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ORIGINAL ARTICLE

Sialoendoscopy as a diagnostic and therapeutic option for obstructive diseases of the large salivary glands—a retrospective analysis

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Abstract
Objectives The diagnosis and therapy of obstructive inflammatory disorders of the salivary glands have changed in the past decades following the introduction of sialoendoscopy. The aims of the present study were to analyze the relevance of sialoendoscopy using our own data and to compare the results to those of other studies.
Patients and methods A retrospective analysis of 70 patients was performed, who were treated for obstructive disorders of the parotid and/or submandibular gland in whom sialoendoscopy was indicated. Two categories of interventions were considered: diagnostic interventional sialoendoscopy and endoscope-assisted interventions. Interventional sialoendoscopy procedures requiring extirpation of the gland were included in the analysis, as were abnormal intraductal processes that were detected during endoscopy.
Results Treatment was successful in 58 of 67 (86.6 %) procedures (sialoendoscopy without surgical intervention n=59; endoscope-assisted surgical intervention n=8). Based on the underlying disease, the success rate was 88.6 % (n=39) in patients with obstructive sialadenitis without sialolithiasis and 86.6 % (n=19) in patients with sialolithiasis. It was not possible to draw definitive conclusions on the underlying disease from the observed pathological intraductal changes.
Conclusions Sialoendoscopy is an effective and safe diagnostic and therapeutic option with low complication rate. However, limiting factors such as the size or the position of potentially removable obstacles must be taken into consideration.
Clinical relevance The rate of gland extirpations can be reduced using sialoendoscopy.

Keywords Sialoendoscopy · Obstructive sialadenitis · Sialolithiasis

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Introduction

The development of various minimally invasive techniques has led to a fundamental change in the therapeutic options for obstructive disorders of the large salivary glands [1–4]. Among these, sialoendoscopy has proven itself to be the "gold standard" in the treatment of obstructive sialadenitis.

Sialolithiasis is one of the main causes of obstructive sialadenitis, occurring in 60–70 % of the cases. The stones are most frequently located in the submandibular gland (83 %) and much less frequently in the parotid (10 %) or the sublingual gland (7 %) [5]. The prevalence of sialolithiasis in the general population is about 1 % [6].

The most common cause for obstructive sialadenitis in the absence of calculi is chronic recurrent sialadenitis, which primarily affects the parotid (27.2 %) and the submandibular gland (20.0 %) [7].

Until only a few years ago, surgical removal of the gland was performed as method of choice in up to 40 % of the patients in whom conservative treatment had not given the desired results [8].

Various therapeutic algorithms based on clinical experience have been successful. The factors that determine the therapy of salivary calculi are their size (limiting size 7 mm) and localization (distal duct, hilum, intraparenchymal ductal system), their number and contact with the surrounding tissue (adherent, impacted, mobile), the number and location of stenotic ductal segments, their length and the degree of stenosis, and the consistency of the tissue surrounding the stenotic portions [9–11]. It is important that therapeutic interventions are performed as early as possible [9, 12].

The success rate of interventional sialoendoscopy ranges between 85 and 90 % depending on the study design and whether or not any limiting criteria were taken into consideration [13]. Koch et al. [4] were able to spare the glands in 96 % of their patients. The therapeutic options of sialoendoscopic have been enhanced using minimally invasive surgical techniques [3, 14].

It was the aim of this analysis to present our experience with this therapeutic option and to compare it with published results. We compared treatment outcomes of *submandibular* vs. *parotid* gland pathologies and different disease entities of the salivary glands (*chronic obstructive sialadenitis* vs. *sialolithiasis*). Another important aspect was the analysis of the "lesion" found in the ductal system related to different pathologies of the gland tissue. Detailed information about this aspect has not yet been published in the literature. It is, however, necessary to improve sialoendoscopic intraductal therapy.

Patients and methods

The present analysis is a retrospective study of patients of the ENT Department of the University of Göttingen Medical School, who presented with obstructive salivary gland disorders and were treated and examined using sialoendoscopy. Thirty-one of the 70 patients were male (44.3 %), and 39 were female (55.7 %). The average age was 47.8 years.

All patients had a 3-month or longer history of recurring symptoms of the salivary gland infection such as swelling or pain, and in whom, treatment with anti-inflammatory medication, antibiotics, sialogogues, and manual therapy of the gland had been unsuccessful. The patients were initially examined using ultrasound and were followed up according to the same protocol after the intervention.

Seventy patients fulfilled the criteria described above and were included in the study. Eight of these patients were examined bilaterally giving a total of 78 interventions for analysis. In order to assess the success of the sialoendoscopy, the patients were followed up at close intervals after the intervention.

The definition of a *successful therapy* relied on one or several of the parameters "reduction of swelling," "reduction of pain," and "reduction of recurrence of inflammation." These were based on entries in the medical chart, the assessment of the attending physicians, and the subjective assessment of the patients.

The technique of sialoendoscopy

We used the Erlangen sialoendoscopy set (Karl Storz). This contains a diagnostic endoscope with an external diameter of 0.8 mm and a 1.1- and a 1.6-mm external diameter interventional endoscope with working and irrigation channels. The set also contains a dilator for dilating the excretory duct, a microdrill to fragment the stone, foreign body forceps, biopsy forceps, and a retrieval basket for stone removal (see Fig. 1).

After local anesthesia of the oral mucosa using 2 % lidocaine spray, the papilla was dilated with dilators of increasing diameters. Local anesthetic (Ultracain® 2 %) was instilled into the duct with a 22-G cannula. This also relaxes the muscles of the duct and makes it easier to insert the endoscope. Under continuous irrigation, we examined the duct and either performed the intervention with the instruments described above or instilled a solution containing a corticosteroid into the duct. In some cases, we had to extend the endoscopic examination with minimal invasive measures, such as mini-papillotomy or distal ductal incision.

Results

General data and success of therapy

Based on the available clinical data and the results of the sialoendoscopic interventions with visual assessment of the salivary ducts and the hilum of the gland, the patients were divided into the groups "sialolithiasis" and "non-stone-related stenosis" of the parotid and submandibular glands and "other causes" (see Table 1).

Twenty-six patients (37.1 %) presented with sialolithiasis of the large salivary glands. The parotid gland was affected in seven (26.9 %) and the submandibular gland in 19 patients (73.1 %). Forty-two of the patients (60.0 %) had an obstruction without intraductal calculus deposition. The parotid gland was affected in 27 of these (38.6 %) and the submandibular gland in 15 (21.4 %). Two patients (2.9 %) could not be assigned to either of the two main groups and were listed as other causes. One of the patients had a long history of sialadenosis, and one had a freshly diagnosed lipoma of the parotid gland (see Table 1).

The success rate in patients with *non-stone-related* obstructive sialadenitis of the parotid gland was 96.6 % (29 patients), while the success rate for the submandibular gland was lower with 71.4 % (10 patients) (see the "Patients and methods" section for the definition of "success"). The total success rate for both glands was 88.6 %.

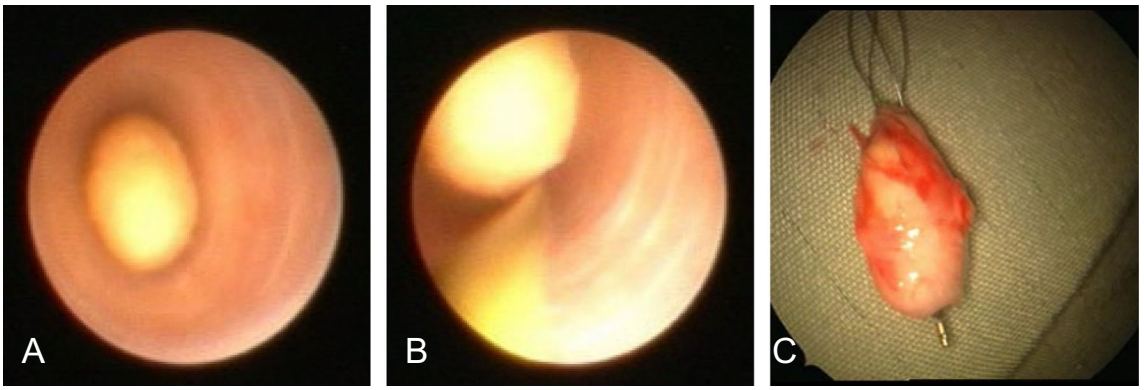

Fig. 1 Sialolithiasis (Wharton duct). The stone was easily visualized and lies mobile in the Wharton (submandibular) duct (**a**). One can see how the retrieval basket passes the stone (**b**). This approach is only possible with mobile stones. The extracted stone can be seen still in the retrieval basket in the right frame (**c**)

Sialolithiasis was seen in 29 sialoendoscopic examinations. Twenty-six patients suffered from sialolithiasis, seven with a location in the parotid gland, and 19 in the submandibular gland. The gland had to be surgically removed in seven of the patients (24.1 %) after sialoendoscopic treatment attempts had failed. Two of them (28.6 %) were located in the parotid gland and five of them (71.4 %) in the submandibular gland. In 19 of the remaining 22 cases (86.4 %), the stones were successfully removed (5 × parotid gland, 14 × submandibular gland), and the symptoms were markedly improved or resolved as described above (see example in Fig. 1). In seven cases, an endoscope-assisted surgical approach was required to remove the stones (1 × parotid gland, 6 × submandibular gland). In summary, sialolithiasis could be successfully treated in 71.4 % of patients with sialolithiasis of the parotid gland and in 73.7 % with sialolithiasis of the submandibular gland.

The mean length of the post-interventional follow-up in the successful cases was 13.3 months.

No complications occurred during the therapy of chronic inflammatory disorders of the submandibular gland. In the course of endoscope-assisted surgical therapy of chronic inflammatory disorders of the parotid gland, one patient developed a salivary fistula that was successfully treated with botulinum toxin.

Treatment modalities

We divided the interventions in the present analysis into three groups. In the first group, only an endoscopic examination was performed, which could include irrigation of the duct system, intraductal corticoid application, mechanical dilation, or intervention with forceps or wire basket. Fifty-nine of the 78 interventions (75.6 %) were in this group. The second group encompassed patients with endoscope-assisted surgical interventions, which consisted of papillotomy, distal ductal incision, or marsupialization of the excretory duct into the oral cavity as supplementary measures. Eight patients were in this group (10.3 %). The first two groups, which together encompassed 67 patients (85.9 %), were combined under the heading "minimal invasive." In the third group were the patients with surgical removal of the gland. This was the ultimate measure when sialoendoscopy was unsuccessful and symptoms persisted on a high level. This final therapeutic option was performed in 11 patients (14.1 %) (see Table 2).

Pathological intraductal findings

A main part of the present study was the assessment of the intraductal pathological findings that were seen during sialoendoscopy. The most common findings were pathological changes of the structure of the duct wall, such as erythema, fibrin exudates, stenosis of the duct, and papillary stenosis (for examples, see Fig. 2). In 24 of the sialoendoscopy examinations, we found erythema in the duct wall (34.3 %); in 28, we saw ductal strictures (40.0 %), fibrin exudates in 33 (47.1 %), and papillary stenosis in 26 cases (37.1 %). We observed combinations of the various pathological changes, but they did not follow any pattern.

Table 1 Underlying diseases and the frequency of their occurrence in the individual glands

Underlying disease	Patient (n=70)	Parotid gland	Submandibular gland
Sialolithiasis	26	7 (26.9 %)	19 (73.1 %)
Non-stone-related sialadenitis	42	27 (64.3 %)	15 (35.7 %)
Sialadenosis	1	1 (100 %)	0 (0 %)
Parotid lipoma	1	1 (100 %)	0 (0 %)

Table 2 Numbers of interventions using the various therapy modalities

Number of interventions (n=78)	
(1) Only endoscopy	59 (75.6 %)
(2) Endoscopy plus endoscope-assisted surgery	8 (10.3 %)
(1) + (2) "minimal invasive"	67 (85.9 %)
(3) Surgical removal of the gland	11 (14.1 %)

With regard to the distribution of the described salivary duct changes amongst the three groups of underlying disorders, one notices that they were seen most frequently in the non-stone-related obstructive disorders (see Table 3) and that the changes were most prominent in the parotid gland.

Erythema in the duct wall was seen in eight patients (33.3 %) with sialolithiasis, in ten patients (34.5 %) with non-stone-related obstructive sialadenitis of the parotid gland, and in five patients (33.3 %) with inflammation of the submandibular gland. Strictures were only seen in five patients with sialolithiasis (20.8 %) but in 15 (51.7 %) and seven patients (46.6 %) with chronic inflammation of the parotid and submandibular gland, respectively.

Fibrin coating and fibrin exudates were seen in only nine patients (37.5 %) with sialolithiasis compared to 15 patients (51.7 %) with inflammation of the parotid gland and eight patients (53.3 %) with inflammation of the submandibular gland. Papillary stenosis was also much less common in patients with sialolithiasis (five patients; 20.8 %) than in patients with chronic inflammation of the parotid (14 patients; 48.3 %) or submandibular (eight patients; 53.3 %) gland.

Discussion

The success rate of therapy was 96.6 % in patients with non-stone-related chronic sialadenitis of the parotid gland, which is similar to the rate published by Koch et al. [4]. This rate is higher than most of those described in the literature, which range between 85 and 90 % [4, 15, 16]. However, the published success rates are only for non-stone-related stenosing processes and are not stratified according to parotid and submandibular gland. This emphasizes the importance of sialoendoscopy in the therapy of non-stone-related obstructive sialadenitis of the parotid gland.

The success rate for the therapy of non-stone-related "obstructive" sialadenitis of the submandibular gland was 71.4 %. This is lower than the rates published in the literature, which range between 85 and 90 % [15, 16]. This might be due to the small sample size of only 14 endoscopic procedures, but on the other hand, it is appropriate to critically note that the published success rates do not differentiate between disorders of the parotid and the submandibular glands. But, a success

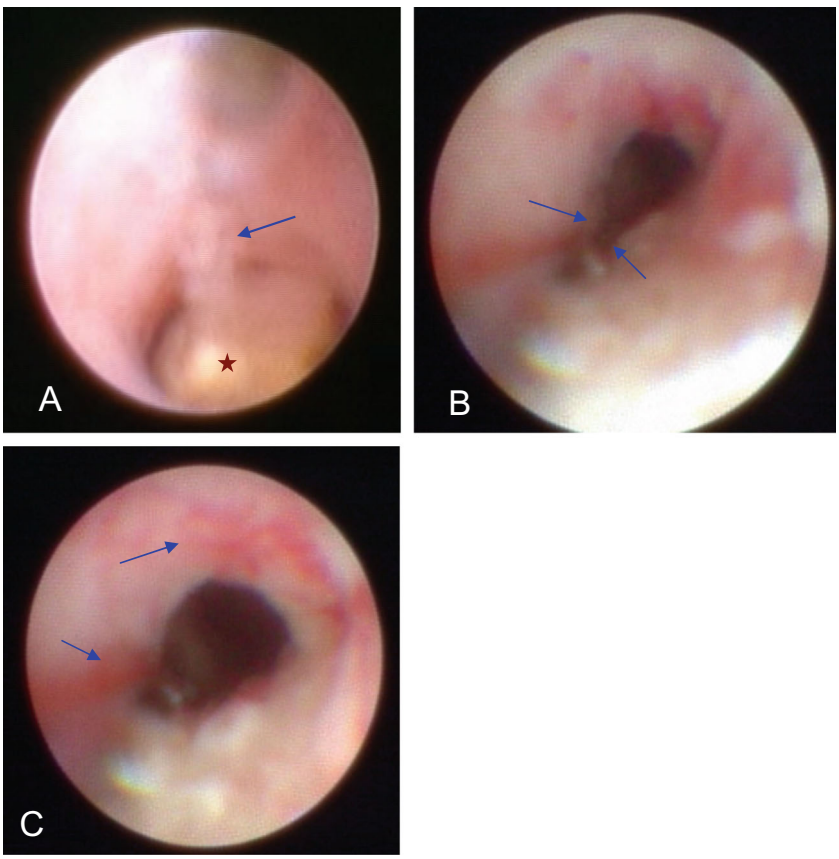

Fig. 2 Sialoendoscopy (Wharton duct). **a** An example of pathological fibrin exudates in the Wharton duct (*arrow*). A stone can be seen further on in the duct (*star*). **b** An example of an inflammatory stricture of the Wharton duct (*arrows*). **c** An example of inflammatory erythema in the Wharton duct wall (*arrows*)

Table 3 Frequency distribution of the duct wall changes in the various underlying disorders of the salivary glands

Underlying disease	Fibrin exudates	Erythema	Strictures	Papillary stenosis
Chronic obstructive parotitis (n=29)	15 (51.7 %)	10 (34.5 %)	15 (51.7 %)	14 (48.3 %)
Obstructive submandibular sialadenitis (n=15)	8 (53.3 %)	5 (33.3 %)	7 (46.6 %)	8 (53.3 %)
Sialolithiasis (n=24)	9 (37.5 %)	8 (33.3 %)	5 (20.8 %)	5 (20.8 %)

rate of 71.4 % is still fairly high. Combining the results of endoscopy in non-stone-related changes of the submandibular and parotid glands gives an improvement rate of 88.6 %, which is very similar to those given in the literature [15, 16]. These results are also higher than the success rates of up to 80 % for interventional radiology [1, 17].

Sialolithiasis was found in 29 of the sialoendoscopic examinations. The gland had to be surgically removed in seven patients (24.1 %) after sialoendoscopic treatment attempts had failed. Stone removal was successful in 19 of the other 22 treatments (86.4 %), and the symptoms resolved or were markedly improved. In seven cases, an endoscope-assisted surgical approach was necessary to remove the salivary stone.

These results parallel those found in the literature and confirm the important role of sialoendoscopy in the treatment of sialolithiasis. The success rates for stone removal reported in earlier studies are between 74 and 89 % [15, 18, 19]. The results of the present study with successful stone removal in 86.4 % of the cases confirm the high success rate of this technique.

No complications occurred in the course of treatment of patients with a non-stone-related stricture either during the treatment itself or afterward. One patient developed an extraoral salivary fistula following a transcutaneous endoscope-guided stone removal from the distal excretory duct of the parotid gland. This was successfully treated with botulinum toxin applied directly into the gland. No further sialoendoscopy-associated complications occurred. Our complication rate was low compared to published results [2, 4]. Other authors reported complications such as strictures, ranulas, and paresthesias of the lingual nerve [2].

The gland had to be surgically removed in 11 patients: five patients with sialolithiasis of the submandibular gland, two with sialolithiasis of the parotid gland, three with non-stone-related obstructive parotid gland disease, and one patient with a parotid lipoma. In all 11 cases, the procedure was seen as the ultima ratio after all other therapy options had failed, and no improvement could be achieved with sialoendoscopy. Excluding the patient with parotid lipoma (for what sialoendoscopy is not a treatment option), the extirpation rate was 13.3 % in the entire patient population. The literature on this topic states that the incidence of gland extirpation had been decreased to less than 5 % in the past years [20]. The discrepancy with our data may have to do with when the extirpations were performed; five of the ten occurred during the first 2 months after sialoendoscopy had been introduced into our institution. If these 2 months were excluded from the analysis, the surgical extirpation rate would be 6.9 %. Other studies have confirmed that the therapy outcome depends on the experience of the surgeon [21].

As mentioned above, we do not perform extracorporeal shockwave lithotripsy (ESWL) as part of our treatment of sialolithiasis or in combination with sialoendoscopy. Particularly stones that cannot be reached by sialoendoscopy or are impacted can be initially fragmented or disintegrated by ESWL. ESWL is frequently described as a first-line therapy option for stones in the parotid gland [15, 22, 23]. It might be possible to reduce the necessity to remove the gland, particularly if the stone is located in the parenchyma.

An important aspect of our analysis was the description of the various intraductal pathological changes. No other report with a comparable level of differentiation has been published to date. It is interesting to note that intraductal pathological changes were seen more frequently in non-stone-related sialadenitis. It was not possible with our data to establish a correlation with a particular disease or a particular gland. One can only speculate that changes affecting the entire gland might be present in non-stone-related sialadenitis as opposed to only local changes in sialolithiasis.

In conclusion, our results show that sialoendoscopy is a safe therapy option that has proved its value in clinical practice. The best success rates were achieved in patients with *obstructive sialadenitis*, particularly, in parotid gland affections. Patients with sialolithiasis showed lower but still acceptable treatment results, independent of the gland location.

Focusing on the affected gland, the most successful treatments (independent of the kind of lesion) could be achieved in the parotid gland group.

Conflict of interest The authors declare that they have no conflict of interest.

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