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Title: Patient Reported Outcomes after Sacral Resection based on the Nerve Roots Sacrificed

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Background: For patients with sacral tumors, who are well enough for surgery, en bloc resection is the preferred treatment. Survival, post-operative complications and recurrent rates are described in the literature. Patient reported outcomes are often not included in these studies.

Questions/Purposes: The purpose of this study is to compare patient reported outcomes, based on the sacral nerve roots sacrificed during sacral resection, in terms of (1) mental health; (2) physical health; (3) bowel function and (4) sexual function.

Patients and Methods: Patients who underwent en bloc sacral resection due to a tumor of the sacrum were prospectively enrolled at 3 tertiary referral institutes. Patients were asked to fill out the National Institute of Health's Patient Reported Measurement Information System (PROMIS) Global Health survey, PROMIS Pain Interference survey, PROMIS Pain Intensity survey, PROMIS Sexual Function survey and the Modified Obstruction and Defecation Score survey. Patients were grouped by the sacral nerve roots sacrificed (i.e. S1-S5, S2-5, S3-5, S4-S5, S5). One-way analysis of variances test on means was used to conduct statistical analysis between groups.

Results: 79 patients were included with a mean age of 56 (range = 13 to 80). 62 (79.5%) of the patients had a chordoma. 9 (11.5%) patients had nerve roots S1-S5 removed, 22 (28.2%) had nerve roots S2-S5 removed, 17 (21.8%) had nerve roots S3-S5 removed, 22 (28.2%) had nerve roots S4-S5 removed and 7 (9.1%) had nerve roots S5 removed. We found there was a significant difference in state of physical health ($P = 0.016$), with the lowest score (indicating poor physical health) in the S1-S5 group (mean = 43.08, SD = 5.25) and the highest score (indicating good physical health) in the S5 group (mean = 53.9, SD = 8.69). The ability to get an erection also differed among the groups ($P = 0.024$). The lowest score was in the S1-S5 group (mean = 40.7, SD = 6.70) and the highest score in the S3-S5 group (mean = 61.1, SD = 6.2). The last difference was found in the MODS survey, with the highest score (indicating worse obstruction) in the S1-S5 group (mean = 12.2, SD = 6.85) and the lowest score (indicating less obstruction) in the S5 group (mean = 3.5, SD = 1.91). Compared to normative data from the general population, the S1-S5 group scored significantly lower on the physical health survey ($P = 0.0042$) and the pain interference survey ($P = 0.0023$). The S2-S5 and the S4-S5 group score lower on the pain interference survey ($P = 0.012$). The S3-S5 group scored lower on the pain intensity survey ($P = 0.011$).

Conclusion: Our analysis shows that when more sacral nerve roots are sacrificed during sacral resection for a primary tumor of the sacrum, patients incur more loss of physical health, sexual function and bowel function in

comparison with patients who had less sacral nerve roots sacrificed. When score are compared to score from the general population, all but the S5 group incurred more pain and the S1-S5 group was in a lower state of physical health. Due to the variety of symptoms, a standardized questionnaire for sacral tumors is needed to be able cover all facets and to compare outcomes of different studies.