

Orthopedic Oncology: The Road Less Traveled

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O rthopedic oncology represents only a small percentage of the field of orthopedics. To be sure, this is due to the fact that malignant tumors of bone and soft tissue are rare.

Even when benign tumors of the musculoskeletal system are included, the incidence of these conditions pales in comparison to trauma, spine, hand and upper extremity, total joints, and even pediatric orthopedics. In addition, the incidence of nononcologic conditions that orthopedist see, continues to increase, while the incidence of primary malignant bone and soft tissue tumors has remained stable for more than 30 years. In an era emphasizing on evidence-based medicine, the rarity of primary malignant bone and soft-tissue tumors makes the development of established protocols nearly impossible.

Despite these facts, the field of orthopedic oncology continues to be invigorated by exciting developments and research that has advanced the care of patients with various bone and soft-tissue tumors. Recognizing that no single institution has enough patients to make evidence-based protocols, practical international cooperative groups have been formed to address this challenge. Groups such as Cooperative Osteosarcoma Study Group (COSS), Scandinavian Study Group (SSG), European Osteosarcoma Intergroup (EOI), The Children's Oncology Group (COG), collectively cover nearly 400 million lives. With such a large population, evidence-based protocols are being created.



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Historically, the major impact on survival of patients with osteosarcoma and Ewing's sarcoma, the most common primary bone sarcomas, came in the 1970s. The introduction of high-dose methotrexate and adriamycin altered the survival rate from 20% to 60-75%. Shortly thereafter, the use of neo-adjuvant chemotherapy was shown to not compromise overall survival and improve the potential for limb salvage surgery.

Today, most patients with primary bone sarcomas are offered limb-sparing surgery without increased risk to overall survival at sarcoma centers. Additional advances have come in the field of imaging. Computer tomography (CT) is used to identify pulmonary metastasis, which can be treated with chemotherapy and/or resection with potential cure in many cases. Magnetic resonance imaging (MRI) better defines local extent of disease and skip metastases to allow accurate definitive surgery and early detection of local recurrence. Finally, positron emission tomography (PET) is proving to be valuable in the detection of local recurrence and may be a valuable predictor of response to chemotherapy in bone and soft tissue malignancies.

Along the road to improving the treatment of patients with bone and soft-tissue malignancies, orthopedic oncologists continue to collaborate with other subspecialists to integrate advances in surgical techniques. This is especially true for the development of implants and image guided surgery. In the past few years, implants designed for skeletally immature patients have been developed and expanded noninvasively. Implants that do not require cement, and rely on biological ingrowth, are being used in tumor reconstructions. Furthermore, image-guided surgery systems used in joint

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reconstruction, have been applied to orthopedic oncology. This may prove especially beneficial for areas such as the pelvis, where the complex anatomy makes resection with a negative margin, and optimizes functional results especially difficult.

With these advances provocative questions are raised. How close is too close with respect to margins? If a tumor involves a portion of the pelvis at presentation, and then regresses after chemotherapy, do you resect where tumor was at presentation or do you resect where tumor is at the time of surgery? Now that expandable prostheses can be lengthened noninvasively, what is the lower age limit this surgery should be offered to?

It is clear that with advancing technologies come new and exciting treatments. The role of orthopedic oncologists is to apply these advances appropriately for our patients. International societies such as the International Society of Limb Salvage (ISOLS) and national soci-

eties such as The Musculoskeletal Tumor Society (MSTS), and similar societies in Europe (eg, European Musculo-Skeletal Oncology Society [EMSOS]), and the world, are dedicated to this role. For now, many of these emerging technologies are in their infancy. As a result, early publications have limited numbers and short follow-up.

While excitement is easily generated with new technologies, we should not overlook the equally impressive advances from more mundane developments. The 2 most obvious examples are education and multidisciplinary treatment centers. General orthopedic surgeons are familiar with the importance of recognizing potential malignancies of bone and soft-tissue, and the importance of referring cases to sarcoma centers. This remains an important educational component of residency training and maintenance of certification (MOC). Similarly, fellowship trained orthopedic oncologists work closely

with radiation and medical oncologists, radiologists, physical therapists, patient educators, and social workers as a team. Ideally, multidisciplinary clinics are structured so that the patient sees the medical, orthopedic, and radiation oncologist simultaneously. What remains critical is that the team of experts is available to collaborate in order to optimize results.

Fortunately, primary malignant bone and soft-tissue sarcomas are uncommon. As we look down the path, as did the traveler in Robert Frost's poem, "The Road Not Taken," I remain confident that "somewhere ages and ages hence" we can say that with cooperation and diligence the field of orthopedic oncology "has made all the difference" for our patients.

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