



Accuracy of Intra-operative Stereovision for Registration of a Spinal Surgical Field Using Explanted Porcine Spines

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Introduction

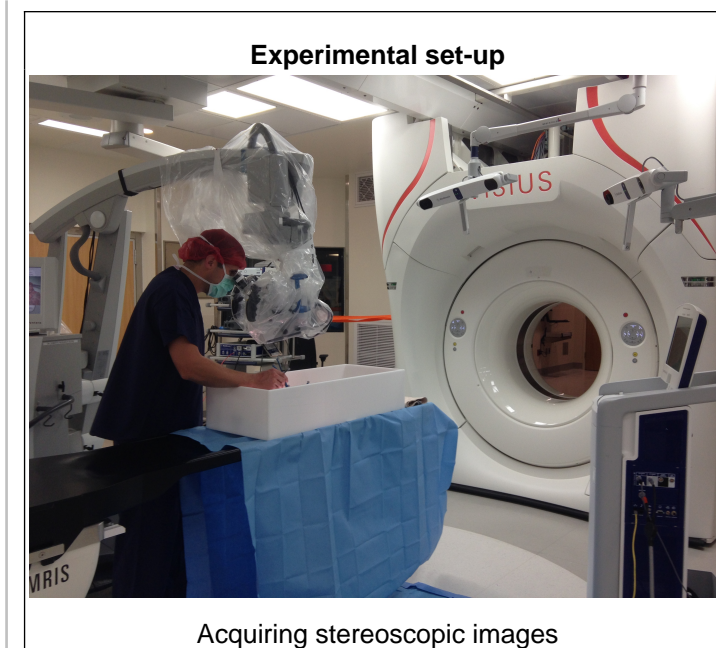
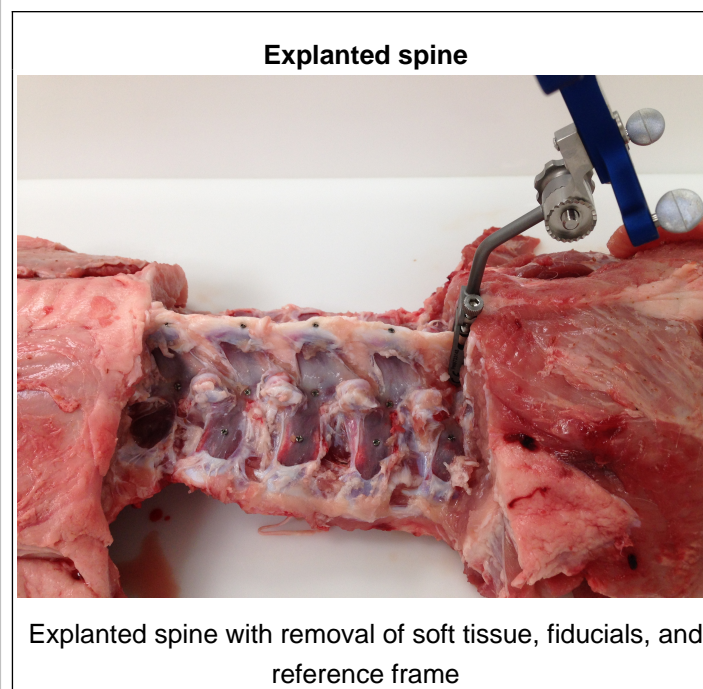
Image guidance has revolutionized the practice of neurosurgery and is used routinely for cranial operations. Spinal image guidance has found more limited use due to inefficient registration methods, significant intervertebral segment motion, and ineffective immobilization of the spine. We previously reported on the feasibility and efficiency of intra-operative stereovision (iSV)-mediated registration of eight human subjects. In the current study, we assessed the accuracy of iSV-mediated registration compared to a fiducial-based registration, with calculation of target registration error (TRE) for each technique.

Methods

Soft tissue was removed from 4 explanted porcine spines exposing laminae, facets, and transverse processes. Titanium mini-screws were implanted into each exposed vertebra, and a CT was obtained. Using a tracked probe, a standard fiducial-based registration was obtained. Stereoscopic images were then acquired with a tracked, calibrated, stereoscopic camera. Images were processed, reconstructed, and coregistered to the CT using a semi-automated multi-start algorithm. TRE for both the standard probe registration and iSV registration were then calculated, using fiducial mini-screws not employed for the original registration.

Results

A total of eight independent imaging sessions were performed. The average TRE with a gold-standard fiducial-based registration was 1.47mm (1.14-2.0mm). The average TRE using a stereovision-based registration method was 2.13mm (1.59 - 2.61mm). Registration with iSV was efficient, requiring less than 1 minute of computation in all sessions.



Conclusions

Intraoperative stereovision is an accurate and efficient method of registration in spinal surgery. To our knowledge, this is the first rigorous validation of iSV against a gold-standard fiducial-based registration. Intraoperative stereovision registration was slightly less accurate than a bone screw fiducial-based registration; however, iSV appears sufficiently accurate for clinical use, and its efficiency and lack of associated radiation may offer advantages over other intra-operative registration methods.

Learning Objectives

By the conclusion of this session, participants should be able to : 1) Describe the limitations of image guidance in spinal surgery; 2) Discuss the unique benefits of stereovision for registration in spinal surgery; 3) Relate the accuracy of stereovision based registration