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Role of transoral robotic surgery in current head & neck practice

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ABSTRACT

Morbidity and mortality associated with increasingly radical doses of chemoradiotherapy have led many to question the current standard of care in head and neck cancer. Recently, surgeons have developed minimally invasive, transoral techniques which have demonstrated excellent survival and favourable functional outcomes. Transoral robotic surgery (TORS) is the most recent, cutting edge in the evolution of transoral techniques; TORS allows surgeons unprecedented access to and visualisation of the upper aerodigestive tract. Early reports of TORS in the head and neck are favourable in both primary and recurrent disease. TORS has a role in the assessment of the patient with unknown primary and in the de-intensification of therapy in patients with cancers secondary to human papilloma virus. In this review we discuss the practical set up and technical features of TORS surgery and the application of TORS in primary and recurrent disease, and carcinoma of unknown primary. We outline the current ongoing research into the use of this technique and set out the vision for the future of this surgical modality.

Surgical care for upper aerodigestive tract cancers has changed dramatically over the last three decades with technological advances in tumour imaging and resection. Recent advances in mechanical instrumentation and energy devices allow surgeons to remove head and neck cancers transorally; it is only rarely that the extrinsic muscles of the neck and the tongue are involved and the transoral route leads to reduced disruption of the external musculature, quicker recovery and a better functional outcome. In this review we will focus exclusively on the advances in transoral robotic surgery which have transformed the shape of resective head and neck cancer surgery.

Non-surgical management of head and neck tumours

There is a growing body of evidence showing that the increasingly radical doses of chemoradiotherapy used to treat head and neck cancer (with the aim of organ preservation) have led to a high treatment morbidity for patients in the short and long term. The use of concurrent chemotherapy alongside radiotherapy improves the survival and locoregional control when compared with radiotherapy

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alone[1,2] but also increases the burden of acute toxicity.[3] Mucositis is one of the main acute symptoms: Trotti et al.[4] demonstrated in a systematic literature review including data from of 6181 patients, that not only did 80% suffer this side effect, but also this in 16% it led to hospitalisation and in 11% modification of radiotherapy regimes. The rate of severe mucositis was higher with the use of altered fractionation regimes as compared to conventional radiotherapy. It is now understood that these acute toxicities persist into the long term, although this is often under-reported or under-estimated in trial reports.[5] Machtay et al.[6] performed a meta-analysis of 230 patients included in three large trials (RTOG 91-11. RTOG 97-03 and RTOG 99-14) to investigate whether they continued to experience toxicity more than 180 days following treatment. Indeed, 43% of patients were found to still be experiencing grade three or higher toxicity, were continuing to use a gastrostomy for feeding or had died from a cause thought to be secondary to laryngeal dysfunction. Those with higher T-stage, higher age or a primary tumour in the larynx or pharynx were found to be most at risk of long-term toxicity. Other authors have echoed the finding of long term dysphagia after chemoradiotherapy[7] and many patients require a permanent gastrostomy or nasogastric tube.[8,9] These long term functional problems such as effects on swallow and dry mouth cannot be ignored; indeed the functional outcome of treatment is considered by many to hold primary importance when making treatment decisions.[10]

The acute and chronic side effects of non-surgical treatment regimens experienced by patients in their care, have led surgeons to explore minimally invasive surgical techniques to remove cancers without as many short and long term functional consequences. Also, the emergence of human papilloma virus as a causative agent which improves prognosis in head and neck cancer has led many to consider whether such radical regimes of chemoradiotherapy are indeed required.

Robotic technology

Although several robotic systems will be available in the not too distant future, the most commonly used system is the daVinci, marketed by Intuitive. This paper will describe the use of the daVinci system in Transoral robotic surgery (TORS). TORS represents an evolution in the field of transoral surgery which has been developing for decades with surgeons becoming skilled with transoral laser microsurgery. However, unlike transoral laser microsurgery, tumours need not be in the "line of sight" of the surgeon, a desirable attribute when resecting tumours of the base of tongue, supraglottis or hypopharynx. The hardware in the daVinci system allows telescopes to achieve excellent visualisation of patient and tumour anatomy, and operating instruments to be controlled remotely within this visual field with excellent manoeuvrability. Progress in telescopic technology means that 3-dimensional visualisation of the tumour can be achieved. The patient side cart comprises the telescope and two (of the three available) robotic arms mounted on a mobile platform, which are docked into the patient's mouth. The operator remotely controls these three instruments from a console across the operating room; the robot eliminates tremor and allows hand movements in seven degrees of freedom which would be impossible with the human wrist.

Theatre set up for TORS

An examination under anaesthetic is performed at a separate sitting to assess the size, extent and resectability of the primary tumour (this takes place as part of the patient work-up and before treatment decisions are made). For the robotic resection, patients are positioned supine and mouth opening is maintained with an appropriate retractor, the choice depending on the site of tumour. Two commonly used retractors include the Boyle Davis or Feyh-Kastenbauer retractor; the latter has been extensively modified to incorporate a range of concave tongue blades that increase the intraoral space and possess a larger frame that allows easier intraoral docking of the robotic arms with less instrument clashes. The patients' face and eyes are appropriately protected to avoid accidental injury to the soft tissues during docking. The operating telescope is inserted into the patients mouth and two instruments (at least one of which is an energy device to cut tissues and the other a grasper to retract tissues) are positioned either side of this (Fig. 1).

An assistant at the head of the patient helps with smoke evacuation, suction, application of ligatures and retraction (Fig. 2). This allows four independently controlled instruments to be used simultaneously in the intraoral environment, providing unparallelled manoeuvrability.

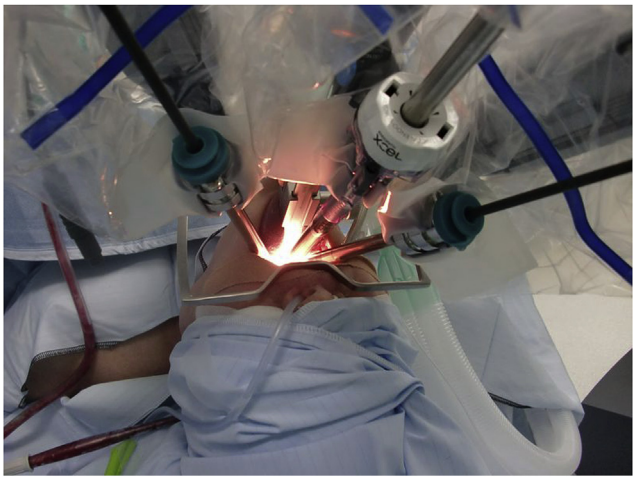

Fig. 1 – Close up view of the Weinstein-O'Malley modification of the Feyh-Kastenbauer retractor used to open the mouth and expose the tumour; three robotic arms (12 mm telescope in the middle with two 5 mm instruments on either side) have been docked prior to resection.