Spinal Navigation

- Percutaneous endoscopic lumbar partial laminectomy assisted by a new miniature parallel surgical robot system: a trial on a cadaveric specimen
- Transperineal Prostate Biopsy Using a Cone-shaped Double-hole Method with Dual-plane Probe Guidance
- Robot-assisted versus navigated spinal fusion surgery: a comparative multicenter study on transpedicular screw placement accuracy and patient outcomes
- Challenges to Neurocritical Care Management in Polytrauma
- A qualitative exploration of unmet healthcare needs for individuals undergoing surgery for symptomatic lumbar spinal stenosis
- Simulation of cerebrospinal fluid (CSF)-venous fistula embolization in a swine model: A technical video
- Pandemic-related experiences of older adults and people with disabilities
- Real-Time MR-Guided Lumbosacral Periradicular Injection Therapy Using a 0.55 T MRI System: A Phantom Study

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Spinal navigation, also known as spinal navigation systems or spinal neuronavigation, refers to the use of advanced technology to assist surgeons in performing spine surgery with increased accuracy and safety. It involves the integration of imaging techniques, such as CT scans or MRI, with real-time tracking and guidance systems.

The primary goal of spinal navigation is to provide surgeons with enhanced visualization and precise navigation during spinal surgeries. It allows surgeons to plan and execute procedures with greater precision, improving outcomes and reducing potential risks. Here are some key components and features commonly found in spinal navigation systems:

Imaging: Spinal navigation systems utilize preoperative imaging data, such as CT or MRI scans, to create detailed 3D models of the patient's spine. These images help surgeons identify anatomical structures and plan the surgical approach.

Tracking Systems: The navigation system uses tracking devices, such as optical cameras or electromagnetic sensors, to continuously monitor the position and movement of surgical instruments and the patient's spine. This real-time tracking provides accurate spatial information during the procedure.

Surgical Instruments: Specialized instruments are equipped with reflective markers or sensors that can be tracked by the navigation system. These instruments include probes, drills, and other tools used during spinal surgery.

Image Guidance: The navigation system superimposes the patient's preoperative images onto the real-time surgical field, creating a virtual representation of the spine. This image guidance allows surgeons to visualize the surgical site in relation to the patient's anatomy, providing better accuracy in instrument placement.

Intraoperative Monitoring: Spinal navigation systems can monitor various parameters during the surgery, such as instrument trajectory, depth, and alignment. This real-time feedback helps surgeons

adjust their approach and ensure the accuracy of their actions.

Benefits of Spinal Navigation:

Enhanced Accuracy: Spinal navigation systems improve the precision of instrument placement, reducing the risk of damaging critical structures and improving overall surgical outcomes.

Minimized Risk: By providing real-time feedback and visualization, spinal navigation systems help surgeons avoid potential complications and minimize the risk of errors during complex spinal procedures.

Reduced Radiation Exposure: With the ability to navigate using preoperative imaging, spinal navigation systems can help minimize the need for intraoperative fluoroscopy, thereby reducing radiation exposure for both the patient and the surgical team.

Improved Planning: The ability to visualize the patient's anatomy in three dimensions allows surgeons to plan procedures more effectively and choose the optimal surgical approach.

Spinal navigation has revolutionized the field of spinal surgery, enabling surgeons to perform complex procedures with greater accuracy and safety. However, it's important to note that the specific features and capabilities of spinal navigation systems may vary across different manufacturers and models. Surgeons should receive proper training and follow guidelines provided by the system's manufacturer to ensure safe and effective use.

Systems

As cost effectiveness improves, the use of navigation is likely to continue to expand. Navigation will also continue to expand with further innovation such as coupling the use of navigation with robotics and improving tools to enhance the end user experience [1]

https://www.brainlab.com/surgery-products/overview-spinal-trauma-products/spinal-navigation/

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https://www.stryker.com/us/en/portfolios/orthopaedics/spine--ortho-/spine-navigation.html

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https://7dsurgical.com/spine-navigation/

3D imaging-based navigation in spine surgery is mostly applied for pedicle screw placement. However, its potential reaches beyond.

Schwendner et al. from the Technical University of Munich analyzed the incorporation of spinal navigation for lateral instrumentation of the thoracolumbar spine in clinical routine at a high-volume spine center.

Patients scheduled for lateral instrumentation were prospectively enrolled. A reference array was attached to the pelvis, and a computed tomography scan was acquired intraoperatively. A control

computed tomography scan was routinely performed after final cage placement, replacing conventional 2-dimensional X-ray imaging.

145 cases were enrolled from April to October 2021 with a median of 1 (1-4) level being instrumented. Indications for surgery were trauma (35.9%), spinal infection (31.7%), primary and secondary spine tumors (17.2%), and degenerative spine disease (15.2%). The duration of surgery after the first scan was 98 ± 41 (20-342) minutes. In total, 190 cages were implanted (94 expandable cages for vertebral body replacement (49.5%) and 96 cages for interbody fusion [50.5%]). Navigation was successfully performed in 139 cases (95.9%). The intraoperative mental load was rated on a scale from 0 to 150 (maximal effort) by the surgeons, showing a moderate effort (median 30 [10-120]).

Three-dimensional imaging-based spinal navigation can easily be incorporated in clinical routine and serves as a reliable tool to achieve precise implant placement in lateral instrumentation of the spine. It helps to minimize radiation exposure to the surgical staff [2]

[1]

Rawicki N, Dowdell JE, Sandhu HS. Current state of navigation in spine surgery. Ann Transl Med. 2021 Jan;9(1):85. doi: 10.21037/atm-20-1335. PMID: 33553378; PMCID: PMC7859779.

[2]

Schwendner M, Liang R, Butenschöen VM, Krieg SM, Ille S, Meyer B. Spinal Navigation for Lateral Instrumentation of the Thoracolumbar Spine. Oper Neurosurg (Hagerstown). 2023 Jul 13. doi: 10.1227/ons.0000000000000803. Epub ahead of print. PMID: 37441800.

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