Transoral and transcutaneous approach for removal of parotid gland calculi: a 10-year endoscopic experience

Xin Ye, SMD, Ya-Qiong Zhang, SMD, Xiao-Yan Xie, SMD, Deng-Gao Liu, SMD, Lei Zhang, SMD, and Guang-Yan Yu, PhD, DDS

Objective. The aim of the study was to evaluate the safety, effectiveness, and long-term gland function of endoscopy-assisted lithectomy for extraction of parotid gland calculi.

Study Design. Overall, 116 consecutive patients with parotid gland calculi underwent endoscopy-assisted lithectomy at our center. The immediate safety and effectiveness were evaluated. After surgery, the patients were followed up, and gland function was analyzed on the basis of clinical manifestations and sialography.

Results. Complete stone extraction was achieved in 110 cases (110 of 116 [94.8%]) by using a transoral (95 cases) or transcutaneous (15 cases) approach. At a median follow-up of 3 years, clinical outcomes were excellent in 86 cases (78.2%), fair in 16 cases (14.5%), and poor in 5 cases (4.5%). Postoperative sialographic appearance in 30 stone-free patients was categorized into 3 types: (1) normal (13 cases); (2) ectasia or stenosis in the main duct but no persistent contrast, as seen on functional films (10 cases); and (3) ectasia or stenosis in the main duct and persistent contrast evident on functional films (7 cases).

Conclusions. In the absence of lithotripsy, appropriate application of various minimally invasive endoscopic procedures has confirmed safety and effectiveness for stone extraction in patients with parotid calculi. Sialography is a viable method for the evaluation of postoperative gland function. (Oral Surg Oral Med Oral Pathol Oral Radiol 2017;124:121-127)

Sialolithiasis occurs primarily in the submandibular gland (80%−90%), with the parotid gland being the next most frequent site of occurrence (10%−20%).[1,2] The typical clinical symptom manifests as a painful swelling of the affected glands after a meal or upon salivary stimulation.

After Katz[3] reported salivary gland endoscopy in the early 1990s, Nahieli and Marchal et al[4-6] used the technique of sialendoscopy in cases of sialadenitis and sialolithiasis. Sialendoscopy can help remove calculi in salivary glands with a fairly high success rate[2,5,7] and eliminate most of the ductal stenosis in salivary glands. In countries where lithotripsy is available, large or fixed parotid stones are primarily treated using extracorporeal lithotripsy, which has a complete success rate of 60% to 70%[8,9]; the remaining 10% to 20% of patients with parotid gland stones can be successfully treated via a buccal or preauricular incision.[5,6,10] In China, extracorporeal lithotripsy has not been approved by the Food and Drug Association (FDA), and thus, endoscopy-assisted surgical procedures have wider application.[11] Our center has used sialendoscopy for >10 years and has treated >150 patients with parotid gland calculi. Various transoral or transcutaneous approaches have been used for removal of stones under endoscopy. The present study aimed to analyze the safety and effectiveness of such minimally invasive procedures and evaluate the long-term outcomes of the treated parotid glands.

MATERIALS AND METHODS

From August 2005 to August 2015, a total of 896 patients presenting with salivary gland calculi were treated with the use of sialendoscopy at the Peking University School and Hospital of Stomatology. Of these patients, 116 (12.9%) had calculi in the Stensen duct; there were 51 male patients and 65 female patients (age range 4−90 years; mean 48 years).

Inclusion criteria

Patients with calculi in the Stensen duct were diagnosed on plain radiography, ultrasonography, sialography, or cone beam or spiral computed tomography (CT); the diagnosis was achieved through one or a combination of these examinations.

Exclusion criteria

Patients with acute infection of the parotid gland or those with severe illness who could not tolerate any operative procedure were excluded from the study.

Statement of Clinical Relevance

Transoral and transcutaneous endoscopic procedures have confirmed safety and effectiveness for stone extraction in patients with parotid calculi, in particular, in the absence of lithotripsy devices.

Department of Oral and Maxillofacial Radiology, Peking University School and Hospital of Stomatology; National Engineering Laboratory for Digital and Material Technology of Stomatology; and Beijing Key Laboratory of Digital Stomatology, Beijing, China.

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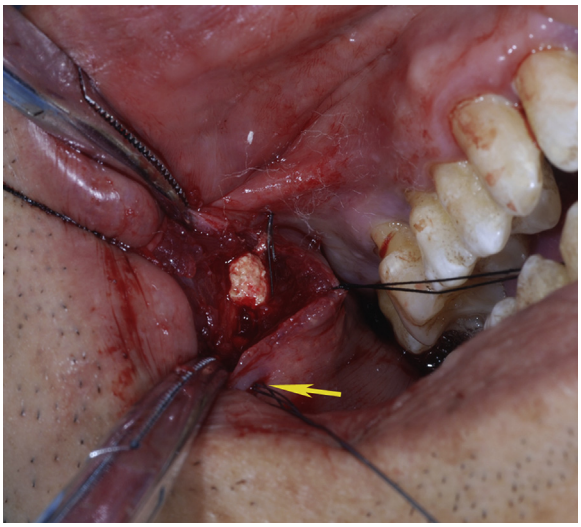

Fig. 1. Stone removal via a paraostial incision (method 3). Note that the basket with an entrapped stone was blocked at the ostium *(arrow)*.

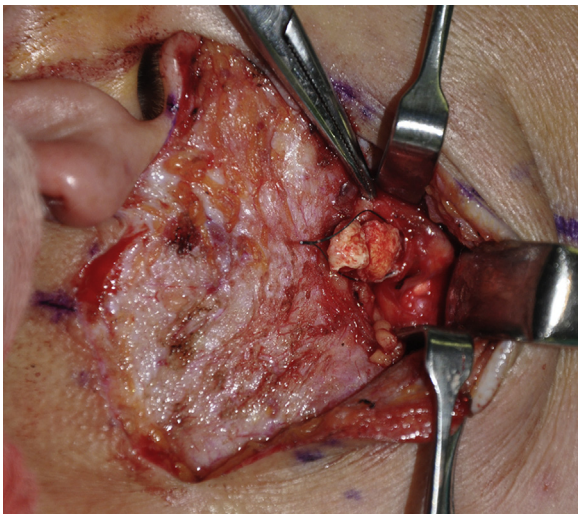

Fig. 2. Stone removal via a preauricular flap (method 5).

Thirteen patients had surgery under general anesthesia, and 103 had surgery under local anesthesia on an outpatient basis. After anesthesia and sterilization were performed, lacrimal probes were used to gradually expand the orifice of the affected Stensen duct. Subsequently, an endoscope (Laduscope T Flex PD-HS-0250 endoscope; Polydiagnost, Pfaffenhofen, Germany) was introduced to explore the main duct of the gland with continuous saline irrigation that helped keep the duct expanded and provided a clear view. The irrigation solution was a mixture of normal saline and dexamethasone (100 mL:10 mg).

One of the following 5 treatment options were used: (1) After basket entrapment or being grasped with forceps, the stones were removed through the natural orifice; (2) after basket entrapment, the stones were removed via a direct incision of the orifice; (3) if the calculus was retrieved but impacted, it was removed via a 2-cm semicircular incision created 1 cm anterosuperior to the natural orifice; after submucosal dissection through the buccinator muscle and the buccal fat pad, the duct was exposed and longitudinally dissected to remove the stones (Figure 1); (4) stones impacted in the middle segment of the main duct were removed via a 2-cm buccal incision; and (5) a preauricular flap was used to expose the duct with the guidance of sialendoscopy to remove the stones impacted at the hilum of the duct or in the intraglandular duct system (Figure 2). Facial nerve branches were meticulously identified and protected in methods 4 and 5. The transoral approach was used in methods 1 to 3, and the transcutaneous approach was used in methods 4 and 5.

After stone removal, the entire duct was re-explored using an endoscope to ensure that there were no residuals. For patients who had transoral or extraoral incisions, a 3/4 Fr angiocatheter (approximately 6–8 cm long) was used as a stent, which extended from the orifice across the opening in the duct, and the duct was repaired using 5-0 Vicryl sutures (Ethicon Inc., Johnson & Johnson, Skillman, NJ). The stent was left in place for 1 to 2 weeks. In addition, a pressure dressing was placed on the buccal incision or the preauricular flap for 1 to 2 weeks. Antibiotics (amoxicillin or cefaclor) and mouth rinse were prescribed for 3 to 7 days. After surgery, patients were advised to avoid spicy foods and sialogogues. After removal of the sutures, stent, and dressing, frequent gland self-massage and use of sialogogues were recommended. Saline irrigation and distal duct dilation were mostly performed 2 to 4 weeks after surgery.

After the initial success of the procedure, patients were periodically followed up to assess the gland status and symptom recurrence. Patients who could not return to the clinic were followed up through telephone calls or mailed questionnaires. Patients who returned to the clinic underwent a clinical evaluation, including detailed symptom enquiry, clinical checkup, and sialography as follows:

1. *Symptoms:* Frequency and duration of swelling or pain; method used to relieve the symptoms
2. *Clinical evaluation:* Size and tenderness of the affected gland and appearance of the ostium; amount and quality of the salivary flow upon massage
3. *Sialography:* Sialography was performed at least 3 months after surgery by using a washing needle (5-gauge) and a water-soluble contrast medium. After introduction of the catheter, 1.5 to 2 mL of contrast was carefully infused. Subsequently, a lateral view and a 5-minute emptying film were

recorded. Appearance of the ductal system and gland function were analyzed. Each film was independently analyzed by 2 experienced oral and maxillofacial radiologists, who reached a consensus through discussion.

A controlled endoscopic inspection was recommended for patients who exhibited evident symptoms after stone removal.

The study design was approved by the institutional review board of our school (PKUSSIRB-201412005), and all participants signed an informed consent.

RESULTS

The size (maximal diameter) of the calculi ranged from 0.3 to 1.9 cm. In 98 cases, the stones were oval or irregular in shape, whereas in the remaining 18 cases, the calculi appeared to be developed from a foreign body. Moreover, 94 patients had a single calculus, 8 patients had 2, and 14 patients had multiple stones. The location of the stone varied in each case as well: the distal segment of the main duct in 53 cases, the middle segment in 37 cases, the hilum in 13 cases, and the intraglandular duct system in 13 cases.

Among these patients, complete stone extraction was achieved in 110 cases, and in 6 cases, the procedure failed, indicating a clinical success rate of 94.8% (110 of 116). Among the 6 cases of failure, 4 had stones in the intraglandular duct, and 2 had stones located at the hilum. Of these 6 cases, 2 cases underwent superficial parotidectomy at another center because of persistent symptoms, and the other 4 cases were asymptomatic during the 1 to 2 years of follow-up.

Table I summarizes the various treatment options used in the 110 successful cases. Among the 12 cases in which a preauricular flap was exposed, 3 cases had stones at the hilum, 7 had stones in the intraglandular duct system, and 2 had stones in the middle segment of the main duct. Among the 3 cases in which a buccal incision was made, all the stones were found to be impacted in the middle segment of the main duct.

The considerable swelling and pain of the affected gland experienced after surgery were relieved in 1 to 2 weeks. One patient experienced slight buccal branch facial palsy that disappeared after 1 month. During the 0.5 to 10 years of follow-up (mean 3.9 years; median 3 years), 86 patients were asymptomatic and had a clear salivary flow; 16 patients experienced occasional swelling or discomfort in the affected gland, which could be relieved by self-massaging; 1 reported a recurrent stone 2 years after surgery and underwent an uneventful second endoscopic procedure; 1 patient experienced numbness in the parotid region; 3 developed duct obturation, and the affected gland became atrophic and asymptomatic; and the remaining 3 patients were lost to follow-up. No fistula formation or persistent facial nerve injury were reported during the follow-up period. Among the 3 patients who developed gland atrophy, ductal obturation was discovered during surgery in 1 case, and ductal obliteration occurred 3 months after excision of the ostium in the other 2 cases. In total, the clinical outcomes were excellent in 86 cases (symptom-free, 78.2%), fair in 16 cases (mild discomfort, 14.5%), and poor in 5 cases (4.5 %).

Table I. Stone size and treatment options in 110 patients

Stone size	*Method 1*	*Method 2*	*Method 3*	*Method 4*	*Method 5*	*Total*
≥5 mm	9	7	9	3	10	38
<5 mm	39	19	12	0	2	72
Total	48	26	21	3	12	110

Methods 1 to 5 have been described in the Materials and Methods section. Stone sizes ranged from 0.3 to 1.9 cm.

Table II. Sialographic appearance in 30 patients

Type	*Symptomatic*	*Stricture*	*Ectasia*	*Total*
1	1	0	0	13
2	3	7	8	10
3	2	4	6	7
Total	6	11	14	30

Among the 110 successful cases, 30 patients who were free of stones (12 males and 18 females) agreed to undergo sialography 3 to 31 months (mean 6.5 months) after surgery. The average patient age was 50 years (range 31−74 years). The size of the calculi ranged from 0.3 to 1.2 cm (average 0.44 cm). Treatment options included extraoral removal in 5 cases and transoral removal in 25 cases. Twenty-four patients were asymptomatic during the follow-up period. On clinical examination, their affected parotid glands were found to be of normal size and tenderness, and salivary flow was clear upon massage. The remaining 6 female patients who underwent transoral stone removal complained of occasional swelling. During examination, salivary flow was scant.

Sialographic appearance was classified into 3 types (Table II): (1) approximately normal (n = 13; Figure 3); (2) dilation or stricture of the main duct, but no persistent contrast seen on the functional film (n = 10; Figure 4); and (3) dilation or stricture of the main duct and persistent contrast evident on the functional film (n = 7; Figure 5). In total, 11 patients developed ductal stricture, and 14 patients were found to have duct ectasia. The correlation between sialographic findings and clinical symptoms is illustrated in Table II. The sialographic appearance in the 5 cases treated via an extraoral approach included type 1 in 3 and type 2 in 2 cases. In the remaining 25

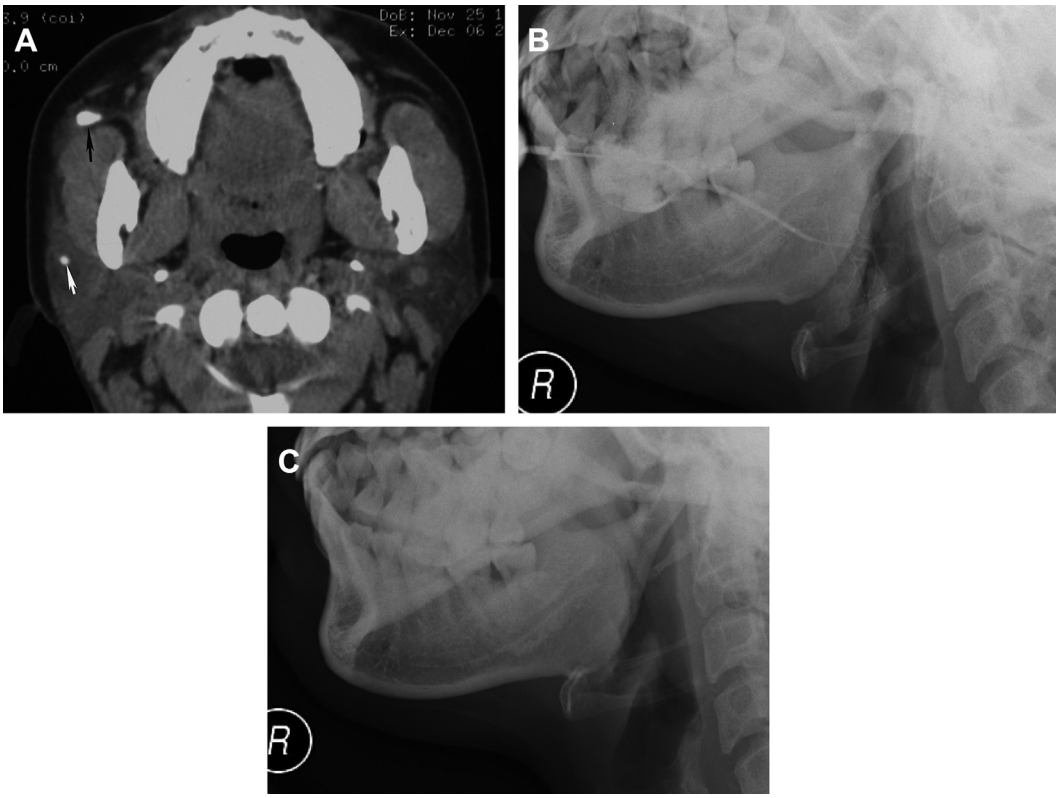

Fig. 3. A 48-year-old woman with a 7-year history of sialoliths in the right parotid gland. The stones were removed using method 3. **A**, Axial computed tomography (CT) showed a small stone in the parenchyma of the gland *(white arrow)* and a large stone in the distal segment of the Stensen duct *(black arrow)*. **B**, This patient remained asymptomatic 9 months after the surgery. Follow-up sialography showed approximately normal shape of the main duct. **C**, Persistent contrast was not detected on the functional radiograph.

cases, the sialographic appearance was type 1 in 10, type 2 in 8, and type 3 in 7 cases.

DISCUSSION

To date, the etiology of salivary gland stones remains unclear. Several authors[12,13] have suggested that sialolith formation is precipitated by the presence of desquamated epithelial cells, foreign bodies, microorganisms, and/or mucous plugs within the ductal canal, which can potentially create a nidus for calcium deposition. Harrison[12] hypothesized that sialoliths may result from disturbances in the chemical composition of secreted saliva (dyschylia) and impairment of its outflow, which could be caused by variation in pH, declined crystallization inhibition, diversification of bacteria, and transformation of protease. Secretory disturbances could be caused by ductal obstruction, anatomic abnormities, and microlith formation.[13]

Diagnostic modalities include conventional radiography, ultrasonography, sialography, and CT.[14,15] Because of its high sensitivity and the absence of radiation injury, ultrasonography has been extensively used as the first choice in the diagnosis of salivary gland calculus as well as in the evaluation of calculus clearance and recovery of physiologic functions.[8,10,13] However, because of its nonspecificity and the possibility of artifacts in ultrasonography, it is used only as an adjunct at our center. In general, sialography is contraindicated in cases of sialolithiasis, but for detection of radiolucent stones or foreign bodies, sialography could serve as an adjunctive diagnostic procedure. In our study, cone beam or spiral CT was the first choice for diagnosis of salivary gland stones.

Traditionally, superficial parotidectomy has been the surgical solution for removal of parotid stones, but it carries the risk of facial nerve palsy, Frey syndrome, and facial hollowing.[16] The introduction of endoscopy has significantly reduced the rate of gland resection.[17] Thus, 80% to 90% of patients with parotid gland stones can be successfully treated through minimally invasive methods, such as sialendoscopy and extracorporeal shock-wave lithotripsy,[6,8,14,18] which conserve the glands. In the present study, 5 methods of endoscopic procedures were used. Despite the absence of lithotripsy, we achieved a rather high success rate (94.8%).

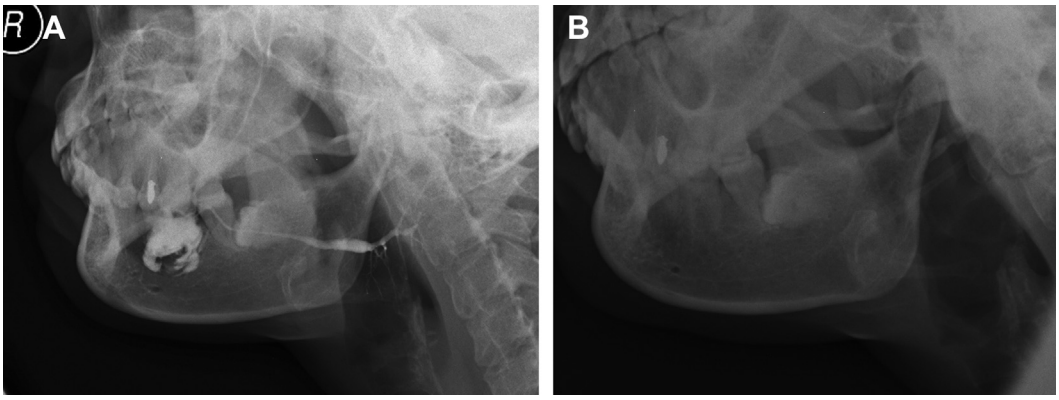

Fig. 4. A 45-year-old woman with a 9-year history of stones in the right parotid gland. The stones were removed using method 5. She had no discomfort after the surgery. **A**, Follow-up sialography at 6 months showed a dilated main duct. **B**, Functional radiograph did not show persistent contrast.

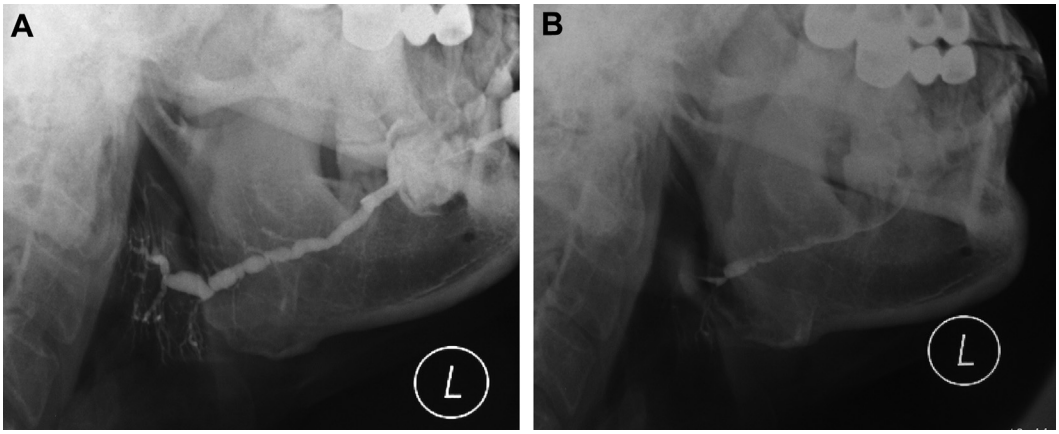

Fig. 5. A 50-year-old man with a 10-year history of sialoliths in the left parotid gland. The stones were removed using method 2. This patient had occasional swelling of the affected gland. **A**, Follow-up sialography at 8 months showed sausage-like appearance of the main duct. **B**, Persistent contrast was evident on the functional radiograph.

Foletti et al.[19,20] and Zheng et al.[11] have described the use of transoral Stensen duct approach (TSDA) in cases of complicated parotid lithiasis after failure of minimally invasive techniques. TDSA avoids a direct papillary approach and avoids duct fibrous scarring with consequent stenosis. In our study, 2 patients who were initially treated via method 2 developed duct obturation and gland atrophy; this can be explained by the fact that direct papillary incision can cause fibrous scarring. Thereafter, TSDA (method 3) was used for anterior-third parotid duct lithiasis or for a stone captured by basket entrapment but stuck 1.5 to 2 cm proximal to the orifice. None of these patients developed ductal obturation.

Several authors have analyzed the advantages and risks of using a combined endoscopic and transcutaneous approach in parotid sialolithiasis.[17,21] In 2002, Nahlieli et al.[5] reported 12 cases of parotid gland stones treated via the combined approach: The stones were completely removed in 9 patients (75%), and 3 of those 9 patients developed gland atrophy after surgery. In another report by Overton et al.,[16] 55 patients with parotid calculi (57 affected parotid glands) were treated via a preauricular flap or a buccal incision: The stones were successfully removed from 56 affected glands (98.2%); 39 patients (40 affected glands) were successfully followed up (3.1 years), of which 28 glands were asymptomatic, 11 had mild or occasional residual symptoms, and the remaining 1 gland had a relapse. The most common side effects were noticeable scars and altered sensation in the cheek or ear. Marchal[6] and Koch et al.[17] also demonstrated that the combined endoscopic and transcutaneous technique was an effective treatment for sialolithiasis. Among these series, a small number of patients underwent ductal ligation or parotidectomy. Among cases with treatment success in our study, 12 stones were successfully removed via a preauricular

flap, and 3 were removed via a buccal incision. All these affected parotid glands were preserved. After surgery, 1 patient experienced numbness in the parotid region, and another developed ductal obturation. No fistula or facial nerve paralysis was noted. The occurrence rate of complications was acceptably low. The selection of buccal incision or preauricular flap was based on the site of stones as well as patients' concerns regarding the possibility of a facial scar. On the basis of our recent clinical records, the indications for buccal incision have been widened. Patients with impacted stones in the middle segment of the duct or at the hilum were preferentially elected to undergo this treatment. With regard to larger surgical injuries, potential risks of healing, and longer hospital stays, we recommend that the preauricular approach be restricted to intraglandular large stones or deeply located stones at the hilum.

Size, shape, and quality of material of the stones dictate treatment options.[8,17,18,22] It is often possible to remove mobile stones measuring <5 mm using sialendoscopy alone; in addition, it is possible to extract very long, thin stones from the duct. Several long stones, probably originating from foreign bodies, were successfully extracted in our study cases. Zenk et al.[22] reported that the mean size of parotid gland stones treated with sialendoscopy alone was 4.2 mm, and in case of larger stones, extracorporeal shock-wave lithotripsy was suggested. In our study, 95 (86.4%) patients were primarily treated with sialendoscopy (methods 1−3), which is comparable with reports by other authors.[8,21,23] Among these, 70 stones measured <5 mm, and the remaining 25 measured >5 mm. Among the 15 cases (13.6%) in which the stones were removed with the use of an extraoral approach, 13 stones measured >5 mm.

Although endoscopy is an important modality to evaluate and treat sialolithiasis, the value of sialography cannot be ignored; it can be used to evaluate the anatomy of a gland and duct after surgery and help assess the secretory functions of affected glands.[18,24] In our study, sialography was used to assess the recovery of the ductal system after stone removal. The sialographic appearance was categorized into 3 types. Type 1 (13 cases) indicated good recovery and function, and 12 patients (of 13) were asymptomatic. Type 2 (10 cases) included cases with abnormal shape of the main duct, but the evacuating function was good. Type 3 (7 cases) included cases with abnormal duct shape and function. Among type 2 and 3 cases, 5 cases (of 17) were symptomatic. Thus, ductal shape and evacuating function on sialography were the 2 significant factors that may adequately represent gland function after surgery. Abnormal ductal shape can develop because of stone formation and surgery. None of the 5 cases treated via a preauricular flap exhibited type 3 sialographic appearance; this can be explained by the fact that the integrity of the orifice and the main duct was preserved during surgery. It must be noted, however, that sialography has its limitations. Scintigraphy and sialometry are quantitative tools for gland function evaluation and require additional research.

CONCLUSIONS

Appropriate application of the various minimally invasive endoscopic procedures has confirmed safety and a high success rate of extraction of parotid calculi, particularly in the absence of lithotripsy. A majority of affected parotid glands can be preserved with satisfactory function. In addition, sialography is a viable method for evaluation of postoperative gland function.

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Reprint requests:

Deng-Gao Liu, SMD
Department of Oral and Maxillofacial Radiology
Peking University School and Hospital of Stomatology
National Engineering Laboratory for Digital and Material Technology of Stomatology
and Beijing Key Laboratory of Digital Stomatology
#22 Zhongguancun South Street
Haidian District
Beijing 100081
P. R. China
Kqldg@bjmu.edu.cn