Chapter 6
Advances of the Robotics Technology in Modern Minimally Invasive Surgery

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ABSTRACT

Currently, numerous robotically controlled steerable needle-based methods have been offered, which can precisely maintain needle tip deflection to monitor premeditated curved paths inside soft tissue. Percutaneous interventions via MIS methods can deliver patients with improved consequences and earlier recovery times than traditional or open surgeries. Precise needle insertions are important for effective procedures, and dynamically piloted needles can intensify system exactness. Current robotic technology can overcome individuals' limitations and upturn the attainment of minimally invasive percutaneous treatment. Needle insertion can also be applied as a "satellite access" area, and parallel calculus can be pushed or broken into the renal pelvis. The main access is applied for the removal of stones, in that way avoiding the formation of various channels and efficiently caring for kidney function. Here, the authors will present the present state-of-the-art insertion needles for MIS, concentrating on the limitations and challenges still open for their application in the medical area.

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INTRODUCTION

The advances in medicinal and clinical performance and modern surgical machinery have continuously developed at the same time. Surgical robotics application in the last few years has succeeded in rapid progress and has been extensively functional in the modern surgical area. The varieties of surgical robotics include orthopedics, neurosurgery, vascular interventional, laparoscopic, prosthetics, exoskeleton robotics, capsule robotics, and rehabilitation robotics. Main technical investigation in advanced robotics in medical science is now very important. The rise of advanced machinery made additional developments in minimal access or invasive surgery (MIS) conceivable. Robotic surgery and telerobotics surgery successfully addressed the restrictions of thoracoscopic, and laparoscopic processes, therefore modernizing the surgery through minimal access. Robotic surgery is estimated to endure to involve a rising portion of advanced surgery. They are computer-controlled self-powered devices that can be planned to help in the arranging and guidance of surgical tools, allowing the surgeon to perform more intricate tasks. The moderately latest signs of progress in endoscopic machinery have permitted the recognition of the MIS or nominally form of surgery (Moit et al., 2019). The signs of progress in robotics assist accurate surgical procedures that are habitually combined with medical image control competence. This opportunity has determined the additional progress of equipment to pay for the exclusive difficulties created by this fresh arrangement and to progress the presentation and increase the possibility of the measures which can be achieved. Surgical robotics technology has been an essential factor of this progress because of the greatly appropriate appearances that a machinelike (programmed)arrangement can significance, with extremely advanced automated compliance and the aptitude to suit operative purposes in surgical robots for doctors to achieve harmless and truthful operations (Zhang et al., 2020). Furthermore, linking the robot-controlled interferences with recognizing and medicinal imaging expertise can importantly progress the existing evidence and thus advantage to confirm that MIS remains to improve accepted and stay at the emphasis of modern medical technology progress (Lee et al., 2011) (Moit et al., 2019) (Barua et al., 2022). Founded on the nature of invasiveness of surgical or operating techniques, there are normally three key techniques: (a) traditional surgery or operation, (b) minimally invasive processes, and (c) noninvasive processes. MIS is planned to deliver excessive assistance to the patient on traditional surgery (open) by reducing avoidable trauma-affected in the procedure of accomplishing a medical process. Also, a smaller amount of disturbance, blood loss, pain, and trauma, these modifications make possible a speedy recovery time and decreased the possibility of difficulties (Wagner et al., 2002). Though, it is also well recognized that this method brings several consistent problems to the medical team performing it. These problems are because of the very restricted workspace, dedicated tools needing additional staff teaching and adjustment for usage, and importantly reduced visual and touch info. Even though the above-mentioned disadvantages, MIS has sustained improvement acceptance and is to be extensively used (Mack et al., 2001) (Barua et al., 2022). A major issue in this sustained acceptance is the conforming growth of surgical tools envisioned for practice in MIS (Barua et al., 2022). Surgical robotic platforms are most appropriate because of their promising features. Such features contain high correctness, repeatability, and the opportunity of planning specific apparatuses that can be useful for precise events and vital organs. Also, modern surgical robots can include sensors to reappearance trace and force recognition and can also be joined with advanced imaging knowledge to permit sovereign, semiautonomous, or teleoperated mechanism, which can recover surgical presentation and the possibility of minimally invasive surgery. Furthermore, by joining evolving imaging methods and non-invasive modalities, cost-effective, more exact, and convenient treatment apparatuses can be made potential. Medi-