MEDINFO 2017: Precision Healthcare through Informatics
A.V. Gundlapalli et al. (Eds.)

doi:10.3233/978-1-61499-830-3-1375

In Vitro Comparative Study Between Conventional and Computer-Assisted Surgery Methods for Planning and Resection of Bone Sarcomas

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Abstract

This poster aims to achieve an "in vitro" comparative study between three methods: 2D digital images planning and execution without navigation (freehand with ruler and caliper), 3D planning and execution without navigation (freehand with ruler and caliper) and 3D planning and execution guided with navigation. 3D planning and navigated procedures potentially improve sarcoma resection.

Keywords:

Informatics, Virtual Navigation, Sarcoma

Introduction

Surgeons plan surgeries using bi-dimensional images from magnetic resonance and tomography to define the tumor extension and then handle standard tools intraoperatively (caliper and ruler) to resect bone sarcoma. We wonder if surgeons have more information about the spatial tumor situation before and during the surgical procedure would it reduce the risk of potential sarcoma recurrence? Thus, the aim of this comparative study is to reach ideal "in vitro" conditions with an experimental design to answer these questions: Which type of planning method is safest for planning an oncologic margin? Which type of executing method is safest for sarcoma resection?

Methods

Two surgeons specialized in bone tumors unfamiliar with computer-assisted techniques and a 2nd year resident were evaluated to measure the accuracy and the impact in bone sarcoma resection according to the tools used. Plastic bones: a proximal femur, a distal femur, a humerus, a pelvis considering iliac wing and acetabulum. The methods evaluated were 2D digital images planning and execution without navigation (freehand with ruler and caliper), 3D simulation scenario planning and execution without navigation (freehand with ruler and caliper) and 3D simulation scenario planning and execution guided with navigation.

Results

Surgeon A, B and C did not remove the tumor when planning in 2D and executing with the freehand method based on those plans. The 3D planned and freehand guided resections exceeded the 3mm threshold a 66% of the times, while the navigated assisted resections a 20% of the times. For the 5mm threshold, the 3D planned and freehand guided resections exceeded it a 41% of the times while the 3D planned and navigated assisted resections a 3% of the time. There is no apparent difference between 3D planned non-assisted resections and 3D planned assisted resections when evaluating safe margin violations. The navigation-assisted resections are closer to the target resection.

Figure 1 – A Plastic Pelvic bone showing color lines that depict each planning and execution method. Black line: 2D planning and freehand. Red line: 3D planning and freehand. Green line: 3D planning and navigation guidance. The yellow circle shows the estimated location of the tumor.

Conclusions

The 2D planning derived in a wrong resection, leaving tumoral tissue inside the patient. The 3D planning method potentially improved the results. There is no significant difference between 3D planned non-assisted resections and 3D planned navigation-assisted resections. The proposed model is on its experimental stage. The model allows physicians to compare advantages and disadvantages of tools and methods used in oncologic surgeries. 3D planning and navigation are potential assets in order to acquire accuracy and to reach an optimum margin in tumor resections.

References

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