Transfacial Ultrasound-Guided Gland-Preserving Resection of Parotid Sialoliths

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Abstract

Study Design. Case series with chart review.

Setting. Two academic tertiary care centers.

Methods. Patients who underwent ultrasound-guided, combined transfacial-endoscopic operation for symptomatic parotid sialolithiasis from June 2010 through June 2012 at 2 tertiary care university hospitals were evaluated. Outcome measurements included stone size, stone location, complications, symptom relief, and gland preservation rate.

Results. A total of 14 patients underwent ultrasound-guided, transfacial operation for symptomatic parotid sialolithiasis. Ten of 14 patients (71%) had completely successful therapy defined by no symptoms postoperatively with a preserved, functional gland. Three of the 4 patients without complete symptom resolution did endorse symptom improvement, whereas the fourth patient eventually underwent parotidectomy. Needle localization was used to aid in transfacial stone retrieval in 57% of cases.

Conclusion. Ultrasound-guided, combined transfacial-endoscopic removal of certain parotid stones is an alternative to parotidectomy. Needle localization is a useful adjunct in stone retrieval.

Keywords
sialolithiasis, sialadenitis, sialendoscopy, salivary endoscopy, salivary stones, minimally invasive, calculi, parotid gland, salivary glands

Chronic sialadenitis of the major salivary glands is a common disorder encountered by head and neck surgeons. Calculi represent an estimated 60% to 70% of obstructive etiologies. Although 1.2% of the general population is found to have sialolithiasis at postmortem evaluation, many remain asymptomatic. It is estimated that annually, 30 to 60 people per million require treatment for symptomatic sialadenitis caused by obstructive stones. Patients commonly present with pain and swelling in the affected gland often during meals, accompanied by a foul-tasting discharge into the mouth. Advanced infection may manifest as a neck abscess and fever.

Nonoperative initial treatments include hydration, sialogogues, gland massage, and warm compresses. Forty percent of cases fail to respond to conservative treatment, and these patients traditionally undergo parotidectomy. However, pathologic analyses demonstrate a normal and functioning gland excluding the obstruction in most cases. Parotidectomy for chronic sialadenitis is associated with prolonged (>3 months) facial paresis in up to 25% to 60% of patients, with permanent facial paralysis estimated at twice that observed with treatment of benign tumors.

Minimally invasive, gland-preserving technologies have emerged to treat chronic sialadenitis over the past 2 decades. These technologies were developed in an effort to overcome potential complications of traditional therapy for recalcitrant salivary gland disease not responsive to conservative management. Diagnostic and interventional salivary gland endoscopy (SGE), developed in Europe, uses semi-rigid, miniature scopes and instruments to address areas of obstruction. Extracorporeal shock wave lithotripsy (ESWL) and laser fragmentation have also been used to fragment stones for retrieval. Algorithms combining these therapeutic techniques have eliminated the need for gland resection in the majority of patients, with an overall gland preservation rate of 90%.

An estimated 10% of parotid stones, however, remain resistant to treatment. Stones that are >6 mm in size, adherent to the duct wall, or intraglandular in location are
often impervious to SGE alone. In addition, ESWL is not approved by the Food and Drug Administration in the United States and is contraindicated in some patients with cardiac pacemakers, limiting its utility. Transfacial stone extraction was first described in 1991 by Baurmash et al.\textsuperscript{15} Subsequent combined endoscopic and transfacial approaches have been employed and refined.\textsuperscript{15-18}

In this article, we report several cases using a combined transfacial-endoscopic approach with the addition of intraoperative ultrasound, with or without needle localization. The aim of this study is to review surgical techniques and initial outcomes.

**Materials and Methods**

**Study Design**

The study is a case series with chart review of 14 adult patients evaluated at the Medical University of South Carolina (MUSC) and the Louisiana State University Health Sciences Center who underwent transfacial resection of symptomatic parotid sialoliths using intraoperative ultrasound, with or without needle localization and SGE, from June 1, 2010, to June 1, 2012. Data included in this study were obtained from the electronic medical records of the MUSC (Charleston, South Carolina) and Louisiana State University (LSU) Health Sciences Center (HSC) (New Orleans, Louisiana). Appropriate institutional review board approval was obtained from MUSC and LSU HSC for this study.

**Patient Evaluation**

All patients presenting to MUSC and LSU HSC with symptomatic chronic sialadenitis unresponsive to medical therapy were given the option of endoscopic-assisted management as the first-line surgical therapy during the period of study (June 1, 2010, to June 1, 2012). All patients treated in the operating room consented to endoscopic-assisted transoral salivary surgery with possible conversion to open transfacial surgery if the procedure could not be successfully performed through a transoral route.

**Surgical Technique**

Patients were placed under general anesthesia in all cases and intubated via nasotracheal intubation to maximize access to salivary ostia. Antibiotics and steroids were administered intravenously prior to the procedure. The ostium was visualized and progressively dilated with a series of Marchal salivary duct probes (Karl Storz Endoscopy, Culver City, California), followed by wider dilation with a tapered salivary duct dilator. The first pass was made with the small diagnostic (0.8-mm diameter) Erlangen salivary endoscope (Karl Storz Endoscopy) to identify the location of the stone within the salivary duct, flush out inflammatory debris, and dilate the ductal tract. Larger (1.1-mm and 1.6-mm diameter) scopes with working channels were then introduced to determine if the stone could be retrieved by endoscopy or fractured and removed in smaller pieces. A transfacial approach was used for stones not amenable to endoscopic retrieval.

The combined endoscopic-transfacial approach was performed in a series of well-defined steps. A marking pen was used on the skin to mark the location of the underlying stone visualized with ultrasound or endoscopic transillumination through the skin (Figure 1A, B). Facial nerve monitoring was performed by placing the oral lead in the distribution of the buccal branch above the oral commissure (Figure 2A). The face was then prepped, towel, and draped using a transparent iodine drape with a hole cut to allow intraoral access with the endoscope (Figure 2B). The skin was incised using a modified Blair incision and flaps raised over the parotid gland fascia, taking care to preserve the sensory branches of the greater auricular nerve. A sterile ultrasound probe was used to visualize the stone, and in some cases, a 23-gauge needle was inserted to the stone under ultrasound guidance (Figure 3A, B). The parotid fascia was sharply incised immediately overlying the stone. This was followed by blunt dissection with a fine hemostat to the level of the stone and along the needle tract if present. In the event that a facial nerve branch was visualized, it was traced out and preserved. An 11-blade was used to open the duct, and stones were extracted with the use of Rosen needles and cerumen curettes (Figure 4A).
stones were removed and measured. At this point, the endoscope and ultrasound were used to investigate for retained fragments in the gland (Figure 4B). The duct was repaired using a 5-0 PDS suture and the parotid fascia reapproximated with 4.0 Vicryl. Stents were place with endoscopic assistance in cases where the main Stensen duct was compromised with an associated stenosis or stricture. The initial cases were closed with a Penrose drain in place, whereas later cases were closed with a pressure jaw bra dressing without a drain. A compressive dressing was applied to the wound for the 72 hours.

Follow-up
Follow-up notes in the electronic medical record were reviewed to determine the success of the intervention. We defined treatment success as asymptomatic patients with no stone and a preserved, functional gland.

Data and Statistical Methods
Data were abstracted from the MUSC and LSU HSC electronic medical records by reviewing attending office notes, operative reports, radiographic reports, and scanned documents from referring physicians. The data were recorded in a de-identified database, which included the following variables: demographics (age and sex), involved gland, location of stone, endoscopic findings, stone palpability, facial nerve visualization, ultrasound usage, use of needle localization, size and number of stones, stent placement, complications, symptom relief, and follow-up time. Statistical analyses were performed with Sigma Stat 3.5, SPSS 15.0, and Sample Power 2.0 (SPSS, Inc, an IBM Company, Chicago, Illinois). Comparisons of stone location were performed with the Fisher exact test, and the t test was used to compare stone size between groups. A P value of less than .05 was considered indicative of statistical significance.

Results
Forty-three consecutive patients with parotid salivary stones presented for treatment during the 2 years of the study. All patients first underwent salivary endoscopy to determine whether the parotid stone(s) could be removed with

Figure 2. The facial nerve monitor is placed to monitor the buccal branch of the nerve (A), followed by placement of an iodin-form drape and marking the site of the stone on the skin surface with transillumination from the endoscope (B).

Figure 3. A steriley covered ultrasound probe (A) allows needle localization of the stone (B).
endoscopy alone. Of the 43 patients, 29 (67%) were treated with endoscopy alone, whereas 14 (33%) required a combined transfacial-endoscopic approach. The mean (SD) stone size was significantly smaller (4.3 [2.3] mm) for the group treated with endoscopy alone compared with the group requiring a transfacial approach (8.7 [2.2] mm) ($P = .0001$). The endoscopy-only group had more stones located in the main duct and hilum (84%) with fewer intraglandular stones (16%) compared with the transfacial group, which had a higher rate of intraglandular stones (57%) ($P = .01$).

The 14 patients who could not be treated by endoscopy alone underwent ultrasound-guided, combined transfacial-endoscopic retrieval of parotid stones. The mean age at presentation was 52 years (range, 31-66 years). The majority of patients were male (64%; 9/14). Eight patients had left-sided sialadenitis, 5 patients had right-sided sialadenitis, and 1 patient had bilateral disease. The stones were palpable preoperatively in 21% of patients (3/14). Stones were visualized with endoscopy in half of the cases (50%), and 4 patients (29%) had multiple stones present.

Intraoperative ultrasound was used in all cases, and needle localization was used in more than half of the cases (57%; 8/14). The facial nerve was visualized in a minority of cases (36%; 5/14). Six stones were located in the main duct, with half of those fixed at the hilum. More than half of the stones were located intraglandularly, often beyond the reach of the endoscope (8/14; 57%). In 1 patient, there was calcified scar debris without a clear stone that likely represented an old abscess pocket. It was identified on pathology as calcified scar and inflammatory tissue. The mean size of removed stones was 8.7 mm (range, 2-12 mm).

Reasons for the combined transfacial-endoscopic approach included the following: (1) intraglandular stones in ducts too small to be visualized with the endoscope (40%; 8/20 stones), (2) significant stenosis/scar limiting approach to the stone (30%; 6/20 stones), and (3) stones too large, hard, or adherent to the duct wall to fragment (30%; 6/20 stones).

Complications, observed in 4 patients (29%) following the combined transfacial-endoscopic approach, included mild periauricular anesthesia in 2 patients (14%) and salivary fistula (7%) in 1 patient each. Due to preservation of greater auricular nerve branches, it is anticipated that periauricular anesthesia will gradually improve with time. The salivary fistula completely resolved within 10 days with a course of glycopyrrolate and 2 needle aspirations. The salivary fistula resolved within 3 weeks with use of a pressure dressing. There was no observed facial weakness following the procedure.

The treatment was successful for 71% (10/14) of transfacial patients compared with 97% (28/29) of the endoscopy-alone group at a median follow-up of 12 months (range, 3-26 months) ($P = .03$). Patients were considered a success if they were symptom and stone free with a preserved gland. Three patients (21%) in the transfacial group had ongoing mild obstructive symptoms despite being stone free at a median follow-up of 10 months (range, 9-19 months) but noted improvement over their preoperative baseline. One of the 3 patients with mild obstruction had the main duct tied off during surgery due to the severe scarring that prevented the identification of a functional lumen. This was performed with the hope of allowing rapid atrophy of the gland now that the infectious nidus of the stone had been removed. There was no difference between symptom-free and symptomatic patients with regard to stone size (7.5 vs 7.7 mm) or rate of multiple stones (20% vs 33%). One patient (7%) with a retained stone was considered a treatment failure due to persistent pain and swelling that eventually required parotidectomy after 4 months of follow-up. This patient had a large stone at the hilum that was removed, but a second stone deep within the gland could not be removed through

Figure 4. The stone is exposed and removed (A) followed by exploration of the open duct for additional fragments with the endoscope (B).
a small incisional approach due to proximity to the main trunk of the facial nerve.

**Discussion**

Although 80% to 90% of patients with symptomatic parotid stones can be treated without an incision, a subset of patients will require combined or hybrid techniques to facilitate stone extraction. Large, adherent, intraparenchymal stones are often refractory to SGE alone. Combining a transfacial approach with SGE has proven beneficial in treating these difficult stones. The present study demonstrates that intraoperative ultrasound, with or without needle localization, is a safe and effective adjunct to transfacial surgical management of parotid sialoliths.

The transfacial gland-sparing approach to parotid stones described by Baumash and Dechiara in 1991 relied on preoperative planning using radiographs and ultrasound, without intraoperative imaging. This approach involved an incision directly over the stone. With the advent of SGE, Nahlieli et al. reported a series of 12 patients using a similar external approach aided by transillumination from the salivary endoscope in 2002. Ultrasound was used intraoperatively if location of the stone was not achieved by SGE. Complete stone removal was possible in 75%, gland function was preserved in 58%, and 1 patient underwent parotidectomy. McGurk et al. subsequently described a series in which a preauricular incision and parotid flap were used in the combined transfacial and endoscopic approach. All 7 patients with stones had complete removal. The duct was repaired in 6 patients, whereas 2 patients required ligation of the Stensen duct. Gland function was preserved in 75% of patients, and 100% were asymptomatic. In 2007, Marchal reported an experience using a combined transfacial and endoscopic approach in which a standard parotidectomy flap was used with the sialendoscope fixed to the oral commissure. This approach allowed improved identification of the buccal branch of the facial nerve. Thirty-seven patients who had large stones (>6 mm) and refractory duct stenosis were treated, with 92% of patients reporting symptomatic improvement. In 2009, Walvekar et al. demonstrated a retrieval success rate of 90% (18/20); however, the analysis contains submandibular gland stones as well. Most recently in 2010, Koch et al. described an 88.9% success rate in 9 patients, with 1 parotidectomy carried out because of a macerated duct that could not be repaired.

The present study is comparable in success rate to the aforementioned studies investigating the combined approach. The majority of patients (93%) were rendered stone free with symptomatic improvement, with 71% completely asymptomatic and considered fully successful. Unique to our series is the method of combining intraoperative ultrasound with needle localization when applicable, which afforded easier and quicker access to certain stones.

A combined transfacial and endoscopic procedure is indicated for large stones (>6 mm), stones adherent to the duct wall, intraparenchymal stones (without access to ESWL), failed attempts at stone removal with other procedures, and patient-specific contraindications to other procedures such as a stenotic ostium that does not allow scope insertion. Goals for therapy in these cases are minimal invasiveness, lack of observed adverse events, and cost minimization, with a high rate of success. The present study provides further evidence for the effectiveness of this procedure as evidenced by no patients having facial nerve injuries and only 1 patient (with multiple stones) eventually requiring parotidectomy. Needle localization in certain instances may provide quicker access to stones and reduce costly operative times.

The principal limitations of this study are the retrospective design, small cohort size, short follow-up time, and lack of a validated salivary quality-of-life instrument. To further validate the success and safety of endoscopic and combined endoscopic-transfacial procedures, continued patient follow-up is needed to assess for symptom control, gland function, and long-term complications such as stone recurrence and duct stenosis. Also, further analysis of needle localization is necessary to see if it can reduce operative time.

**Conclusion**

Ultrasound-guided, endoscopic-transfacial combined resection of certain parotid stones is an alternative to parotidectomy without serious observed adverse events for patients in whom endoscopy or shock wave therapy for stone retrieval is ineffective, unavailable, or contraindicated. Needle localization is a safe and useful adjunct in stone retrieval. Additional long-term follow-up and prospective trials with larger cohorts are needed to better determine the role of this surgical technique in the management of chronic sialadenitis.

**Author Contributions**

William W. Carroll, substantial contributions to conception and design, acquisition of data, drafting the article; Rohan R. Walvekar, substantial contributions to conception and design, acquisition of data, critically revising the article; M. Boyd Gillespie, substantial contributions to conception and design, acquisition of data, critically revising the article, final approval of the article.

**Disclosures**

**Competing interests:** Dr. Gillespie has received honoraria from Karl Storz for a course on salivary endoscopy.

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