Accuracy of Chest Wall Tumor Resection Guided by Navigation: Experimental Model

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Abstract
Difficulty in identification wall chest tumors lead to unnecessary wide resections. Optical navigation and preoperative virtual planning are assets for surgeries that require exactness and accuracy. These tools enable physicians to study real anatomy before surgery and to follow an established pathway during procedure ensuring effectiveness. The aim of this paper is to demonstrate that Preoperative Virtual Planning is a useful tool in chest tumor interventions to define oncological margins successfully. Moreover, it is possible to use a virtual specimen in order to quantify accuracy. Optical navigation has been used in surgical procedures such as neurosurgery, orthopaedics and ENT over the last ten years. This principle is used in order to orientate the surgeon in three dimensional spaces during the surgery. Surgeons are guided intraoperatively with navigation and are able to obtain a correspondence between images acquired and processed before the surgery and the real anatomy.

Keywords: Optical navigation; Chest wall tumor; Preoperative virtual planning; Chest wall allograft.

Introduction
The main problem of chest wall tumors is the non-visible or non-palpable oncology margins that lead to wide surgical resections. Preoperative planning and navigation introduce a new concept in computer-assisted surgery that consists of using specific tools, which provide safe and accurate localization to optimize the surgical margins while keeping the safety margins unharmed [1]. The objective of this paper is to describe technical aspects and to establish an experimental design in order to demonstrate accuracy in a chest wall navigation.

Methods
The four cases included in this work were patients with a chest wall tumor where the margin cannot be determined using direct visual inspection nor palpable features. A navigated pointer was used to mark the osteotomy, which had been previously planned, on the superficial bone with a surgical marking pen. Next, the surgeons performed the osteotomy following this mark with a freehand saw. After surgery, the surgical specimen was CT scanned, reconstructed and registered to the bone cortex in the plan. A plane fitting algorithm was used to find the precision of the osteotomy (Fig 1).

Results
The accuracy (median) of the osteotomy was of 0.44mm with a precision (equivalent to a 6 sigma dispersion) of 3.78mm. The 99.99966% of the osteotomy surface is below the tolerance threshold of 2mm. In the four cases, it was possible to generate a preoperative plan and achieve a good intraoperative registration between the virtual scenario and the patient.

Conclusion
Navigation is an essential computer-assisted tool for surgery, which should be taken into account in order to assist the surgeon in the operating room. This technique is accurate and reproducible. Furthermore, this tool shows exactness and potentially reduces morbidity during surgery. The present validation model, using a virtual specimen scanned, is an useful and novel method to quantify results after a chest wall tumor resection is executed.

References

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