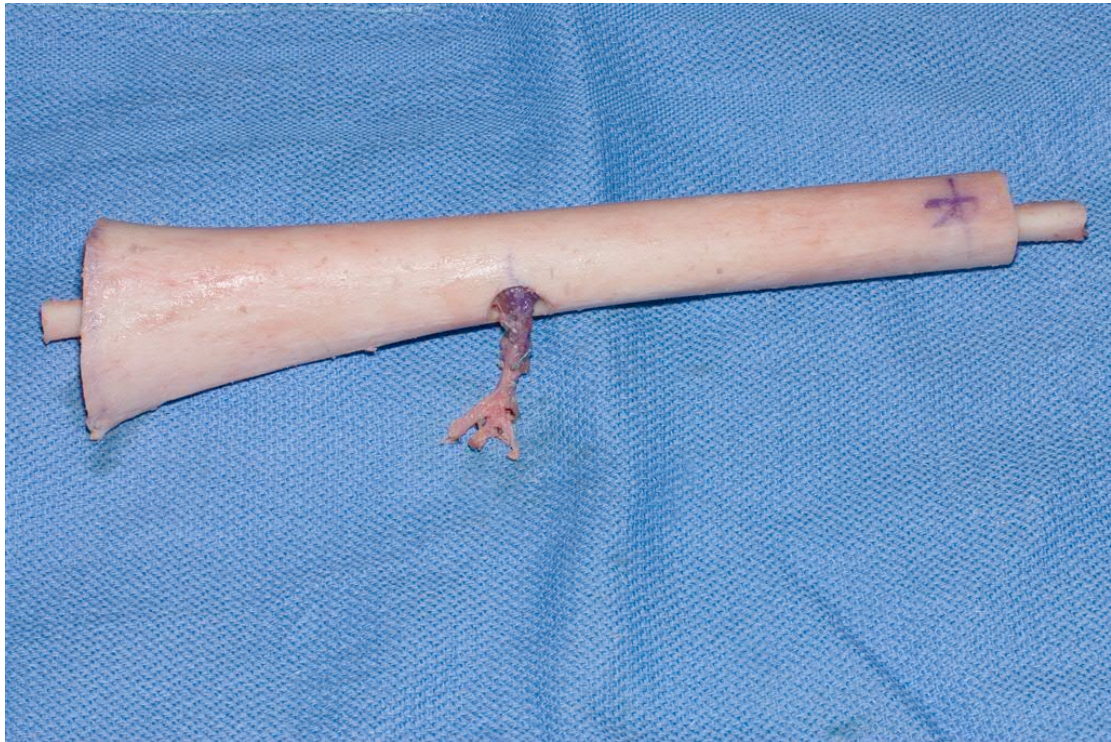


Figure 1: Vascularized fibula flap was inserted into the cadaveric allograft and a window was created for the vascular pedicle.

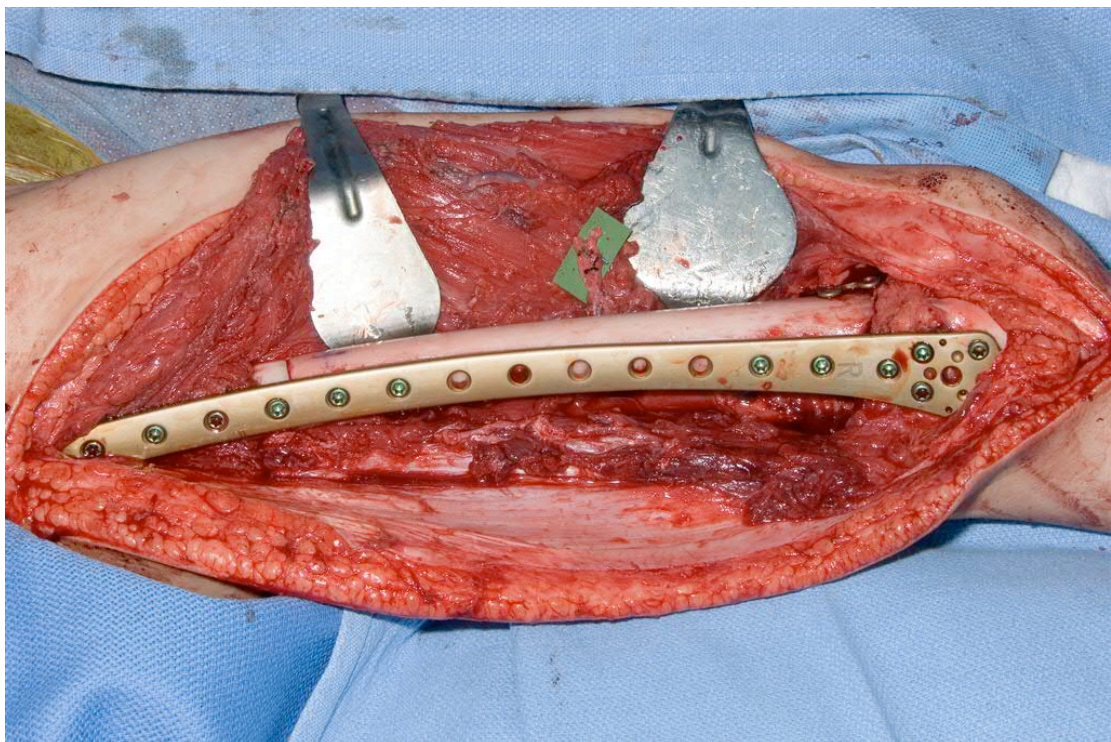


Figure 2: Bone defect was filled with the combined cadaveric allograft and free fibula flap and fixed with Less Invasive Stabilization System (LISS). The pedicle was ready for the anastomosis.