COMBINED USE OF EXTRACORPOREALLY-IRRADIATED AUTOGRAFT AND FREE VASCULARIZED BONE GRAFT FOR THE RECONSTRUCTION OF MASSIVE SKELETAL DEFICIENCIES AFTER MALIGNANT TUMOR RESECTION OF THE EXTREMITIES.

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Background：Reconstruction of massive skeletal deficiencies following tumor resection still presents a challenging problem to the musculoskeletal oncologist. At present, several procedures are available. In Japan, devitalized extracorporeally-irradiated bone autograft is more common because of difficult use of allograft. Free vascularized bone grafting is a living bone graft and useful tool to reconstruct massive skeletal defects. Combined use of extracorporeally-irradiated autograft and vascularized bone graft seems to be the ideal graft for oncological reconstruction. We present here our clinical outcomes to discuss the advantages and complication.

Patients and methods: We reviewed eight patients (six men, two females, mean age 34 y.o.) who had undergone curative resection for malignant musculoskeletal tumor and reconstructed with FVBG and IRBG in combination. The average follow up time after surgery was 38 weeks. Histologic diagnoses are osteosarcomas in three, chondrosarcomas, Ewing sarcoma, SCC, Adamantinoma, MPNST in one. The tumor location was the proximal humerus in one, shaft of ulna in one, distal femur in one, shaft of tibia in five. Six were used for intercalary graft and two were for osteochondral graft. Vascularized fibula graft was used in six patients and scapula was used in two.

Results: Seven cases are None evidence of disease, one case is dead of disease. Seven vascularized bone grafts survived. Complications were non-union in two, necrosis of free flap and one claw deformity in one. In one case with sarcoma located in the forearm, bony union between recipient bone and graft failed due to the short length of the grafted scapula, resulting in nonunion. No local recurrence was detected from the irradiated bones. In five patients reconstructed with vascularized fibula and irradiated intercalary tibial bone graft, radiological and functional outcomes were excellent. In a girl with Ewing sarcoma of the proximal humerus, after anatomical reattachment of all tendons and ligaments, proper alignment of the shoulder joint was maintained and no osteoarthritic changes were apparent after 16 months.

Discussion: Combined use of a free vascularized bone graft and extracorporeally-irradiated autograft was reliable and safe procedure for reconstruction of massive bone defect after resection of malignant tumor. The combination of FVFGs with a massive devitalized autografts in a hybrid complex was proven to provide adequate bone stock, immediate stability, mechanical support for weight bearing and enhancing neo-vascularization to the avascular graft, in clinical setting. In 5 cases with intercalary graft for shaft of tibia, bony union was achieved earliest between vascularized bone graft and tibia at the mean time of 4.4months and vascularized bone graft and irradiated bone graft at the mean time 6.8 months , and the irradiated bone graft and tibia. This method is best indicated for intercalary defects of the tibia. In cases with osteochondral graft for distal femur, some degree of articular change clearly occurred in the long-term and cannot be prevented even with the combined use of vascularized bone graft. But the patients were almost pain-free. We supposed that irradiated osteochondral graft changed similar to Charcot joint.

Conclusion: Eight patients with malignant tumor resection were reconstructed in combination with vascularized bone graft and extracorporeally-irradiated autograft. We obtained successful clinical outcome with no serious complications. The rationale for a combined vascularized and irradiated bone autograft is the cumulative advantage provided by mechanical endurance from the latter with the biological properties of the former. The method is best indicated for intercalary defects of the tibia. Some degree of osteoarthritis can not be prevented in osteochondral graft in the long-term.

Compensation of disadvantages of the each graft by advantages

Grafts	*Advantages*	*Disadvantages*
Irradiated osteochondral graft	1. No residual tumor 2. Preservation of the joint capsule and muscle insertions 3. No donor morbidity 4. Perfect adaptation 5. Easy technique 6. No allogeneic infection 7. No immunologic reaction 8. No storage problem 9. Maintain matrix proteins	1. Dead bone graft 2. Late osteoarthritic changes 3. Low union rate 4. Intolerates infection 5. Bone absorption
Vascularized fibula graft	1. Living bone graft 2. High union rate 3. Supporting the mechanical strength 4. Tolerates infection 5. Enhancing neo-vascularization 6. Healing potential after fracture	1. Limited donor 2. Inadequate adaptation 3. Technically demanding 4. Donor mobidity 5. Late fatigue fracture