Navigated Pelvic Bone Cuts Using an Osteotome and an Oscillating Saw: A Sawbones and Cadaver Study Assessing Accuracy and Reproducibility of Resection Planes

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Disclosures:

Introduction: The objective of this study was to assess the accuracy and reproducibility of pelvic bone cuts using a navigation system with a navigated osteotome and an oscillating saw.

Methods: Using a novel navigation system and 3D planning tool, we navigated pelvic bone cuts which were representative of typical cuts made in pelvic tumor resections. The system includes a prototype mobile C-Arm for intraoperative cone-beam CT, real-time optical tool tracking (NDI Polaris), and 3D visualization software. A 3D virtual view was utilized in addition to tri-planar navigation (axial/sagittal/coronal). A second post-procedure CT was acquired to assess results. In part one of the study, we navigated 24 sacral bone cuts in sawbones and validated our results in 16 similar cuts in cadavers. In part two, we developed three pelvic tumor sawbone models (a peri-acetabular tumor, a sacral tumor and an SI joint tumor) based on actual patient scenarios, and compared 3 navigated resections to 3 non-navigated resections for each tumor model. Part three assessed the accuracy of the system with multiple users.

Results: There were 90 navigated cuts in sawbones which were compared to 54 non-navigated cuts. In the navigated sawbones cuts, the mean entry and exit cuts were 1.4±1 mm and 1.9±1.2 mm from the plan respectively. The entry and exit cuts in sawbones which were not navigated were 2.8±4.9 mm and 3.5±4.6 mm respectively. The navigated cuts were significantly more accurate (p≤0.01). In the cadaver study, entry and exit cuts were 1.5±0.9 mm and 2.0±1.5 mm from the planned cuts. The variation between three different users was less than 1 mm on both the entry and exit cuts. The mean image to tracker point-to-point registration error was 0.97±0.3 mm in sawbones and 0.9±0.3 mm in cadavers. The mean image-to-image registration error was 0.88±0.24 mm in sawbones and 0.9±0.3 mm in cadavers. Using a saw blade of actual width 1.25 mm, the mean cut width for the oscillating saw was 1.9±0.7 mm.

Discussion: Using navigation for pelvic bone cuts is accurate and feasible. 3D views should be used for improved accuracy. Navigated cuts were significantly more accurate than non-navigated cuts. A margin of 5 mm between the target tumor volume and the planned cut plane would result in a negative margin resection in more than 95% of the cuts. Similar accuracy was achieved in cadavers.

Significance: Freehand complex three dimensional pelvic cuts can be performed with better than 5 mm of accuracy with the developed system. Similar methodology can be utilized with future navigation systems in order to determine the appropriate safety margins to use around tumors and important structures when relying solely on computer navigation.

Acknowledgments:

References:

ORS 2014 Annual Meeting
Poster No: 1114