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Computerized Navigation Resection of Simulated Bony Tumors Using Skin Fiducials and K-wires: An In Vitro Cadaveric Study

John Whitaker¹, Shikha Sachdeva MD¹ Jon Carlson MD¹,
Tolani Are MD¹, Campbell Edwards¹, Rodolfo Zamora MD¹
¹University of Louisville, Louisville, KY
John.whitaker@louisville.edu

Introduction: It is estimated that 3,600 new cases of Primary Bone Cancer (PBC) will be diagnosed in 2021, with 1,720 deaths. Additionally, metastatic bone lesions may require orthopaedic intervention for mechanical stabilization. Accurate localization and correlation of surrounding anatomy and clear margins is essential for tumor surgery success. Advancements in computerized navigation has demonstrated to be helpful in multiple areas of orthopaedics. The purpose of this study was to evaluate the agreement between planned and resected margins of simulated bone tumors (SBT) using both skin fiducial and 1mm k-wires for navigated resection.

Materials and Methods: Skin fiducial markers and k-wires were applied prior to an O-arm scan of cadaveric pelvic specimens with SBT. The k-wires were applied to one side and the skin fiducials were applied to the contralateral side. A navigation pointer was used for registration and for resection. Resection margins were determined from the cortex to the edge of the simulated tumor. A resection was considered acceptable if it was no more than 2mm inside the resection margin.

Results: 36 resection margins were measured, (18x skin fiducials; 18x k-wires). The planned margin mean was 10.0mm for both sides (Skin fiducial: 95% CI = 8.9 – 10.9mm; K-wire: 95% CI = 8.8 – 10.3mm) and the resected margin mean was 9.6 mm (95% CI = 8.1 – 11.0mm skin fiducials) and 9.9 mm (95% CI = 9.0 – 11.0mm k-wires). One of the 36 (2.7%) resections was 2mm inside the planned resection margin.

Conclusions: Computerized navigation resection shows promising results when comparing planned and resected margins of SBT in cadaveric specimens. Further research in advanced image guided tumor resection using skin fiducial marker and or k-wires may be an effective method for localizing and aiding in obtaining clear surgical margins in bony tumors in human subjects.