Clin Orthop Relat Res (2016) 474:1110–1112 / DOI 10.1007/s11999-015-4660-8

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

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Published online: 10 December 2015

CORR Tumor Board

CORR® Tumor Board: Does Microwave Ablation of the Tumor Edge Allow for Joint-sparing Surgery in Patients with Osteosarcoma of the Proximal Tibia?

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What are the surgical and research implications of "Does Microwave Ablation of the Tumor Edge Allow for Joint-sparing Surgery in Patients with Osteosarcoma of the Proximal Tibia?" DOI: 10.1007/s11999-015-4447-y.

A Note from the Editor-in-Chief: We are pleased to present the next installment of The CORR® Tumor Board column. *The* CORR® Tumor Board *column provides multidisciplinary perspective on the themes raised in selected* CORR® *tumor papers. In this column, we will discuss the implications of the highlighted article from the varied disciplines of the Tumor Board members: Orthopaedic surgery, pathology, and radiology. This month's column discusses* "Does Microwave Ablation of the Tumor Edge Allow for Joint-sparing Surgery in Patients with Osteosarcoma of the Proximal Tibia?" *by Li and colleagues available at:* DOI: 10.1007/s11999-015-4447-y.

The authors certify that they, or any members of their immediate families, have no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

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This *CORR* Tumor Board column refers to the article available at DOI: 10.1007/s11999-015-4447-y.

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With the development of effective chemotherapy for osteosarcoma, limb-salvage surgery has evolved as an accepted and often preferred option for the majority of patients. With the goal of accomplishing local control of the tumor with best possible function, we must assess new technology in light of safety and effectiveness. For the topic presented in this manuscript, safety is fairly straightforward: Is the frequency of local recurrences the same as or less than observed with standard treatment? Are the complication numbers and types the same or less than standard treatment? The authors demonstrate preliminary information that is reassuring to this end with a plan for further followup in a larger series. What may be more challenging is to settle on what "standard treatment" is and to develop a protocol that would directly compare experimental and standard arms. Standard treatment might include joint replacements (such megaprostheses), reconstructions (like allografts, allograft-prosthetic composites, and rotationplasty), and ablative procedures such as amputation. Since each patient with an osteosarcoma must be carefully

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selected for the appropriate local control surgery, there is no option for a randomized study. Therefore, we rely on carefully reported data in case series such as these and comparisons to historical data or control cohorts of patients.

Effectiveness is more of challenge. We have the sense that preserving the native articular surface must be better than joint-sacrificing reconstructions, but our ability to prove that is less than ideal, since the instruments we use to assess outcomes are not sensitive nor specific enough. In addition, the duration of followup needed to show that difference makes obtaining those data extremely challenging. We must continue to take on the task of improving physician-, patient- and/or parent-reported functional outcomes, and to actualize institution- and nation-wide registries.

What issues does this study raise in terms of musculoskeletal imaging?

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Musculoskeletal Radiologist

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As treatment options for osteosarcoma expand and limb salvage procedures are being performed more routinely, imaging continues to play an important role. The article by Li et al. [3] highlights the need for accurate imaging capable of detailing tumor extent to within a few millimeters in order to guide treatment. In their study, they imported both CT and MRI images into a navigation system to guide placement of the ablation needles and tumor resection. CT can best delineate the bony landmarks whereas MRI has proven to be the best imaging modality at detailing tumor extent and relationship to anatomic structures. However, one of the biggest questions that comes to mind is, "How accurate is MRI at delineating tumor extent?" If the MRI underestimates tumor extent, the margins will be positive as the surgeon will not remove the tumor in its entirety, or microwave ablation may be performed inside the tumor edge. Conversely, if the MRI overcalls disease, too much tissue is unnecessarily removed or ablated and this could potentially exclude a patient from having a limb-salvage procedure. The good thing is that most studies have shown fairly good correlation between tumor extent using T1 and T2 fat suppressed MR images with the final pathologic specimen [1, 2]. However, these studies have used 2 cm to 3 cm for the surgical margin. Although the results in this study were excellent, with no cases of local disease recurrence and good MSTS functional scores, they sought to achieve an intralesional margin at the edge of the tumor. It will be important to see if future larger studies will confirm that treating such a planned intralesional margin with microwave ablation is adequate. Moreover, it is important to understand that the edge of the tumor with normal bone can be indistinct or contain peritumoral edema on MRI making determination of the true tumor margin difficult. In addition, adjuvant chemotherapy or granulocyte colony-stimulating factor therapy can also cause marrow edema, leading to overestimation of tumor extent [4]. Awareness of these imaging pitfalls is important for all members of the treatment team.

What more does the surgeon need to know about musculoskeletal pathology in order to get the most out of this study?

Sara O. Vargas MD

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The technique described by Li et al. brings up several considerations related to pathology. First, it might be asked what the pathologic features of the microwave-treated osteosarcoma teach us about the method's success. The resected bone specimen shows a blackened area extending for what might be 1 cm to 1.5 cm into the proximal portion of the specimen (Fig. 1). If a similarly sizeable amount of thermal necrosis occurs proximal to the resection plane, then the procedure

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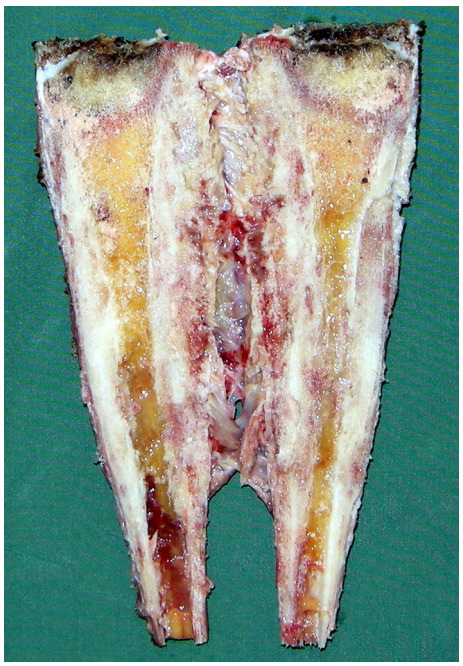

Fig. 1 The resected bone specimen shows a blackened area extending approximately 1 cm to 1.5 cm into the proximal portion of the specimen. If a similarly sizeable amount of thermal necrosis occurs proximal to the resection plane, then the procedure seems likely to effectively ablate unresected tumor in a substantial number of juxtaarticular osteosarcomas. (Figure originally published as part of Li J, Guo Z, Wang Z, Fan H, Fu J. Does microwave ablation of the tumor edge allow for joint-sparing surgery in patients with osteosarcoma of the proximal tibia? *Clin Orthop Relat Res*. 2015;473:3204–3211).

seems likely to effectively ablate unresected tumor in a substantial number of juxtaarticular osteosarcomas. Pathologic evaluation of the unresected juxtaarticular bone is not feasible, but it is possible that a more-detailed microscopic examination of the resection specimens might provide more information about the extent and nature of the thermal injury.

A second pathologic consideration pertains to potential compromise of specimen integrity that results when ablation is conducted before resection. There is no doubt that histologic evaluation of margin status and percent tumor necrosis would be compromised by thermal ablation. In treated bone tumors, viable residual tumor can sometimes be scarce, and obliteration of a critical focus also may hinder assessment of other histologic parameters, special staining procedures, genetic/cytogenetic evaluation, or novel techniques that may emerge, such as vaccine development. In any case, with microwave ablation of a juxtaarticular osteosarcoma margin, it is clear that it will not be the pathologist who will declare a surgical margin positive or negative. Rather, time will tell.

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