Int. J. Oral Maxillofac. Surg. 2019; 48: 1520–1524
https://doi.org/10.1016/j.ijom.2019.07.004, available online at https://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
Clinical Pathology

Transoral robotic surgery for hilo-parenchymal submandibular stones: step-by-step description and reasoned approach

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P. Capaccio, F. Montevecchi, G. Meccariello, G. D'Agostino, G. Cammaroto, S. Pelucchi, C. Vicini: Transoral robotic surgery for hilo-parenchymal submandibular stones: step-by-step description and reasoned approach. Int. J. Oral Maxillofac. Surg. 2019; 48: 1520–1524.

Abstract. The conservative transoral approach to hilo-parenchymal submandibular stones has been proposed as an alternative to traditional sialadenectomy. The main purpose is to preserve the gland and eliminate the risk of a cervical scar and damage to the marginal mandibular branch of the facial nerve. The spread of transoral robotic surgery has favoured its application not only in the oropharynx, but also in the anterior oral cavity. This article describes a transoral robotic approach for hilo-parenchymal submandibular stones. In January 2019, two patients with a right and a left hilo-parenchymal submandibular stone of 15 mm and 8 mm, respectively, underwent removal of the stone with transoral robotic surgery using the Si Da Vinci surgical robot. The procedure was performed successfully and tolerated well, with a one-night hospitalization. There were no complications such as lingual nerve damage, painful gland swelling, infection, or ranula. The patients were followed up clinically and ultrasonographically for the first 3 months to verify symptom relief and persistence of stones; no symptoms or stones were found. The transoral robotic surgical approach seems to be safe and adequate for the conservative management of large hilo-parenchymal submandibular stones. An adequate diagnosis together with proper docking and an appropriate approach to the oral floor is mandatory.

Key words: submandibular stones; transoral surgery; transoral robotic surgery; CBCT.

Accepted for publication 2 July 2019
Available online 21 July 2019

Most salivary stones involve the submandibular gland (80–90%), and the most frequent locations are the distal tract of the duct, the hilum, and the hilo-parenchymal area[1–4]. Although sialadenectomy is still the most widely used procedure to treat proximal and hilo-parenchymal submandibular stones[5,6], due to its known risks[6,7], the conservative transoral approach has emerged as a valid alternative[8–11]. This trend has increased further since the introduction of interventional sialendoscopy[12].

In fact, it has been shown that the transoral removal of large (>7 mm) and deeply located submandibular stones is safe, effective[11,13–15], and highly successful in terms of stone removal and symptom relief[13–15], especially if an adequate diagnostic process based on clinical oral floor palpation, ultrasonography (US), and cone beam computed tomography (CBCT) is adopted[16–19].

Several stone recurrences have been described after performing a transoral surgical approach by means of loupe lens-guided surgery[13,14]. A possible partial explanation for this finding is the difficulty for the main surgeon of obtaining an adequate visualization of anatomical landmarks in the oral floor after the parenchymal incision, due to the narrow and deep surgical field. Performing a sialendoscopic check through the main preserved duct after the removal of the hilo-parenchymal stone could help the surgeon to reduce the risk of leaving residual stone fragments in the parenchyma; however, the narrow, deep, and blood-filled surgical field does not guarantee a clear view.

Recently, the application of robotic technology in the head and neck field[20–24], and the transoral robotic approach in particular, has favoured the spread of this procedure not only for oropharyngeal disorders[20], but also for anterior oral floor diseases[25]. Transoral robot-assisted management of large submandibular gland stones and transoral robotic submandibular gland removal have recently been described in case reports and small and heterogeneous series of patients[26–29]. These initial experiences appear very interesting, although they do not clearly specify certain steps of the procedure, such as docking, which in the current authors' opinion should be considered a mainstay of the surgical robotic technique[21]. The main goal of this article was to provide a step-by-step reasoned description of all phases of the transoral robotic approach to hilo-parenchymal submandibular stones through the oral floor.

Patients and methods

In January 2019, a male patient (age 56 years) with a right hilo-parenchymal submandibular stone (15 mm) and a female patient (age 43 years) with a left hilo-parenchymal submandibular stone (8 mm) underwent transoral robotic surgical removal by means of a Si Da Vinci surgical robot (Intuitive Surgical, Sunnyvale, CA, USA) in the Head and Neck Department, ENT and Oral Surgery Unit of G.B. Morgagni – L. Pierantoni Hospital, Forlì, Italy. The patients underwent preoperative US and Doppler US assessments (Hitachi H21, 7.5 MHz; Hitachi High Technology Corporation Ltd, Tokyo, Japan), three-dimensional (3D) CBCT (Fig. 1), and a clinical evaluation to establish the size of the stone and its location. The location was clinically defined as hilo-parenchymal when only the distal margin of the stone was detectable during bimanual palpation of the oral floor[13]. The exclusion criteria were an inability to open the mouth sufficiently and non-palpable stones[13,14]. The study was approved by the appropriate local ethics committee CEIIAV (Comitato Etico IRST IRCCS AVR Meldola) and was performed in accordance with the principles stated in the Declaration of Helsinki. The patients gave informed consent to participate in the study.

The procedure was performed under general anaesthesia with a nasotracheal tube. A Molt mouth gag was introduced. The Si Da Vinci surgical robot was docked behind the head of the patient at an angle of 30° (Fig. 2), and a downward facing 30° endoscope was placed into the scope holder. Two robotic 5-mm instruments, a Maryland dissector and a monopolar cautery with spatula tip, were placed into arms 1 and 3 according to the side of the stone. A square-shaped tongue retractor, covered by rough gauze, was positioned to retract the tongue to the contralateral side and to flatten the oral floor. The location of the stone was marked on the mucosal surface by means of palpation. The robotic sur-

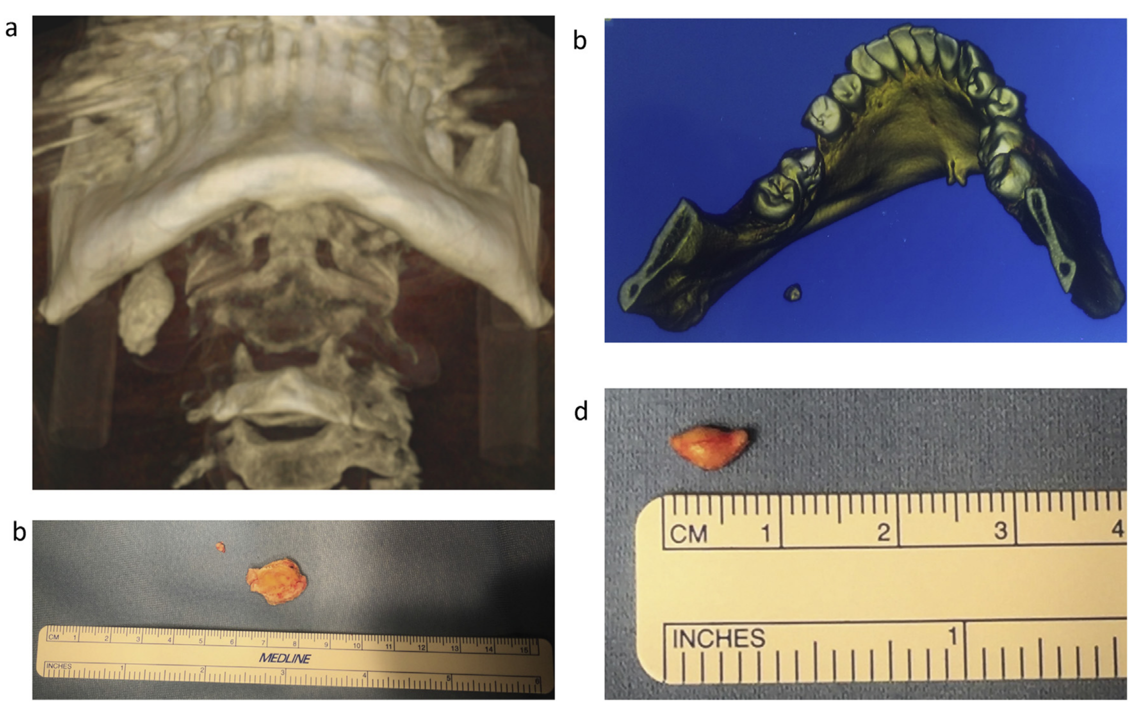

Fig. 1. (a) 3D CBCT reconstruction of the right 15 mm submandibular parenchymal stone. (b) Shape of the right stone removed by robotic surgery. (c) 3D CBCT reconstruction of the left 8 mm submandibular parenchymal stone. (d) Shape of the left stone removed by robotic surgery.

Fig. 2. Docking of the Si Da Vinci robot positioned behind the head of the patient on the opposite side to the affected gland, at an angle of 30°.

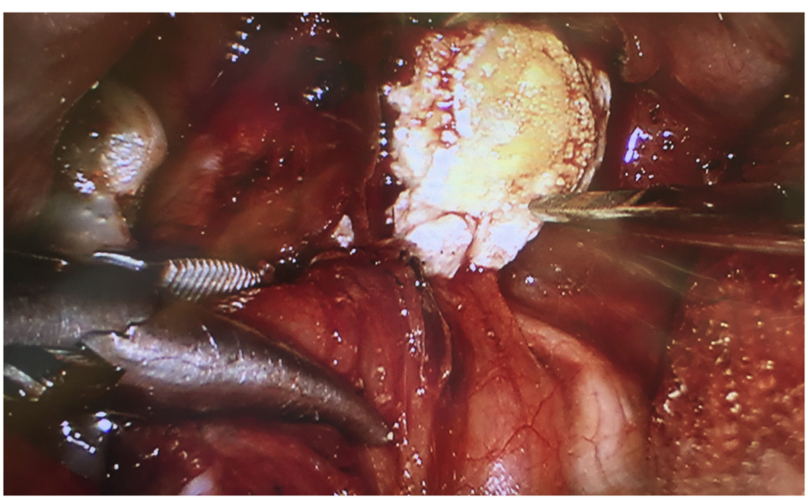

Fig. 3. The stone extracted from the parenchyma and the relationship with Wharton's duct and the lingual nerve.

geon sat at the surgical console and the assistant surgeon was positioned on the side contralateral to the affected gland and was responsible for suction and the tongue retractor. The duct was identified and cannulated using a salivary probe (Bowman probe; Karl Storz, Tuttlingen, Germany).

Using the monopolar cautery of the robot set at 15 W of coagulation, an oblique mucosal incision was made over the marked area near the papillary region of Wharton's duct, along the floor of the mouth, towards the second molar. A blunt dissection of the loose areolar tissue was performed medial to the internal edge of the sublingual gland, which was rotated laterally to expose Wharton's duct (Fig. 3). The lingual nerve is easily identified running obliquely from the tongue, passing under the duct, and then ascending medially through the tail of the sublingual gland over Wharton's duct. The lingual nerve was mobilized from the duct and retracted medially to visualize the gland hilum, which was moved upwards to the submandibular gland area by means of external finger pressure of the assistant surgeon, who was also able to palpate the stone to verify the exact location before hilo-parenchymal incision. An incision was made over the hilar region to expose the calculus by means of the monopolar cautery; a gentle dissection with the spatula and with the help of the Maryland dissector was done to detach and deliver the stone en bloc from the parenchyma (Fig. 3). The stone was then measured in size and compared to the shape in the 3D CBCT scan (Fig. 1).

The docking was removed and the incisional cavity was irrigated with saline solution to clear any debris. The robotic surgical procedure was concluded and surgery continued by a traditional transoral approach. A haemostatic and antimicrobial fibrillar surgical mesh (Tabotamp; Johnson & Johnson Medical Ltd, Gargrave, Skipton, UK) was placed over the hilar opening to avoid the risk of stricture or stenosis. Finally, the wound was irrigated with antibiotic solution (rifampicin), and the oral floor was sutured using resorbable stitches (3–0 Vicryl).

A sialendoscopic check (0.8–1.1 mm, Erlangen sialoendoscope; Karl Storz, Tuttlingen, Germany; always available on the surgical table) was not done because of the perfect concordance between the stone removed and imaging. All of the patients received antibiotic therapy (amoxicillin and clavulanic acid) for 1 week after the operation. Steroids were also administered in the case of oral floor oedema. The patients underwent clinical follow-up examinations at 1 week, 1 month, and 3 months after the procedure and they were also offered an US examination at the 3-month follow-up in order to ascertain any possible ductal system dilation or residual stones.

Results

The stones were successfully removed by means of the transoral robotic surgery. The stone located in the right submandibular gland was removed in multiple pieces, while the stone located in the left submandibular gland was removed en bloc. In both cases there was perfect concordance in size and shape between the stone removed and the stone observed on 3D CBCT. The mean duration of the procedure was 50 minutes (55 minutes for the right stone and 45 minutes for the left stone, including 15 minutes for the robotic setting and 10 minutes for the suture). No intraoperative or postoperative complications, such as lingual nerve injury, duct stenosis, ranula, or persistent gland swelling, were encountered. The female patient only referred to mild and transitory pain in the gland a few days after the procedure; interestingly, ductal kinking of the proximal third of the duct was observed during the procedure. Both patients were discharged the day after surgery. Neither residual stones nor duct dilation was observed on US evaluation at 3 months postoperative.

Discussion

The transoral approach nowadays represents an effective and gland-preserving alternative to sialadenectomy for deep hilo-parenchymal stones[9,11–15]. The main limitations of previously published studies are that the majority have described heterogeneous series of patients in which stones located in the main submandibular duct were also encountered. At the same time, the so-called combined sialendoscopy–assisted transoral procedure (particularly useful if the main duct is incised during the procedure) has been advocated as the mainstay for parenchymal stones[13,14]. However, it is questionable how postoperative sialendoscopy might influence the result of transoral stone removal, considering the blood-filled and narrow intraoperative surgical field.

This article provides a step-by-step description and reasoned approach to transoral robotic surgery for hilo-parenchymal submandibular stones. The assumption was that all anatomical structures encountered in the oral floor have to be preserved to obtain a successful result in terms of functional preservation of the gland. Two large hilo-parenchymal submandibular stones were successfully removed with transoral robotic surgery. The smaller stone (8 mm) was removed en bloc, while the larger one (15 mm) was removed in multiple pieces. The piecemeal extraction of large parenchymal stones is relatively frequent with the traditional transoral approach, due to the fact that stones are impacted and adherent to the parenchymal gland tissue. This partially explains the 11.2% of residual stones seen with long-term experience of the transoral approach[13,14]. In this regard, a postoperative sialendoscopic check of the hilo-parenchymal incisional area is not always useful to identify deep residual microliths that have cracked during removal of the main stone. Based on long-term surgical experience[14], a diagnostic process based on US and 3D CBCT has been adopted; an intraoperative comparison of 3D images to the size and shape of the extracted stone is performed to avoid the risk of leaving ancillary microliths near to the main stone that were not detected during US, as performed by an experienced operator.

The transoral robotic surgical removal of submandibular parenchymal stones was safe, as no intraoperative or postoperative untoward effects such as tingling of the tip of the tongue, ranula, persistent lingual nerve injury, or recurrent sialadenitis due to hilar stenosis were observed, which have been reported by others[11]. The successful result in terms of safety is in part due to the fact that the 3D view of the surgical field on the robot console allowed the main surgeon to have a clear anatomical delineation and enhanced perception of the depth of the oral floor, lingual nerve and Wharton's duct, the sublingual gland, and the hilo-parenchymal submandibular area. Woo et al.[30] described their experience of the transoral approach for deep stones, with the removal of a piece of the sublingual gland. This approach appears to be risky and harmful, due to the potential occurrence of ranula.

Another interesting observation of our initial experience is that the blunt dissection with the spatula supported by the gentle use of the Maryland forceps to detach and deliver the stone, guaranteed a clean surgical field with a small amount of blood visible, thus favouring a better view of the deep surgical plane.

Very little information about the docking of the robot in the operating theatre for the removal of parenchymal submandibular stones could be found in the literature[26–28]. In our experience, an adequate docking of the robot is essential for a precise robotic procedure[21–23]. Contrary to what is currently performed for other transoral procedures, the robot should be positioned behind the head of the patient and on the opposite side with respect to the gland involved, and at an angle of 30°. Finally, to obtain a better view of the posterior part of the oral floor, a downward facing 30° endoscope was inserted in arm 2 of the robot.

As described previously in the literature[13,14], the traditional transoral loupe lens-guided surgery is performed by three surgeons, i.e. the main surgeon and two assistant surgeons, one for the oral field and one to push up the submandibular gland from the neck. In our initial experience, it was observed that the assistant surgeon could simultaneously perform the suction, tissue traction, and push-up of the gland from the neck to better expose the parenchyma in the oral floor, thus avoiding the need for a third surgeon. Furthermore, all of the surgical steps could be observed by the surgical staff via video monitoring.

Finally, the duration of robotic surgery was relatively fast (20 minutes and 30 minutes). In our opinion, the surgical time will be further reduced as greater numbers of robotic procedures are performed, thus minimizing tissue damage in the oral floor and subjective patient complaints.

In conclusion, the transoral robotic surgical removal of large (>7 mm) hilo-parenchymal submandibular stones is a safe and effective conservative surgical procedure, in line with other initial experience[26–28]. Due to the 3D visualization and enhanced depth perception of the oral floor, the robotic approach preserves the main submandibular duct, the sublingual gland, and the lingual nerve, and allows the stone to be removed through a minimal incision in the hilo-parenchymal region, thus guaranteeing the functional preservation of the obstructed gland. The preservation of Wharton's duct allows sialendoscopic access through the natural ostium in the case of residual microliths, or to perform a new conservative transoral approach to the parenchyma in the case of a discrete stone recurrence. Adequate preoperative clinical and radiological assessments by means of US and 3D CBCT evaluation are always advisable, in order to locate the stone precisely and minimize the risk of failure. Proper docking of the robot, together with an accurate endoscopic view is essential to help the surgical staff reach a successful conservative result.

Funding

None.

Competing interests

None.

Ethical approval

The study was approved by the appropriate local ethics committee CEIIAV (Comitato Etico IRST IRCCS AVR Meldola) number 1335 (Prot. 2587/2015) and was performed in accordance with the principles stated in the Declaration of Helsinki.

Patient consent

The patients gave informed consent to participate in the study.

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