Neuronavigation

Neuronavigation is a computer-assisted surgical guidance system primarily used in neurosurgery. It provides real-time spatial information to the surgeon, enhancing precision during procedures involving the brain and spinal cord.

Key Components

- **Imaging data**: Preoperative MRI or CT scans with high resolution.
- **Registration system**: Aligns patient anatomy to imaging data using fiducial markers or surface matching.
- **Tracking system**: Optical or electromagnetic tracking of surgical instruments.
- **Workstation**: Displays interactive 2D/3D anatomical reconstructions.

Applications in Neurosurgery

- Tumor resections (e.g., gliomas, metastases)
- Stereotactic biopsies
- Epilepsy surgery
- Spinal instrumentation placement
- Deep Brain Stimulation (DBS)
- Ventriculostomy for hydrocephalus

Advantages

- Improves accuracy and safety
- Reduces risk of damage to healthy tissue
- Enables better surgical planning
- May shorten operative time

⚠ Limitations

- Accuracy relies on correct image-to-patient registration
- Brain shift during surgery can affect accuracy
- Requires setup time and training
- Cost of equipment and maintenance

Common Systems

- **Medtronic StealthStation®**
- **Brainlab Curve™ / Kick®**
- **Stryker NAV3i®**

- **Fiagon™ (for ENT/neuro)**

Notes

Neuronavigation is often combined with intraoperative imaging (e.g., ultrasound, intraoperative MRI) to compensate for anatomical shifts and improve intraoperative accuracy.

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