Learning Progression in the Use of Sialendoscopy for Sialolithiasis: Effect on Gland Preservation
Mara C. Modest, Lauren Galinat, Mindy R. Rabinowitz, Joseph M. Curry, David Rosen and David M. Cognetti
Otolaryngology -- Head and Neck Surgery 2014 151: 240 originally published online 8 May 2014
DOI: 10.1177/0194599814533658

The online version of this article can be found at:
http://oto.sagepub.com/content/151/2/240
Learning Progression in the Use of Sialendoscopy for Sialolithiasis: Effect on Gland Preservation

Mara C. Modest, MD¹, Lauren Galinat², Mindy R. Rabinowitz, MD¹, Joseph M. Curry, MD¹, David Rosen, MD¹, and David M. Cognetti, MD¹

No sponsorships or competing interests have been disclosed for this article.

Abstract
Objective. Evaluate how learning progression affects outcomes for the use of sialendoscopy for sialolithiasis.

Study Design. Case series with chart review.

Setting. Academic tertiary care center.

Subjects and Methods. A retrospective chart review was conducted on 81 patients presenting with sialolithiasis between 2008 and 2012 who underwent surgical intervention on 85 salivary glands. Outcomes compared between the first 43 and subsequent 42 consecutive glands included successful removal, surgical method, and need for further intervention.

Results. For the first 43 patients (group A), mean age was 47.3 years (range, 15-77), and 44.2% were male. For the second 38 patients (group B), mean age was 49.9 (range, 23-76), and 50% were male. Mean stone size was similar in both groups; 8.3 versus 7.6 mm, respectively. In cases of stone visualization and removal, complete removal without gland excision was accomplished in 78.4% of cases in group A versus 94.3% in group B (P = .04). Endoscopic removal occurred in 24.3% of patients in group A versus 45.8% in group B. A combined approach was used in 54.1% of patients in group A versus 48.6% in group B. In group A, 18.9% underwent gland removal as part of initial intervention versus 0% in group B (P = .007). Overall gland preservation was 81.4% in group A versus 97.6% in group B (P = .015).

Conclusion. This study documents the effect of learning curve on sialendoscopy for the management of sialolithiasis. With experience, the success of sialendoscopy increases with a significant decrease in the number of gland excisions.

Keywords
sialendoscopy, sialolithiasis, salivary, sialadenitis

Received August 23, 2013; revised March 13, 2014; accepted April 9, 2014.

Introduction
Over the past 10 years, sialendoscopy has changed both the diagnosis and therapeutic management of sialolithiasis. Before the advent of sialendoscopy, any salivary gland stones that could not be treated conservatively or with sialodochoplasty ultimately ended in surgical excision of the affected gland.¹ Benefits of sialendoscopy include absence of an external scar, visualization of the ductal system and its pathology, outpatient surgery, faster recovery times, and gland preservation.² In centers where this procedure is done routinely, successful removal of stones approaches 75%.¹ The size, location, and mobility of the stone can determine how easily stone extraction can be accomplished with sialendoscopy alone.³,⁴ There is very little data in the literature addressing how experience affects sialendoscopy outcomes in patients with sialolithiasis. Here we report the difference in outcomes for a single surgeon at our institution between the first 43 consecutive glands and the second 42 consecutive glands where sialendoscopy was used in the treatment algorithm of sialolithiasis.

Materials and Methods
A retrospective chart review was performed at the Thomas Jefferson University Hospital of all patients who presented with sialolithiasis and subsequently underwent surgical intervention between December 2008 and December 2012. All patients had imaging completed prior to the procedure; the majority were computerized tomography (CT) scans. Institutional review board approval by the Thomas Jefferson University Division of Human Subjects Protection was
obtained to create a database including both demographic and clinical data. To analyze the effect of a learning curve, only procedures performed by the senior author at the study center (DMC) were included. Prior to the first case, the senior author completed a brief laboratory course on sialendoscopy. The number of surgical procedures performed were divided into 2 groups: group A included the patients with the first 43 consecutive glands (each gland was counted separately), while group B included patients with the next 42 consecutive glands. Information collected for each group included age, sex, any prior surgical intervention, surgical indications, relevant imaging findings, type of procedure (endoscopic versus combined approach vs gland removal), complications, and any need for further intervention. Stone size and number were also documented. The Erlangen 1.1 mm sialendoscope (Karl Storz, Tuttingen, Germany) was used for all procedures. In patients where endoscopic removal of a stone was anticipated to be difficult either due to size or location, a preoperative consent was selectively obtained for a combined approach (CA) or gland excision. Endoscopic approach was defined as procedures in which the stone was retrieved through the distal end of the duct with or without a papillotomy. The combined approach included endoscopic localization with an open excision (transoral in submandibular cases versus external for parotid cases—Figure 1). In combined procedures, the stones were retrieved via a sialolithotomy into the side of the duct.

Outcomes compared between the 2 groups included successful removal, surgical method used, if gland sparing removal was achieved, and any need for further intervention. Success of the endoscopic procedure was determined as the percentage of visualized stones that were successfully removed without requiring gland excision. Criteria for complications were adapted from Bowen et al to include any acute infection postoperatively, any problems directly related to the procedure, and any ductal tears that occurred during the procedure. Further interventions were also documented and included any treatment provided subsequent to the initial peri-operative period. Operative times were obtained from the anesthesia record. Since only total operative time was recorded, cases with multiple procedures could not be individually analyzed. All patients presented for a routine follow-up evaluation within 2 weeks of the procedure. Patients were scheduled for a second postoperative visit at 2 to 3 months following the procedure. Since many people traveled significant distance for treatment, patients were told they may cancel the second follow-up appointment if they remained asymptomatic and were counseled to return to the office on an as needed basis.

Statistical analysis was performed using JMP software (SAS Institute Inc, Cary, North Carolina) using a 2-sample t test for continuous variables and Fisher’s exact test of Pearson chi-square test for nominal values.

Results

A total of 81 patients underwent intervention on 85 glands for sialolithiasis under general anesthesia as an outpatient procedure. The median follow-up time was 8 weeks (range, 0.7-177 weeks). Of the 85 procedures, 64 were performed on submandibular glands (75.3%), while 21 were performed on parotid glands (24.7%). The demographic data for groups A and B can be seen in Table 1.

### Outcomes

**Group A.** In the first 43 consecutive glands treated for sialolithiasis, the mean stone size was 8.3 mm (range, 3-37). Sialendoscopy was performed for submandibular stones in

---

**Figure 1.** Combine approach for the submandibular gland (a) demonstrating transoral access with preservation of the lingual nerve and for the parotid gland (b) demonstrating pre-tragal access with transillumination guidance with the endoscope.
34 cases, while 9 cases were for parotid stones. Stone characteristics, which include stone size, location, and method of extraction, are found in Table 2. Stones were not visualized despite successful endoscopy in 13.9% (6 of 43) of the procedures. Successful stone removal was achieved without gland excision in 78.4% (29 of 37) of cases where stones were visualized or removed (2 patients elected gland excision without sialendoscopy). It was possible to remove the stone endoscopically in 24.3% (9 of 37) of cases (Figure 2) versus 54.1% (20 of 37) that required a combined approach. Gland excision was performed in 18.9% of cases (7 of 37). There was 1 case where a stone was visualized and was unable to be removed in a single-stage procedure (2.7%, 1 of 37). There was 1 case where a patient underwent parotidectomy for recurrent stone formation 3 years after an initial combined approach. As such, the overall gland preservation rate for group A was 81.4% (35 of 43 glands).

**Group B.** There were 38 patients in the second group, with 4 patients having endoscopy performed on multiple glands for a total of 42 glands. The mean stone size was 7.58 mm (range, 1-25 mm). Sialendoscopy was performed for a submandibular stone in 30 cases, while 12 cases were for parotid stones. Stone characteristics, which include stone size and method of extraction, are found in Table 2. A stone was not visualized in 16.7% (7 of 42) of cases despite successful sialendoscopy. Stone removal was achieved without gland excision in 94.3% (33 of 35) of the remaining cases. It was possible to retrieve the stone endoscopically in 45.8% (16 of 35) of cases, versus 48.6% (17 of 35) that required a combined approach. None of the patients underwent gland excision with initial intervention. There were 2 cases from the intervention group where a stone was unable to be removed in a single-stage procedure (5.7%, 2 of 35). One of these patients ultimately elected for parotidectomy 1 year after initial sialendoscopy with laser lithotripsy did not completely remove his stone. As such, the overall gland preservation rate for group B was 97.6% (41/42 glands).

**Complications and Interventions**

**Group A.** Thirty-eight procedures (88.4%) were performed without any complication in the first 43 procedures performed at our institution. Five complications were reported; all of them minor and can be seen in Table 3.

All 43 patients in group A presented for follow-up. Six of these patients required further intervention (14.0%). Four were surgical, while 2 were medical and can be viewed in Table 3. Three of the patients who underwent further...
surgical intervention had stones in the parotid, while 1 had a stone involving the submandibular gland. In 2 of the parotid patients, the stones were not visualized at the initial endoscopy despite successful cannulation and visualization of the ductal system. In both of these patients, the stones were visualized and retrieved endoscopically during a second sialendoscopy. The third parotid patient who required further surgical intervention underwent successful combined approach at the initial procedure. He presented with recurrence of symptoms and stone after 3 years of being asymptomatic. Sialendoscopy at that time could not visualize the stone and the patient elected to proceed with parotidectomy, which was accomplished without complication. The fourth patient who required further surgical intervention had a stone visualized in the submandibular duct during initial endoscopy. This patient had a small submandibular stone that was initially visualized in the duct but retreated into an intraglandular ductule during the procedure. It could not be flushed free or further visualized during the procedure. The patient returned for a second sialendoscopy that did not visualize the stone and it was subsequently determined that the stone self-extruded. The patient was ultimately asymptomatic.

Both medical interventions were for recurrent sialadenitis more than 1 month after the procedure; neither patient had any further symptoms following a course of antibiotics.

Group B. Thirty-nine procedures (92.9%) were performed without any complication in the second 42 procedures performed at our institution. Three minor complications were reported and can be seen in Table 3. Of the patients who required further surgical intervention, 1 patient had a stone in the submandibular gland and 2 patients had stones in the parotid gland. The patient with the submandibular stone had a previous sialodochoplasty, and the scarring from the sialodochoplasty prevented successful cannulation of the duct. A second procedure with wire guided dilation and cannulation of the duct allowed endoscopic retrieval of the stone. In 1 of the patients with a stone in the parotid gland, the stone was not visualized on initial endoscopy. The stone was successfully removed with an ultrasound guided combined approach during the second setting. The second patient with a parotid stone had a very large stone. During the first procedure this was visualized and partially removed with laser lithotripsy. Unfortunately, during the procedure the instruments stopped passing through the scope (likely due to thermal damage to the scope) preventing complete removal. When the patient returned for a second attempt at lithotripsy, the duct was found to be scarred in front of the stone and the stone could not be visualized. The patient elected to undergo parotidectomy, which was subsequently accomplished without complication.

Operative Times
Operative times were compared between group A and group B. Analysis was limited to submandibular cases due to the small number of parotid cases. Specific procedure types were compared directly, and since only total operative time was available, only cases limited to 1 intervention were included. The results are illustrated in Table 4.

Discussion
Sialendoscopy has been established as a safe and effective technique for the diagnosis and treatment of sialolithiasis. Successful sialendoscopy, like other endoscopic procedures, hinges upon a surgeon’s level of training and experience to acquire a specific skill set. The learning curve for modular sialendoscopes has been established in the literature, with 30 cases required to reach satisfactory operations and a
were instructed to return if any issues arose.

the second follow-up appointment if asymptomatic. Patients

distances, the option was given to patients to call and cancel

to postoperative protocols. Since many patients travel far

parotid stones was slightly smaller than in group B (4.3 mm

is also comparable (Table 2). The mean stone size for sub-

submandibular gland 81.4 ± 53.9 (n = 9) 53.4 ± 33.54 (n = 9) .11

Combined submandibular gland 75.9 ± 26.3 (n = 15) 64.9 ± 32.9 (n = 13) .17

*P-values are from 2-sample t test for continuous variables and Fischer’s exact test of Pearson chi-square test for nominal values.

leveling off of improvement at 50 cases.1 The all-in-one endo-
scopes used at our institution are slightly different from the
modular endoscope used for the study by Luers et al,1 but simi-
lar enough to allow 43 cases to serve as the analysis point for a
learning curve. When comparing our outcomes between the first
43 cases and the second 42 cases, a learning curve was indeed
demonstrated. There was a decrease in complications, further
interventions, and operative time and a significant decrease in
gland excisions between the first and second group.

Demographically, the patients in groups A and B were
similar as can be seen in Table 1, with no statistically sig-
nificant difference between the 2 groups. The number of
submandibular and parotid stones visualized in each group
is also comparable (Table 2). The mean stone size for sub-
mandibular stones in group A was slightly larger than in

P

5.9 (n = 9) 53.4

submandibular and parotid stones visualized in each group
is also comparable (Table 2). The mean stone size for sub-
mandibular stones in group A was slightly larger than in

P

3.7 mm vs 7.7 mm), while the mean stone size for

parotid stones was slightly smaller than in group B (4.3 mm

vs 7.0 mm). Neither met statistical significance. Patients
with a follow-up time as short as a week were included due
to postoperative protocols. Since many patients travel far
distances, the option was given to patients to call and cancel
the second follow-up appointment if asymptomatic. Patients
were instructed to return if any issues arose.

Luers et al6 describe that in stones greater than 5 to 6
mm endoscopic removal alone is usually not sufficient.
They reported positive prognostic factor for stone removal
to include small size, good mobility, being round or oval,
and a distal location. In our series, when looking at all the
cases combined we found that there was a significant differ-
ence in the use of endoscopy and the combined approach
for larger (greater than or equal to 5 mm) and smaller
stones. Endoscopy was used more than the combined
approach in small stones (66.7% endoscopic, P = .004),
while it was the opposite with larger stones (64% CA, P =
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
for patients in group B. Additionally, as success and experience of sialendoscopy grew, so did the number of referrals to our institution specifically for gland preserving procedures. This is reflected in the fact that the patients in group A represented patients from a 3-year timeframe after the initiation of sialendoscopy at our institution, whereas it required only 13 months to accrue the patients from group B.

Measuring a learning curve in a clinical context has been attempted in a myriad of ways including looking at operating time. In our study, operative times did trend shorter in the latter cohort but did not reach statistical significance. Limitations contributing to this include the small number of patients who could be directly compared by procedure type and active resident training at our institution.

Sialendoscopy’s safety has been demonstrated repeatedly in the literature from studies with only a small number of patients to studies with over a thousand patients. In a study of 33 patients and 36 procedures, which falls within the beginning of the learning curve described by Luers et al, there was 1 major complication (3%) and 7 minor complications (19%). In group A of our study, we had no major complications and a minor complication rate of 11.6%, which is consistent with Bowen et al. In group B, there were again no major complications and a minor complication rate of 7.1%.

The number of postoperative interventions required in group B was also less than group A (9.5% vs 14.0%). Of note, across both groups, the gland involved did significantly influence the need for further surgical intervention (P = .003). Cases involving the parotid required further surgical intervention in 23.8% of cases (5 of 21) while submandibular cases required further surgical intervention only 3.1% of the time (2 of 64).

**Conclusion**

This study documents a learning curve for sialendoscopy for the management of sialolithiasis. With experience, the success of sialendoscopy increases and there is a significant decrease in the number of gland excisions.

**Author Contributions**

Mara C. Modest, study design, data acquisition, interpretation, drafting final article; Lauren Galinat, study design, data acquisition; Mindy R. Rabinowitz, study design, revising article; Joseph M. Curry, study design, revising article; David Rosen, study design, revising article; David M. Cognetti, study design, revising article, interpretation, final approval.

**Disclosures**

**Competing interests:** None.

**Sponsorships:** None.

**Funding source:** None.

**References**


