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Stereotactic Radiosurgery and its Applications

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Description

Stereotactic radiosurgery (SRS) is a non-invasive alternative to conventional surgery using precisely targeted beams of ionizing radiation directed from outside the patient to replace the surgical resection of solid tumors, other lesions, or functional targets. SRS was originally developed for intracranial applications and required the use of a stereotactic frame mechanically attached to the patient's skull to achieve the required beam alignment precision. Treatment was delivered in a single session (or treatment fraction) using multiple beams distributed over a large solid angle. Subsequently, the same general principles have been applied with new technologies to treat extracranial targets, either as an alternative to or in combination with conventional surgery and radiation therapy. Such extra cranial treatment is commonly referred to as stereotactic body radiation therapy (SBRT) or stereotactic ablative radiotherapy (SABR), the subtle distinctions between which are beyond the scope of this chapter. Current techniques use either mechanical frame-based or imaging based stereotactic alignment, and are typically delivered in one to five treatment fractions. Common clinical indications include intracranial targets malignant and benign tumors arteriovenous malformations (AVMs) and functional diseases spinal tumors and AVMs and malignancies in the lung, prostate, liver, head and neck, and other sites, including both primary and metastatic diseases.

It provides patients with improved perioperative outcomes, improved postoperative recovery with earlier return to normal activity and work, and minimal incisions and scarring compared to open surgery. Patients commonly are discharged the same day they undergo laparoscopic procedures unlike the longer and increased care required for inpatients following open surgery. Although these benefits to patient outcomes of laparoscopic surgery are not debated, less has been reported on the physical and mental toll of laparoscopy on the general surgeon. Park and colleagues revealed that 86.9% of laparoscopic surgeons suffer from performance-related symptoms, with the principal predictor being high case volume. Burnout a syndrome characterized by emotional exhaustion, depersonalization, and a decreased sense of personal accomplishment caused by work-related stress is particularly prevalent in surgical specialties (with a range of 32%-55%) and has 49% prevalence among general surgeons. Considering the ergonomic vision and control limitations of laparoscopy, the high rate of general surgeon burnout, and our growing elderly patient population, healthcare systems need to adapt to the shifting technological environment and address and update technology to help surgeons do their jobs efficiently and effectively. General surgeons operate across a broad range of surgical indications including those among a heterogeneous and growing elderly patient population, and the high burnout rate among general surgeons indicates they may not be able to keep up with patient demand. These factors feed surgical variability, which often leads to disparate outcomes for patients and higher resource utilization, costs, and waste, such as time, inventory, motion, waiting, and skills. Value based healthcare requires hospitals to find new ways to deliver the best clinical outcome relative to the optimal cost of care within an environment that fosters the right patient experience delivered by engaged and satisfied surgeons. Until recently innovations have not been driven to benefit all stakeholders' patients, surgeons, hospitals, and government and private payers and have not addressed operating room inefficiencies, cost containment, and surgical variability. Current technology does not leverage existing laparoscopic experience and training and as a result imposes a high hurdle to learning new techniques. Robotic-assisted digital laparoscopy with the Senhance Surgical System is designed to be used in the majority of laparoscopic procedures, with similar operating room times to laparoscopy and comparable per-procedure costs to standard laparoscopy. The fully reusable nature of the Enhance instruments allows for no present limitation to the number of reuses of the instruments. The only true disposable component of the system is the required sterile draping.

Robotic-assisted digital laparoscopy with the Senhance Surgical System is best described as a digitized interface between the surgeon and the patient during a laparoscopic procedure that enhances surgeon control of the instruments. From an ergonomically supportive open console, the surgeon controls visualization of the surgical field and senses haptic forces of the instrument tissue interface. Eye tracking visualization allows the surgeon continuous control of the camera without needing to interrupt performing the procedure to reposition the camera or rely on support staff to adjust the laparoscope's field of view. The sensation of touch and force was designed into the system to minimize tissue trauma. The robotic component allows minimally invasive access

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to difficult to reach anatomy, precise, scaled, and tremor-free instrument control and the ability to visualize within anatomically tight spaces using 3D cameras. The latter confers clarity of detail regarding delicate tissues and depth and spatial relationships in the surgical field. The fully reusable nature of the Senhance instruments allows for no preset limitation to the number of reuses of the instruments. The only true disposable component of the system is the required sterile draping. The 3D digitized inter-face between the surgeon and the patient affords surgeon control and reduces surgical variability. The open architecture system comprises independent robotic-assisted manipulator arms that are compatible with conventional trocars and familiar instruments thereby, leveraging the existing operating room and surgical suite environment.

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