Navigated Complex Bone Tumor Resections in the Hands of Non-Tumor Surgeons

A skill translation study

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Objective:

To assess the accuracy achieved by non-tumor surgeons, of different levels of training, using navigation for the first time to aid guide a complex bone tumor resection.

Methods:

Using a novel navigation system and 3-dimensional (3D) planning tool we navigated bone cuts to resect a distal femur parosteal osteosarcoma saw-bone model, identical to an actual patient scenario. The system includes a prototype mobile C-Arm for intraoperative cone-beam CT, real-time optical tool tracking (NDI Polaris) and visualization software. 3D virtual views and color coded real-time guidance visual scales were utilized to guide navigation. Fifteen non-tumor orthopaedic surgeons (5 staff surgeons, 5 fellows and 5 residents) were compared to three tumor surgeons.

Results:

The mean distance from plan to actual entry into bone was 1.5mm (SD 1.4) for all users. The mean difference in pitch and roll between the plan and actual cut was 3.5 degrees (SD 2.8) and 3.7 degrees (SD 3.2) for all users. There was no significant difference between surgeons based on their levels of experience with regard to accuracy of the actual bone cuts compared to the plan. There were 2 intralesional cuts out of 144 navigated cuts in 18 resections. The mean time to complete the resection was 30 minutes (range 17-44).

Conclusions:

Navigation to guide complex resection of bone tumors is accurate and feasible. 3D views and visual scale guidance should be used for improved accuracy. The level of surgeon training did not influence the accuracy of the bone cuts when guided by navigation.

Clinical Implication:

Navigated resection can reduce the rate of positive margin resection and lower the local recurrence rates while sparing function in surgeons of all levels of training thereby increasing safety.