# Approaches of robot-assisted neck dissection for head and neck cancer: a review

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Robot-assisted surgery is being increasingly used by surgeons because of its enhancement of visualization, precision, and articulation compared with conventional minimally invasive techniques. In recent years, robot-assisted neck dissection (RAND) has begun to be used as an alternative method of neck dissection, one of the classic surgical procedures in the area of head and neck surgery. Currently, there are four kinds of approaches for RAND: (1) modified facelift or retroauricular incision, (2) combined transaxillary and retroauricular incision, (3) transaxillary incision, and (4) transoral incision. RAND may help perform minimally invasive surgery and achieve excellent cosmetic results as well as the desired oncologic outcomes, and this requires selecting an appropriate approach based on the different needs of neck dissections. Although experienced surgeons wishing to avoid large cervical incisions in patients can safely perform RAND, there are still quite a few limitations; in particular, surgical morbidity and oncologic outcomes should be verified by further prospective clinical trials with longer follow-up periods. Also, RAND needs to be standardized and its use disseminated. In this review, we introduce the applications of different approaches for RAND and their indications and determine whether RAND can be more beneficial compared with conventional surgeries. (Oral Surg Oral Med Oral Pathol Oral Radiol 2016;121:353-359)

Minimally invasive surgery (MIS) has been gradually becoming more widely used in a number of fields in order to reduce the morbidity of surgery to the maximum extent possible. With the use of the endoscope, coupled with improved imaging and positioning technology, tumors can be resected completely with minimal damage to the surrounding tissues. In 1985, equipment for robot-assisted surgery (RAS) was introduced in the field of MIS. Since then, many researchers have contributed to the rapid development of RAS. In the 1990s, there were three kinds of main systems: (1) the *da Vinci Surgical System* (Intuitive Surgicals, Sunnyvale, CA), (2) the *Computer Motion System* (Aescop; Computer Motion, Inc., Goleta, CA), and (3) the *Zeus Robotic System* (Computer Motion, Inc.). Currently, only the da Vinci System is being actively marketed as a surgical robot. As of June 2012, a total of 2341 da Vinci Surgical System had been installed all over the world.[1] This system was first introduced in the field of head and neck surgery by the Department of Otorhinolaryngology − Head & Neck Surgery, University of Pennsylvania School of Medicine (Philadelphia, PA) in 2005.[2] It is well known that since neck dissection is one of the classic surgical procedures in head and neck surgery, some surgeons have started to study RAND for the treatment of head and neck cancer. Hence, the applications of RAND and its approaches will be reviewed in this article.

## APPLICATIONS OF ROBOTIC SURGERY

### Advantages

Compared with traditional endoscopic techniques, the da Vinci Surgical System offers the advantages of a three-dimensional view of the operative field, absence of fulcrum effect, and seven versus four degrees of freedom of movement. Additionally, the "wristed" instruments can facilitate intracorporeal suturing, eliminate surgeon tremor, and have ergonomic benefits. As such, robotic assistance may facilitate the learning curve for surgeons transitioning to MIS. At the same time, RAS has shown consistent advantages over open approaches, including smaller incisions, reduced intraoperative blood loss, decreased postoperative pain, shorter lengths of hospital stay and recovery time.[3] These advantages guarantee a more precise procedure, with minimal surgical wound compared with traditional techniques.

### Applications in the field of surgery

Over the past 10 years, two big breakthroughs have occurred in the treatment of cancer. One is the

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## Statement of Clinical Relevance

This review article introduce the applications of different approaches for robot-assisted neck dissection and their indications, and determine whether robot-assisted neck dissection can convey any benefits compared to conventional surgeries.

widespread use of MIS, mainly based on laparoscopic surgery, and the other one is the standardization of anticancer drug treatment based on evidence. RAS, a typical representative of MIS, has successfully met the increasingly complex requirements in the surgical treatment of cancer. Among urologic procedures, robot-assisted radical prostatectomy for prostate cancer is, by far, the most commonly performed robotic operation. RAS was also used for radical cystectomy, partial nephrectomy, and epinephrectomy. In gynecology, robot-assisted surgeries include hysterectomy, trachelectomy, and pelvic lymphadenectomy. In general surgery, RAS is used for resections for colon and rectal cancers, pancreatectomy for pancreatic cancer, adrenalectomy for adrenal lesions, hepatectomy for liver lesions, and gastrectomy for stomach cancer. For thoracic procedures, RAS is used for lobectomy and esophagectomy. RAS is safe and cost-effective compared with open and endoscopic approaches and appears to provide clinical benefits over conventional endoscopy, particularly for complex tumors.[3]

### Applications in head and neck surgery

Kavanagh[4] evaluated the feasibility of applying image-directed robotic technology in the field of otolaryngologic surgery in 1994. Weinstein et al.[5] developed a technique for computer enhanced robotic transoral supraglottic partial laryngectomy in a canine model in 2005. Later, in 2006, following their study in cadaver models, they successfully provided a novel and minimally invasive approach to resection of neoplasms in the base of tongue using transoral robotic surgery (TORS).[6] Since then, the number of publications related to the studies and applications of robotic surgery in the field of oral and maxillofacial, craniofacial, and head and neck surgery has increased exponentially in recent years.[7] To date, based on preclinical experiments and clinical studies, TORS can be successfully used to perform common and accepted procedures, such as resection of neoplasms in the base of tongue,[8] radical resection of supraglottic squamous cell carcinoma,[9] surgical treatment for obstructive sleep apnea,[10] removal of parapharyngeal lesions,[11] and so on. RAND has been described in other reports in the literature as well.[12]

## APPLICATIONS OF THE APPROACHES FOR RAND

A variety of traditional incisions for neck dissection provide the best surgical views and approaches for surgeons, and at the same time, satisfactory outcomes of cancer treatment are also achieved. Because of the increasing emphasis placed on aesthetics by patients with head and neck cancer, some surgeons have devoted themselves to research new methods so that complete neck dissections can be successfully performed with smaller surgical incisions. It is well known that endoscopic neck dissection can help achieve this goal of aesthetics. However, a long learning curve, technical limitations associated with a two-dimensional view, and reduced dexterity of movement, particularly when operating in deep and narrow spaces, such as the neck region, are all limitations of endoscopic neck dissection. RAND has been developed to overcome these limitations and to make operations easier and shorten the learning curve.[13]

### Modified facelift or retroauricular incision

In 2012, Kim and his colleagues[14] successfully performed RAND via modified facelift (MFL) incision (Figure 1) in five patients with parotid gland cancer. All robot-assisted selective neck dissections (level I-III), combined with primary tumor resection, were successfully performed. Before the robot-assisted surgical procedure, dissection of the entire parotid gland including the primary tumor and part of the neck was performed under direct vision as much as possible with the conventional technique. Level Ia and parts of level Ib, IIa, and III were dissected with the help of the robot. The results showed that RAND via the MFL approach is a feasible and useful method, with excellent cosmetic results of the surgical treatment in selected cases of parotid gland cancer. However, because of the small study population and the short period of follow-up, the oncologic validity of this procedure needs to be evaluated with further prospective studies.

Kim et al later performed primary tumor resection with RAND using a retroauricular (RA) incision (Figure 2) in six patients with submandibular gland cancer.[15] Before docking the robotic system, neck dissection was performed under direct vision as much as possible with the traditional technique. The marginal mandibular branch of the facial nerve was identified, and level IIb was dissected. The rest of the I-V levels and the entire submandibular gland, including the primary tumor, were dissected with the da Vinci Surgical System. The major disadvantages of RAND for these patients were the longer operating time and the high financial cost. However, surgical morbidity and length of hospital stay were not significantly different from those for the conventional approach. The authors believed that RAND using the RA approach could offer promising benefits in the treatment for submandibular gland cancer, including excellent cosmetic results.

Thirty patients with head and neck squamous cell carcinoma (HNSCC) with clinically node-negative necks (cN0) underwent RAND via the RA approach