



Review Article

The pros and cons of additional axillary arm for transoral robotic thyroidectomy

Hoon Yub Kim ^{a,*}, Dawon Park ^a, Antonio A.T. Bertelli ^{b,1}

^a Department of Surgery, Division of Breast and Endocrine Surgery, Korea University College of Medicine, Seoul, South Korea

^b Department of Surgery, Head and Neck Surgery Division, Santa Casa de Sao Paulo Medical School, Sao Paulo, SP, Brazil

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Transoral endoscopic thyroidectomy vestibular approach

Abstract *Background:* Transoral vestibular approach thyroidectomy using robotic system has advantages with articulating instrumentation. Transoral robotic thyroidectomy (TORT) can be done either using just two robot arms for instruments and an extra one for the endoscopic camera, or using three robot arms for instruments (third arm through axilla) and an additional arm for the camera.

Pros of additional axillary arm for TORT: The 4th arm through an additional axillary port is mainly responsible for a counter-traction of strap muscles and thyroid tissue. The additional axillary port tract is also an excellent passage for the specimen removal with lower risk of disruption or fragmentation. Ultimately, these merits from the additional axillary arm allows TORT to be performed safely in a wide range of patient groups.

Cons of additional axillary arm for TORT: One of the issue with the additional axillary arm in TORT is that it leaves a cutaneous scar. Another issue to consider is the cost. In some places, robotic surgery operation fee varies with the number of arms used during the operation. Retraction of strap muscles through subcutaneous stitches applied after establishing the working space may make up for the lack of counter-traction.

Conclusion: TORT can be done safely with or without the transaxillary arm and surgeon may consider pros and cons based on multiple factors.

* Corresponding author.

E-mail address: hoonyubkim@gmail.com (H.Y. Kim).

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¹ Dr. Antonio A.T. Bertelli as a co-first author.

Background

The ideal minimally invasive approach, defined by Benhidjeb et al,¹ should be a safe procedure that respects surgical planes while minimizing surgical trauma, substitutes distant surgical accesses, excessive tissue dissections, and avoid a scar. Transoral vestibular approach thyroidectomy fulfills the idea of true minimally invasive surgery with its proximity to the thyroid gland through oral mucosa, providing an equal access to both lobes, excellent cosmetic outcomes and minimal flap dissections.^{2,3} Robotic system for transoral vestibular approach has exceptional advantages with articulating instrumentation which allows a range of motion and dexterity not possible with laparoscopic instruments in a narrow operative space.⁴ Transoral robotic thyroidectomy (TORT) can be done either using just two robot arms for instruments and an extra one for the endoscopic camera, as in transoral endoscopic thyroidectomy vestibular approach (TOETVA), or using three robot arms for instruments (third arm through axilla) and an additional arm for the camera.

Pros of additional axillary arm for TORT

During TORT operation, the 4th arm through an additional axillary port is mainly responsible for a counter-traction of strap muscles and thyroid tissue. Consequently, this facilitates the use of the other two arms for dynamic dissections and ensures safe conduct of the procedure in critical areas (Fig. 1).⁵ For example, in dissecting around the ligament of Berry, this arm provides upward traction of the thyroid tissue. Securing a clear view of the operative field with the axillary arm allows a surgeon to still have two arms for more precise, fine dissection around the perineural tissue. Therefore, it reduces the risk of recurrent laryngeal nerve traction injury. As a result, transient vocal cord palsy (3 months or less) rate was reported to be 1% in TORT.

Moreover, the additional axillary port tract is an excellent passage for the specimen removal. This is because the skin of the axilla is sturdier than the oral mucosa. Thus, the axillary incision can well tolerate the applied forces during the specimen removal. Therefore the specimen can be retrieved inside an endo-bag with lower risk of disruption or fragmentation. Furthermore, tumor size up to 8 cm can be removed in its entirety with adequate subcutaneous tunneling and dissection. Also, intact specimens facilitate more accurate pathologic diagnosis. For instance, evaluating the capsular invasion of the nodule in thyroid follicular neoplasm is important to determine the pathological nature of the tumor. This will help design an appropriate post-operative management plan as recurrences of thyroid carcinoma have been reported in association with disrupted specimens.^{6,7} Accordingly, maintaining the integrity of the specimen is a crucial element in oncological procedures.

Another utility of the axillary port is drain insertion when necessary without an additional scar.

Ultimately, all these merits deriving from the additional axillary arm allows TORT to be performed safely in a wide range of patient groups.

Cons of additional axillary arm for TORT

One of the main issue with the additional axillary arm in TORT is that it leaves a small, but definite cutaneous scar. As a result, when TORT is done through 4-port system with the additional axillary arm, the operation is no longer a "true scarless" surgery. Even though the incision site is concealed in the axillary area, young females are usually hesitant to have a scar in this area as it cannot be covered when wearing summer wear.

Another issue to consider when using the additional axillary arm is the cost. In some countries, robotic surgery operation fee varies with the number of arms used during the operation. Therefore, using additional axillary arm is associated with higher costs since it will require more surgical instruments (forceps, trocar, etc). In general robotic surgeries, including TORT, are much more expensive making the additional costs of the axillary arm a financial burden for patients and the healthcare system.

TOETVA has been developed with three ports including one central 10 mm port for the camera and two lateral 5 mm ports for insertion of several laparoscopic instruments.⁸ TORT may be performed the same way, using one central 8 mm port for the robot camera and two lateral



Fig. 1 TORT using 4-port system with additional axillary arm. The additional axillary arm (Fenestrated Forceps) is retracting the thyroid gland superior-laterally, exposing the surgical field to clearly visualize the recurrent laryngeal nerve. Now the operator can two hands (Harmonic shears and the Maryland Forceps) for a safe dissection around the critical anatomical structures.

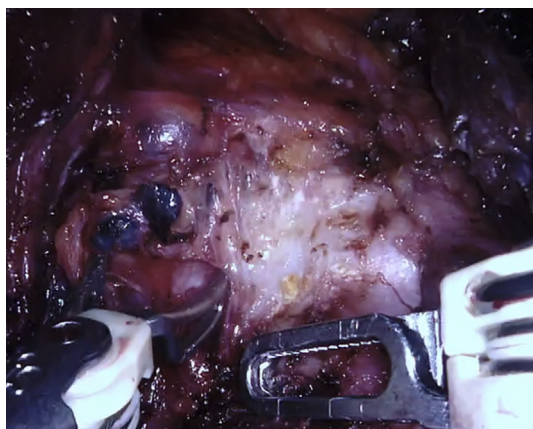


Fig. 2 Fenestrated Bipolar Forceps retracting trachea and Maryland bipolar forceps dissecting the recurrent laryngeal nerve (white structure under the Maryland) for right central neck dissection after right lobectomy for papillary carcinoma. On the right upper corner, a hanging suture (purple line) is retracting strap muscles. Black nodes above the Maryland are metastatic nodes. This patient was submitted to total thyroidectomy and bilateral level VI dissection without the additional axillary arm.

8 mm ports for robot instruments with the fourth arm disabled, when utilizing da Vinci Xi system.⁹

This technique usually requires retraction of strap muscles through subcutaneous stitches applied after establishing the working space¹⁰ with laparoscopic instruments and before docking the robot.⁹ This way surgeon may retract the gland using one hand while dissecting with the other hand. For example, when accessing the right lobe, Harmonic shears and Bipolar Maryland are used in the right hand to dissect and seal vessels, while Fenestrated Forceps in the left hand is used to retract the lobe. Additionally, the Maryland may also be used for nerve stimulation simply by touching the Maryland bipolar plug with a regular nerve stimulator. Optimal view and dissection of the recurrent laryngeal nerve and parathyroid glands are granted using this approach (Fig. 2), especially with magnification and 3D view promoted by robot cameras in addition to mobility and versatility of robot instruments.^{3,11} Therefore, although the three-arm TORT technique requires one hand dissection, it is still feasible and safe to preserve recurrent laryngeal nerve and parathyroid glands with only one hand. In a near future the new generation DaVinci SP will certainly be used for TORT, using the central single port which contains the scope and three forceps, and the possibility to use two additional 5 mm lateral ports for energy devices, nerve stimulation, vessel clips, laparoscopic instruments and more, all handled by the assistant that stays in the head of the patient.

However, removing the specimen in three-port method is challenging, and it is always important to remove the specimen using a small bag through the central port. Small thyroids are easy to remove but glands with nodules greater than 2 cm are challenging and sometimes requires dilation of the central vestibular tract after removing the trocar.⁹

In Table 1 we summarized the pros and cons of using a transaxillary arm for TORT.

Table 1 Pros and cons of additional axillary arm for TORT.

Item	Pros	Cons
TORT in 4-port system using additional axillary arm	Better exposure	Visible cutaneous scar
	Two hands dissection	Price of using another robot arm
	Excellent passage for specimen Excellent visualization	
TORT in 3-port system without additional axillary arm	Completely avoids cutaneous scar	Difficult dissection with one hand dissection
	Cheaper solution	Challenging specimen removal

Conclusion

TORT can be done safely with or without the transaxillary arm and surgeon may consider pros and cons based on multiple factors, such as cost of operation and patient preference. In difficult cases such as big nodules and posterior nodules close to the nerve, the additional axillary arm can be helpful in retracting the gland and removing the specimen.

Declaration of Competing Interest

Hoon Yub Kim: The corresponding author is a consultant for Medtronic.

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