In neurosurgery, **trajectory** often refers to the path or approach taken to access a target area in the brain or spinal cord during a surgical procedure. This term is crucial for ensuring precision and minimizing damage to surrounding tissues. Below are some key aspects of trajectory planning in neurosurgery:

1. **Key Components of Trajectory Planning**

1. **Entry Point**: The site on the skull, spine, or other anatomical location where the surgeon begins the approach.
2. **Target Point**: The specific area of interest (e.g., tumor, aneurysm, or lesion) that needs to be accessed.
3. **Angle and Pathway**: The route taken between the entry and target points, designed to avoid critical structures like blood vessels, functional brain areas, and cranial nerves.

2. **Techniques for Planning**

1. **Neuronavigation Systems**: These technologies use imaging (MRI, CT) to create a 3D map, allowing surgeons to plan and monitor trajectories in real time.
2. **Stealth Guidance**: Real-time feedback from systems like Medtronic's StealthStation ensures precise alignment with the planned trajectory.
3. **Minimally Invasive Approaches**: For surgeries such as endoscopic or stereotactic procedures, smaller entry points and shorter trajectories are prioritized.

3. **Applications in Neurosurgery**

1. **Tumor Resection**: The trajectory is chosen to maximize access to the tumor while preserving healthy tissue.
2. **Deep Brain Stimulation (DBS)**: Electrodes are precisely implanted into deep brain structures like the subthalamic nucleus.
3. **Stereotactic Biopsies**: Precise trajectories allow small tissue samples to be taken from deep or sensitive areas safely.
4. **Spinal Surgery**: Trajectory planning is vital for pedicle screw placement and decompressive procedures.

4. **Factors Influencing Trajectory Choice**

1. **Patient Anatomy**: Individual variations in anatomy must be accounted for.
2. **Lesion Characteristics**: Size, location, and type of lesion guide trajectory decisions.
3. **Surgical Goals**: Priorities such as extent of resection, functional preservation, and cosmetic considerations.

5. **Emerging Innovations**

1. **Robotic Assistance**: Robots like the ROSA system enhance trajectory precision, particularly for complex cases.
2. **Augmented Reality (AR)**: AR overlays anatomical and trajectory data onto the surgical field, aiding decision-making.
3. **Artificial Intelligence (AI)**: AI algorithms help predict optimal trajectories and outcomes based on patient-specific data.