



# Utility of the Highly Articulated Flex® Robotic System for Head and Neck Procedures: A Cadaveric Study

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## Objectives

Robotic head and neck surgery potentially reduces the morbidity associated with traditional open procedures, but has its limitations. This study's goal was to employ a novel, FDA approved, highly articulated robotic system (Flex® Robotic System Medrobotics Corp., Raynham, MA) for several head and neck procedures, including a hemithyroidectomy, submandibular gland (SMG) removal, and cervical lymphadenectomy, all through a postauricular facelift approach.

## Study Design

It was hypothesized that the Medrobotics Flex® Robotic System could safely be used for procedures such as hemithyroidectomy, submandibular gland removal and cervical lymphadenectomy.

## Background

The da Vinci Robotic System (Intuitive Surgical, Inc., Sunnyvale, CA) has been extensively studied, as the popularity of minimally invasive approaches to the head and neck continues to increase. However, the da Vinci's widely known limitations of large size, and rigid scope and instruments, limit the robot's applications in otolaryngology.

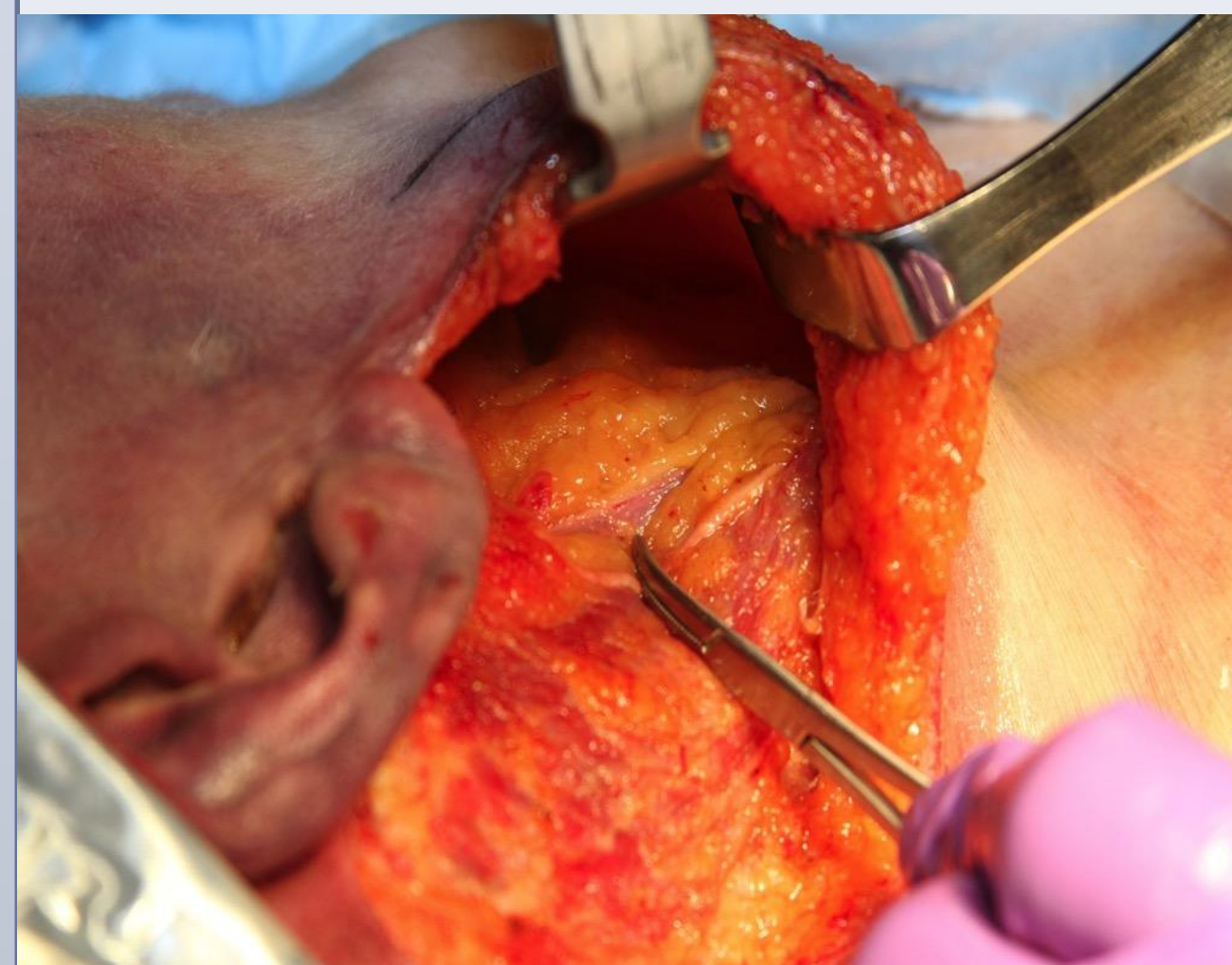
The Medrobotics Flex® Robotic System was specifically designed for head and neck procedures, during which, visualization may be compromised by existing vital anatomical structures, and is able to maneuver around them in a nonlinear fashion. Previous studies have employed the Flex® Robotic System for transoral base of tongue resections, tonsillectomy, procedures on the endolarynx, and nasopharyngectomy without the need for palate splitting<sup>1-3</sup>. The Flex® Robotic System has not been previously applied to transcervical procedures.



**Figure 1.** Operator controlled flexible endoscope with 50 individual linkages that can be advanced nonlinearly, using a joystick controller. Tooling support that for third-party 3.5 mm flexible instruments (Design Standards Corporation Charlestown, NH). The Flex Console houses controls and monitors. The reusable Flex Base converts electrical signals to mechanical movements. The disposable Flex Scope controls the motions of the endoscope<sup>2</sup>.

Johnson et al. *Laryngoscope*. 2013.

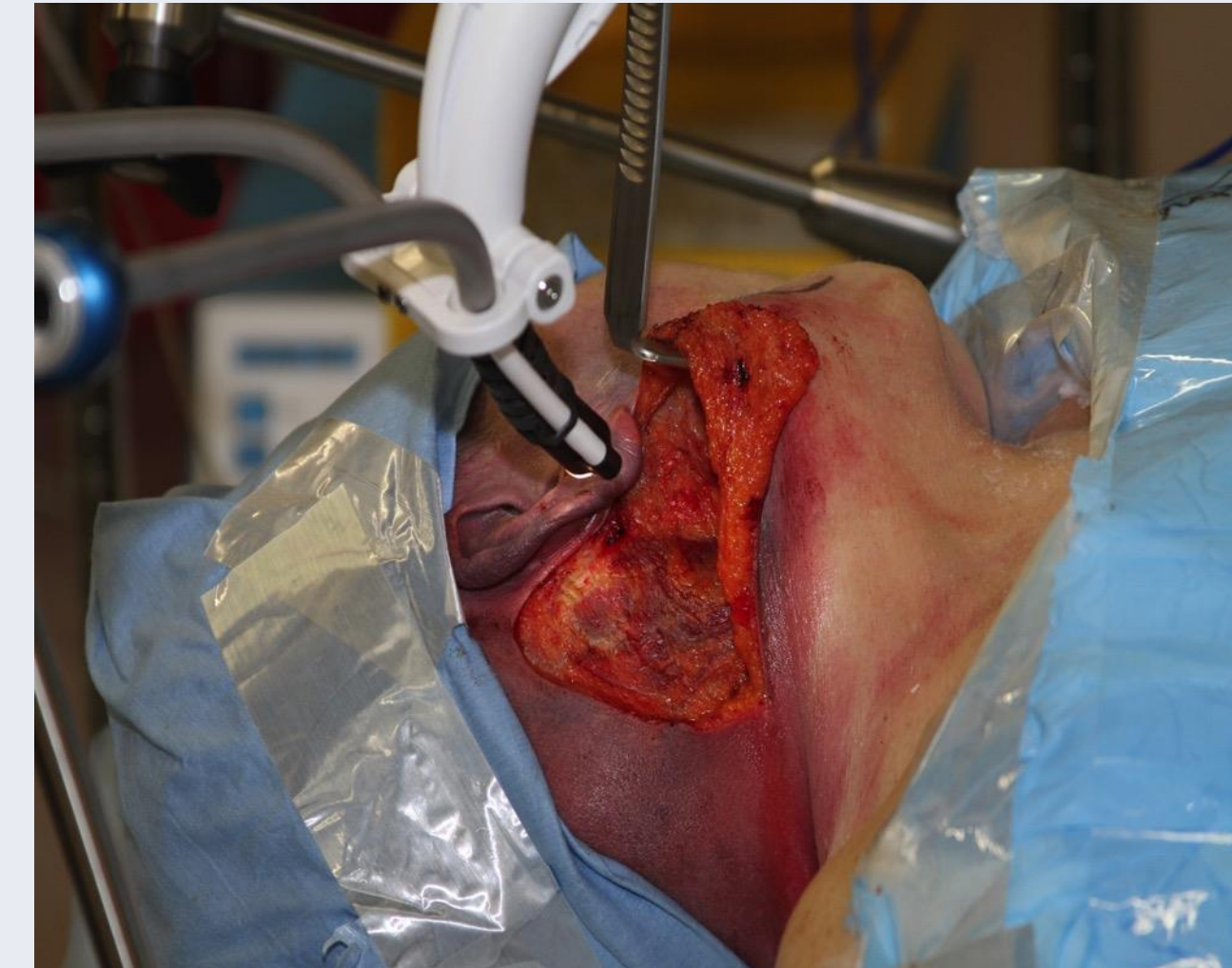
## Methods



**Figure 2.** Two fresh upper body cadavers were obtained. A postauricular incision was made and subplatysmal flaps were manually raised. A retractor was inserted to create space for the introduction of the robot into the neck.



**Figures 3,4.** The Medrobotics Flex® Robotic System was introduced into the neck through postauricular access. The snake-like scope composed of multiple linkages allowed for non-linear advancement. The flexibility of the scope is easily demonstrated.



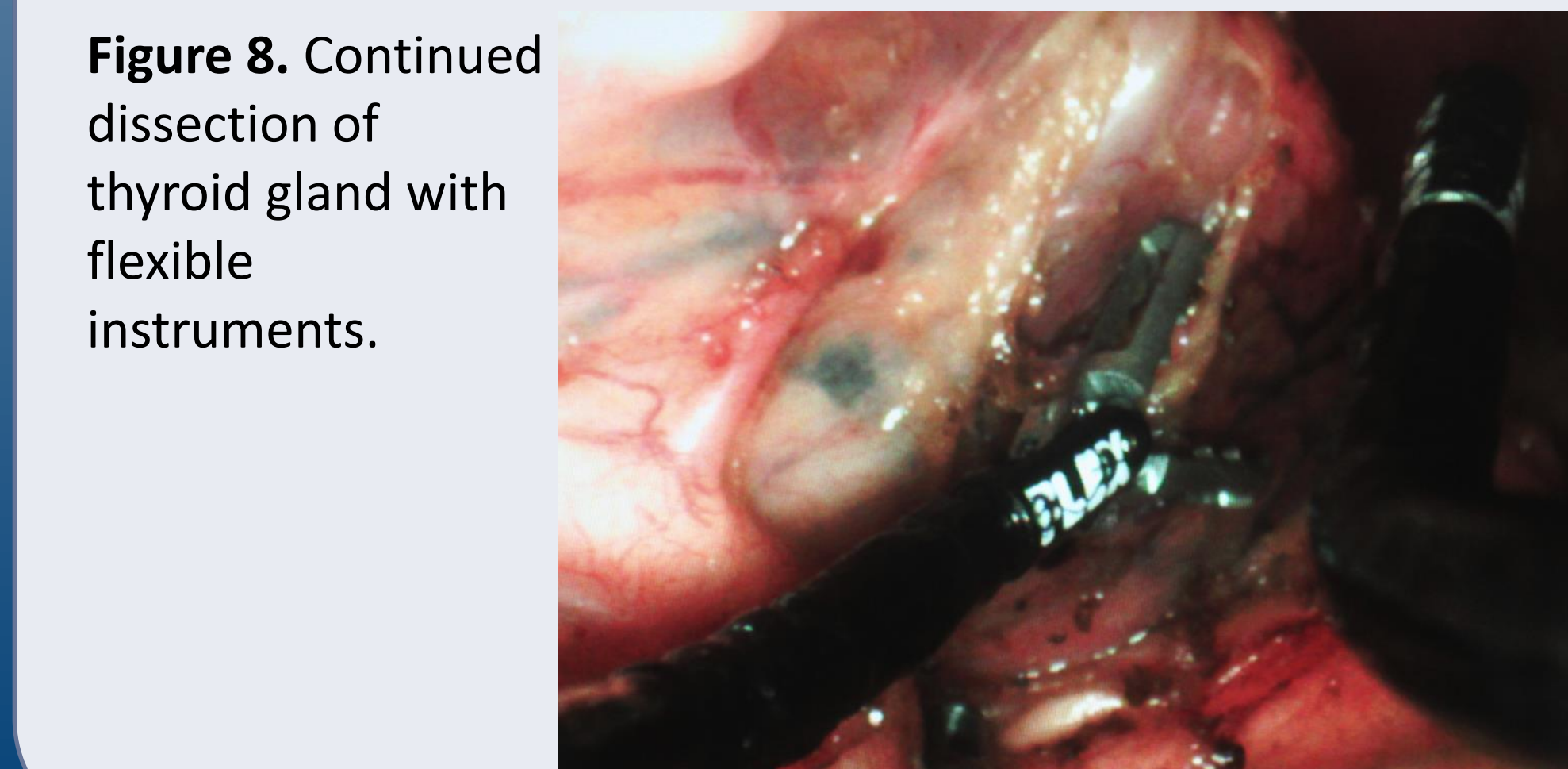
**Figure 5.** Surgical set up. Primary surgeon sits on operative side of patient. The Flex console is at the foot of the bed. The Flex Scope is positioned in the neck and is advanced by surgeon control. The tooling support enables physician to use two instruments simultaneously.



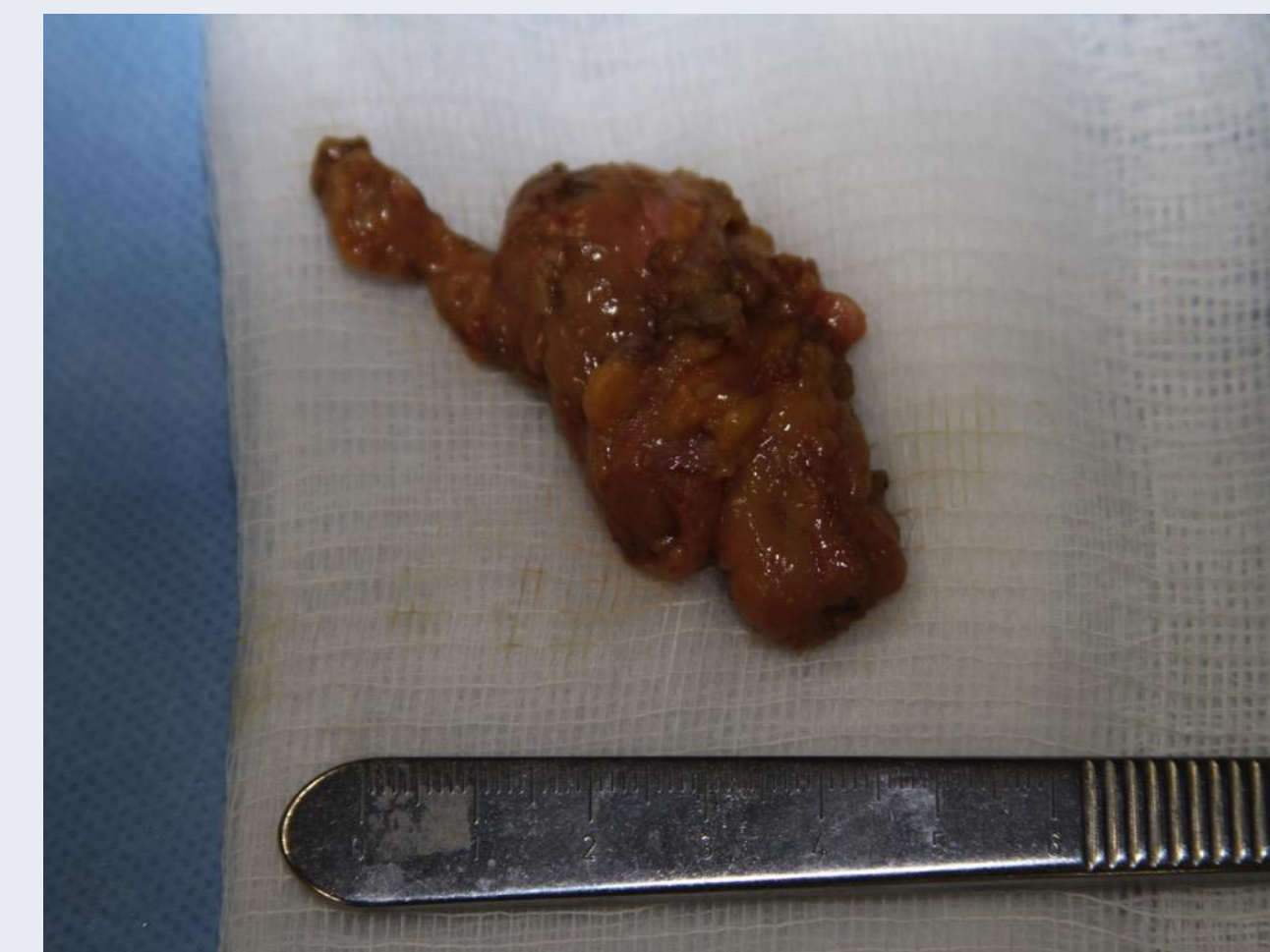
**Figure 6.** Accessory nerve is identified during neck dissection with the Medrobotics Flex® Robotic System.



**Figure 7.** Strap muscles are lifted exposing the thyroid gland during robotic thyroidectomy.



**Figure 8.** Continued dissection of thyroid gland with flexible instruments.



**Figure 9.** Nodal packet specimen at the completion of robotic cervical lymphadenectomy dissection through postauricular incision.

## Results

The Flex® Robotic System was used to complete the following transcervical procedures: hemithyroidectomy, cervical lymphadenectomy, and submandibular gland removal, on both sides of the cadaver's neck through a postauricular incision.

•Once docked, there was no need for redocking of the robot.

•Collision and interference of robot arms was avoided throughout procedure duration.

•Procedures were completed without the need for additional incisions.

## Conclusion and Future Directions

Although this study represents an early preclinical study on the usage of the the Flex® Robotic System, it demonstrates feasibility of using this novel robot for standard transcervical procedures.

Future work includes:

1. Cadaver studies to demonstrate oncological soundness of procedures completed with the Flex® Robotic System,
2. Human studies employing the Flex® Robotic System.

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This work does not represent the views of the US Government or Department of Veterans Affairs.

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