Robot-Assisted Glandular Surgery

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KEYWORDS

• TORS • Robotic surgery • Sialolithotomy • Submandibular gland excision • Sialolith • Salivary stones • Robot-assisted sialolithotomy

KEY POINTS

- The role of robotic technology is expanding in head and neck surgery.
- Minimally invasive gland-sparing surgery is becoming the gold standard approach to benign salivary gland pathology.
- The use of robotic technology can enhance the visualization and dexterity of surgeons performing transoral submandibular sialolithotomy for large hilar stones.
- Although data suggest improved lingual nerve safety and improved surgeon's ergonomic posture, cost and learning curve remain the main limitations to using robotic technology in submandibular sialolithotomy.

Introduction

The use of robotic surgery technology has increased substantially over the past two decades. The utility of transoral robotic surgery has gained popularity in head and neck surgery over the past few years. Since the Food and Drug Administration approval gained in 2009, head and neck surgeons have been exploring different potential uses of the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA) to address various diseases of the head and neck area. That includes oropharyngeal tumors, obstructive sleep apnea, parapharyngeal tumors, and thyroid surgery.[1,2]

With the recent advances in sialendoscopy and instrumentation, gland-sparing surgery is becoming the gold standard treatment of nonneoplastic obstructive glandular pathology. With the recent emphasis on minimally invasive surgery, the focus has shifted away from the conventional transcervical incision whenever possible when addressing neoplastic conditions of the salivary glands or large stones that are not amenable to sialendoscopy approach.[3,4]

Combined approaches for large submandibular and parotid stones were described by Marchal in 2007.[5] Multiple large case series published in the literature showed incidence of permanent lingual nerve injury in about 2% of transoral submandibular gland (SMG) sialolithotomy.[6]

Transoral SMG excision has been described in the literature.[7–9] The advantages of this approach are avoidance of a neck skin incision and scar, minimizing the chance of marginal mandibular nerve injury, and faster healing. Robot-assisted transcervical SMG excision feasibility was first described by Terris and colleagues in 2005.[10] Minimally invasive gland excision via a robot-assisted retroauricular approach was described by Lee and colleagues[11] in 2012 in a feasibility study. The use of robotic technology has provided clear advantages including increased surgical accuracy and precision, 360° range of motion beyond the human hand manipulation, tremor reduction, three-dimensional magnification of the operative field with stereoscopic vision, motion scaling, less musculoskeletal discomfort for the surgeon, supervised training, and remote operation.[12]

Work-related musculoskeletal disorder (WMSDs) is a common problem with estimated costs of $20 billion a year in the United States.[13] There has been a growing interest in WMSDs among surgeons lately reflected in the number of studies and publications on this topic. It is becoming clear that surgeons are at increased risk of WMSD and pain because of prolonged and abnormal posture assumed during surgery. Chronic musculoskeletal pain might impact a surgeon's career length. Special attention to this problem is of importance from the issue of patient safety, and overall health care prospective given the potential time loss of practice and the cost involved in medical education and surgical training.[14–16]

In a recent systematic review of the literature it was suggested that the prevalence of WMSDs might be lower in robotic surgeons (23%–80%) compared with open surgery (66%–94%). Accurate estimates of the prevalence might be challenging because of underreporting of injury. Trunk rotation and overstretched arms are significant risk factors for low back pain. Use of head light, magnification (loupes or microscopes), and the neck positioning during surgery add additional hazards to the cervical spine.[17–19] Many of the risk factors associated with WMSDs apply to transoral surgery. Seated position during robotic surgery with comfortable positioning of the monitor in relation to eye level and keeping the arms close to the body might lessen eye and neck strain and improve technical precision. It also can eliminate the unbalanced lower limbs and back weight bearing often assumed with abnormal posture seen with open or endoscopic surgery.[20–23]

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The disadvantages of robot-assisted technology include the following:

- Lack of tactile and haptic feedback.
- Cost of the device ranges from $1.5 to 2.5 million depending on the model, in addition to about a $100,000 annual maintenance fee. Instruments alone tend to cost $2300 for a 10-use device in addition to the cost of the disposables (eg, drape).
- Need for operating room space to fit the machine and trained operating room staff for setup and handling of the machine.
- Operative time and learning curve: head and neck surgeons across the country are getting more exposure to the technology and most training programs include robotic surgery in their curriculum.
- Availability of the device: the technology is becoming more accessible in more hospitals as it is becoming more popular in other surgical specialties (eg, urology, obstetrics/gynecology, and general surgery), but that can also create a challenge for lower utilization services, such as ear-nose-throat and maxillofacial surgeons.

Robot-assisted sialolithotomy and sialendoscopy

Walvekar and colleagues[24] first reported on a transoral robotic-assisted approach for a large SMG hilar stone in 2011. Since then, a case series has been published reporting on 22 patients who underwent the procedure with procedure success of 100% and no permanent lingual nerve injury encountered. Next we focus on this procedure and describe it in detail.

Studies have shown that a hilar location of SMG sialolith is a significant risk factor for lingual nerve injury intraoperatively.[6] Robotic technology allows for a superb three-dimensional visualization and protection of the lingual nerve, a wider field of view compared with conventional transoral sialolithotomy or combined approach, use of four operating hands (two of the primary surgeon and two of an assistant) without compromising the field of view, and a delicate handling of the duct and the nerve with optimal hemostasis.

Surgical technique

Preoperative planning

All patients should have either a noncontrast computed tomography scan or ultrasound of the affected gland to determine the number and location of stones.

Indications

- Symptomatic large singular stone in SMG hilum (>5 mm)
- Recurrent or retained proximal large stones after sialoadenectomy

Contraindications

- Absolute:
  - Moderate to severe trismus or limited mouth opening
  - Intraglandular stones
  - Contraindications of general anesthesia
- Relative:
  - Distal stenosis or scarring of Wharton duct
  - Multiple or recurrent stones
  - Atrophic, nonfunctional SMG

Preparation and patient positioning

Patient lays supine on the operating room table with the bed turned 90° away from the anesthesia station (Fig. 1).

Surgical approach

Please refer to Box 1 for detailed surgical steps.

Complications

- Lingual nerve injury: Razavi and colleagues[25], reported an 18% incidence of temporary paranesthesia of the ipsilateral tongue that resolved within 2 to 3 weeks, likely caused by direct trauma during the manipulation and

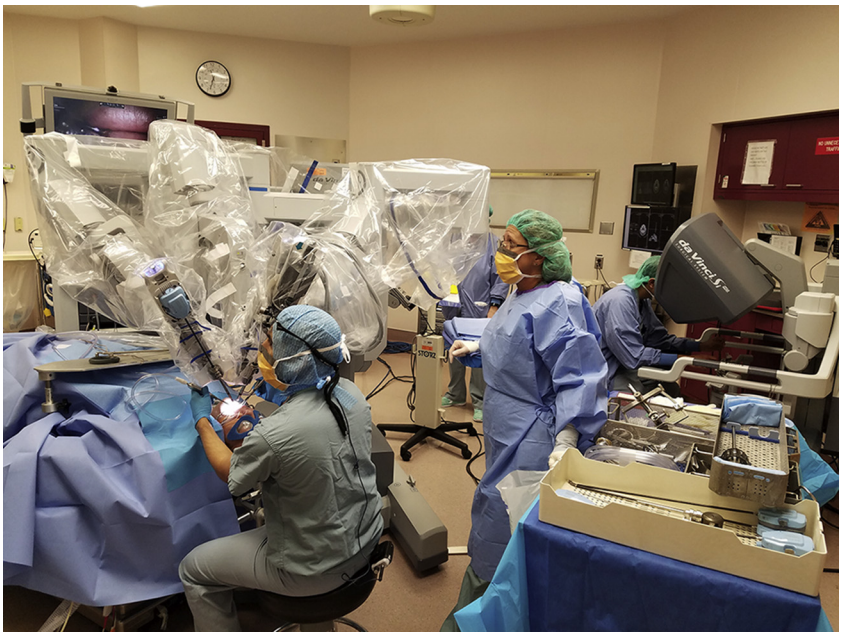

Fig. 1 Room arrangement for use of robot-assisted sialolithectomy.