Intraoperative Ultrasound for Spine Surgery

Accurate and efficient registration of pre-operative computed tomography or magnetic resonance images with iUS images are key elements in the success of iUS-based spine navigation. While widely investigated in research, iUS-based spine navigation has not yet been established in the clinic. This is due to several factors including the lack of a standard methodology for the assessment of accuracy, robustness, reliability, and usability of the registration method. To address these issues, Gueziri et al. presented a systematic review of the state-of-the-art techniques for iUS-guided registration in spinal image guided surgery (IGS). The review follows a new taxonomy based on the four steps involved in the surgical workflow that include pre-processing, registration initialization, estimation of the required patient to image transformation, and a visualization process. They provided a detailed analysis of the measurements in terms of accuracy, robustness, reliability, and usability that need to be met during the evaluation of a spinal IGS framework. Although this review is focused on spinal navigation, they expect similar evaluation criteria to be relevant for other IGS applications.

Intraoperative ultrasound (iUS) has been applied in spinal surgery for all kinds of diseases ranging from trauma, degenerative diseases, developmental malformations, vascular diseases, to imaging in spinal tumor surgery.

Intraoperative Ultrasound for spinal tumor surgery

Syringomyelia

Intraoperative ultrasound is often helpful for:

a) localizing the cyst

b) assessing for septations (to avoid shunting only part of cyst)

Controversial, for intramedullary spinal cord tumors favored by some experts. Astrocytomas are usually iso-echoic with the spinal cord, whereas ependymomas are usually hyperechoic.

Transpedicular thoracic discectomy

Intraoperative ultrasound is a simple yet valuable tool for real-time imaging during transpedicular thoracic discectomy. Visualization provided by intraoperative US increases the safety profile of posterior approaches and may make thoracotomy unnecessary in a selected group of patients, especially when a patient has existing pulmonary disease or is otherwise not medically fit for the transthoracic approach.

References


