Bangladesh J Otorhinolaryngol 2013; 19(2): 78-81

## *Editorial*

# Robotic surgery in otolaryngology and head - neck surgery

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Now a days minimally invasive surgery (MIS) has becomes a popular approach over standard surgical approaches for its several advantages like more rapid recovery, lower rate of postoperative infection, decreased pain, better postoperative immune function, and cosmetic results. It is a well-tolerated and efficient technique in several fields of surgery due to recent advances in equipment and surgical techniques. In this way, robotic-assisted surgery (RAS) has gained popularity in several surgical specialties and many institutions are now investing in medical robotic technology for applications in general, urological, cardiac, gynecological, and neurological surgery. Surgical robot is a self-powered, computer controlled device that can be programmed to aid in the positioning and manipulation of surgical instruments, enabling the surgeon to carry out complex surgical tasks. Systems currently in use are not intended to act independently from human surgeons or to replace them. Instead, this device act as remote extensions completely governed by the surgeon and thus is best described as master-slave manipulators.

In 1985 the first robotic surgical system developed was the Puma 560, which was used to place a needle for brain to perform neurosurgical biopsies using CT guidance with increased precision. Since this time, a series of robots have been developed. Two robotic surgical systems have FDA approved and actively marketed systems in USA are in use-the da Vinci Surgical system (Intuitive Surgical Inc, Sunnyvale, CA, USA) and the ZEUS system (computer Motion, Goleta, California). Only the da Vinci Surgical Robot is FDA approved and actively marketed system for head and neck surgery and Transoral Robotic Surgery (TORS) in 2009.

Robotic surgery has given surgeons better tools to perform the most intricate procedures and achieve better outcomes for their patients. It's this state of the art technology which when combined with the experience of a highly trained medical staff gives patients the best possible outcomes and quicker recoveries in a growing range of surgical specialties.

Today the speed of progress in the field of laparoendoscopic surgery demands continuous education and upkeep of every modern surgeon. In the last decade, the impressive development of robotic surgical systems in laparoscopic surgery, as well as their rapid spread across the world, has opened new horizons in the surgical art. This new and exciting technology has been shown to be safe, have better or comparable outcomes, and can be cost effective when compared with conventional surgical approaches. The advantage over conventional endoscopic surgery is construction in difficult areas approach in the body. These advantages are mainly due to the excellent three dimensional images of the surgical field as well as the higher degree of freedom provided by the robotic arms and instruments, which imitate the human wrist motion. Operations contain negligible blood loss with minimal surgical stress for the patient allowing him/her to mobilize quickly after surgery and return to everyday activity.

Telerobotic surgery is a type of surgery performed by the surgeon at a certain distance from the patient. Now in advance telecommunication technology, surgeons can have control of robotic arms and instruments from a distance. With great accuracy, the robotic manipulators reproduce all surgical maneuvers performed inside the patient's body.

The number of robotic surgery applications grows every day in various fields including: cardiac, thoracic, urologic, gynecologic, pediatric and general surgery. This has raised interest in its use in otolaryngology and head and neck surgery. Head and neck and several airway procedures have been associated with a large amount of surgical dissection with associated large surgical incisions. This can result in major tissue damage, functional impairment, and a decreased quality of life.

Advantages of robotic surgical over traditional surgery in human are,

1. Enhanced visualization: The three-dimensional visualization and tenfold magnification of the operative field enhance the depth of the field and the clarity of the tissue planes during dissection. This can be especially helpful during head and neck surgery and pediatric surgery, because of the small size of the surgical field and the inability to maneuver the instruments and the camera within it. It can also help in distinguishing tissue types in oncological dissection.
2. Elimination of Physiologic Tremors and Scale Motion. Procedure is stable, untiring and no chance of tremor. The surgical system eliminates the surgeon's tremor through hardware and software filters. In addition, movements can be scaled, whereby large handmovements can be translated into micromovements inside the operative field, allowing the surgeon more precision.
3. Robotic surgery is less stressful for the surgeon. Surgeon become less fatigue as he/she is sitting with his/her forearms resting comfortablyin an improving ergonomics.
4. Restore Proper Hand-Eye Coordination. The robotic system eliminates the "fulcrum effect" of endoscopic surgery and makes instrument and camera manipulation more intuitive, emulating another property of open surgery.
5. Training. The robotic system provides some interesting tools and opportunities for teaching.
6. Multiarticulated instruments can be used.
7. Telesurgery: Robotic surgery overcomes geographical constraints and the availability of specialists in surgical cases. Telesurgery allows for these barriers.
8. It have good geometric accuracy, Incision is less, miniaturization and precision
9. Surgery is more in sterilized field. less pain and blood loss and quick healing

It has some disadvantages like, limited dexterity, absence of tactile and haptic sensation and hand-eye coordination, limited to relatively simple procedures, equipment size and weight expensive for the cost of the device, difficulty to construct and new technology and unproven benefit.

Clinical applications of Robotic Surgery in Otolaryngology and Head-Neck Surgery.

The first robotic surgery performed transorally in the head and neck was carried out in 2005 by MacLeod and Melder, whereby a vallecular cyst was excised. In Head and Neck Oncology O'Malley Jr. et al. initiated the transoral robotic surgery (TORS) and applied the technique to clinical practice. In 2006, three patients underwent robot-assisted transoral tongue base resection in a prospective clinical trial. In this study, the robot enabled the surgeons to easily identify the glossopharyngeal, hypoglossal and lingual nerves, as well as the lingual artery. One T1 and one T2 squamous cell (AJCC cancer staging), two instances of squamous cell carcinoma (one T1 and one T2) were adequately resected with negative margins, good hemostasis, and no postoperative complications.

In 2007, Solares and Strome described transoral carbon dioxide (CO2) laser robotic-assisted supraglottic laryngectomy in a 74-year-old woman with a large supraglottic tumor. Postoperatively, the patient was able to swallow by day five. The use of the carbon dioxide laser linked to the surgical robotic system allows more maneuverability of the instrument's tips and improves beyond "sight of beam" limitations.

In addition to tumor resection, robotic surgery can be used in the reconstruction of postresection defects. Mukhija et al. reported two cases of robotic-assisted free flap reconstruction in the oral cavity and oropharynx. These studies highlight the improved visualization provided by RAS, avoiding the need to perform a mandibulotomy for access, thereby reducing morbidity and operative time.

After preliminary studies assessing the feasibility of transoral robotic surgery transoral robotic surgery (TORS) for oncologic resection, a series of studies were performed to examine the functional outcomes of these procedures. Most studies primarily report on oropharyngeal and oral cavity cancer, however, there are also case series on hypopharyngeal and laryngeal malignancy treated with transoral robotic surgery (TORS). Failure due to suboptimal access has been reported. In the study performed by Weinstein et al. regarding the overall procedure time, the surgery is faster.

In benign head neck diseases robot-assisted surgery done in Obstructive Sleep Apnea-Hypopnea Syndrome (OSAHS) for a tongue base resection, with some patients also having a supraglottoplasty and uvulopalatoplasty Overall patient satisfaction, assessed by a Visual Analogue Scale (VAS, 0 to 100%) was 94%. Robot-assisted thyroidectomy had done in thyroid diseases. The transaxillary robotic technique was first described in 2005 by Lobe et al, where a hemithyroidectomy was successfully performed in a pediatric patient.

It seems that the indication for robotic thyroidectomy can be expanded to include advanced thyroid cancer, because lymph node resection can be performed with great dexterity, removing a similar number of lymph nodes as in open surgery.

Technically similar to the surgery performed for thyroidectomy, robot-assisted parathyroidectomy was described in 2004 by Bodner et al. Validated questionnaires regarding quality of life and cosmetic appearance showed good subjective results for this new approach.

Due to the technical feasibility of TORS to gain access to many regions the robot can reach more difficult places. TORS used in skull base surgery was initially in resection of parapharyngeal cystic neoplasm extending into the infratemporal fossa. There were no adverse surgical events with acceptable operative time and blood loss, and no significant complications such as hemorrhage, infection, trismus or tumor spillage. Concern regarding identification of important structures, such as the carotid artery, jugular vein and cranial nerves was raised, and was solved by appropriate demonstration of surgical technique and hemostasis.

In another report, in 2007, Hanna et al. obtained excellent access to the anterior and central skull base in cadavers, including the cribriform plate, fovea ethmoidalis, medial orbits, planum sphenoidale, nasopharynx, pterygopalatine fossa, and clivus. In addition, sella turcica and suprasellar and parasellar access was achieved using the robotic arms. However, there is a continuing need for further development of appropriate instruments, in terms of size, flexibility, and function.

The trend towards the use of minimally invasive surgery has had an impact on the way new technology is thought of, developed, and incorporated into clinical practice. Robotic surgery is continuing to advance, and is overcoming its limitations. It is improving the outcomes, such as reducing hospital stays and infection rates, and allowing for better cosmetic results. However, surgical robots were developed to perform procedures in spacious cavities, such as the abdomen, and thus, the instruments are over sized to perform many of the otolaryngology and head and neck procedures. The da Vinci robot system is starting to be adopted to carry out a number of otolaryngology procedures, and it has done so with excellent results so far. Other limitations of robotic surgery are like the large size of the robotic system, which necessitates additional manpower to set it up and creates new challenges for the anesthesia team and surgical assistants. Unfortunately, the high cost of the robotic equipment forbids its routine presence and use in most operating rooms across the globe. This calls for the development of smaller, less expensive and easy to operate robotic platforms, which are portable and flexible to use, as well as specific instruments for tasks in head and neck surgery.

Besides the evidence of robotic feasibility and safety in head and neck surgery, postoperative outcomes regarding airway management and oropharyngeal function are comparable or better to traditional surgical approaches. Although the details concerning oncologic results were not explored, robot-assisted surgery showed a trend towards favorable cure and recurrence rates. This can be attributed to its capability to resect tumour en-bloc—a feature that is provided by the increased dexterity and 3D visualization of the robotic system.

We believe that future studies comparing robotic techniques to Transoral Laser Microsurgery (TLM), open surgery and chemoradiotherapy are required to support these assertions. Reported studies are supportive of the feasibility and safety of robotic surgery in head and neck procedures and encourage its continuing use and exploration.

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