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CASE REPORT
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# Transoral robotic surgery for bilateral parenchymal submandibular stones: the Flex Robotic System

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## ABSTRACT

Traditional management of the submandibular gland stones is based on transcervical sialadenectomy. Recently, conservative treatments emerged. In particular, transoral robotic surgery (TORS) has been used for the removal of submandibular sialoliths. Previous case series of TORS reported the use of the Da Vinci system with a high success rate. We describe an uncommon case of bilateral hilo-parenchymal submandibular stone removed via transoral approach with the Flex Robotic System. We report the step-by-step procedure for the transoral robotic approach to hilo-parenchymal submandibular sialoliths through the oral floor. The procedure was successful without complications. The total procedure time was 130 minutes, including 20 minutes for the robotic setting. The Flex Robotic System appeared to be a safe conservative surgical tool for hilo-parenchymal submandibular sialoliths by simultaneously preserving submandibular glands and avoiding severe complications on anatomical structures of the oral floor.

**Keywords:** Conservative salivary surgery, oral surgical procedures, robotic surgical procedures, salivary calculi, salivary glands

## Introduction

Conventional treatment for submandibular gland stones consists of transcervical sialadenectomy with known complications (1). The traditional transoral removal was introduced by Downtown and Quist in 1960 but was recently described using robot-assisted glandular surgery (2-4). Conservative salivary techniques, such as sialendoscopy-assisted transoral surgery, ensured the ability to treat obstructing symptoms with stones removal (5, 6).

First cases of transoral robotic submandibular stones removal were performed with the Da Vinci Si HD (Intuitive Surgical, Sunnyvale, CA, USA), reporting 100% procedural success (7, 8). Another minimally invasive robotic approach in head and neck surgery is the Flex Robotic System (Medrobotics Inc., Raynham, MA, USA). It consists of a new combination of 2 instruments manually controlled by the surgeon with a fully robotic snake arm monocular robotic camera (9). The Flex Robotic System was successfully used for head and neck cancer surgery and was validated in multicenter studies (10).

By combining our experience with transoral robotic surgery (TORS) for head and neck cancer and conservative transoral salivary surgery (4, 5), we present the use of Flex Robotic System in a case of bilateral submandibular stones. The aim of this paper was to present a step-by-step description of the transoral robotic approach to hilo-parenchymal submandibular sialoliths through the oral floor with the Flex Robotic System.

## Case Presentation

A female patient aged 68 years reported recurrent bilateral submandibular swelling with mild pain lasting for 6 months. During oral examination, purulent discharge from the orifice of Wharton's ducts flushed out. Ultrasonography showed bilateral salivary stones with dilation of the intraparenchymal duct system; moreover, submandibular glands had a dishomogeneous appearance owing to recurrent inflammation. Antibiotic and steroid therapy was administered with mild clinical improvement. Computed tomography showed the presence of large bilateral salivary stones located in the parenchyma near the glandular hilum (Figure 1). The patient's consent was obtained.

TORS was scheduled to remove stones through the oral floor with preservation of the submandibular glands. General anesthesia with a nasotracheal tube was necessary to achieve

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**Figure 1.** Axial computed tomography that shows the presence of large bilateral salivary stones in the Wharton ducts (15 × 11 mm at the right side and 11 × 8 mm at the left side) near the submandibular hilum

broad exposure and access to the floor of the mouth, bilaterally. The tongue was retracted to the contralateral side, and the oral floor was flattened by positioning the Flex retractor. The Flex Robotic System was placed behind the head of the patient. The Flex scope was moved by the first surgeon using a 3-dimensional (3D) high definition (3D-HD) monitor through a controller on the Flex console. Suction and external pressure over the submandibular gland were provided by the first assistant. The surgeon marked the site of the left salivary stone on the mucosal surface through palpation (Figure 2). Mucosal incision was performed using monopolar cautery of the robot along the line demarcated previously (Figure 3). The Wharton duct was exposed through a blunt dissection using the Maryland dissector. The lingual nerve was identified and was gently mobilized from the duct and retracted medially to visualize the gland hilum (Figure 4). Then, external finger pressure of the assistant surgeon was mandatory for the next steps. A duct

**Main Points:**

- Transoral robotic submandibular stone removal is emerging, and the Da Vinci Si HD is the most used robotic system.
- The Flex Robotic System showed great potential as a surgical tool in the surgery of the oral floor, providing the following: flexible instruments, excellent visualization, maneuverability, and tactile feedback.
- Our case report showed that Flex Robotic system represents a viable and safe conservative surgical tool for hilo-parenchymal submandibular stone removal.

**Figure 2.** The location of the left salivary stone was marked on the mucosal surface through palpation

**Figure 3.** Transoral Robotic Surgery with Flex Robotic System. The mucosal incision was performed using the monopolar cautery of the robot along the line demarcated previously

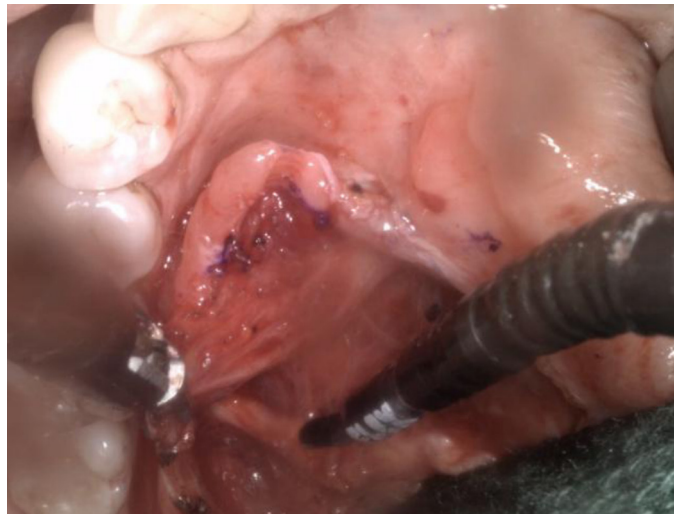

**Figure 4.** The lingual nerve was identified and gently dissected to separate it from the Wharton duct

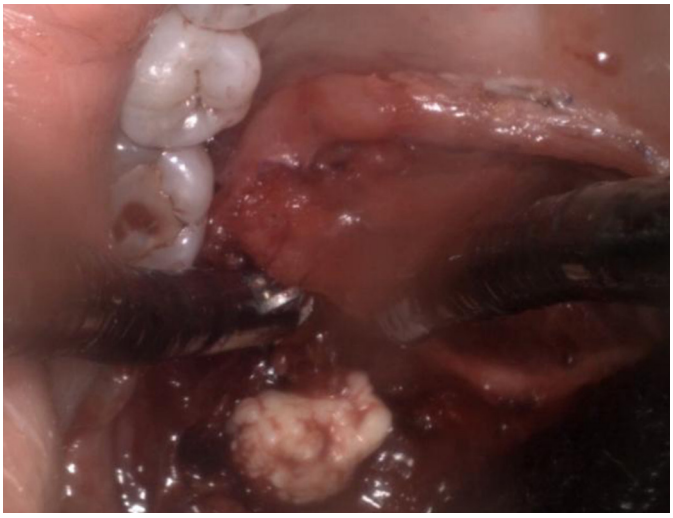

**Figure 5.** A duct incision was performed over the sialolith, and the stone was carefully dissected from its attachment to the hilum of the submandibular gland

incision over the sialolith and a careful dissection of the stone from its attachment to the gland hilum were performed (Figure 5). The sialolith was then removed. The surgical incisional area was then irrigated with saline solution to remove any debris. A hemostatic and antimicrobial surgical net (Tabotamp, Johnson & Johnson Medical Ltd, Skipton, United Kingdom) was placed over the incisional area, and closure of the oral mucosa was done using absorbable 3-0 Vycril stitches. The same procedure was repeated for the right salivary stone.

The stones were successfully removed using the Flex Robotic System. Visualization and exposure of the lingual nerve, the Wharton's duct, and the parenchyma harboring the stone were excellent. The total procedure time was 130 minutes, including 20 minutes for the robotic setting. No intraoperative complications occurred. The patient was discharged on the second day after the surgery. Moderate pain in the oral floor was described by the patient for 1 week after the surgery; the patient also referred to bilateral lingual hypoesthesia lasting for 1 month. Perioperative and postoperative antibiotic (amoxicillin + clavulanic acid) and steroid therapy was administered during the hospital stay. Then, antibiotic was further prescribed for 5 days.

Medical examinations were performed 7, 30, and 90 days after the surgery. An ultrasonographic examination was done 3 months after the procedure to check the glandular parenchyma echogenicity and to assess any ductal system dilation or residual stones. No persistent gland swelling, ranula, or ductal stenosis were observed. Ultrasonography did not reveal any residual stones or ductal dilation.

## Discussion

About 80%-90% of salivary stones involve the submandibular gland, being usually located at the distal tract of the Wharton duct, hilum, and hilo-parenchymal area (11, 12). Stone recurrence after the transoral approach is possible, probably because of the deep and narrow surgical area. Indeed, an appropriate view of oral floor anatomical landmarks after incision of glandular parenchyma is difficult (5, 6). The introduction of the transoral robotic approach made it possible to overcome some of these limitations (13). In particular, because the robotic approach guarantees a 3D and enhanced depth perception of the oral floor, it allows to follow the anatomical course of the lingual nerve and to maintain healthy submandibular duct until incision to the parenchyma.

TORS with the Da Vinci system has some limitations, such as a limited number of cutting instruments, rigid and relatively bulky robotic arms, and high costs (14). Recently, the Flex Robotic System combined the benefit of a robotic system with a flexible endoscope that supports cutting instruments and flexible devices for TORS (9). Furthermore, because the devices are controlled by the surgeon's hands rather than by a remote robotic system, the Flex Robotic System ensures tactile sensation and manual haptic feedback (9).

Despite the increasing literature showing successful results with the Flex Robotic System for head and neck lesions, it has never been applied to the anterior oral floor (15). In our case, bilateral large hilo-parenchymal submandibular sialoliths were removed using the Flex Robotic System. The procedure was safe because no intraoperative or postoperative and persistent unfavorable effects, such as lingual nerve injury, tongue tingling, ranula, or hilar stenosis with recurrent sialadenitis, were reported. Moreover, this was the first reported case of bilateral submandibular stone removal using TORS.

An adequate exposure of the oral floor is necessary through correct positioning of the Flex retractor. Moreover, a blunt dissection of the Wharton duct and the stones using the Maryland dissector guarantees a clean surgical field with a small amount of blood. This ensures a better visualization of the deep surgical area, which is enhanced by the 3D-HD camera. The role of the assistant surgeon is important while performing suction, traction of the tissue, and external gland push up for a better exposure of the gland parenchyma in the oral floor. Finally, the procedure lasted for 130 minutes for bilateral stones removal, but the surgical time can be further decreased by increasing the experience of the surgeon.

In conclusion, the Flex Robotic System seems to be a safe conservative surgical tool for hilo-parenchymal submandibular stones removal.

**Informed Consent:** Verbal informed consent was obtained from the patients who agreed to take part in the study.

**Peer-review:** Externally peer-reviewed.

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**Conflict of Interest:** The authors have no conflict of interest to declare.

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