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# Specificity of Parotid Sialendoscopy

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***Objective:*** **To present our initial experience with sialendoscopy of the parotid duct.** ***Study Design: Methods:*** **Diagnostic and interventional sialendoscopy procedures were performed in 79 and 55 cases, respectively. Diagnostic sialendoscopy was used to classify ductal lesions into sialolithiasis, stenosis, sialodochitis, and polyps. Interventional sialendoscopy was used to treat these disorders. The type of endoscope used, the type of sialolithiasis fragmentation and/or extraction device used, the total number of procedures, the type of anesthesia, and the number and size of the sialoliths removed were the dependent variables. The outcome variable was the endoscopic clearing of the ductal tree and resolution of symptoms.** ***Results:*** **Diagnostic sialendoscopy was possible in all cases, with an average duration of 26 ± 14 minutes and no complications. Interventional sialendoscopy was successful in 85% of cases, with an average duration of 73 ± 43 minutes (± standard deviation). Multiple procedures were performed in 45% of cases, general anesthesia was used in 24%, and parotidectomy in 2%. Multiple sialoliths were found in 58% of ducts and associated with more procedures under general anesthesia and longer operations. The average size of sialoliths was 3.2 ± 1.3 mm; larger stones were associated with more procedures under general anesthesia, longer and multiple procedures, use of fragmentation, and sialendoscopy failures. Sialolithiasis fragmentation was required in 10% of cases, with a success rate of 70%. Semirigid sialendoscopes performed better than flexible ones. Complications were mostly minor but were encountered in 12% of cases.** ***Conclusions:*** **Diagnostic sialendoscopy is a new technique for evaluating salivary duct disease, a technique which is associated with low morbidity. Interventional sialendoscopy allows the extraction of sialoliths in most patients, preventing open gland excision.** ***Key Words:*** **Salivary gland, parotid, sialolithiasis, stones, endoscopy, instruments, surgical technique, laser, treatment, outcome.**

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## INTRODUCTION

An obstructive disease is the usual diagnosis in case of unilateral diffuse parotid swelling (after exclusion of mumps parotitis). The classic attitude is an antibiotic and anti-inflammatory treatment, followed by radiological studies, usually sialography,[1] which is still considered the gold standard. Diagnostic sialendoscopy is a recent procedure[2,3] allowing complete visualization of the ductal system and its diseases and disorders. Major advances in optical technologies and the development of semirigid sialendoscopes are responsible for significant progress in salivary gland endoscopy.[4,5] This procedure, by allowing the complete exploration of the salivary ductal system, is positioned to replace sialography and other radiological studies[6] because of its higher specificity and cost-effectiveness.

Because sialolithiasis is the main cause of obstructive disease of the parotid gland, treatment of repeating episodes includes either a parotidectomy or, rarely, marsupialization (sialodochotomy and/or sialodochoplasty) of the initial part of Stensen's duct, allowing the direct removal of the stone. However, parotidectomy is rarely performed for inflammatory conditions because it remains a tedious procedure and carries a higher incidence of postoperative paresis.[7,8] While diagnostic sialendoscopy is an evaluation procedure, interventional sialendoscopy must be considered as a valid operation to relieve the obstructive ductal process, alleviating the need for open surgeries.

Several techniques have been developed since 1990 to fragment sialoliths. Extracorporal lithotripsy, popularized for sialolithiasis by Iro et al.,[9] as well as ductal procedures such as laser,[10,32,33,35–37] electrohydraulic,[11–13] and pneumoblastic[14] lithotripsy, has been reported, but leave stone fragments in the ductal system. The clearance of these fragments is incomplete and could become the nidus of recurrent sialolithiasis.[15]

The literature on Stensen's duct sialendoscopy is limited (Table I) because most series report on parotid as well as submandibular sialolithiasis. Probably, the smaller diameter of Stensen's duct[16] has made its exploration more challenging and therefore most previous authors[17–19] have performed an endoscopy, followed by the blind retrieval of the stone with a Dormia basket, corresponding, possibly, to a "endoscopically-assisted stone retrieval," but certainly not to the interventional sialendoscopy described in the present report.

The aim of this study is to report our 5-year experience with four successive generations of endoscopes in 77

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patients who had surgery performed by the first author (F.M.) in two university centers (Geneva University Hospital, Switzerland, and Edouard-Herriot Hospital, Claude Bernard University, Lyon, France).

## PATIENTS AND METHODS

### *Patients*

The study population consists of 77 consecutive patients suspected of having a disease or disorder of Stensen's duct who were seen between November 1995 and March 2000. Two patients having bilateral symptoms, a total of 79 diagnostic sialendoscopic procedures were attempted. These were followed by a therapeutic sialendoscopy in 55 cases.

Because of concomitant study protocols,[6,20] most of the patients had a preoperative radiological evaluation including sialography, ultrasound, magnetic resonance imaging (MRI) sialography, or, rarely, computed tomography (CT) scan.

The observed diseases and disorders of Stensen's duct were classified as sialolithiasis, stenosis, sialodochitis, and ductal polyps. The number of instances of each pathological finding in each ductal system was noted. When there were multiple stones, the largest stone was measured with calipers.

The number of diagnostic and interventional procedures was recorded, as well as the type of anesthesia (local vs. general), the fragmentation and extraction device used (discussed later in this section), the total number of sialendoscopic procedures performed per patient, and the number of parotidectomies performed. "Sialendoscopic success" was considered when the lumen of all the ductal branches was free of any disease. "Sialendoscopic failure" was considered when sialendoscopy was impossible or unsuccessful or when a gland resection was performed.

In the last 40 patients, the pain experienced as a result of sialendoscopy was evaluated using a 10-cm visual analogue scale.

Statistical analysis for categorical variables was performed with the $\chi^2$ test; numerical variables were analyzed with the Student $t$ test (two groups) or the Kruskal-Wallis test (three or more groups), as implemented by the Statistical Package for the Social Sciences (SPSS) software (version 9.0, Chicago, IL).

### *Endoscopes*

The technology of the endoscopes that were used evolved in four generations (free optical fiber, flexible endoscope, and two generations of semirigid endoscopes device of various diameters), as follows:

1. Initial trials were performed with free optical fibers (range, 0.5–0.8 mm) without a rinsing or a directional system. When visualized, the stones were extracted blindly with commercially available Dormia baskets[21] (reference no. 27023VB, Karl Storz AG, Tüttlingen, Germany).
2. The second group of endoscopes that were used were flexible with a 1.5-mm–outer diameter (OD) flexible endoscope and a 0.5-mm working channel. These flexible endoscopes had a directional system, and in 1996, Marchal et al.[22] began to use a rinsing solution.
3. The third system included two devices, a semirigid single-lumen device (OD, 1.3 mm) for diagnostic endoscopy and a double-lumen device for interventional procedures. In the latter, one channel was 1.1 mm and the other 0.8 mm, the total surface being 2.67 mm$^2$. In both instruments, a 1-mm semirigid endoscope for visualization was secured (reference no. 11510, Karl Storz AG) in one of channels. The second channel of the double-lumen device was a working channel,[21] which was used to pass different instruments for sialolithiasis fragmentation and/or retrieval.

TABLE I.
Interventional Sialendoscopy of the Parotid Gland in the Literature.

| Author, Year | No. of Interventional Sialendoscopic Cases | No. of Parotid Sialendoscopic Cases |
|---|---|---|
| Königsberger, 1990[32] | 1 | 1 |
| Gundlach, 1992[33] | 73 | 8 |
| *Gundlach, 1994[34] | 240 | 12 (?) |
| Iro, 1995[35] | 20 | 0 |
| Ito, 1996[36] | 15 | 0 |
| Arzoz, 1996[37] | 27 | 4 |
| Nahlieli, 1997[38] | 46 | 9 |
| *Nahlieli, 1999[5] | 154 | 57 |

*Probably including cases of the previous reports.

4. The fourth endoscopic system also includes two different devices (reference no. 11.516 KA and KT, Karl Storz AG). The diagnostic sialendoscope resembles the single-lumen diagnostic device described above, with slight modifications (handle with rinsing system). The OD is 1.3 mm, and the cross-section area is 1.33 mm$^2$. The interventional sialendoscope is a double-lumen device with one channel of 1.1 mm for the endoscope and a working channel of 0.8 mm diameter, which is used for custom-made baskets and/or laser fibers (Fig. 1). The overall cross-section is 2.29 mm$^2$. The tip of the instrument has been beveled and blunted for easier cannulation of the duct. Both instruments were slightly bent to facilitate exploration of the ductal tree.

### *Other Materials*

Other materials include a customized papilla dilator (reference nos. 745910 and 745845–744856, Karl Storz AG) and customized grasping wire baskets (prototypes not referenced yet). Fragmentation of larger stones was achieved in this study using the following devices: an electrohydraulic lithotriptor with a 0.5 mm probe (Calcutript, Karl Storz AG) and a 0.4 mm holmium laser probe (Coherent, Versapulse Select, Santa Clara, CA).

### *Surgical Technique*

Details of the surgical technique have been described previously.[3,4] In most cases the procedure is performed with the patient under local anesthesia. Topical anesthesia is achieved by Xylocaine spray. Papillotomy of Stensen's duct is rarely necessary; simple dilation with the customized papilla dilator is sufficient. The administration of anesthesia, the cleansing of the endoscope tip, and slight dilation of the duct are achieved by an intermittent rinsing through the endoscope with a local anesthetic solution (Xylocaine 2% and NaCl 0.9% [1:1]).

The initial procedure is a diagnostic sialendoscopy, allowing a minimally invasive but complete exploration of the ductal system (Fig. 2). When a stone or other ductal disease or disorder is located, an interventional sialendoscopy is planned. For sialolithiasis smaller than 4 mm in diameter, it is performed during the same stage, using the interventional sialendoscope. The customized wire basket is passed behind the stone and deployed, the stone is trapped, and the entire sialendoscope removed (Fig. 3). For larger stones, fragmentation is required before extraction. The use of the Calcutript lithotripter or the Holmium laser in local anesthesia having proven to be painful, we perform the fragmentations with the patient under general anesthesia (Figs.

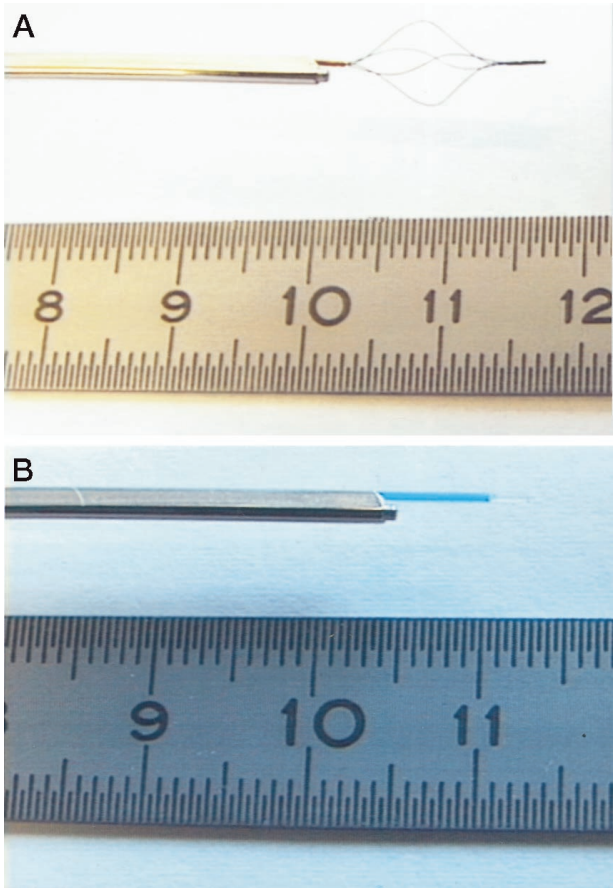


Fig. 1. Tip of the interventional sialendoscope with **(A)** the grasping basket and **(B)** the laser probe in the working channel.

4 and 5). After the last stone is removed, the endoscope is introduced in most cases one final time, to rinse the duct and verify its integrity.

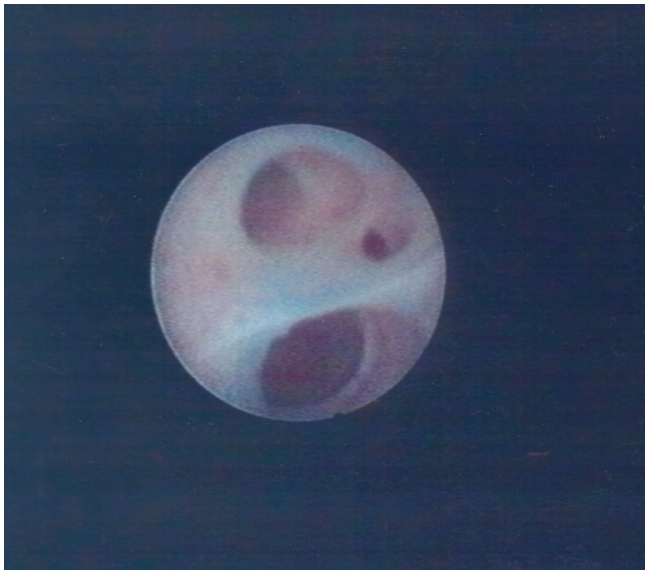

Fig. 2. Endoscopic view of the terminal ductal branches of Stensen's duct.

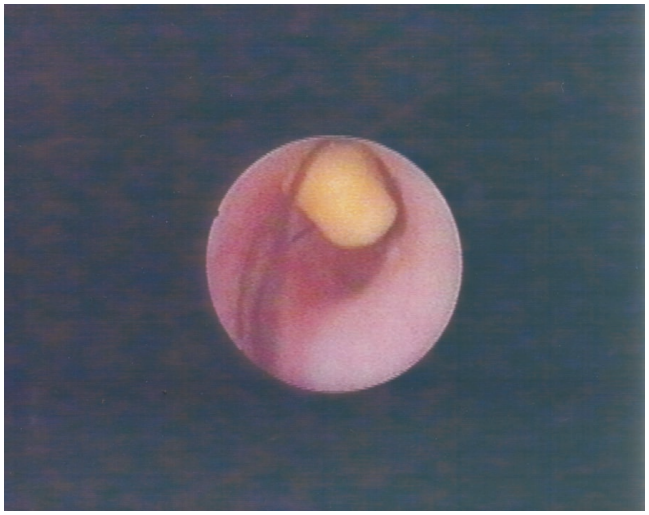

Fig. 3. Endoscopic removal of a 3-mm-diameter stone by the grasping basket.

The intervention is performed with the patient under antibiotic prophylaxis. Oral antibiotics (amoxicillin–clavulanic acid or clindamycin) and corticosteroids (prednisone 40–50 mg/d) are given for 48 hours. Frequent self-massages of the gland are recommended. A clinical control is performed 10 days after the procedure.

## RESULTS

The average age of the 77 patients studied was 40.6 ± 14.5 years (± standard deviation), with a minimum age of 6 years and a maximum age of 91 years. There were 33 female and 44 male patient. Diagnostic sialendoscopy was achieved in all 79 parotid glands in which it was attempted. The sialendoscopic findings of the 79 explored ducts included 50 cases of sialolithiasis (66%), 6 of stenosis (8%), 31 of sialodochitis (39%), and 2 of polyps, as well as 13 normal ducts (16%). In 23 cases (22%), a combination of two of the above diseases or disorders was found. The average duration of diagnostic sialendoscopy was 26 ± 14

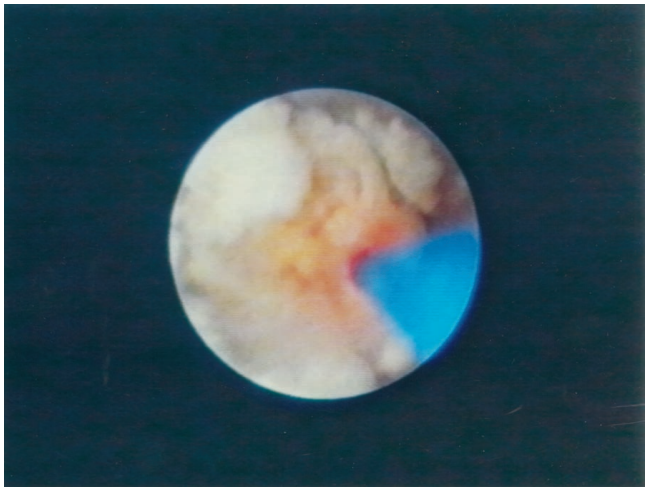

Fig. 4. Endoluminal laser lithotripsy of a 6-mm-diameter stone.

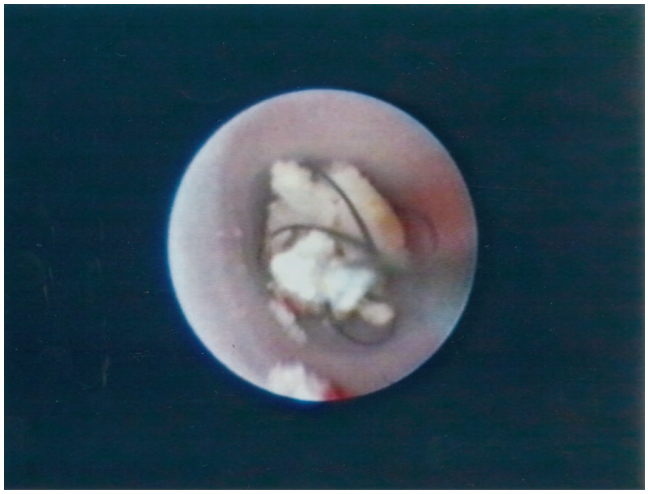

Fig. 5. Removal of the stones fragments after endoluminal laser lithotripsy.

minutes. No complications were encountered during diagnostic sialendoscopy.

Interventional sialendoscopy was attempted in 55 cases, including all cases of sialolithiasis, stenosis, and polyps. The average duration of the procedure was 73 ± 43 minutes. More than one interventional sialendoscopy was necessary in 25 cases (45%). In 13 cases (24%), the procedure was performed with the patient under general anesthesia.

Interventional sialendoscopy was successful in relieving the ductal obstruction in 47 cases, for an overall success rate of 85%. In the remaining eight cases, failures were due to sialolithiasis embedded in the ductal wall in four cases, unsuccessful dilation of ductal stenosis in two cases, and impossibility of retrieving the totality of stone fragments after fragmentation in two cases. In one case, in which the ductal stenosis was unsatisfactorily relieved, a parotidectomy was necessary because bothersome burning during meals was present, probably secondary to reflux of saliva and aliments in Stensen's duct, following a large papillotomy. This patient was also having repeated parotid swellings (pneumoparotitis) during his professional activity as a wind instrument player.

A unique sialolithiasis was present in 21 cases, whereas multiple sialoliths were found in 29 cases (58%). Two stones were retrieved in 9 cases (18%), 3 stones in 12 cases (24%), 4 stones in 6 cases (12%), 5 stones in 1 case, and 10 stones in another case (Fig. 6). The average number of retrieved sialoliths per gland was 2.3 ± 1.6. The presence of multiple sialoliths was statistically correlated to procedures performed with the patient under general anesthesia and long operations (Table II).

The average diameter of sialoliths was 3.2 ± 1.3 mm. The presence of larger sialoliths was statistically related to procedures performed with the patient under general anesthesia, long operations, multiple procedures, use of fragmentation, and sialendoscopy failures (Table III). Sialoliths were smaller than 3 mm in diameter in 36 cases. In this group, the success rate of stone retrieval with the basket was 97% and fragmentation was required in only one case.

Sialoliths were larger than 3 mm in diameter in 14 cases. In this group the overall success rate was 71%. Fragmentation was used in 10 cases (64%). An electrohydraulic device was used in five cases, with a successful fragmentation in three cases and achieving a complete clearing of the ductal system in two cases. A holmium laser was used for fragmentation in five cases, with com-

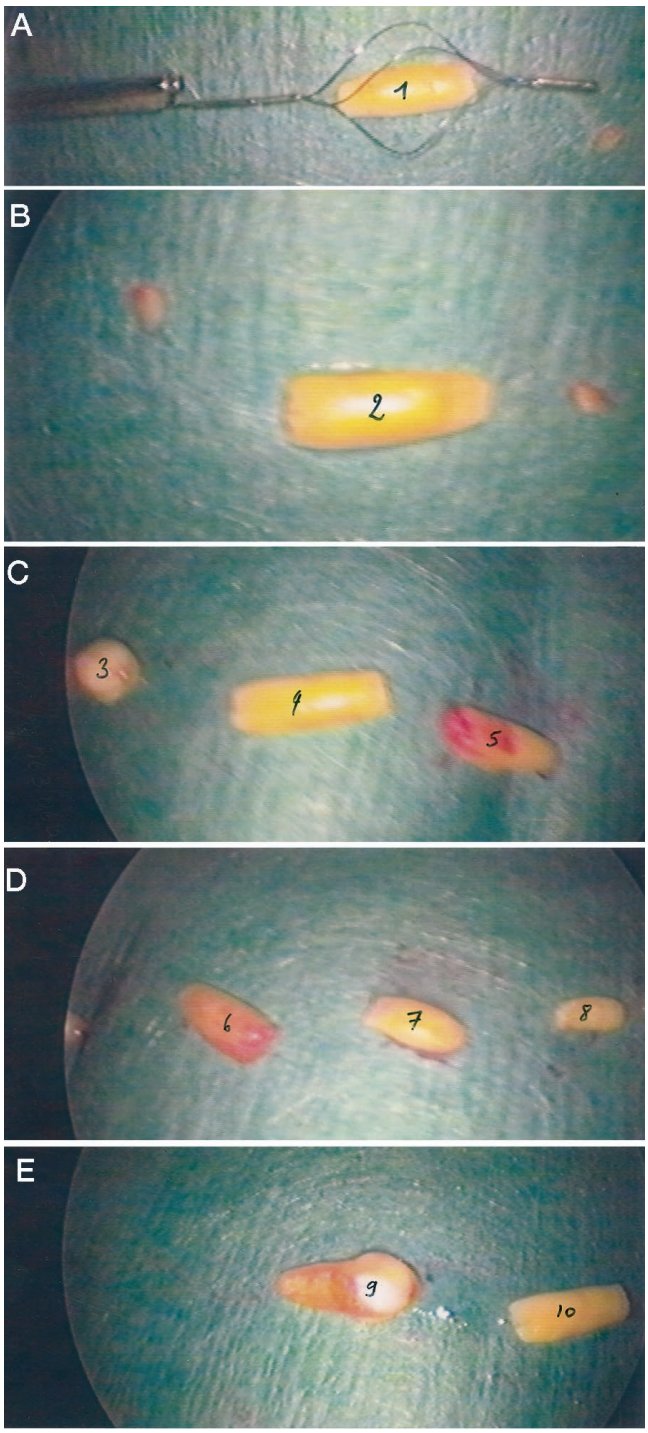


Fig. 6. Multiple stone removal (10 stones) in Stensen's duct.

TABLE II.
Interventional Sialendoscopy Results in Single versus Multiple Sialolithiasis.

| | Single Sialolith | Multiple Sialoliths | *P* |
|---|---|---|---|
| No. | 21 (42%) | 29 (58%) | |
| Average maximal size (mm) | 3.3 ± 1.0 | 3.9 ± 1.4 | .06 |
| General anesthesia | 2 (10%) | 11 (39%) | .047* |
| Duration of the procedure (min) | 57 ± 39 | 89 ± 43 | .009* |
| Multiple procedures | 10 (47%) | 15 (52%) | 1.0 |
| Parotidectomy | 1 (5%) | 0 | .4 |
| Sialendoscopy failures | 2 (10%) | 4 (14%) | .9 |

*Statistically significant difference.

plete clearing of the ductal system in four. In the last case described below, ductal clearance was possible, but fragments embedded in the wall were left in place. The remaining four cases had direct sialolith removal with the grasping basket, with three successes and one failure.

The results of interventional sialendoscopy with the four different sialendoscopic techniques are shown in Table IV. The success rate was statistically lower with the flexible endoscope (58%) and with the large, semirigid device (63%) than with our current instrumentation (96%).

Complications occurred in six cases (12%). Three patients had wire-basket blockages, two of which could be removed by firm traction with the patient under sedation. The third patient required general anesthesia for removal, which resulted in ductal wall perforation. Canal wall perforations occurred in three other patients following stone retrieval with the wire basket, as a result of canal wall stripping. Two of these patients required hospitalization, intravenous corticosteroids, and antibiotics, because of important parotid swelling.

Recurrence of obstructive symptoms occurred in three cases at 15, 18, and 24 months, respectively, following the initial procedure. In two patients, a repeat sialendoscopy showed several small sialoliths, which could be easily extracted by the basket with the patient under local anesthesia. In the third patient described before a stone, embedded in the ductal wall, was found, 9 cm from Stensen's duct papilla. A laser fragmentation was attempted with the patient under general anesthesia, but because of the characteristics of the holmium laser, only a repermeabilization was performed, resulting in partial ductal clearance.

The pain of the procedure was evaluated at 2.4 ± 1.3 cm for the diagnostic and 3.2 ± 1.9 cm for the interventional sialendoscopy.

TABLE III.
Interventional Sialendoscopy Results as a Function of the Size of the Sialolithiasis.

| Size | <3 mm | 3–7 mm | 7–10 mm | *P* |
|---|---|---|---|---|
| No. | 36 (72%) | 13 (26%) | 1 (2%) | |
| General anesthesia | 2 (6%) | 10 (77%) | 1 (100%) | <.001* |
| Duration of the procedure (min) | 57 ± 26 | 120 ± 41 | 180 | <.001* |
| Multiple procedures | 13 (36%) | 11 (85%) | 1 (100%) | .007* |
| Fragmentation | 1 (3%) | 8 (62%) | 1 (100%) | <.001* |
| Parotidectomy | 1 (100%) | 0 (0%) | 0 (0%) | .8 |
| Sialendoscopy failures | 1 (3%) | 3 (23%) | 1 (100%) | .001* |

*Statistically significant difference.

## DISCUSSION

### *Diagnostic Sialendoscopy*

Diagnostic sialendoscopy was performed in all 79 salivary glands (100%) with the patient under local anesthesia with excellent patient tolerance. No complications, such as ductal wall perforations, hemorrhage, or nerve damage, were encountered.

In 36 of 50 cases the size of the sialoliths was smaller than 3 mm in diameter. This incidence of smaller stones differs from previous data.[23] It might result from a selection because of concomitant study protocols[6] investigating every case of parotid swelling of unclear origin.

At present, sialography is still considered the gold standard in the evaluation of salivary ductal disease, despite the necessity of contrast solution (possible allergy), pressure injection (possible deeper displacement of the obstruction), and patient irradiation equivalent to about 20 chest radiographs. Based on our experience, we think diagnostic endoscopy should become the investigation of choice for any suspected obstructive disease of Stensen's duct.

The various sialendoscopes that were used resulted in differences in the quality of the images and in the possible depth of exploration. Our experience with the single optic fiber endoscope was disappointing. Although other authors have reported extensive series of diagnostic procedures with similar devices,[18] we no longer recommend the use of these fibers: progression can only be achieved in the main duct, because of the absence of an orientation system and of a technique to dilate the duct. Moreover, if a therapeutic retrieval of stones is to be performed, it is performed blindly.

The second generation of endoscopes we used were fiberscopes, which provided satisfying images and allowed satisfactory exploration of ductal branches. Although it seemed initially easier and less traumatic to progress in the canal with a flexible device, we encountered other problems: because the endoscope could be oriented in only one direction, frequent 180° twisting of the entire fiberscope was required to advance in the ductal system. To be effective, this torsion had to be applied close to the papilla. Because the overall length of the fiberscope was 40 cm and the resistance of a fiber to torsion is directly proportional to its length, several fiberscopes were damaged. Because of similar experiences, Gundlach et al.[10] have adopted very long flexible fiberscopes for salivary duct exploration and treatment.

Our experience with diagnostic endoscopy with the third and fourth generations of endoscopes is similar, both using a 1.3-mm-OD semirigid device (1-mm semirigid endoscope) and a rinsing system. The illumination and im-

ages are excellent. Another advantage is better maneuvering because of the rigidity of the instrument. However, a disadvantage of semirigid endoscopy is that the instrument has difficulties passing sharp angles, which are present at certain points of ductal branching.

Sialendoscopy has not fully realized its diagnostic potential. For example, we observed several cases of sialodochitis, which were confirmed by sialography or MRI sialography. Although the clinical significance of sialodochitis remains to be defined, the sialendoscopic evaluation of inflammatory salivary diseases remains a potential development.

### *Interventional Sialendoscopy: Stone Retrieval and Endoscope Types*

The first reports of parotid stone retrieval with a basket were published only recently.[24] Similar blind stone retrieval was used in the initial part of this study in 10 cases, with a success rate of 90%. These excellent results probably represent cases of single stones located in the main duct and selected by prior radiological examinations. Because of the blindness of the technique and the potential risks of perforation and ductal lesions, we no longer recommend this procedure.

Our first non-blind attempts to perform stone extraction under endoscopic control were made with a flexible fiberscope, using customized wire baskets introduced in the working channel to retrieve the stones. The problems encountered were related to the fragility of the endoscope, as described above, in addition to the frequent "stripping" of the internal coating of the working channel by the grasping wire basket.

Satisfying results were obtained with semirigid endoscopy, although differences in the outside diameter of the devices could explain the observed difference in parotid sialendoscopy success rates (Table IV). Our device could be seen as the juxtaposition of two tubes, with a cross-section smaller than a round instrument of equivalent inner diameter. The resulting reduction in diameter has obvious implications: when the diameter of the instrument is larger than the diameter of the dilated lumen, progression within the canal becomes almost impossible, and the entire duct wall tends to be stripped and ductal perforations can result. Although we have observed ductal wall tears endoscopically with the use of our third-generation endoscope, these have been extremely rare with the fourth instrument mentioned in this study.

Nahlieli and Baruchin[5] recently reported the use of a sialendoscope consisting of two tubes that are 1.3 mm in diameter with an overall cross-section of 3.32 $mm^2$. Although we do not have firsthand experience with their device, we remain skeptical about the possible systematic exploration of the parotid ductal system and its branches with a device of such size.

### *Interventional Sialendoscopy: Endoscopic Stone Fragmentation and Retrieval*

Fragmentation before sialolith extraction was necessary in 20% of cases. The success of fragmentation is related to the size and shape of the stones and their location, and to the fragmentation device used. While the use of holmium laser is well established for urolithiasis,[25,26] its efficacy and, mostly, its harmlessness for sialolithiasis remain to be demonstrated. Its limitations are related to both the thermal effects and the absorption by the surrounding tissues. We would like to warn potential newcomers to this technique that its use for sialolith fragmentation might be dangerous unless the procedure is performed under direct vision, with profuse rinsing and strict aiming toward the stone.

According to various in vitro and in vivo studies,[27–30] the dye laser seems a better alternative to other laser systems because it is harmless to the canal wall. The main problems are the cost of the laser and its specificity. Gundlach et al.,[10] using a 1.6-mm-diameter flexible endoscope with a working channel, were the first to report the intraductal lithotripsy with a laser beam. Although this technique allows adequate stone fragmentation, stone extraction was achieved blindly[10]; therefore, several sessions were sometimes required for stone fragmentation to a small enough size for spontaneous evacuation through the papilla.

Electrohydraulic devices, initially described as promising,[11] have been proven to be of low efficiency at low voltages. At higher voltages, although we have found that destruction was possible,[12] injuries of the canal wall have been described and the technique criticized.[13]

Pneumoblastic devices, which are used routinely by urologists with satisfying results, are based on the delivery of mechanical energy to the stone. Although no clinical

TABLE IV.
Interventional Sialendoscopy Results According to the Type of Endoscope Used.

| Endoscope | Free Optic Fiber | Flexible Endoscope | Modified Foetoscope | Marchal Sialendoscope | Significance |
|---|---|---|---|---|---|
| No. | 10 (18%) | 12 (22%) | 8 (15%) | 25 (45%) | |
| General anesthesia | 0 (0%) | 5 (38%) | 1 (12%) | 7 (28%) | .1 |
| Duration of the procedure (min) | 48 ± 17 | 94 ± 57 | 56 ± 30 | 78 ± 41 | .9 |
| Multiple procedures | 3 (30%) | 9 (75%) | 2 (25%) | 11 (44%) | .09 |
| Parotidectomy | 0 (0%) | 0 (0%) | 1 (100%) | 0 (0%) | .1 |
| Sialendoscopy failures | 1 (10%) | 5 (42%) | 3 (37%) | 1 (4%) | .01* |

*Statistically significant difference.

trials with this technique have been published for salivary stones, in vitro studies tend to emphasize the risks of canal wall perforations.[14]

In addition, external lithotripsy has been advocated for the fragmentation of salivary stones, mainly by Iro et al.[31] in the early 1990s. The use of the Minilith device (Karl Storz AG) usually requires several sessions at intervals of a few weeks. Because sialendoscopy has not been described with this technique, fragmented stones are left in the ductal system, hoping for a spontaneous excretion. Success rates of up to 75% for the parotid and up to 40% for the submandibular gland have been reported.[31]

### *Interventional Sialendoscopy: Role of Shape and Size of Stones*

Sialolithiasis can either be round or exhibit sharp edges. In our hands, round stones are associated with an easy retrieval, whereas stones with edges are often embedded in the canal wall (data not shown). In parotid sialoliths, size is probably the most important factor in predicting the success of interventional sialendoscopy (Table III). For stones smaller than 3 mm, 97% could be retrieved with the wire basket without fragmentation; for stones larger than 3 mm, the success rate of this technique was 35%. With the adjunct of fragmentation, the success rate for large stones increases to 72%. Therefore, we recommend interventional sialendoscopy and stone extraction and/or fragmentation as soon as the diagnosis is made; stones that are diagnosed early tend to be smaller and are easily retrieved under local anesthesia, whereas larger stones might require several sessions, often with the patient under general anesthesia.

Despite its apparent simplicity, interventional sialendoscopy is a technically challenging procedure. The maneuvering of the rigid sialendoscope within the small salivary ducts requires extensive experience. Manipulation is delicate; progression should remain absolutely atraumatic and might be hazardous, because of the theoretical risks of perforation and vascular or neural damage. Significant trauma of the ductal wall could result in later stenosis. The necessity of performing the entire procedure under direct visualization cannot be overemphasized.

## CONCLUSION

Differences in equipment, as well as in complexity, duration, and potential complications of the operation, justify a distinction of two different procedures: diagnostic sialendoscopy and interventional sialendoscopy. Diagnostic sialendoscopy is a low-morbidity, minimally invasive technique, which may become the investigational procedure of choice for salivary duct disease. Interventional sialendoscopy allows the extraction and/or fragmentation of the majority of sialolithiasis; therefore, salivary gland excisions are avoided. Further technical developments might facilitate these procedures and bring them within the armamentarium of any otolaryngologist.

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