Sialendoscopy: Experience With the First 60 Glands in Turkey and a Literature Review

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Objectives: We performed a retrospective analysis to contribute to the increasing number of reports on sialendoscopy in the literature and give basic concepts for beginners at the same time.

Methods: Between 2004 and 2009, 83 patients with symptoms of ductal obstruction of the major salivary glands were admitted to our clinic. Diagnostic and/or interventional sialendoscopy was applied to 60 glands (33 submandibular and 27 parotid) of 54 patients. A holmium:yttrium-aluminum-garnet laser or a pneumatic lithotripter was used for intraductal stone fragmentation.

Results: Sialendoscopy revealed no disorder in 2 cases, and in 38 glands (28 submandibular and 10 parotid) sialolithiasis was the underlying disease. Fifteen glands (5 submandibular and 10 parotid) were found to have other main disorders such as stenosis, synechia, or kink formation. Other findings included sialodochitis in 6 glands (2 submandibular and 4 parotid), a polyp in 1 parotid gland, mucus plugs in 21 glands (6 submandibular and 15 parotid), ductal ectasia in 4 glands (2 submandibular and 2 parotid), and ductal collapse in 1 parotid gland. The overall interventional success rate was 83% of all cases, and no complications occurred.

Conclusions: The success rate of the interventional sialendoscopy performed in the current study shows consistency with the results given in the related medical literature. In the age of sialendoscopy, the adjunctive intraoral surgeries can be argued to be safer, easier, and more successful than before. Sialendoscopy may be considered to be the best practice not only in sialolithiasis, but also in other treatments of obstructive ductal disorders.

Key Words: salivary duct, sialadenitis, sialendoscopy, sialolithiasis.

INTRODUCTION

The current surgical philosophy advocates minimally invasive approaches from the point of view of both the physician and the patient. Thus, since 1990, the technique of sialendoscopy has been applied in obstructive diseases of major salivary gland ducts in order to avoid gland resection. The main approach in this technique is to enter into the salivary gland ducts, visually observe the disorder, and decide on the treatment. At the beginning of the sialendoscopy era, the approach had limited applications and was considered inappropriate for most cases because of technical shortcomings. However, with the development of advanced optical systems, it has become the routine procedure for many cases. The state-of-the-art sialendoscopes present ever-increasing visual quality that widens their scope of applications. The articles published in the medical literature and the presentations made at the seminars and conventions held in recent years have resulted in the popularization of this technique worldwide. Currently, interventional sialendoscopy has an average success rate of 80% (Table 1). When sialendoscopy fails to produce an effective treatment on its own, it can be combined with additional methods such as lithotripsy techniques, minimal intraoral surgery, or external approaches. The success rate then generally rises to above 80% (Table 1). Such success rates, based on a large number of patients, indicate that sialendoscopic approaches should be considered as the primary alternative approach to traditional gland excisions in ductal disorders.

Although sialendoscopy was initially considered for sialolithiasis treatment, it has now become a viable option for treatment of other diseases, such as stenoses, polyps, juvenile recurrent parotitis, and radiation sialadenitis. Therefore, its application areas have multiplied and have been reported in detail. As a result of successful treatments, the following indications have currently been added: all stones in salivary ducts that are considered to be removable by intraductal lithotripsy; stones with a diameter under 7 mm in Wharton’s duct, and stones under 5 mm in Stensen’s duct; cases in which detection of residual calculi is required; and conditions revealed by sialography and ultrasonography that are associated with ductal dilatation or stenosis.
### TABLE 1. SIALENDOSCOPIC SERIES AND THEIR RESULTS, COMPILED FROM THE LITERATURE

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number of Sialendoscopies</th>
<th>Sialolithiasis</th>
<th>Noncalcular Ductal Disorders</th>
<th>Supportive Devices</th>
<th>Invasion Intraoral Surgery</th>
<th>Total Interventional Success Rate</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katz³</td>
<td>1,105 gl</td>
<td>821 (72.5%)</td>
<td>218 (21%)</td>
<td>Dye laser, ELT</td>
<td>*</td>
<td>96%</td>
<td>*</td>
</tr>
<tr>
<td>Nahlieli et al⁴</td>
<td>1,078 gl (722 S, 347 P, 9 SL)</td>
<td>736 (68%)</td>
<td>202 (19%)</td>
<td>ELT</td>
<td>*</td>
<td>81% in strictures; 86% P, 89% S</td>
<td>5.7%</td>
</tr>
<tr>
<td>Koch et al¹</td>
<td>318 gl (176 S, 140 P, 2 S+P)</td>
<td>150 (47.2%)</td>
<td>117 (36.8%)</td>
<td>Erbium, ESWL, ELT</td>
<td>*</td>
<td>83.5%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Marchal et al⁵.⁶</td>
<td>214 gl (135 S, 79 P)</td>
<td>156 (70%)</td>
<td>62 (28%)</td>
<td>Holmium: YAG, ESWL</td>
<td>*</td>
<td>83%</td>
<td>~10%</td>
</tr>
<tr>
<td>Ziegler et al⁷</td>
<td>72 gl (48 S, 24 P)</td>
<td>54 (75%)</td>
<td>18 (25%)</td>
<td>ESWL, ELT</td>
<td>*</td>
<td>87%</td>
<td>None</td>
</tr>
<tr>
<td>Papadaki et al⁸</td>
<td>94 gl (77 S, 17 P)</td>
<td>73 (78%)</td>
<td>18 (19%)</td>
<td>ELT, holmium: YAG</td>
<td>5 (5.3%)</td>
<td>80%</td>
<td>3%</td>
</tr>
<tr>
<td>Yu et al⁹.¹⁰</td>
<td>89 gl (68 S, 21 P)</td>
<td>62 (70%)</td>
<td>27 (30%)</td>
<td>ELT</td>
<td>31 (34%)</td>
<td>84%</td>
<td>12%†</td>
</tr>
<tr>
<td>Walvekar et al¹¹</td>
<td>56 gl (26 S, 27 P, 3 S+P)</td>
<td>29 (52%)</td>
<td>4 (7%)</td>
<td>ESWL, ELT</td>
<td>3 (5%)</td>
<td>74%</td>
<td>*</td>
</tr>
<tr>
<td>This study</td>
<td>60 gl (33 S, 27 P)</td>
<td>38 (63.3%)</td>
<td>15 (25%)</td>
<td>ISWL (PLT), holmium: YAG</td>
<td>8 (13.3%)</td>
<td>83%‡</td>
<td>None</td>
</tr>
</tbody>
</table>

gl — glands; ELT — electrohydraulic lithotripter; S — submandibular; P — parotid; SL — sublingual; ESWL — extracorporeal shock wave lithotripter; holmium:YAG — holmium:yttrium-aluminum-garnet laser; ISWL — intracorporeal shock wave lithotripter; PLT — pneumatic lithotripter.

*No clear explanation.
†Complications have been reported in 11 cases of this study; however, 10 of those were swelling.
‡Sialolithiasis and noncalcular main disorders were contained in scope of study, including cases subjected to treatment in combination with intraoral surgery.

Koch et al¹² gave a list of indications based on their experiences: 1) detection of asymptomatic salivary calculi; 2) detection of salivary calculi in the early development period (mucus plug or fibrin plug) and taking preventive steps against the development of stones; 3) treatment of obstructions and stenoses following inflammation; 4) determination and treatment of anatomic variations or malformations; 5) diagnosing autoimmune diseases associated with salivary glands and investigation of likely obstructive causes; and 6) follow-up and control of treatment success rates.

Sialendoscopy can also be used for examining the proximal portion of the duct after marsupialization or ductoplasty in cases with atresia of the ductal orifice.¹⁶ Moreover, it has been used to diagnose and manage kinks, which are defined as acute angulations of the main duct.¹⁷ Recently, it has been used for irrigation purposes in chronic sialadenitis or for interventional purposes in sialadenitis following radioiodine therapy.¹⁸-²⁰ There is no age limit for this procedure, and successful results have been reported in both sialolithiasis and juvenile recurrent parotitis.²¹-²⁵ A different perspective that we can add to previous experiences is that even in cases in which the use of only sialendoscopy is known to be inadequate and in cases of all intraoral ductal surgeries, it can be performed as a guiding, supportive, facilitative, and complementary method.

It is widely known that sialendoscopy has no remarkable contraindication except for acute sialadenitis.²³

In this report, we aim to contribute to the growing literature on the use of sialendoscopy by reporting the results of our cases.

### MATERIALS AND METHODS

Between 2004 and 2009, 83 patients were admitted to our clinic with obstructive major salivary duct symptoms. Particularly at the beginning of our practice of sialendoscopic intervention, we acted very selectively in choosing in which indications to apply the technique. The patients who seemed suitable according to the indications given above and who consented to the procedure underwent sialendoscopy. The patients whose ultrasonographic stone size was more than 1 cm were excluded. We performed diagnostic and/or interventional sialendoscopy on 60 glands in 54 patients, of whom 33 were female and 21 were male. The ages of the patients ranged from 19 to 66 years, and the mean age was 42 years. All patients were subjected to ultrasonographic study before the operation. Since we prefer not to practice in the office, all of the procedures were carried out in operating room settings, and most of the
interventional procedures were done under general anesthesia. The classification of the findings was given according to the new LSD (lithiasis, stenosis, dilatation) classification. In this classification, L0 = duct free of stones; L1 = floating stone; L2a = fixed stone, totally visible, less than 8 mm; L2b = fixed stone, totally visible, more than 8 mm; L3a = fixed stone, partially visible, palpable; and L3b = fixed stone, partially visible, nonpalpable. The endoscopic classification of stenosis was as follows: S0 = no stenosis; S1 = intraductal diaphragmatic stenosis (unique or multiple); S2 = unique ductal stenosis (main duct); S3 = multiple or diffuse ductal stenosis (main duct); and S4 = generalized ductal stenosis. The endoscopic classification of dilatation was as follows: D0 = no dilatation; D1 = unique; D2 = multiple; and D3 = generalized.

The instruments used are listed below; they were all manufactured by Karl Storz AG, Tuttlingen, Germany. For diagnostic sialendoscopy, one of the following was used: a semirigid Marchal sialendoscope with a 1.3-mm outer diameter (OD); a semirigid Marchal miniature telescope with a 1.1-mm diameter, for use with a 1.3-mm OD examination sheath; a Nahlieli sialendoscope with a 0.89-mm OD; or a miniature Nahlieli telescope with a 0.7-mm OD, for use with a 1.1-mm-OD examination sheath.

For interventional sialendoscopy, one of the following was used: a semirigid miniature telescope with a 1-mm OD (dual-channel Marchal operating sheath with a 0.8 mm/1.3 mm diameter or a dual-channel Marchal operating sheath with a 1.3 mm/1.3 mm diameter); a miniature telescope with a 0.7-mm OD (dual-channel Nahlieli operating sheath with a 1.1 mm/1.3 mm diameter or a dual-channel Nahlieli operating sheath with a 1.1 mm/0.8 mm diameter); a semiflexible miniature straight-forward telescope with a 1.1-mm OD (Erlangen type); or a semiflexible miniature straight-forward telescope with a 1.6-mm OD (Erlangen type).

Other materials that we used during sialendoscopy were salivary gland probes, dilators, and bougies with increasing diameters. We used bougies and balloon dilators for dilating stenoses or synchieae. Forceps and wire baskets were among the equipment used for intervention purposes. In order to induce fragmentation of large calculi, we used a holmium:yttrium-aluminum-garnet laser probe of 365-μm diameter (Versapulse Powersuit Slimline, Lumenis, Santa Clara, California) or an intracorporal pneumatic lithotripter (Calcusplit, Karl Storz AG). We used the repeated single-shot modality in performing either of these energy-assisted lithotripsy techniques to avoid the intraluminal injury reported in the literature. Lately, we have begun to use instruments such as drills for perforating and fragmenting stones, and brushes for cleaning small particles and collecting cytologic samples.

We preferred to use local anesthesia in a limited number of patients and carried out this procedure by administering Xylocaine spray (10% lidocaine), followed by applying 0.5 mL lidocaine hydrochloride–epinephrine solution for infiltration of the area around the papilla. In patients in whom we chose to administer general anesthesia, we infiltrated the area around the papilla. At the beginning of our practice, we performed infiltration as a routine procedure, but later we preferred to apply it only if there was a need for papillotomy. We use a 50/50 mixture of 0.9% sodium chloride and 2% injectable Xylocaine or lidocaine as an irrigation solution. Detailed information on papilla dilation, insertion into the lumen, and interventional sialendoscopy can be found in many sources. It should be noted that our treat-
ment algorithm for both indications and procedures is consistent with the algorithm accepted at the Paris consensus meeting in 2008 (Figs 1 and 2).29

RESULTS

The observations made on the 60 glands (33 submandibular and 27 parotid) of 54 patients are discussed below.

Submandibular sialendoscopy revealed no disorder in 2 cases. Sialolithiasis was found in 38 glands (28 submandibular and 10 parotid). Among them, 16 had multiple stones (10 submandibular and 6 parotid), whereas 22 had a single stone (18 submandibular and 4 parotid). The locations of the submandibular stones were as follows: 56% main duct, 35% hilum, and 9% intraparenchymatous ductal system. The locations of the parotid stones were as follows: 40% main duct, 30% hilum, and 30% intraparenchymatous ductal system. According to the LSD classification, 63% of the stones were L1, 10% L2a, 5% L2b, 10% L3a, and 2% L3b.

Noncalcumin obstructive disorders were seen in 15 glands: 5 submandibular and 6 parotid stenoses, 3 parotid radioiodine synechiae, and 1 parotid polyp. According to the LSD classification, 21% of the stenoses were S1, 43% S2, 21% S3, and 14% S4. As coexisting disorders, sialodochitis was found in 6 glands (2 submandibular and 4 parotid), a kink was found in 1 parotid gland, mucus plugs were found in 21 glands (6 submandibular and 15 parotid), ductal ectasia was found in 4 glands (2 submandibular and 2 parotid), and ductal collapse was found in 1 parotid gland. Consequently, 2 coexisting disorders were detected in 9 cases, 3 in 8 cases, and 4 in 1 case.

The frequencies of the main disorders seen in the study were as follows: 38 of 60 glands (63.3%) exhibited sialolithiasis; in 27 of these cases (71.1%), sialendoscopic removal on its own resulted in total success (Figs 3 and 4). In 5 cases (3 parotid and 2 submandibular) of this sialendoscopically successful group, mechanical lithotripsy was used in 2 cases and a holmium:yttrium-aluminum-garnet laser (1 case) or pneumatic lithotripsy (2 cases) was used in the rest of them (Fig 5). The stone fragmentations were removed endoscopically by a forceps or a wire basket. One case of pneumatic lithotripsy was not successful. In 4 cases of submandibular sialolithiasis, combination intraoral duct dissection was needed, and in 1 case, the stone could not be

[Fig 2. Algorithm for treatment of submandibular sialolithiasis (as per consensus29).

Fig 3. Sialendoscopic stone retrieval with forceps (f).]
removed despite the combined approach, because a submandibular calculus was embedded in the hilum. Thus, overall, 31 of the 38 cases (81.6%) in the sialolithiasis group were considered a total success. In the remaining 7 cases in this group (including the failed case in which an intraoral approach was attempted), 3 subjects with submandibular stones underwent gland resection, and the remaining 4 did not give consent to the operation.

According to the further observations on the noncalcular obstructive group, 15 of 60 glands (25%) displayed noncalcular disorders, including stenosis, synechiae, or polyps; 10 (66.6%) of those exhibited clinical recovery as a result of the application of sialendoscopic intervention alone (Fig 6). In 3 submandibular cases, sialendoscopy was started in combination with intraoral surgery because of the papillary scars that had formed as a result of previous intraoral attempts in other clinics (Figs 7-9). The rate of success in this group thus reached 86.6% (13 cases). The remaining 2 parotid cases had more complicated ductal stenotic and dilated segments, and intraoral surgery was recommended. The polyp

![Fig 4. Sialendoscopic stone retrieval with wire basket.](image)

![Fig 5. Sialendoscopic intraductal stone fragmentation with intracorporeal shock wave lithotripter. p — pneumatolithotripter probe.](image)
The case was diagnosed as Sjögren syndrome in later clinical assessment (Fig 10). In this case, there was no obstructed lumen, and we did not attempt to remove the polyp because of the risk of bleeding.

The mucus plugs observed in 21 of 60 glands (35%) were generally associated with other disorders. In the current study, disorders such as sialodochitis, ductal ectasia, and ductal collapse were generally recorded as secondary to calculi, stenosis, and/or chronic sialadenitis.

**DISCUSSION**

In recurrent swelling of the salivary glands, particularly in cases in which the underlying reason cannot be diagnosed with conventional methods, most physicians associate the ductal disorder with salivary gland stones and use a conservative treatment (including wait-and-see and follow-up). However, it is now known that the stones obstructing salivary gland ducts grow about 1 mm each year. Consequently, the chance of removing the calculi by a sialendoscopic method decreases year by year and paves the way for conventional surgery.21,30 Thus, the current concept of conservative treatment has changed. The modern practice regarding ductal disorders of salivary glands is to advocate sialendoscopy as a conservative treatment. In recent years, as a result of the popularization of the minimally invasive techniques, coupled with the technical developments in endoscopes, sialendoscopy has become the primary method in surgical treatment of obstructive diseases of the salivary glands, taking the place of the intraoral approaches and gland resection. The conventional techniques can be used in a complementary manner, depending on the type, location, size, shape, and number of the disorders. Moreover, sialendoscopic interventions have turned intraoral surgery into a more reliable, definitive, relatively safe, and easy procedure. Sialendoscopy can be indicated in all salivary gland swellings of unknown cause, and it has no significant contraindication except acute sialadenitis.4,5

In the swelling of major salivary glands, we use sialendoscopy as the primary diagnostic tool after ultrasonographic examination.31 It is our opinion that diagnostic sialendoscopy is a distinct method that provides accurate diagnoses for all ductal disorders. According to our own cases and the medical literature data, we have rearranged the distribution of the obstructive ductal disorders (Table 21-5,7,8,28).
Two or more coexisting disorders were detected in 18 of our cases. Sialendoscopic stone removal was carried out successfully in 71.1% (27 of 38) of these cases. With the combination of intraoral surgery, the success rate increased to 81.6% (31 of 38). The success rate of interventional sialendoscopy was 66.6% (10 of 15) in noncalcular main disorders such as stenosis, synechia, and kink formation. With the combination of intraoral surgery, this success rate increased to 86.6% (13 of 15; Table 1).

It should be noted that we have generally considered mucus plugs and sialodochitis as secondary disorders, because most of our cases coincided with predominant disorders such as sialolithiasis. According to our experience, mucus plugs are encountered in patients with stenosis, Sjögren syndrome, radiation sialadenitis, and chronic sialadenitis, particularly in sialolithiasis cases. Another issue is that kinks may be considered as anatomic variations, but they may sometimes be challenging operative obstacles. So-called ductal collapse is an endoscopic observation that can result from dilated ducts that are seen in chronic sialadenitis and/or sialolithiasis. During sialendoscopic dilation, we faced ductal spasm several times, attributable to a sphincterlike mechanism. Additionally, a common observation in daily life is a physiologic saliva ejection. Therefore, we assert that the ductal system has a “pumping function.” This function may be part of the pathophysiology and should be studied further.

The sialendoscopic technique, in addition to diagnosis, can be used for interventional purposes, as well as for treatment of various disorders in the salivary gland ducts. The success rates obtained from several series of cases are given in Table 1. From our experience, we can say that the major reasons behind failures of sialendoscopy are as follows: embedded calculi in the ductal wall or hilum, anatomic difficulties occurring as a result of previous casual intraoral surgical interventions, and a lack of a variety of supportive equipment such as that for intracorporeal shock wave lithotripsy (electrohydraulic) and extracorporeal shock wave lithotripsy.

In addition to the treatment of primary ductal dis-
eases, sialendoscopy can also be used for salivary gland diseases that occur secondary to ductal diseases. For example, in inflammatory diseases, the injection of various drug solutions into the ductal system can be achieved by sialendoscopy. In patients in whom the underlying reason for clinical symptoms cannot be detected even with sialendoscopy, the mere process of sialendoscopic irrigation with saline solution has many treatment benefits. We concur with this opinion; in our experience, even...
Fig 10. Polyp in Stensen’s duct in case of Sjögren’s syndrome.

dilation and irrigation of salivary gland ducts and insertion of a stent can be considered as a stand-alone treatment that decreases clinical signs and relieves symptoms of uncertain cause.

TABLE 2. DISTRIBUTION OF DUCTAL OBSTRUCTIVE DISORDERS REVIEWED FROM VARIOUS STUDIES, INCLUDING OUR OWN1-5,7,8,28

<table>
<thead>
<tr>
<th>Disorder</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sialolithiasis</td>
<td>65.5</td>
</tr>
<tr>
<td>Stenosis</td>
<td>12.2</td>
</tr>
<tr>
<td>Kink</td>
<td>2.0</td>
</tr>
<tr>
<td>Anatomic variation</td>
<td>1.6</td>
</tr>
<tr>
<td>Ductal polyp</td>
<td>1.3</td>
</tr>
<tr>
<td>Foreign body</td>
<td>0.6</td>
</tr>
</tbody>
</table>

With the rapid development of technologies and increasing experience, it can be stated that the variety of intraductal interventions will increase and that we will be able to treat the majority of cases with sialendoscopic and combined techniques. Furthermore, as a result of sialendoscopy, our knowledge of ductal anatomopathological information is ever increasing. Sialendoscopy may be considered to be the best practice not only in sialolithiasis, but also in other gland diseases such as Sjögren’s disease and radioiodine-induced sialadenitis.

REFERENCES


