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## CORR Insights

# **CORR** Insights<sup>®</sup>: Sacral Insufficiency Fractures are Common after High-dose Radiation for Sacral Chordomas Treated With or Without Surgery

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## Where Are We Now?

hordoma is a rare malignant tumor of the vertebral column that is thought to arise from

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notocordal rest cells. The tumors characteristically occur in the midline of the neuro-central axis, from the skull base to the sacrum. The highest percentage of these are seen distally, frequently arising from the sacrococcygeal junction, and surgical resection is the treatment of choice for these tumors. However, the complex anatomy of the neural axis can make obtaining acceptable margins challenging. The ideal surgical treatment consists of resection with wide margins, but it remains challenging to preserve essential neural function and avoid injury to visceral and vascular structures during resection. Frequently, margins are positive, marginal, or contaminated [7-9] and adjuvant

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joshua.patt@carolinashealthcare.org; joshuapatt@hotmail.com treatment strategies must be considered. The most common adjuvant treatment employed is radiation therapy, but because chordomas often are radioresistant, high dose radiotherapy (> 60 Gy) generally is used [1]. Highly conformal strategies such as proton beam or stereotactic radiosurgery techniques are commonly employed to maximize dose to the operative bed. Some institutions have employed neoadjuvant radiation as a strategy to try and improve local control—as is the protocol at the authors' institution [1]. One of the critiques of radiation therapy is that it can cause pathological fractures of bones that lie in the radiation field [4]. While prior studies of chordoma have appropriately pointed out the major morbidity and mortality associated with sacral resections [5, 7, 10], the authors recognized a disparity between prior studies and their own cohort with respect to this functionally relevant complication of sacral insufficiency fractures.

The current paper takes a focused look at this common complication of



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radiation therapy by comparing the frequency of sacral insufficiency fractures in sacral chordomas treated with radiation alone compared to those treated with surgery. They provide a succinct take-away message for the reader, reporting 2-year fracture-free survival probability is 0.36 after high sacrectomy and radiation, while it is 0.77 after radiation alone. They further dichotomize the surgical cases into high and low sacrectomies for risk stratification showing high rates of fracture after high sacrectomy and no fractures after low sacrectomies. This study helps the clinician understand who is at risk for the complication of sacral insufficiency fracture and can help educate a patient about the risks and benefits of the addition of radiation therapy as part of the treatment for chordomas.

#### Where Do We Need To Go?

The authors' institution has helped advance the science of radiation therapy for sacral chordomas [1–3]. The authors from those prior papers have pioneered the utilization of proton-based regimens for chordoma, and so they have a unique ability to look at longer-term followup of patients treated with radiation. While existing data on radiation therapy have consistently shown an ability to improve

local control [11], followup studies such as this raise some questions about longterm safety and functional issues related to radiation [6]. Prior studies have showed a much lower incidence of insufficiency fractures (6%) [5, 9] with nonroutine use of high-dose radiation. This raises an important question as to whether the benefits of radiation outweigh the risks. The low incidence of fracture (0%) in the low sacrectomy group suggests that the treatment field may allow protection of the upper, structural portion of the sacrum and not predispose the patient to fracture while still giving them the benefit of radiation. This would improve local control, suggesting that the benefits (better local control) in the low sacrectomy group may outweigh the risks. While the study by Osler and colleagues focuses on risk fractures, a number of interesting questions do remain: (1) What are the functional consequences of sacral insufficiency fractures in this population? (2) What treatment or preventive measures that should be considered in patients with a high-risk of fracture? (3) Who should receive radiation therapy as part of their treatment plan?

## How Do We Get There?

Due to the nature of this retrospective study design, it was not possible to properly measure the functional outof these patients. comes considering treatment options and counseling patients, it would be helpful to know what the functional consequences are of these fractures. For example, if all fractures were evident radiographically but there was no pain or functional limitations, their incidence would be irrelevant to clinical outcome. Any further study should include functional outcome scores and some sort of quality of life scores or disease specific outcome score (SF-36, Oswestry Disability Index) to further clarify these issues.

It would be beneficial if we better understood how to treat this complication. While having better data about the treatment of these fractures would be helpful, consideration should also be given to preventing fracture complications. Prophylactic reinforcement or fixation should be considered for higher risk patients (low bone density, older age, high sacrectomy, radiation only and female patients). Using a similar concept, the Toronto group created a nomogram for predicting fracture risk, and then made recommendations for prophylactic treatment for patients radiated for soft-tissue sarcomas of the lower extremity [6]. Functional outcomes could be compared, as well as the results of intervention for the treatment of fracture.



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Determining how to best care for and advise the patient with a sacral chordoma remains challenging. The first question that must be asked is whether or not radiation is necessary in all patients with sacral chordoma. Like most clinical questions, the answer may only be found in the prospective randomized study. Unfortunately, like many oncologic conditions, the incidence of this problem is too low to enroll patients in a properly powered study, and treatment, as well as tumor heterogeneity, can bias against a scientific answer. For patients who are deemed unresectable due to oncologic issues or who are intolerant of the potential morbidity of surgery, it may not be necessary to elucidate this answer any further. Radiation clearly is indicated for this inoperable group [1]. It is in the surgical group that we must work to find a more scientific answer. The ultimate way to mitigate radiation complications would be to not irradiate every patient. Therefore, a stratified study looking at surgery with and without radiation would be ideal. A good place to start may be to focus on whether a patient resected with negative margins needs radiation. Unfortunately, clinical equipoise may make this difficult, as existing clinical experience and existing practice patterns may make this unfeasible and the rare nature of this tumor would necessitate a large, multiinstitutional trial.

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