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Australia and New Zealand Horizon Scanning Network

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AN INITIATIVE OF THE NATIONAL, STATE AND
TERRITORY GOVERNMENTS OF AUSTRALIA
AND THE GOVERNMENT OF NEW ZEALAND

Horizon Scanning Technology Prioritising Summary

Transoral robotic surgery (TORS) for head and neck cancers

February 2009



ASERNIP/S

**Australian
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and Efficacy
Register
of New
Interventional
Procedures -
Surgical**



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Enquiries about the content of the report should be directed to:

HealthPACT Secretariat
Department of Health and Ageing
MDP 106
GPO Box 9848
Canberra ACT 2606
AUSTRALIA

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This Horizon scanning prioritising summary was prepared by Dr Prema Thavaneswaran from the Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP-S).

PRIORITISING SUMMARY

REGISTER ID S000094

NAME OF TECHNOLOGY TRANSORAL ROBOTIC SURGERY

PURPOSE AND TARGET GROUP PATIENTS REQUIRING SURGERY FOR HEAD AND NECK CANCERS

STAGE OF DEVELOPMENT (IN AUSTRALIA)

- | | |
|---|---|
| <input checked="" type="checkbox"/> Yet to emerge | <input type="checkbox"/> Established |
| <input type="checkbox"/> Experimental | <input type="checkbox"/> Established <i>but</i> changed indication or modification of technique |
| <input type="checkbox"/> Investigational | <input type="checkbox"/> Should be taken out of use |
| <input type="checkbox"/> Nearly established | |

AUSTRALIAN THERAPEUTIC GOODS ADMINISTRATION APPROVAL

- | | |
|---|--------------------|
| <input checked="" type="checkbox"/> Yes | ARTG number: 97348 |
| <input type="checkbox"/> No | |
| <input type="checkbox"/> Not applicable | |

INTERNATIONAL UTILISATION

COUNTRY	LEVEL OF USE		
	Trials Underway or Completed	Limited Use	Widely Diffused
United States	✓		

IMPACT SUMMARY

Transoral robotic surgery (TORS) is a novel minimally invasive surgical procedure that has the potential to remove cancers of the head and neck while causing fewer side effects than standard open head and neck surgical resection or transoral endoscopic laser surgery.

BACKGROUND

Head and neck cancer is a general term used to describe a group of cancers which originate from the upper aerodigestive tract (including the lip, mouth, nose, paranasal sinuses, pharynx and larynx), and are biologically similar. The majority of these cancers originate from the mucosal lining of these different parts of the upper aerodigestive tract, and tend to be squamous cell carcinomas. In many cases, the initial manifestation

of the disease at the time of diagnosis is the presence of cancer in the lymph nodes of the neck, where it often spreads. There are a variety of environmental and lifestyle risk factors that have been strongly correlated with the development of head and neck cancers, including certain strains of the human papillomavirus which is transmitted sexually, as well as tobacco smoking and the consumption of alcohol. If detected early, head and neck cancer is highly curable, and treatment usually involves some form of surgery, including open head and neck surgical resection or transoral approaches such as transoral endoscopic laser surgery. In many cases there may also be a role for chemotherapy and radiation therapy.

One of the major obstacles to the removal of cancers of the head and neck through the oral cavity has been limited access to the area (Weinstein et al. 2007). In cases where the cancer has spread to surrounding tissues, an open surgical approach is required, which involves cutting through the skin of the neck. Such procedures are lengthy, can result in scarring and long-term difficulty swallowing, usually require the placement of a tracheotomy tube, and can involve a painful recovery (Weinstein et al 2007).

Transoral robotic surgery (TORS), which is defined as surgery done via the oral cavity that uses a minimum of 3 robotic arms and allows for bimanual surgical techniques (Weinstein, O'Malley and Hockstein 2005), has the potential to improve accuracy for surgeons and lessen the scarring, breathing problems, damage to speech and post-operative pain associated with treating head and neck cancers, and may therefore also shorten recovery times for patients. TORS has been designed to avoid open neck surgery, and its proponents claim that it is able to provide the surgeon with unparalleled access to areas of the mouth and throat which are small and often hard to reach. In the case of procedures such as radical tonsillectomy, it has been suggested that TORS may also be superior to current transoral approaches such as transoral endoscopic laser surgery, as the view of the oropharynx in these procedures is limited (Weinstein et al. 2007).

The da Vinci Surgical System (Intuitive Surgical Inc.) that is currently used in TORS, is composed of a console at which the surgeon is seated at a distance from the patient, a surgical cart, and four robotic arms (three laterally placed instrument-holding arms and a fourth centrally placed arm with an endoscope) that are controlled by the surgeon's movement of handles in the console. This surgical system allows surgeons to overcome a number of the limitations associated with traditional transoral approaches, such as line of site obstruction and a limited operative field (O'Malley, Weinstein and Hockstein 2006) and has been claimed to provide them with improved dexterity and precision (Weinstein et al. 2007). The da Vinci system enables natural hand movements from the hand grips at the console to be transferred to the operative field (Weinstein et al. 2007a). Specifically, the purported advantage this system provides over standard endoscopic equipment, is that the movements of the "wristed" ends of the robotic surgical instruments allow for 6° of freedom and translate precisely the movement of the surgeon's wrist (Weinstein et al. 2007a). In addition, supporters state that unlike conventional endoscopic surgery, the da Vinci system lacks the "fulcrum effect" in which the hand movements of the surgeon are translated into an opposite movement on

the working end of the instrument (Weinstein, O'Malley and Hockstein 2005). The suggested increase in surgical accuracy of the da Vinci system when compared to conventional open or laparoscopic surgery is due to the small video cameras attached to the end of the instruments that offer a magnified, three dimensional view inside the body.

CLINICAL NEED AND BURDEN OF DISEASE

In 2005, the number of new cases of head and neck cancers (including cancer of the tongue, mouth, major salivary glands, oropharynx, nasopharynx, hypopharynx, pharynx (unspecified), nasal cavity, middle ear and sinuses and larynx) in Australia was 2,672 (1,940 of these were in males) accounting for 2.7% of all new cancer cases (AIHW 2008). The age standardised incidence rate of head and neck cancers in 2005 was 12.5 per 100,000 (19.1 in males and 6.5 in females). In addition, head and neck cancers were responsible for 889 deaths in 2005 (677 of these were males), accounting for 2.3% of all deaths from cancer in Australia (AIHW 2008). The age standardised mortality rate of head and neck cancers in 2005 was 4.2 per 100,000 (6.8 in males and 1.8 in females). In the 2005-2006 time period there were 7,517 head and neck cancer-related hospital separations in Australia, out of a total of 365,509 cancer-related hospital separations. The average length of stay (including same-day separations) for head and neck cancer-related hospital separations was 6.7 days, compared with an average of 4.8 days for all cancers (AIHW 2008).

DIFFUSION

The use of TORS for head and neck surgery has been trialled in animal models (Weinstein, O'Malley and Hockstein 2005; O'Malley, Weinstein and Hockstein 2006; Solares and Strome 2007; O'Malley and Weinstein 2007) and human cadavers (Ozer and Waltonen 2008; O'Malley and Weinstein 2007; Solares and Strome 2007; Rahbar et al. 2007; Hockstein, O'Malley and Weinstein, 2006). While the procedure is still at an early stage of development, human trials of TORS for the treatment of head and neck cancer have been conducted in United States (Weinstein et al. 2007; Genden, Desai and Sung 2008).

The da Vinci Surgical System was first cleared by the United States Food and Drug Administration (FDA) in 2000 for general laparoscopic procedures such as gall bladder removal, as is now available worldwide (FDA 2005). Since 2000, the FDA has approved the use of the da Vinci system for a wide variety of surgical procedures, including prostatectomy, hysterectomy, myomectomy, mitral valve repair and coronary artery bypass surgery. In Europe the da Vinci system has full regulatory clearance and is entitled to affix the CE mark to the system. In Australia, the da Vinci surgical robotic system is listed on the Therapeutic Goods Administration (TGA) Australian Register of Therapeutic Goods (ARTG) (Class Iib) and is distributed in Australia by Device Technologies Australia, P/L.

COMPARATORS

Currently, there are no other robotic telemanipulator systems that are comparable to the da Vinci Surgical System. In 2001, the FDA approved another system called the Zeus

Robotic Surgical System, which was manufactured by Computer Motion Inc. (California), and in 2002, over 30 Zeus systems had been installed in hospitals in the United States. However in 2003, Computer Motion was bought by Intuitive Surgical, which is the company that manufactures the da Vinci and the Zeus system is no longer marketed (FDA 2005). The comparator procedures to TORS for the treatment of head and neck cancer are:

- Standard open head and neck surgical resection
- Transoral endoscopic laser surgery

SAFETY AND EFFECTIVENESS ISSUES

Study description

Two recent case series studies have used TORS for the treatment of patients with head and neck cancers. A prospective phase 1 clinical trial by Weinstein et al (2007) examined the feasibility of TORS for radical tonsillectomy in patients with previously untreated cancer of the tonsillar region. TORS radical tonsillectomy without free-flap reconstruction was performed in 27 adult patients (25 male and 2 female) between May 2005 and April 2007, using the da Vinci Surgical System (Intuitive Surgical Inc, Sunnyvale, California). Three patients were stage II, 14 patients were stage III and 10 patients were stage IVa (Weinstein et al. 2007). None of the tonsillar neoplasms were recurrent. Sixty three percent (17/27) of patients underwent a separate panendoscopy under general anaesthesia for PEG tube placement; while the remaining patients, who were deemed suitable for TORS in the outpatient setting, underwent panendoscopy and PEG tube placement at the same time as surgery. Surgery was followed 1-3 weeks later by staged neck dissection and adjuvant therapy. Twenty-six out of the 27 patients underwent neck dissection, while one patient who had a clinically negative neck chose not to undergo neck dissection. Nine (33%) patients received postoperative radiation therapy without chemotherapy, while 15 (56%) patients received postoperative radiation with chemotherapy. Of the three remaining patients, two patients had negative margins, no perineural invasion and no pathologically involved lymph nodes and underwent no postoperative irradiation, while one patient who had undergone prior irradiation and chemotherapy for lymphoma, received postoperative chemotherapy alone. The minimum length of follow-up was 6 months (Weinstein et al. 2007).

A more recent prospective study by Genden, Desai and Sung (2008) examined the technical feasibility, safety and efficacy of TORS for a range of malignant head and neck cancers. TORS using the da Vinci Surgical System was employed for the management of tumours involving the oral cavity, oropharynx, hypopharynx and larynx, in 20 adult patients (16 male and 4 female) between April 2007 and November 2007 (Genden, Desai and Sung 2008). The average age of patients included in the study was 58.36 years (range, 36-91 years). In 2 out of 20 patients, inadequate access to the tumour meant that the procedure had to be terminated. The clinical staging (TNM) of the 18 remaining patients was as follows: T1N0 (n=6), T1N1 (n=2), T1N2 (n=2), T2N0 (n=8), with 15 patients suffering from squamous cell carcinoma (SCC), 2 patients suffering from adenoid cystic carcinoma (ACC), and 1 patient suffering from clear cell carcinoma (Genden, Desai and Sung 2008). Negative resection margins were achieved

in all 18 patients who underwent the TORS procedure. Intraoral reconstruction was performed in 9 patients. Fifteen patients with SCC underwent concomitant unilateral (n=10) or bilateral (n=5) selective neck dissections immediately after surgery. The pathological staging of the 18 patients was as follows: T1N0 (n=4), T1N1 (n=4), T1N2 (n=2), T2N0 (n=6), T2N1 (n=1), T2N2 (n=1). In addition, all patients had pathologically negative margins, and none of the neck dissection specimens demonstrated any evidence of extracapsular spread. Ten patients received postoperative adjuvant radiation, and 4 patients were eligible for postoperative adjuvant chemotherapy, although only 3 of these decided to have the treatment. Follow up was limited to an average of 5.1 months (range, 2-8 months) (Genden, Desai and Sung 2008).

Safety

The study by Weinstein et al (2007) reported no mortalities; however operative complications occurred in 19% (5/27) of patients within 30 days of the TORS procedure. Two patients experienced moderate trismus, one patient required surgical resection in order to correct hypernasality of his voice due to scarring, while another patient experienced delirium tremens from alcohol withdrawal (Weinstein et al. 2007). A fifth patient underwent cautery of minor mucosal bleeding, and also underwent an unplanned tracheotomy for temporary exacerbation of sleep apnoea caused by postoperative swelling.

Genden, Desai and Sung (2008) reported that there were no intraoperative or postoperative complications, including no intraoperative or postoperative haemorrhages.

Efficacy

In the study by Weinstein et al (2007) TORS was successfully performed in all 27 patients, and all robotic arms functioned optimally during surgery, with no observed interference between the arms. The mean operative time for performance of the TORS procedure was 1 hour and 43 minutes (range, 26 minutes-3 hours, 53 minutes), which included a mean of 9 minutes for exposure and robotic positioning (range, 2-22 minutes). One patient was lost to follow-up and one patient developed widespread distant metastasis, however 93% (25/27) of patients achieved final margins that were negative for cancer (Weinstein et al. 2007). Mean blood loss during surgery was 189 ml (range, 0-500 ml), and no blood transfusions were required. One patient required a tracheotomy during surgery due to concerns about airway swelling. Seventy four percent (20/27) of patients were extubated at the end of surgery, while the remaining 6 patients were intubated for an average of an additional 2.7 days post-surgery (range, 2-3 days). As mentioned above, following extubation one patient required an unplanned tracheotomy after surgery for an exacerbation of his sleep apnoea (Weinstein et al. 2007). All 27 patients underwent percutaneous gastrostomy, and 96% (26/27) of patients were able to swallow without the use of a gastrostomy tube at last follow-up.

As mentioned above, the study by Genden, Desai and Sung (2008) reported that in 2 patients, access to the tumour was inadequate and the procedure was terminated, thus TORS was able to be successfully performed in 90% (18/20) of patients. The mean

operative time for performance of the TORS procedure, from incision to closure, was 84 minutes (range, 45-150 minutes). At last follow-up there was no evidence of recurrence in any of the patients who underwent TORS. Average estimated blood loss during surgery was 80 ml (range, 20-200 ml), and no blood transfusions were required during or after surgery. None of the patients required tracheotomy (Genden, Desai and Sung 2008). Patients were able to begin an oral diet an average of 1.4 days (range, 1-4 days) after surgery, with no evidence of aspiration or velopharyngeal reflux. One month after surgery, voice quality and articulation were unchanged when compared with preoperative assessment, while barium swallow evaluation studies showed no evidence of aspiration or velopharyngeal reflux. The average length of patient hospital stay was 1.7 days (range, 1-3 days) (Genden, Desai and Sung 2008).

COST IMPACT

There are no cost-effectiveness studies on the use of TORS for the treatment of head and neck cancer. Weinstein et al. (2007a) identified cost as one of the obstacles to the broader application of TORS, reporting that the cost of the da Vinci Robotic Surgical System with the 4-arm system and software upgrades is approximately \$USD1.5 million. In addition, the service contract for the system is approximately \$US100,000 per year and the cost of surgical instruments, which may be used for 20 cases, is approximately \$USD2,000 (Weinstein et al. 2007a). In the US, the da Vinci Robotic Surgical System is now being used in over 170 hospitals, primarily for cardiac and urologic surgery, and in these institutions there would be no incremental cost associated with the use of the system for TORS (Weinstein et al. 2007a).

ETHICAL, CULTURAL OR RELIGIOUS CONSIDERATIONS

No issues were identified from the retrieved material.

OTHER ISSUES

It should be noted that in the study by Weinstein et al (2007), Drs Weinstein and O'Malley made a financial disclosure, stating that they received a one-time compensation from Intuitive Surgical Inc for time, materials, and teaching a TORS workshop on October 28, 2007.

SUMMARY OF FINDINGS

There is a lack of high quality evidence on TORS, with the majority of the available evidence focused on the use of TORS for treatment of tumours of the mouth and throat. While both of the included case series studies focused primarily on the feasibility of the TORS procedure, and lacked long-term oncologic follow-up, it is important to note that one study reported no evidence of recurrence in any patients over the 5.1 month follow-up period (Genden, Desai and Sung 2008), while the other study reported that there were no early local or regional recurrences and only 1 distant oncologic failure (Weinstein et al. 2007). With regard to safety, Weinstein et al (2007) reported that the early complication rate for TORS was similar to that reported for both open and transoral surgical approaches, and that a number of the complications that have been reported following these approaches, such as death, pneumonia, and fistula did not

occur following TORS. Similarly, Genden, Desai and Sung (2008) reported that patients tolerated the TORS procedure with minimal morbidity. In summary, based on the findings of two small case series studies, it appears that TORS is a feasible, minimally invasive procedure for the treatment of patients with head and neck cancer, however the long-term safety and efficacy of this procedure are yet to be established. The authors of both studies (Weinstein et al. 2007; Genden, Desai and Sung 2008) agreed that there is a need for further prospective studies examining long-term outcomes for TORS, including swallowing and speech function, degree of neck and shoulder disability, general quality of life, and oncologic outcomes, in order to determine its risks and benefits compared with currently available open and transoral procedures.

HEALTHPACT ACTION

Further studies are necessary as long-term outcomes for TORS have not been elucidated and comparison with existing procedures is non-existent. Therefore, this technique is archived. However, based on the potential of TORS as well as other techniques which make use of the da Vinci surgical system, procedures which make use of the da Vinci system will be monitored.

NUMBER OF STUDIES INCLUDED

Total number of studies	2
Level IV intervention evidence	2

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SEARCH CRITERIA TO BE USED

Transoral robotic surgery

TORS

Robotics*

da Vinci