



Challenge of Leg Length Discrepancy after Resection of Malignant Bone Tumors in Children

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Editorial

Limb salvage has changed from being an exception to a standard practice in the management of primary malignant bone tumors [1]. Limb salvage surgery is currently the gold standard of treatment in bone sarcoma. It involves resection of the tumor with clear margins and then reconstruction of the bony defect. The aim of limb salvage surgery is to preserve a limb with adequate function without compromising the overall survival of the patient [2]. The majority of patients can be cured by the virtue of multidisciplinary team including oncologists, radiation oncologists, surgeons, pathologists, radiologists and involvement of patients in clinical trials [3]. Up until the 1970s, amputation was the main form of treatment and yet the survival was only 11%. This dramatic improvement in the survival of children with bone sarcomas in the past 30 years is attributed to the introduction of chemotherapy for systemic treatment and a combination of improved imaging techniques, mainly the introduction of MRI scan, better understanding of the pathophysiology of the disease, improved surgical skills and advances in biomedical engineering has revolutionized the management and the survival of children with bone sarcomas. At present 85% of patients will undergo limb salvage surgery with survival ranging from 60% to 92% [4].

Leg length discrepancy "LLD" is a major challenge in the bony reconstruction of children after resection of malignant bone tumors due to their continuing growth. The level of activity and functional outcome depend to a large extent on the way of management of LLD as well as other factors, especially most of the malignant tumors in children arise around the knee, especially in the distal femur where the physis has the largest contribution to height growth of the child; 10 mm / year, contributing to 70% of femoral growth or 54% of lower limb growth; followed by proximal tibia where its physis contribute by about 46% of the lower limb growth by about 6mm/ year. Accepted amount of LLD is a matter of debate; [5] while some authors had limited the accepted amount of LLD to 20 or 30 mm, some others depended on the functional outcome to decide the 'accepted' LLD. Resection of the tumor will often involve excision of the growth plate and hence result in a loss of growth. This expected LLD could be estimated from knowledge of the bone age of the child and from growth charts [6]. In general, if the resection of the growth plate is expected to result in limb length discrepancy of less than 30 mm then the limb can be lengthened by 10–20 mm during reconstruction leaving an acceptable leg length difference of 10 mm – 20 mm at the completion of growth. However if the anticipated leg length difference is >30 mm then allowance must be made in the reconstruction for future growth or lengthening. The next challenge is to decide what type of limb salvage surgery and there are several options, both endoprosthetic and biological. Expandable Endoprosthetic replacement minimizes the challenge of lengthening if used, which is not always the case. Absolute amount of LLD is another challenge, where some authors indicated amputation when LLD at maturity is more than 20 cm, we believe that it is not only the absolute value of LLD is enough to decide if it is 'accepted' or not, as in our postoperative rehabilitation protocol, when the child has complete bone union, we encourage the physical activity and sports, thus LLD within accepted range may present a hinder for the child in running and jumping, or other physical activity.

Another challenge is the time and site of lengthening, as regard timing; we prefer Paley multiplier method [7] for the remaining growth to determine the time and expected LLD at maturity to minimize number of elongations, it is reliable, easy applicable, high inter-observer agreement. In case of reconstruction by expandable prosthesis, lengthening is performed according to development of LLD, soft tissue allowance, on frequent, timely adjusted intervals, the less amount of lengthening each time is preferred to minimize soft tissue complications, but it would increase the number of lengthening procedures till skeletal maturation. When reconstruction is performed using biological techniques, i.e., autoclaving, pasteurization, or freezing, we prefer to perform lengthening on the 'virgin' bone, i.e., if the reconstructed bone is the femur, we lengthen the tibia, and vice versa,

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because the full revitalization of the biologically recycled bone takes long time, up to six years in case of using freezing techniques [8]. In addition, the regenerate is more biologically powerful in the virgin bone, doesn't interfere with the fixation procedure, and doesn't mask local recurrence. Lengthening is performed by distraction osteogenesis using Ilizarov device, or Taylor Spatial frame TSF, distraction usually starts at the usual time after the operation. Lengthening through the virgin bone usually leads to knee joint unlevelling, which has no or minimal effect on the functional outcome in our experience.

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