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Challenges of Skeletal Reconstruction in Growing Children—Hobson's Choice

Anand Raja[1] Chandra Kumar Krishnan[1] Madhusudhan Reddy[1]

[1] Department of Surgical Oncology, Cancer Institute (WIA), Chennai, Tamil Nadu, India

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Address for correspondence Anand Raja, MS, MCh, Department of Surgical Oncology, Cancer Institute (WIA), No: 38, Sardar Patel Road, Adyar, Chennai 600036, Tamil Nadu, India (e-mail: dr_anand@yahoo.com).

Reconstruction of skeletal defects after resection for bone tumors in children is challenging due to (a) small size bones, (b) limited bone stock, (c) challenges with microvascular anastomosis, and (d) risk of limb length discrepancy. Reconstructions should be durable to ensure long-term stability and allow for axial growth. Reconstruction with metal prosthesis, biological reconstruction, and allo/auto-prosthesis composites come with challenges unique to them. This is further compounded in our country with constraints of resources and advanced stage of presentation.

Tumors around the joint need prosthetic reconstruction. Pediatric patients need some form of expansion that is built into the prosthesis which can be periodically expanded to account for longitudinal growth. Third-generation metal prostheses where the expansion is noninvasive (Juvenile Tumour System, Stanmore Implants Worldwide, Stanmore, United Kingdom) have revolutionized the management of these patients. This has overcome the problems of (a) multiple surgeries and (b) infection, in second-generation implants that were minimally invasive and needed repeated surgeries to expand the prosthesis which was based on an elongating screw or telescoping mechanism. Third-generation expandable prostheses are expensive, about Rs 20 lakh, which is not affordable for most patients in our country.

Our "go-to" modality for reconstruction has been the vascularized fibular graft. It is a versatile flap and can be used for reconstruction at a variety of sites.[1] We have used this graft for (a) intercalary resections, either alone or with recycled autograft (Capanna technique—combination of auto/allograft and vascularized fibula),[2] or for (b) reconstruction of combined epiphyseal-diaphyseal defects (humerus and radius). Monitoring of these flaps without skin paddle is a challenge. We use a triple-phase Tc99 MDP bone scan at 48 hours after surgery to assess viability and use Jones index to score the flap.[3] The fibula is usually harvested based on peroneal vessels. This, however, does not supply the proximal epiphysis. For longitudinal growth, the fibula should be harvested with the vessels supplying the epiphysis (epiphyseal transfer technique) that branches from the anterior tibial artery (first/second recurrent epiphyseal arteries or inferior genicular artery). Rarely due to small caliber they may not be demonstrable, in which case anterior tibial artery may be harvested in addition to peroneal vessels. Transposition of the ipsilateral fibula for tibial defects (Huntington's procedure or tibialization of fibula)[4] is an attractive option.

Postoperative radiation after biological reconstruction is a barrier to healing. All components of bone from epiphysis to osteoblasts, osteoclasts, periosteum, periosteum, vascularity, and quality of mineralized bone are detrimentally impacted by radiation, leading to increased problems with wound healing and bone union.[5] This represents a Hobson's choice between (a) delivery of radiation leading to issues with bone union or (b) avoiding radiation in biological reconstruction, leading to undertreatment that may compromise survival. We have attempted to circumvent this problem by using preoperative radiation in patients with Ewing's sarcoma in patients (a) who mandatorily need radiation (pathological fracture, large prechemotherapy tumor volume, etc.) and (b) who have biological reconstruction being performed.

Multiple choices exist of reconstruction for skeletal defects in children and should be individualized based on patient characteristics, need for additional therapy, patient affordability, and availability of expertise.

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Conflict of Interest
None declared.

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