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Navigated joint sparing bone tumor resections

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A sawbones study assessing accuracy and reproducibility of resection planes.
Objective: To assess the accuracy and reproducibility of joint sparing bone cuts using a navigation system with a navigated oscillating saw.
Methods: Using a novel navigation system and 3-dimentional (3D) planning tool, we navigated bone cuts to resect bone tumors. The system includes a prototype moblie C-Arm for intraoperative cone-beam CT, real-time optical tool tracking (NDI Polaris), and 3D visualization software. 3D virtual views and color coded real-time guidance visual scales were utilized to guide navigation. We developed three saw-bone tumor models identical to actual patient scenarios. Three surgeons each completed 3 navigated and 3 non-navigated resections for each tumor model.
Results: There were 126 navigated cuts in sawbones which were compared to 126 non-navigated cuts. Non-navigated cuts went through tumor in 22% (6/27) of the resections compared to navigated cuts which did not go through tumors (0/27)/ In the navigated sawbones cuts the mean entry was 1.6mm (SD 1.4) from the plan compared to the non-navigated cuts which were 3.4mm (SD 2.6) from the planned osteotomy site. Pitch and roll were 3.5 deg (SD 4.3) and 3.7deg (SD 4) in the navigated cuts compared to 13.3deg (SD 10.6) and 10.9deg (SD 9.1) in the non-navigated cuts, respectively. The navigated cuts were significantly more accurate ($P<0.001$). The variation between three different users using navigation was less than 0.6mm on the entry cut and 1.5deg on pitch and roll.
Conclusion: Navigation to guide joint sparing resections of bone tumors is accurate and feasible. 3D views and visual guidance should be used for improved accuracy. Navigated cuts were significantly more accurate than non-navigated cuts.
Clinical Implication: Navigated resection can reduce the rate of positive margin resection and lower the local recurrence rates while sparing function.