PAPER 3

BIOLOGIC RECONSTRUCTION WITH DISTRACTION OSTEOGENESIS IN OSSEOUS SARCOMAS: A PROSPECTIVE ANALYSIS

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Background

Biological reconstruction with distraction osteogenesis (DO) is an effective reconstructive method following resection for osseous sarcomas, particularly in the pediatric, adolescent and young adult population. Sustainable long-term function has been established, but there is a paucity of published data informing surgeons and patients on important milestones in the reconstructive process. The objectives of this study are to determine when to expect cortex formation, bone healing, and full weight bearing, as well as the influence of chemotherapy on the bony regeneration process. We also describe the number and types of surgical procedures subsequent to the index surgery as well as the final functional outcome scores in our cohort.

Methods

Prospectively, laboratory, clinical and patient reported outcome scores (PROS) data was collected on 30 consecutive patients who underwent primary or secondary DO-based reconstruction following osseous resection at Memorial Sloan Kettering Cancer Center from 2018-2021. Serial radiographs indicated the time to cortex formation and full union, bone metabolic laboratory analysis was collected monthly, and PROS at routine surveillance frequency. We report means and standard deviations. Some data were non-parametrically distributed by Shapiro-Wilk testing and thus median values and interquartile ranges (IQR) are reported. An unpaired t-test was used to compare the times required for full bone remodeling of primary and subsequent lengthening segments. Functional outcome metrics included the Musculoskeletal Tumor Society (MSTS), Time to Get Up and Go (TTGUG), and Toronto Extremity Salvage Scores (TESS).

Results

17 males and 13 females were included. Median age at initiation of lengthening was 14 (range 4.5-56). Tumor subtypes included conventional high-grade osteosarcoma (16), Ewings sarcoma (6), UPS of bone (3), Adamantinoma (2), undifferentiated round cell sarcoma (BCOR-CCNB3) (2), and parosteal osteosarcoma (1). The average resection length was 13.6 cm (4-22). Resections were from 16 femurs, 11 tibias, 2 humeri and 1 radius. Patients underwent an average of 6.1 procedures (1-14). Half (50%) of all additional procedures were planned repeat lengthening procedures while half were unplanned (20% for infection, 16% to address a regenerate bone non-union or mal-union, 7% for fracture, 4% hardware failure, 2% for specific docking site issues, 2% for premature consolidation, and 1% for neuropraxia). The first lengthened segment, often initiated concurrently with chemotherapy, required an average of 17 months (+- 7.0) for full

remodeling; formation of the first cortex occurred 10.7 months (+- 6.6) after initiation. Subsequently lengthened segments, occurring after completion of systemic therapy, required an average of 8.6 months (+- 3.4) for full remodeling and 4.6 months (+-2.8) for formation of the first cortex (p=.0002). Median time to full weight bearing was 12 months (IQR 9-16). Final functional outcomes scores were 24.2 (+-4.8) for MSTS and 81.5 (+-11.5) for TESS, and 7.9s (+-1.9) for TTGUG.

Conclusion

This is the largest reported series of distraction osteogenesis reconstruction in oncological patients. Our cohort, similarly to other reported series in the literature, demonstrated a relatively high rate of unplanned returns to the operating room. Despite the increased complications, DO reconstruction remains an attractive option for autologous bone regeneration after massive bony resections for sarcoma. Ongoing prospective data collection will help to strengthen the findings from this study with updated information on functional outcome scores and influence of chemotherapy on DO. Surgeons and patients can expect bone healing to be nearly twice as fast for segments occurring after completion of systemic chemotherapy compared to segments initiated concurrently with adjuvant chemotherapy.