Evaluation of Sialendoscopy-Assisted Treatment of Submandibular Gland Stones

Jin-Qing Xiao, MS, Hai-Jiang Sun, MS,† Qi-Hui Qiao, MS,‡ Xin Bao, MS,§ Chuan-Bin Wu, MS,|| and Qing Zhou, DDS, PhD¶*

Purpose: The aim of the present study was to evaluate the therapeutic efficiency of sialendoscopy-assisted operations in the treatment of submandibular gland stones.

Materials and Methods: The data from 8 patients with sialolithiasis who underwent sialendoscopy from August 2015 to January 2016 at the Department of Oral and Maxillofacial Surgery, School of Stomatology, China Medical University (Shenyang, China) were retrospectively reviewed. All the patients had undergone preoperative technetium-99m pertechnetate salivary gland scintigraphy. The results revealed that the salivary glands exhibited normal or slightly reduced uptake and excretion dysfunction. Computed tomography examinations revealed stones located in the intraductal area near the glands or in the branches that could not be removed owing to their deep locations within the mouth. Therefore, an endoscope was inserted, the stones were located intraductally using sialendoscopy, and a transcervical incision was made to remove the stones and preserve the submandibular gland.

Results: The stones were completely removed, and the submandibular gland was preserved in all cases. The patients recovered well postoperatively, and no complications developed.

Conclusions: Our results suggest that sialendoscopy-assisted sialolithectomy is an effective and safe surgical technique for the removal of proximal and intraglandular submandibular gland stones. The patients' quality of life had obviously improved postoperatively.

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Salivary stones are the most common cause of salivary duct obstruction, and more than 80% of salivary calculi are located in the submandibular ductal system.[1] Approximately 40% of submandibular stones are situated within the distal portion of Wharton's duct. These stones can be removed using a straightforward intraoral procedure.[2] Approximately 10% of stones occur in the proximal submandibular duct. Proximal submandibular stones and intraglandular stones are difficult to remove transorally because of their positions in the proximal submandibular duct or its branches.[1,3-5]

Traditional management of proximal submandibular stones, stones in the hilum of the submandibular gland, and hiloparenchymal submandibular calculi has been based on sialadenectomy.[6] Sialadenectomy carries the risk of injury to the facial, lingual, and hypoglossal nerves, Frey syndrome, and unaesthetic scars.[7,8] Salivary gland functioning is impaired by the calculi; however, removal of the glands can do more

Received from Department of Oral and Maxillofacial Surgery, School of Stomatology, China Medical University, Liaoning Institute of Dental Research, Shenyang, People's Republic of China.

*Resident.

†Resident.

‡Resident.

§Resident.

||Resident.

¶Professor.

Address correspondence and reprint requests to Dr Zhou: Department of Oral and Maxillofacial Surgery, School of Stomatology, China Medical University, Liaoning Institute of Dental Research, Shenyang, Liaoning Province 110002, People's Republic of China; e-mail: zqforstudent@163.com

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harm than good. Submandibular sialoadenectomy results in the appearance of postoperative local concave deformities, and submandibular gland secretion is affected.

Therefore, various minimally invasive and gland-preserving techniques have recently been developed for stone removal, including extracorporeal and intracorporeal lithotripsy, interventional sialography and basket retrieval, and sialendoscopy.[9-11] However, previous studies have revealed that 62 to 80% of submandibular gland resections are for sialolithiasis.[8,12]

We know of no studies involving the removal of stones from an extraoral incision using a transcervical incision with simultaneous preservation of the submandibular gland. We, therefore, adopted a new method for the removal of stones from the proximal submandibular gland and the hilum of the submandibular gland.

Sialendoscopy enables the preservation of the salivary gland while relieving the symptoms of most patients.[13,14] In the present study, we used an endoscopic technique in which the endoscope was used to help locate the stones, which was the most important aspect of the entire procedure.

Materials and Methods

The institutional review board of our institution approved the present study. All participants provided written informed consent. During the course of the study, all guidelines and protocols of the Declaration of Helsinki were followed.

PATIENTS

A total of 8 patients with sialolithiasis treated from August 2015 to January 2016 at the Department of Oral and Maxillofacial Surgery, School of Stomatology, China Medical University, were selected for our study. The patients included 5 men and 3 women. Their age range was 21 to 53 years (mean 34; Table 1). The size of the stones ranged from 6 to 9 mm (mean 7.5). The stones were located in the proximal submandibular duct or its minor branches; sometimes, the stones were in the intraglandular portion of the submandibular gland.

The inclusion criteria were as follows:

1. Color Doppler ultrasonography was applied preoperatively to all patients to eliminate false-positive results.
2. All patients underwent preoperative computed tomography (CT) to evaluate the stone dimensions and ductal locations. The CT examinations revealed stones near the glands or within the proximal one third of the duct. Because of their locations, the stones were nonpalpable at the mouth opening (Fig 1).
3. The preoperative excretion and uptake function of the submandibular glands were quantitatively assessed using technetium-99m pertechnetate salivary gland scintigraphy (ECT). The examinations revealed normal or slightly reduced salivary gland uptake function, with dysfunctional excretion (Fig 2). The time–activity curves of the left submandibular glands revealed a decline in excretion, but the right submandibular glands

Table 1. PATIENT DETAILS

Pt. No.	Age (yr)	Gender	Diagnosis	Duration (mo)	Treatment	Follow-Up (mo)
1	33	Male	Left SGD	7	Sialendoscopy-assisted extraoral incision	4
2	21	Female	Bilateral SGD	3	Sialendoscopy-assisted extraoral incision	2
3	26	Male	Right SGD	5	Sialendoscopy-assisted extraoral incision	3
4	35	Male	Left SGD	13	Sialendoscopy-assisted extraoral incision	6
5	39	Female	Left SGD	11	Sialendoscopy-assisted extraoral incision	5
6	42	Male	Right SGD	15	Sialendoscopy-assisted extraoral incision	6
7	53	Female	Left SGD	16	Sialendoscopy-assisted extraoral incision	7
8	23	Male	Right SGD	4	Sialendoscopy-assisted extraoral incision	5

Abbreviations: Pt. No., patient number; SGD, submandibular gland duct.

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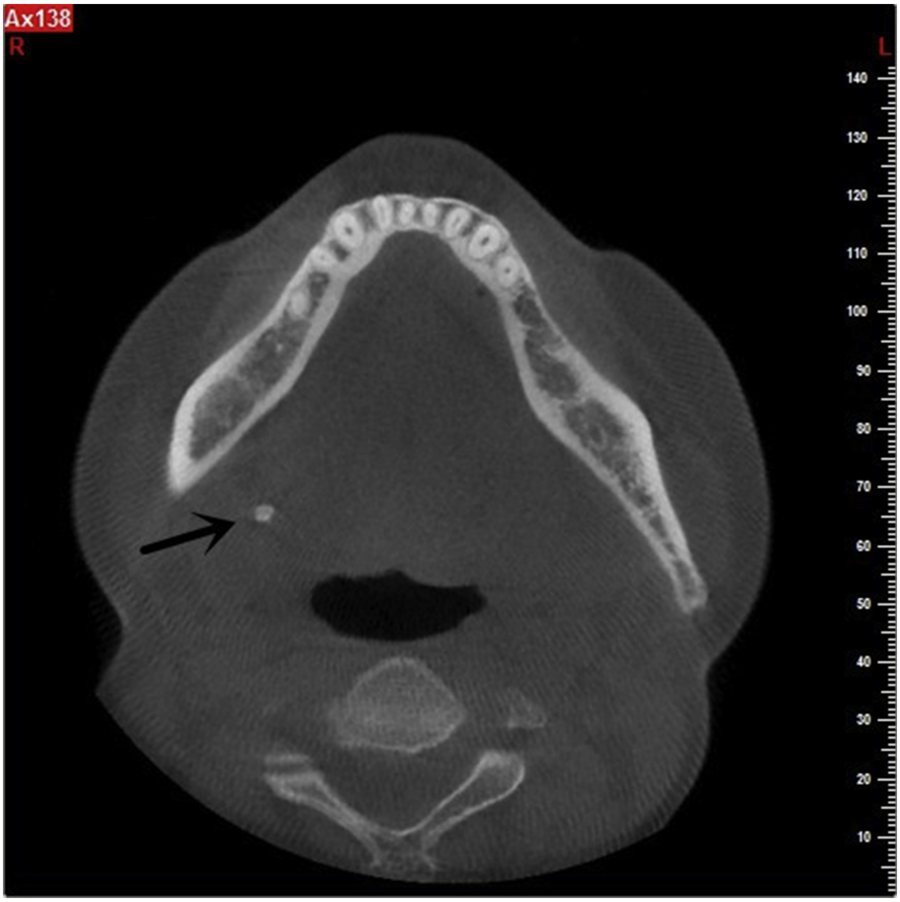

FIGURE 1. Axial computed tomography scan showing a large hilar submandibular gland stone (*black arrow*) on the right side.

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exhibited no decline in excretion. These findings indicated that the right submandibular glands could excrete saliva but that the saliva excretion was not normal.

The exclusion criteria included the following:

1. Recurrent submandibular gland infection
2. Submandibular gland fibrosis
3. ECT results demonstrating abnormal or absent salivary gland function
4. Stones located in the distal portion of Wharton's duct that could be removed using the intraoral method

SURGICAL PROCEDURE

The entire surgery was performed with the patient under general anesthesia administered by nasal intubation. An incision was made in the floor of the mouth to expose the submandibular duct. The lingual nerve crossing the duct was identified and carefully preserved. The duct was incised, the endoscope was inserted, and external manual pressure was simultaneously applied to the submandibular gland. The endoscope was further inserted until the stone was displayed on the screen (Fig 3). Because of the deep locations of the stones in the mouth, they could not be removed using the oral route; thus, a transcervical incision was made to remove the stones (Fig 4). The subcutaneous and muscle tissues were gradually separated to fully expose the submandibular glands. When the area in which the nerves and blood vessels requiring protection was identified and the position of the salivary gland duct was visible through the sialendoscope, the light source was activated to localize the stones (Fig 5). The duct was fully exposed, a tube was inserted into the incision, and the stones were removed (Fig 6). After the stones were removed (Fig 7), the duct was irrigated with a large amount of normal saline. After removal of the stones, the distal portion of the duct was examined with the sialendoscope to ensure that other stones or residual fragments had not been overlooked. After endoscopic verification, the duct was sutured using 6-0 Prolene sutures (Fig 8). The submandibular gland was moved back to

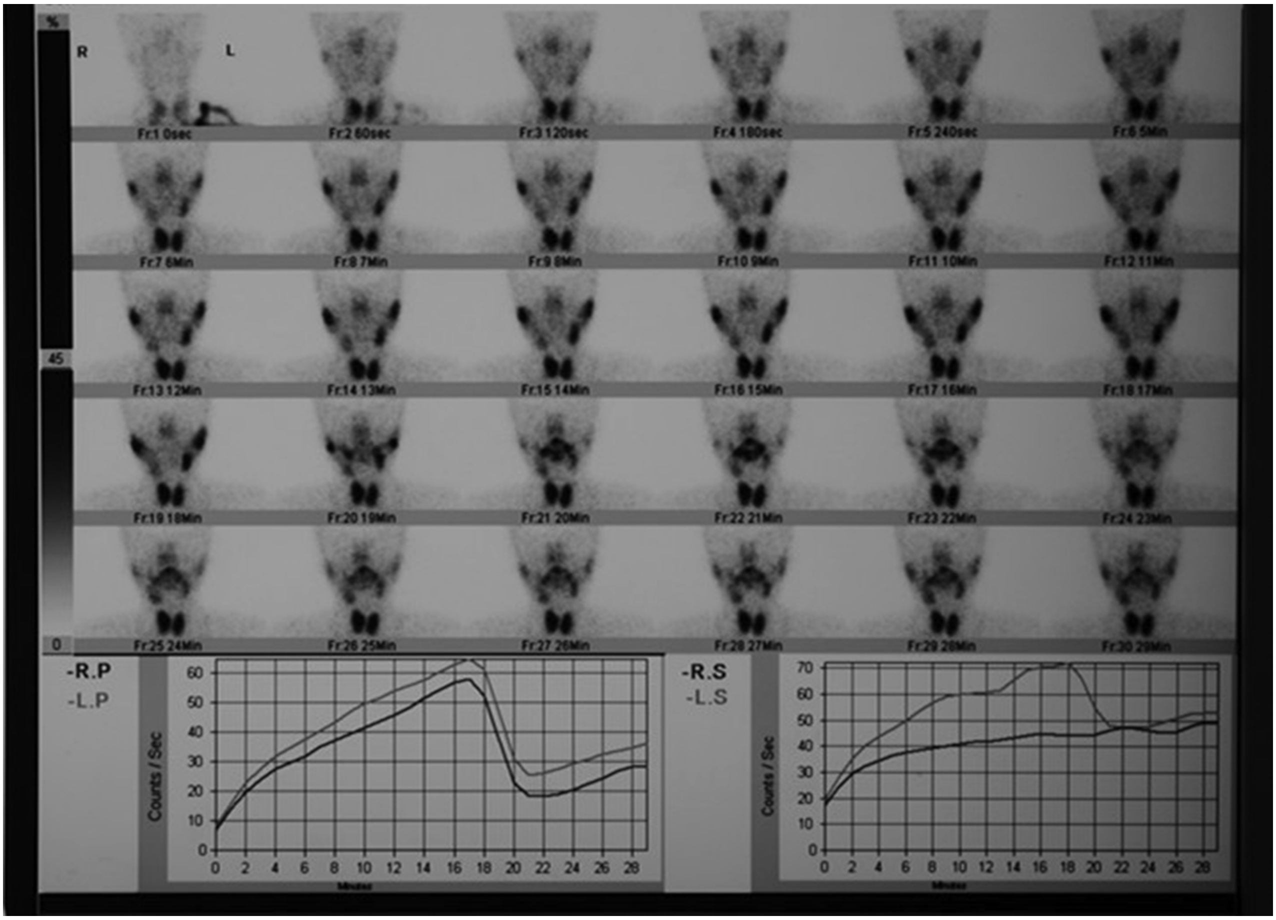

FIGURE 2. Technetium-99 m pertechnetate salivary gland scintigraphy showing normal uptake and poor excretion of a right submandibular gland and an obstruction in the ductal system.

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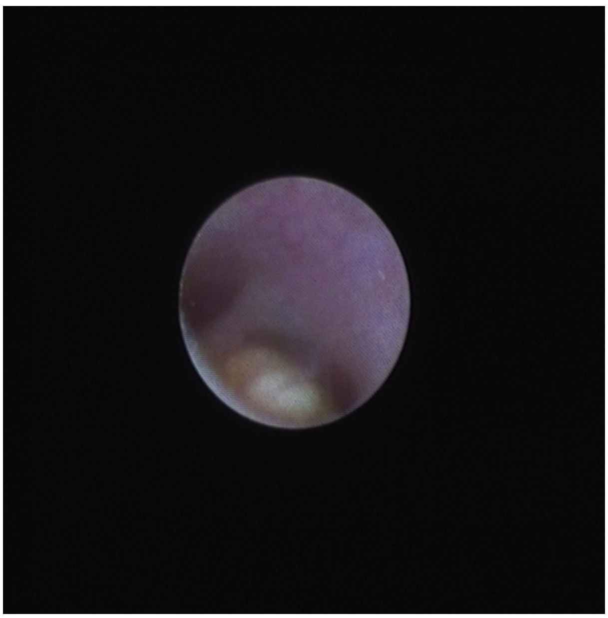

FIGURE 3. Sialendoscopic image showing a stone in the ductal system.

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its original position, and the muscle, subcutaneous, and skin tissues were sutured in layers. The skin was sutured with 6-0 Prolene sutures. A drainage tube was placed and a compression bandage applied. The oral floor was sutured with resorbable sutures (3-0

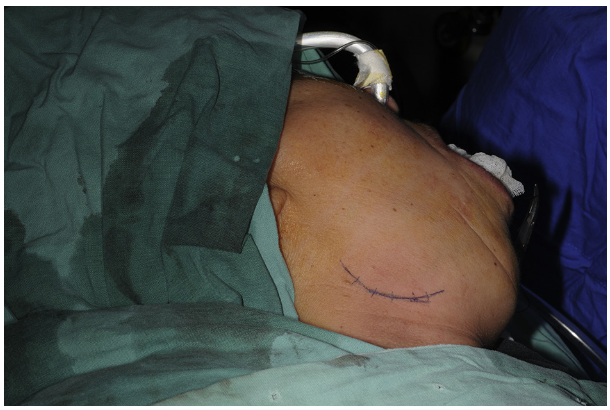

FIGURE 4. Transcervical incision.

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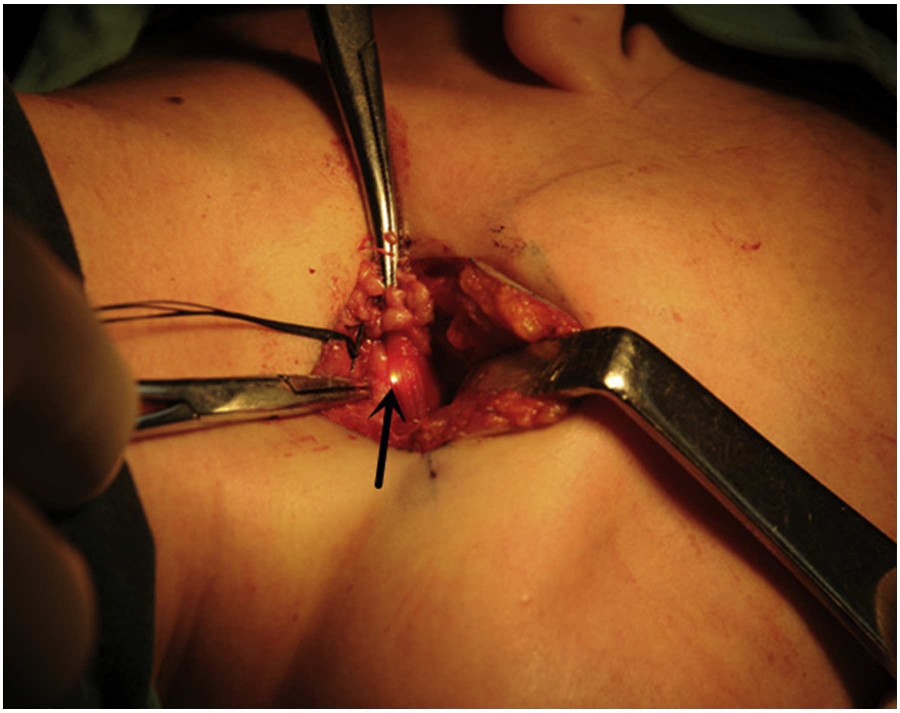

FIGURE 5. Sialendoscopic lighting to guide the removal of the submandibular stone.

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Vicryl suture). Sialodochoplasty might not be necessary in patients who have had a distal salivary stone removed.[15]

The patients were treated with antibiotics and hormones for 3 days, in addition to cleaning their mouths with water or mouthwash. The patients left the hospital 4 to 6 days after surgery.

Results

Using our surgical procedure, we successfully removed the stones while preserving the submandibular gland in all 8 patients. Gland swelling and edema of the floor of the mouth persisted for approximately 2 to 4 days. The patients reported normal tongue

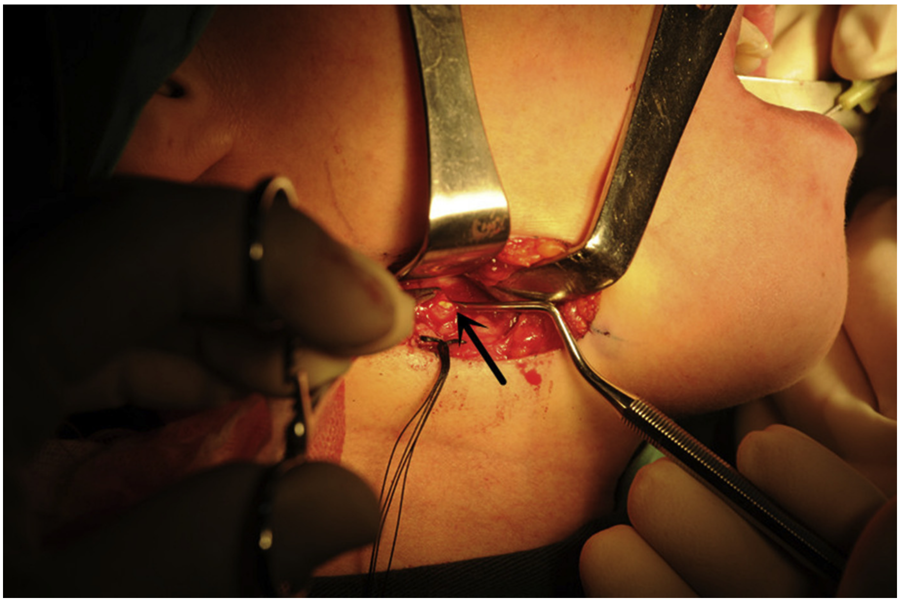

FIGURE 6. Removal of the stone.

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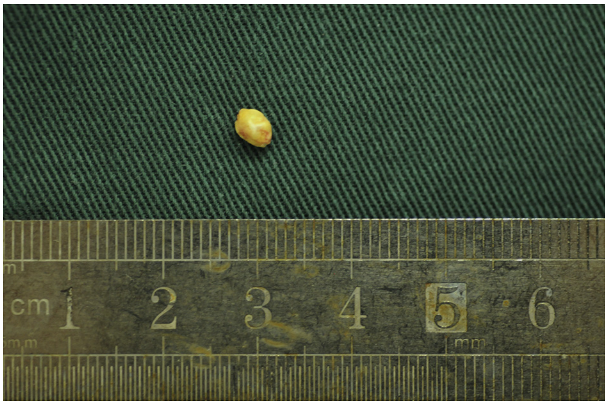

FIGURE 7. Photograph showing a removed stone from a right submandibular duct.

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movement and feeling, and their facial morphology was intact. The collected data included recurrence, lingual nerve function after surgery, and patient satisfaction. None of the patients reported any symptoms of lingual nerve injury.

The patients were clinically followed up at 1, 3, and 6 months. The clinical endpoint considered was functional secretory recovery. At the 3-month follow-up visit, technetium-99m pertechnetate salivary gland scintigraphy revealed that the excretion function of the right submandibular glands had been restored to normal, and the bilateral glands exhibited equivalent function (Fig 9).

Discussion

The removal of stones in the proximal submandibular or intraglandular area is difficult. In these circumstances, removal can also be harmful to the lingual nerve and blood vessels, especially in the case of small nonpalpable stones.[1] The general public desires minimally or less invasive techniques, and in recent years, conservative and gland-preserving techniques for the management of salivary gland calculi have been preferred.[16] Preoperative assessment is important in the context of patient informed consent.

We used technetium-99m pertechnetate salivary gland scintigraphy, which is a method that allows assessment of the real-time flow rates from the major salivary glands and enables quantitative measurement of gland function.[9,17] When the glands are removed, patients can experience a series of complications that include local concave deformity and overall salivary gland function can be affected. The preservation of gland function can prevent reductions in unstimulated salivary flow after resection of the submandibular gland.[18]

A histopathologic study of submandibular glands that were removed because of submandibular gland stones revealed that a substantial percentage of the glands were histologically normal.[19] Thus, sialoadenectomy can be an overtreatment of ductal disorders. With the help of an endoscope, stones can be located, and a path to remove the stones that avoids nerve and vascular injuries can be plotted. Moreover, the excision of the salivary glands can be avoided.[20]

Berini-Aytes and Gay-Escoda[19] reported that long-term complications develop in 25.3% of patients after resection of the submandibular gland. Possible early and late postoperative complications include neurologic and aesthetic sequelae and functional impairment.

Three types of stone removal methods are available. One approach involves the removal of the stones directly from the mouth. The second approach involves the removal of stones from the mouth with the aid of sialendoscopy. The third surgical method is sialoadenectomy.

Our study reported a surgical method that can improve the success rate of stone removal and avoid the need for gland excision. This procedure enabled the successful removal of stones from the proximal submandibular and intraglandular areas of the submandibular gland. Furthermore, endoscopy can be used to localize stones in the hilum or gland parenchyma during surgery, which might aid in the removal of impalpable submandibular gland stones.[14] Our study using ECT also found that salivary gland functional recovery after sialendoscopic removal of salivary gland calculi was reasonable and satisfactory.

The risk of lingual nerve damage is because of the anatomic structure of the nerve in relation to Wharton's duct, which lies immediately deep to the lingual nerve as it exits the submandibular gland at the hilum.[21,22]

Sialendoscopy can be performed for 2 purposes: to better locate stones in the hiloparenchyma before

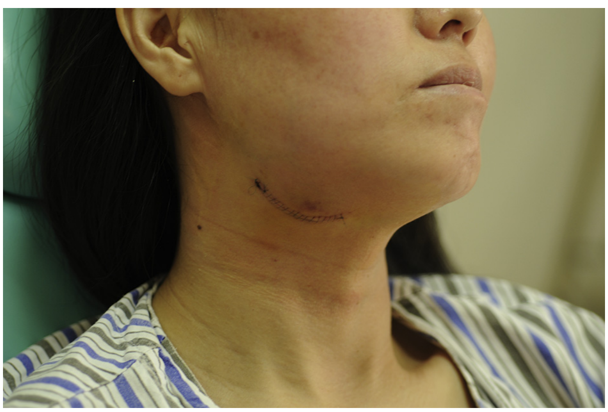

FIGURE 8. The skin was sutured with 6-0 Prolene sutures.

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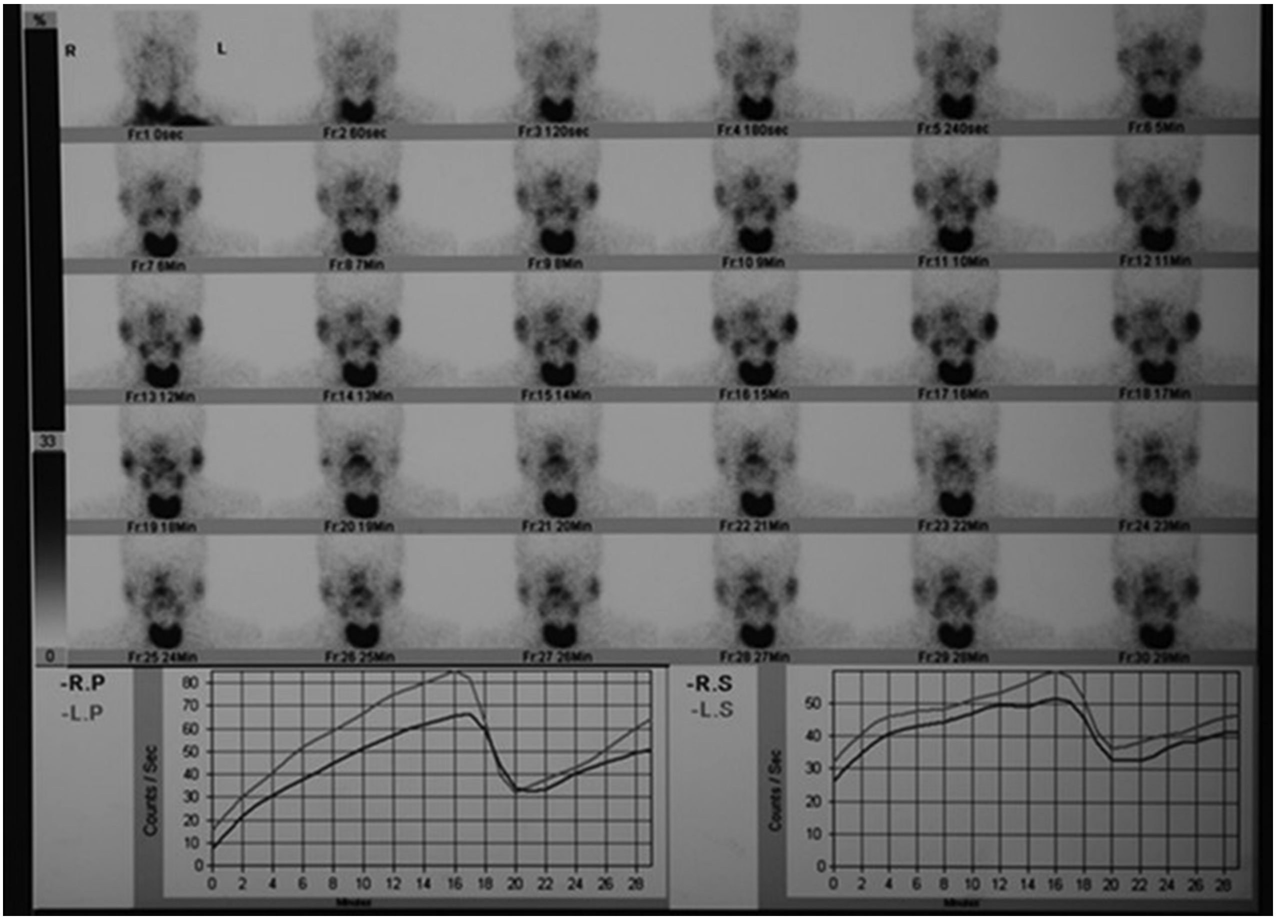

FIGURE 9. Technetium-99 m pertechnetate salivary gland scintigraphy showing normal uptake and excretion function.

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incision and to check for any residual intraparenchymal calculi through the hilar surgical incision. Another use of sialendoscopy is the identification of the catheter, nerves, and blood vessels to avoid the risk of cutting the nerve. With the endoscopic light that is transmitted inside the duct, it is easier to locate the sialoliths, and the light also enables the operator to more reliably distinguish the duct from the lingual nerve.[14,16] Moreover, the enhanced visualization and dexterity enabled by the use of the endoscope allow for safer dissections of the lingual nerve and Wharton's duct at the hilum of the gland.

Adequate preoperative clinical, CT, and ECT evaluations should always be performed to precisely locate the stones and minimize the risk of failure. It is important to highlight that these techniques require surgical expertise, and surgeons are required to perform procedures such as sialendoscopy. Clinicians have the option of converting sialendoscopy into submandibular gland surgery and have the ability to handle the possible sequelae and complications.[23]

The present study had some limitations. First, the number of included patients was limited. Second, the functional recovery of the submandibular glands of each patient after surgery needs to be assessed.[14] Although the functional recovery of the submandibular glands observed in our study are encouraging, the lack of sufficient data for statistical analysis is a limitation of the present study. Long-term clinical studies and the resultant statistical analyses are needed to confirm the curative effect and the risk of stone recurrence after the application of this new surgical method.

In conclusion, sialendoscopy-assisted removal of submandibular hilar gland stones is an effective and safe surgical technique. The initial clinical outcomes were satisfactory, but the long-term results and functional recovery of the glands have not yet been investigated.

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