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Musculoskeletal Oncology: From Amputation to Limb-Salvage Reconstruction

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Musculoskeletal tumor surgery has changed considerably during the past three decades. Until the late 1970s, most malignant bone and soft tissue tumor were treated with amputation. The role of orthopedic oncologist was to determine the appropriate level of amputation and to perform high level of amputation. Nowadays approximately 90% to 95% of bone and soft tissue sarcomas can be treated by limb-salvage, which is due to advances in adjuvant and neoadjuvant chemotherapy, diagnostic imaging, and surgical technique for resection and reconstruction. Eric Lexer, German surgeon, used massive osteoarticular allograft implantation for the first time in 1908. For the next 50 years, this type of surgery has rarely been reported. In 1954, Herndon and Chase published the results of fresh and frozen allografts in dogs and showed that immunogenicity of the graft could be reduced by freezing. Since 1971, Mankin et al. reported the results of 150 resections and allografts implantation mostly for the management of tumorous conditions; this technique of reconstruction became an attractive alternative for orthopedic oncologists, due to the possibility of early, cost-benefit obtaining and the ability to attach host ligaments and muscles to the grafts (1). Given the high rate of compilations of this procedure (up to 80%), the use of custom-made endoprostheses in limb-salvaging procedures started to gain popularity in the 1970s. Nonetheless, osteoarticular allograft has the advantage of not disturbing the adjacent growth plate and is superior to prosthesis for reconstruction of the bone defect around the knee in children between 10 to 14 years old (2).

There was a six- to eight-week lag time between diagnosis and creation of a custom endoprosthesis. Rosen and Marcove invented the neoadjuvant chemotherapy to compensate for this wasted time. According to their work, patients with bone sarcoma received chemotherapy during the interval between time of diagnosis of the tumor and the delivery of the patient's custom-made implant (3). Since mid-1980s, custom-made endoprosthesis have been replaced by modular replacement system (MRS) and expandable prosthesis for children. Modular systems provided patient-specific endoprostheses that could be modified during surgery without the cost and delay of a custom prosthesis. These modular systems allowed surgeons to use components of the best size and length for the individual. The components were then joined together in the operating room to create a unique and well-fitting endoprosthesis (4). Another challenge in implant use is attaching the tendon directly to a metallic implant. A tendon is directly attached to a metallic implant with no scaffold and is held together by fibrous ingrowth, which is a weak interface. This type of attachment has only 20% of the strength of a normal tendon insertion. The possibilities for advancements in limb-salvage reconstruction seem promising. Improved techniques of stem fixation and soft tissue attachment will further increase implant survival, promote quality of life, and continue to improve the prognosis and hope for those diagnosed with a musculoskeletal tumor.

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