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ORIGINAL ARTICLE

Role of Sialendoscopy in Non-neoplastic Parotid Diseases: A Prospective Study of 241 Patients in Indian Population

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Abstract
Objectives To assess the role of sialendoscopy as a diagnostic modality and in managing cases of non-neoplastic parotid gland diseases. Secondly, to provide descriptive analysis of intraoperative findings.
Methods The patients of chronic parotid sialadenitis who presented with complaints of recurrent unilateral or bilateral parotid swelling and pain were included in the study. All patients underwent sialendoscopy, and the findings were noted. Intervention was carried out in the same sitting like dilatation of stenosis, stone removal by basket, combined approach, flushing of mucoid flakes, etc. Failed cases were worked up with radiological investigation and managed accordingly.
Results Two hundred and forty-one cases of parotid sialadenitis who underwent sialendoscopy between 2012 and 2018 were included. Diagnostic sialendoscopy was achieved in 100% cases, while intervention was successful in 96.7% (233/241) cases after the first procedure. On diagnostic sialendoscopy, ductal stenosis was the most common pathology present in 177 (73.4%) patients followed by stones (12%) and debris (11.6%). All cases of stenosis were serially dilated with increasing sizes of sialendoscopes followed by stenting in 75% of the cases. The diagnosis of juvenile recurrent parotitis was confirmed in 17 children (mean age 5.6 years) with consistent clinical history and sialendoscopic findings of stenosis along with pale ductal mucosa. There were 18 cases where ductal perforation was seen. One case showed multiple hyperdense foci in bilateral parotid gland along with multiple strictures that underwent repeat sialendoscopy, but the symptoms did not resolve, and finally the patient underwent bilateral superficial parotidectomy.
Conclusion Sialendoscopy is a safe and highly effective modality in managing non-neoplastic parotid gland disorders with low complication rates and resulted in gland preservation in the vast majority of patients. Therefore, it can be concluded that sialendoscopy is the diagnostic and therapeutic modality of choice for parotid obstructive sialadenitis.

Keywords Sialendoscopy · Parotid · Sialadenitis · Salivary stone · Stenosis · Sialolithiasis · JRP

Introduction

Obstructive sialadenitis is the most frequent cause of major salivary gland dysfunction and represents approximately 50% of benign salivary gland disease. Submandibular gland obstruction accounts for 80–90% of cases followed by parotid (5–10%) and sublingual (<1%) glands [1]. The common causes are stones in 60–70%, stenosis in about 15–25%, inflammatory (5–10%) and other causes (mucus plugs, polyps, foreign body, external compression, or variations in anatomical ductal systems) in 1–3% [2]. Patients of parotid sialadenitis often present with recurrent episodes of painful parotid gland swelling, usually during mealtime, and can be associated with intraoral discharge, bacterial super infection, cellulitis or abscess [3]. Traditionally, the management involves a conservative approach, i.e., hydration, salivary flow stimulation, anti-inflammatory medications and antibiotics; however,

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refractory cases may require surgery ranging from papillotomy to complete gland extirpation [3]. The complications resulting from parotid sialadenectomy include permanent facial paralysis, Frey's syndrome and sensory loss in the distribution of great auricular nerve while hypoglossal, lingual and marginal mandibular nerve paralysis in case of submandibular gland excision, in addition to a scar over the face which in some cases can become hypertrophic [4].

Earlier, most of these diseases were considered primarily as pathologies of gland or parenchyma, and therefore, the treatment consisted mostly of surgical gland excision. Various studies have found that in most of these cases, primary pathology lies in the duct and treatment of these ductal pathologies can avoid sialadenectomy [5].

Ultrasound (USG), magnetic resonance imaging (MRI), computed tomography (CT) and conventional sialography are the imaging tools most often used and can all contribute to diagnosis of these obstructive pathologies. However, sialendoscopy allows complete exploration of the salivary ductal system and therefore a precise evaluation of its pathologies [6]. With the introduction of miniature endoscopes and availability of high-resolution cameras and monitors, sialendoscopy intends to become the investigational procedure of choice for parotid duct pathologies. When used for therapeutic purposes, sialendoscopy is a minimally invasive and non-traumatic surgical technique enabling endoscopic stone removal, stricture dilatation, lavage and combined approaches, ultimately reducing or eliminating the need for sialadenectomy and obviating related surgical risks [7].

The aim of this study is to present our experience with sialendoscopy, both as diagnostic and as therapeutic modality in obstructive diseases of parotid gland.

Methods

Between 2012 and 2018, 241 patients of chronic parotid sialadenitis who presented with complaints of recurrent unilateral or bilateral parotid swelling and pain, associated with meals, sometimes with intraoral discharge, dryness of mouth or eyes were candidates for sialendoscopy and were included in the study. The patients presenting with acute episodes were managed conservatively, whereas patients presenting as bilateral parotitis with fever, malaise, myalgia and diagnosed as mumps, or swellings suspected to be neoplastic, which were diagnosed as non-recurrent, progressive and firm, were excluded from the study. The study was approved by the ethics committee of our institute.

After detailed history and clinical examination, a written and informed consent was taken from the patients explaining the sialendoscopy procedure and the risks involved. Preoperatively, the patients did not undergo any imaging and straightaway underwent sialendoscopy under anesthesia (general vs local) depending on patient's factors and preferences.

General anesthesia was achieved using nasotracheal intubation, whereas in cases under local anesthesia, a pledget soaked in 4% lignocaine and applied to punctum provided the necessary anesthesia. The procedure was carried with patient in the supine position, and an adequate exposure was achieved using a molar retractor on the side opposite to the one to be explored.

The Stenson's duct orifice was identified by conventional anatomical knowledge, present on buccal mucosa opposite to the upper maxillary molar. The punctum was dilated with probes of ascending sizes and conic dilator (if necessary) until the 0.89-mm endoscope (Marchal All-in-one miniature endoscope, Karl Storz, Tuttlingen, Germany) could be atraumatically inserted. Firstly, diagnostic sialendoscopy was done using 0.89 mm all in one scope, which allowed minimally invasive exploration of the ductal system and aimed to look for the presence of any sialoliths, strictures, stenotic segment, debris, foreign body or mucosal changes.

A constant infusion of 0.9% NaCl through flushing channel helped to maintain a good surgical endoscopic view and flush out any debris if present. Based on the findings of initial diagnostic endoscopy, interventional sialendoscopy was done which included:

a. Dilation of stenotic duct using serial sizes of endoscopes (1.1, 1.3, 1.6 mm all in one scopes) or balloon catheter followed by stenting (infant feeding tube no.5, Romsons International, Noida, India) of the duct for three weeks.
b. Dilation of strictures using sialendoscopic balloon catheter (Karl Storz) and stenting of duct.
c. Sialolith removal using 3/4/6 wire basket (stone extractor, Karl Storz) or forceps (Karl Storz)
d. Sialolith removal by combined approach (under sialendoscopic guidance and external incision)

At the end of each procedure, the duct was flushed with steroid (hydrocortisone 50 mg diluted in 5 ml normal saline) and/or antibiotics (1 gm ceftriaxone diluted in 10 ml normal saline) if stenosis, stricture or debris was present.

The stenosis was classified according to the LSD Classification (Lithiasis, Stenosis, Dilatation) given by Marchal [8]. The stone location was defined with reference to the masseteric bend, distal or proximal to the masseteric bend.

Adequate dilatation was said to be achieved when 1.3-mm sialendoscope could be passed till hilum and 0.9-mm sialendoscope could be negotiated in secondary branches. The procedure was labeled *'Successful single-step procedure'* when the combined procedure of diagnostic

sialendoscopy and appropriate intervention was done in the same sitting. The procedure was labeled as '*failed*' if sialendoscopy could not be performed due to non-visualization of punctum, intervention could not be done due to ductal perforation, or the patient had persistence of symptoms. In such cases, appropriate radiological investigation (CT or MR sialography) was advised to do further workup and analyze the cause of failure.

In cases where proximal stone, large stone, or fixed stone was visualized, which was not amenable for sialendoscopic removal alone, the procedure was abandoned and CT scan was done in the postoperative period after 4 weeks (after inflammation subsides). After taking consent, the combined approach was planned.

Postoperatively, all patients received injectable antibiotic (amoxicillin—clavulanic acid) for the first 24 h. Most of the patients were discharged next day on oral antibiotics, sialogogues, and were advised to massage the parotid gland to decrease the postoperative swelling. Follow-up was done weekly for the first month, monthly for 3 months and then six monthly. Stent (if placed) was removed at third postoperative visit, i.e., at 3 weeks. A minimum follow-up of 24 months was done for all patients to be included in the study.

In suspected cases of Sjogren's syndrome (based on clinical history), further workup was done by MR sialography and serum antibodies (anti Ro/La) to confirm the diagnosis and plan further management of such patients.

If even after three unsuccessful attempts of sialendoscopy and failure to achieve symptomatic improvement, such patients were offered parotidectomy as a definitive option (Fig. 1).

Results

Descriptive Analysis

Two hundred and forty-one cases of parotid sialadenitis underwent sialendoscopy, which included 103 males (43%) and 138 females (53%) with a mean age of 32 years (3–70). The mean duration of symptoms was 34.7 months (range 1–240 months) with 98.3% of patients having recurrent symptoms. The aggravation of symptoms after meals was noted in 79.3% cases. The occurrence of swelling (seen in 98.8% cases) was similar on both sides (right—35.1%, left—31.4%, bilateral—33.5%), and intraoral discharge was seen in 59.5%, whereas 91.7% of patients also complained of pain.

The sialendoscopy was done in general anesthesia in 118 (48.8%) patients, while in 123 (51.2%), the procedure was done in local anesthesia. In 100% cases, diagnosis could be made by sialendoscopy, while intervention was successful in 96.7% in the same sitting. The duration of procedure was short with average of 36.5 min, and the average hospital stay was 1 day.

Endoscopic Profile

On diagnostic sialendoscopy, stenosis (Fig. 2) was the most common pathology present in 177 (73.4%) patients followed by stones (12%) and debris (11.6%) (Table 1). Generalized ductal stenosis (S4) was the commonest type seen in 35.1% cases, and the single intraductal stenosis (S1) was the least common, seen in 7.9% cases. Some additional findings were noted in these cases of stenosis like presence of inflammatory debris (mucoid flakes) in 42

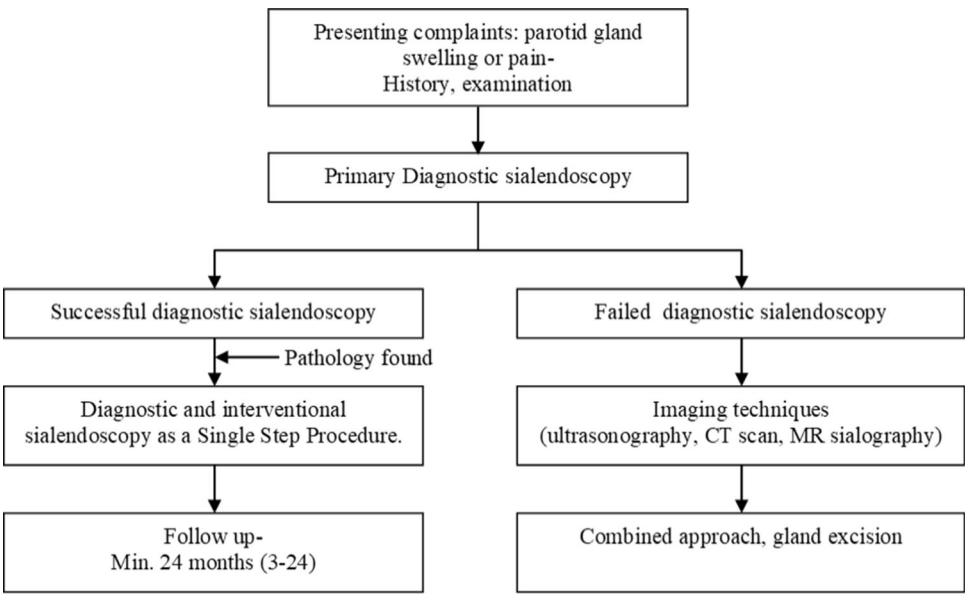

Fig. 1 Flowchart for methodology and workup

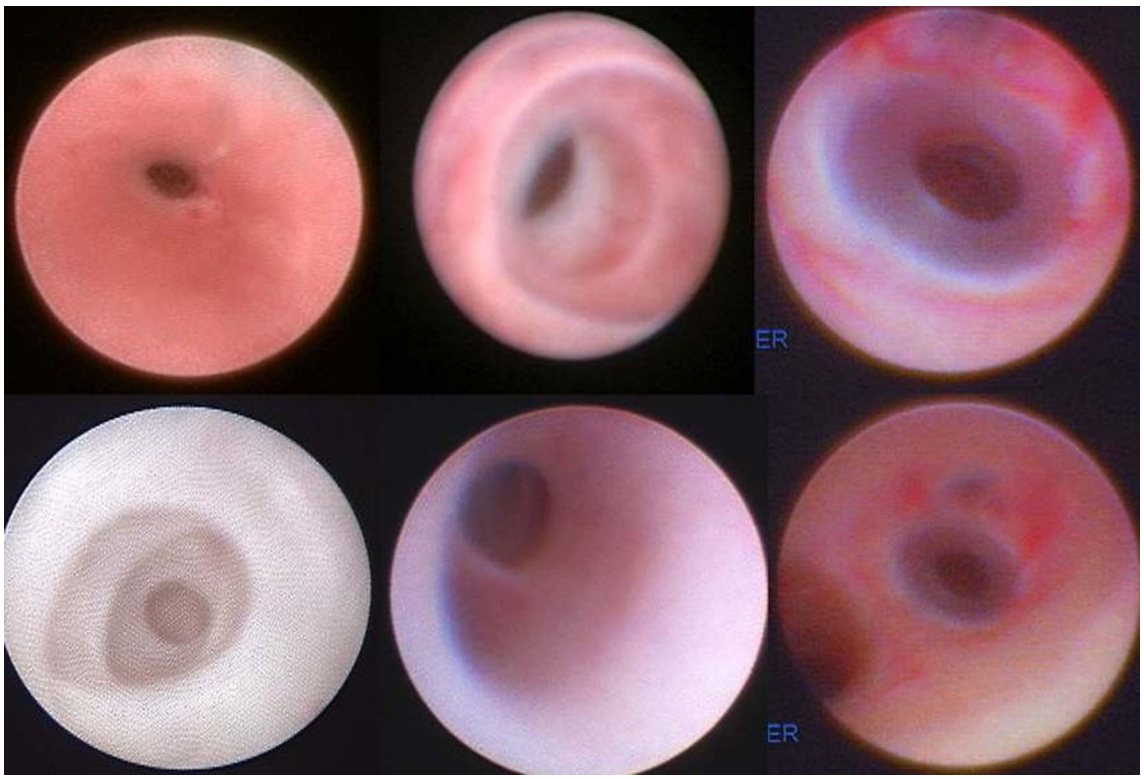

Fig. 2 Endoscopic picture showing stenosis

Table 1 Results of the endoscopic profile

Pathology	Number of cases	% of cases	Complete relief of symptoms at 1 year (%)	Complications (perforation)	Further investigation	Comments
Stenosis						
S1	14	7.9%	100%	1 case	–	–
S2	57	32.2%	98.2%	3 cases	–	–
S3	44	24.9%	97.7%	1 case	CT sialography	CT sialography was normal
S4	62	35.1%	96.7%	7 cases	MR sialography done in 2 cases	One case—repeat sialendoscopic dilatation Second case—parotidectomy
Stone						
Distal	23	79.3%	100%	1 case—wire basket struck so intraoral incision given	–	–
Proximal	6	20.7%	Not removed via sialendoscopy alone	2 cases	CT scan	Combined approach used to remove stone in all cases
Debris	28	11.6%	100%	3 cases	–	Antibiotic flushing of the ductal system done in all cases
No pathology	4	1.7%	100%	–	–	No complaints on follow-up
Miscellaneous						
Sialocele	2	0.8%	100%	–	–	Stenting done for 3 weeks and sialogogues given
Polyp	1	0.4%	100%	–	–	No complaints on follow-up after a course of antibiotics

Table 2 Subsets of stenosis cases

Pathology (stenosis)	Number of cases	% of stenosis cases	Complete relief of symptoms at 1 year (%)	Complications (perforation)	Further investigation	Comments
JRP	17 (S4)	9.6%	94.1%	0	–	1 case underwent repeat sialendoscopic procedure
Sjogren's syndrome	2 (S4)	1.1%	50%	0	MR sialography, mucosal biopsy, anti-Ro/La antibodies	
Mucoid flakes	42 (S1–S4)	23.7%	100%	3	–	2 cases—underwent interventional sialendoscopy after 2 months

cases of stenosis (S1-4), pale ductal mucosa with ill-defined vascular markings in another 17 cases (all S4), two cases of stenosis (S4) had history suggestive of Sjogren's syndrome, which collaborated with endoscopic findings (Table 2).

Stone (Fig. 3) was found to be the source of obstruction in 29 cases (12%) with a mean stone size of 3.6 mm. The stones were more commonly located distal to the masseteric bend (79.3%) as compared to proximal location seen in 20.7% cases. In 28 cases, the only endoscopic finding was mucous fakes/inflammatory debris (Fig. 4) with normal ductal mucosa and architecture, whereas the endoscopy was perfectly normal in four patients. A rare finding of polyp in the ductal mucosa was observed, obstructing the lumen of the duct in one case and two cases have parotid duct sialocele. Other peculiar anatomic findings observed were accessory ostia in 36 cases and acute masseteric bend in 28 cases, which posed difficulty in negotiating the sialendoscope beyond acute turn (Table 1).

Intervention

Stenosis

Balloon dilatation was done in 14 cases of membranous single stricture(S1) followed by stenting for 3 weeks. Serial dilatation with increasing sizes of sialendoscopes was done in S2-S4 cases of stenosis along with steroid flushing. Stenting could be done in only 75% of these cases. There was associated finding of mucoid flakes in the duct in 42 of these cases for which additional antibiotic flushing was done.

Seventeen cases of stenosis along with pale ductal mucosa seen in children (mean age 5.6 years) associated with the clinical history were consistent with the diagnosis of JRP (Fig. 5). All these cases had sialendoscopic dilatation and steroid flushing. The mean number of attacks reduced to 2.8 as compared with the preoperative 9.2. However, one case had persistent attacks with same severity, so a repeat sialendoscopic dilatation was done after 6 months and following which the attacks reduced in number and severity.

Two cases of stenosis (S4) also had mucoid flakes along with pale mucosa, and detailed history and examination revealed history of dryness of mouth and eyes. These patients were further worked up with MR sialography, lip mucosal biopsy and anti-Ro/La antibodies, and finally, Sjogren's Syndrome was diagnosed. They had partial relief with the sialendoscopic dilatation procedure.

Sialolithiasis

Retrieval of stone was done using wire baskets in all cases (23) of distal stone. In one case, while removing a partially fixed stone using basket, the wire got stuck in the duct for which papillotomy and intraoral incision had to be given for stone removal. In six cases, we were unable to extract the stone using wire baskets as in these cases stone was fixed to the ductal wall and located proximal to masseteric bend. In four of these cases, a combined sialendoscopic and external SMAS flap approach with the modified Blair's incision was used; a combined sialendoscopic and transcutaneous approach with linear incision was used in one case, while in the remaining one case, intraoral incision was given to isolate the duct and remove the stone, which was engaged in the wire basket. One case of stone removal by combined approach had complaint of swelling after five months for which check sialendoscopy was done and stricture was found at the site of stone which was dilated using balloon.

Others

In 28 cases, only mucoid debris was seen for which antibiotic flushing was done. Four cases had no pathology on endoscopy. Two cases of ductal sialocele were seen where sialendoscopic dilatation of the strictures was done

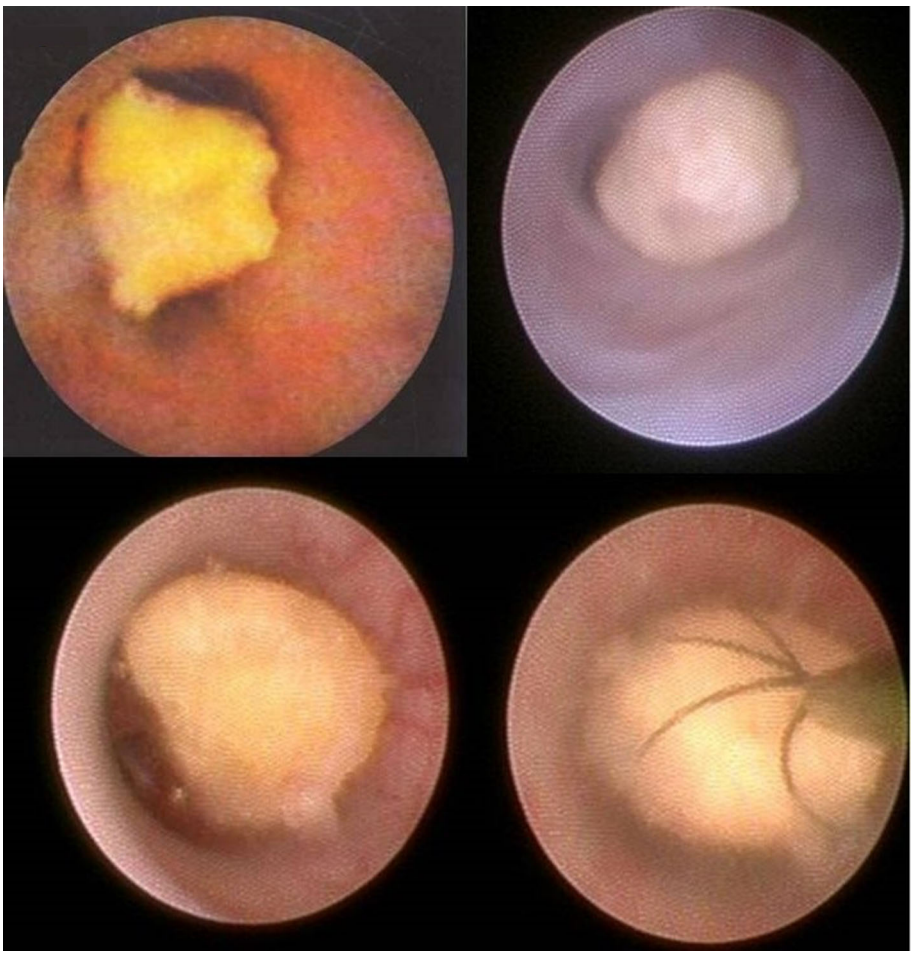

Fig. 3 Endoscopic pictures showing stone

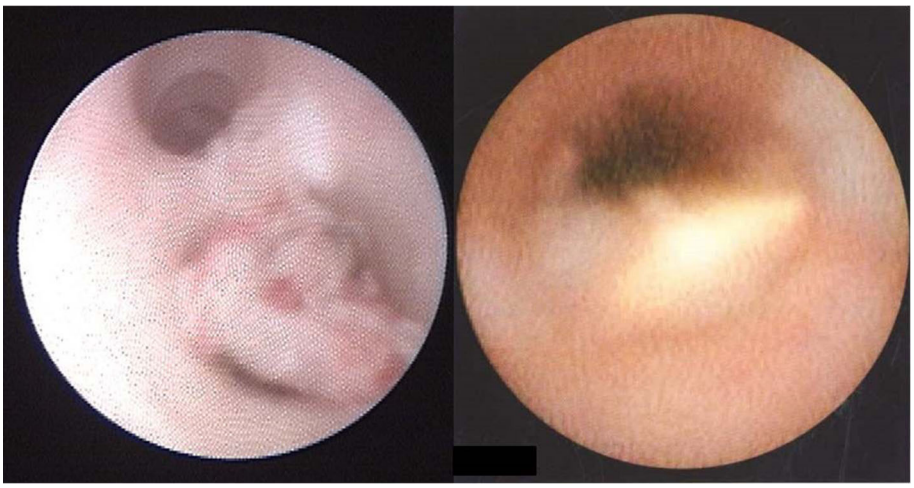

Fig. 4 Endoscopic picture showing mucoid debris and flakes

and a wide papillotomy was done followed by stenting for 3 weeks.

Complications

There were 18 cases where ductal perforation was seen, but the diagnostic procedure could be completed in all cases. The intervention was not done in the same sitting but completed in the second procedure after 2–3 months. (The duct was found well healed, and the intervention could be done successfully.) In all these cases, stricture was dilated using endoscopes and steroid was instilled. The reason for ductal perforation in 12 cases was due to forceful dilatation with probes and conical dilator, and in other 6 cases,

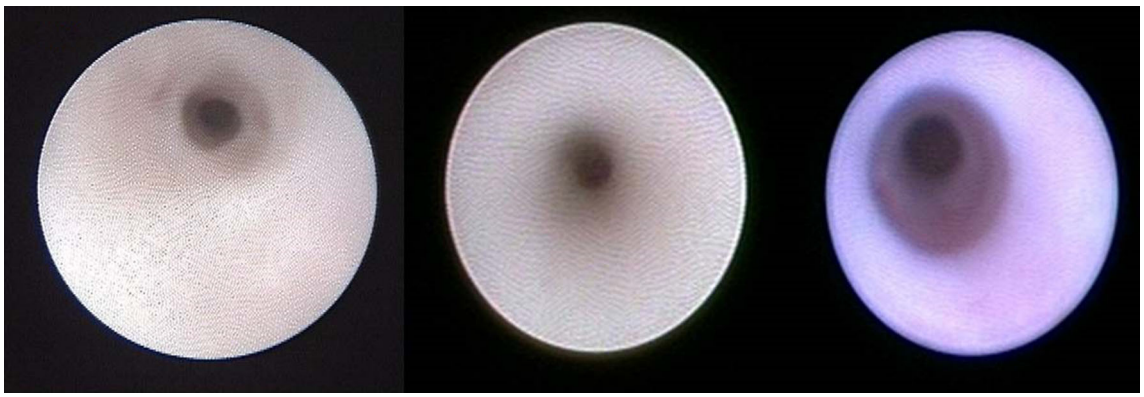

Fig. 5 Endoscopic picture in cases of juvenile recurrent parotitis

perforation occurred due to misdirection of scope in the stenosed duct.

Three cases complained of persistent intraoral discharge at 3 and 6 months, for which imaging (CT/MRI sialography) was done: CT sialography in 1 case was normal. MR sialography showed generalized stenosis in 1 case for which repeat endoscopy was done (dilatation and stenting was done), while in another case showing multiple hyperdense foci in bilateral parotid gland along with multiple strictures, he underwent repeat sialendoscopy but the symptoms did not resolve and finally the patient underwent bilateral superficial parotidectomy.

Discussion

Chronic sialadenitis is characterized by glandular swelling and pain that often flares during meals mostly with intake of sour or acidic foods. The common causes comprise stenosis, sialolithiasis, mucus plugs, polyps, foreign bodies, external compression and variations in anatomical ductal system. Various imaging modalities including ultrasonography (USG), CT, MRI and sialography have been used for identifying the above-mentioned pathologies leading to obstructive sialadenitis with varying degrees of success and results. These cases were earlier managed conservatively with antibiotics, massage, sialogogues, anti-inflammatory drugs and ultimately sialoadenectomy, if no improvement. The knowledge about the obstructive causes of sialadenitis has led to the development of techniques for detailed examination of the salivary ducts [9]. Sialendoscopy is a well-recognized procedure used for sialadenitis management and may either be diagnostic (to find a cause) or interventional (done to address the cause), and these may be done simultaneously or separately. Obvious advantages of the technique include a minimally invasive approach of disease management due to direct intraluminal visualization and therefore definitive diagnosis and treatment of diseases of the ductal system at the same time [10]. This ultimately reduces or eliminates the need for sialadenectomy and obviates associated surgical risks including temporary facial nerve weakness (16–38%), permanent facial nerve damage(9%), Frey's syndrome (8–33%), facial scarring, greater auricular nerve numbness (2–100%), salivary fistulas, hematomas, wound infection, etc. There is a distinctly favorable patient-perceived benefit and improvement in quality of life with this technique.

Diagnostic imaging for salivary glands includes USG, CT, MRI, and sialography. CT and MRI are noninvasive techniques and have the advantage of demonstrating detailed regional anatomy; however, they are limited in their ability to detect many of the other potential obstructive pathologies including non-calcified sialoliths, strictures, mucous plugs and stenosis [11]. Sialography can demonstrate these better, but it is invasive and does not show regional anatomy and is not universally available as an imaging technique. Finally, none of these imaging techniques have potential for therapeutic intervention for management of identified obstructive etiologies, which is the advantage with sialendoscopy. Sialendoscopy has proven to be a great diagnostic tool for rare pathologies, which were earlier not even mentioned in the literature like matted appearance of duct, peculiar connection between calculi and ductal wall, foreign bodies, etc. Cappacio et al. [12] compared sialendoscopy and MR sialography in evaluating sialectasis and stenosis in 24 patients and concluded that sialendoscopy has advantage over imaging modalities in terms of complete visualization of the ductal system, viewing small stenotic segments, mucus plugs, polyps, mucosal change, characteristic segmented matted appearance of ducts, etc.

A diagnostic sialendoscopy is considered successful if one can either completely visualize the ductal system or one is able to diagnose the cause for obstructive symptoms. Marchal and Dulguerov [13] reported a success rate of 98% for diagnostic sialendoscopy in 450 patients, while Nahlieli

and Baruchin [14] retrospectively assessed 236 patients and reported a success rate of 96% in their series. Although diagnostic sialendoscopy is possible in most patients, failure to pass scope along the entire ductal system may result from ductal stenosis, inflammation and presence of an acute masseteric bend of the Stenson's duct or papillary stenosis secondary to acute inflammation. In our series, we could successfully navigate the ductal system and were able to make a diagnosis in 96.3% of patients. Currently, the only contraindication for doing sialendoscopy is acute sialadenitis for fear of ductal injury, complications and spread of infection [15].

The most common pathology seen in our series was ductal stenosis (73.4% cases). In addition to allowing assessment of tissue characteristics in the area of stenosis, sialendoscopy at the same time allows appropriate therapy including dilatation of the stenosis using serial sizes of endoscopes or balloon and instillation of steroids. Cortisone is well known to have anti-inflammatory and antiproliferative effects on tissues [16]. In several publications, gland preservation rates in range of 80–90% subsequent to the treatment of salivary duct stenosis after short- to medium-term follow-up periods have been reported [16–18]. Our study group reported a significant reduction in symptoms in 97.2% of cases and a gland preservation rate of 99.4% after a mean follow-up of 24 months. In 23.7% (42/177) cases, fibrinoid discharge and plaques were also seen with stenosis, and stimulation of gland secretion with sialogogues (e.g., ascorbic acid) followed by gland massage was strongly recommended to all these patients, rationale being to clear the fibrinoid discharge out of the duct system and reduce or prevent plaque formation and duct obstruction in the future. Meta-analysis done by Koch and Iro determined that interventional sialendoscopy is the first-line management for parotid duct stenosis with ductal dilatation using endoscope followed by irrigation (using saline and cortisone) being the most commonly used technique [18]. Ardekian et al. reported a success rate of 81.7% in his study on 87 parotid duct stenoses with sialoballoons and forced manipulation using microdrill followed by irrigation with cortisone in all cases [19]. Vashishta and Gillespie treated 51 patients (92% had stenoses) by using microdrills and dilators in 78%, stenting in 10% and botulinum toxin injection in 8%. Overall, 61% patients were symptom-free, and gland resection was performed in 1 case [7].

We diagnosed and treated 17 cases of juvenile recurrent parotitis (JRP). Our results for all children showed a clear clinical improvement and even complete resolution of the symptoms goes along with those of other recently published studies. The therapeutic effect is mainly due to flushing of ductal system with corticosteroids, which possibly calms the chronic inflammation. Besides, dilatation of the duct and especially the orifice might positively influence the drainage of gland. In our study, the mean numbers of attack were reduced to 2.8 per year from 9.2 per year before sialendoscopy. It is comparable to the results of Nahlieli et al. [20] in 2004, series of 26 cases of JRP were treated by dilatation and abundant washing, and resolution of symptoms was achieved in 92% of cases, and in 2009, Kanerva et al. [21] included 20 children with JRP who were treated with sialendoscopic dilatation and lavage (saline followed by hydrocortisone) with a success rate of 90% after a single sialendoscopy and 100% after a second endoscopy.

Two cases had history of dryness of mouth and eyes along with bilateral parotid gland swelling, and sialendoscopy revealed stenosis along with mucoid debris bilaterally. His symptoms persisted so MR sialography, blood autoantibodies and minor salivary gland biopsy were done for diagnosis of Sjogren's Syndrome. Sialendoscopy has been increasingly employed in the differential diagnosis and treatment of SS in recent years, with pale, avascular ductal walls; atrophic ducts; mucous plugs; sialodochitis; and strictures being the most common endoscopic findings [22]. Treatment options are irrigation with saline to wash out mucous plugs and dilate the duct; dilatation of the duct with balloons; and infusion of steroids to reduce inflammation. In our patient, we did repeated flushing of the ductal system with steroids, and he had partial relief of symptoms. Capaccio et al. reported resolution of symptoms in 22 patients with SS of parotid glands using endoscopic techniques [23].

Endoscopes with working channels allow for concomitant use of instrumentation to assist in sialolith removal. In some cases, lithotripsy or laser devices may be used to facilitate stone fragmentation prior to removal. For stones not amenable to endoluminal removal, a combined approach using a limited incision in combination with sialendoscopy to localize and stabilize the stone was used [24]. We treated 29 cases of sialolithiasis, 23 cases had floating stone of sizes 2–4 mm, distal to the masseteric bend, which were removed using sialendoscopy and wire basket. The center of the masseter is a general landmark for the removal of sialoliths from the parotid duct using sialendoscopy [25]. Large salivary stones (>4 mm) or stones located proximal to masseteric bend or fixed to the wall of the duct are difficult to remove using sialendoscopy alone. The combined endoscopic-external approach allows for precise control of the ductal pathology, retrieval of stones of any sizes, and microsurgical enlargement of the ductal stenosis. In one interesting case, we were unable to retrieve a 5-mm stone distal to the masseteric bend using wire basket, and the stone was then removed by intraoral incision and duct isolation under sialendoscopic guidance. Nahlieli et al. [26] described 12 patients treated for parotid

gland sialolithiasis using external approach (horizontal external skin incision over the stone) and reporting a success rate of 75%. Hills et al. [27] used sialendoscopic-guided intraoral and external approach in 115 patients and stone removal achieved in 97% cases with asymptomatic long-term follow-up in 89% patients.

There were four cases in which no pathology was found but on follow-up, all these patients were symptom-free. These results can be attributed to dilatation of the papilla, dilatation of duct with saline irrigation and flushing of ductal system. It has been mentioned by Serbetci et al. [28] that dilatation and irrigation of salivary ducts and insertion of stent can be proposed as treatment for salivary glands in which no pathology is detected.

Sialendoscopy is not free from complications, and several complications after sialendoscopic procedures, namely ductal perforations, avulsion of duct, post-sialendoscopic strictures, and gland swelling, has been reported [29]. Perforation was the most common complication noted in our study in 7.5% (18/241) of cases. This is similar to the study performed on 900 patients by Marchal, where he reported perforation (false tract) in 6.23% cases [15]. Perforation (false route) of the duct can happen either near the papilla because of forceful dilatation with conical dilators (seen in 12 cases) or due to mechanical mis-negotiation of the scope (seen in 6 cases). The identification of this is possible through the endoscopic picture, which might not show the regular ductal features. As discussed by Kent et al. [30], papilla identification and dilatation is the rate-limiting step and poses a major challenge for beginners. Another sign is excessive swelling of the gland externally due to leakage of irrigation solution into the surrounding tissue. Avulsion of the duct is one of the serious iatrogenic complications, but it was not seen in our study. Postoperative stricture was seen in one case where stone was removed via combined approach, and it was later dilated using balloon. Nahleili et al. [31] reviewed 1589 cases; 39 cases developed postoperative strictures. Postoperative glandular swelling is sequelae and resolves in 24–48 h by gentle massaging. In addition, salivary fistula, sialocele, minor ductal tears, and minor hemorrhage have been reported as rare complications. We did not encounter these complications in our study.

Finally, we must note the limitation of our study. The lack of preoperative diagnosis did not allow for a targeted counseling of the patients. In cases of large, fixed stone which were not amenable for sialendoscopic removal alone, a preoperative knowledge of the size and location of the stone could have helped in planning the combined approach in the same sitting and appropriate consent and counseling of the patient could have done. So a preoperative noninvasive radiological investigation like ultrasound should be a part of routine workup of all the patients presenting with recurrent sialadenitis.

Conclusion

Sialendoscopy is a safe and highly effective modality in managing non-neoplastic parotid gland disorders with low complication rates. It is a promising diagnostic technology that overcomes the limitations of radiologic diagnosis and at the same time decreases the morbidity of more invasive surgical procedures used to manage obstructive sialadenitis. Salivary endoscopy assists in therapeutic interventions that lead to symptom control and gland preservation in the vast majority of patients. Therefore, it can be concluded that sialendoscopy is the diagnostic and therapeutic modality of choice for parotid obstructive sialadenitis. However, we feel ultrasonography (USG) should form a part of routine workup of these patients as having a preoperative diagnosis in certain cases is beneficial for both patients and operating surgeon. Our institution has successfully implemented this technique, and we have demonstrated favorable outcomes for our patients, comparable to other institutions that use sialendoscopy.

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Availability of Data and Material The detailed data can be requested and shall be provided if needed.

Compliance with ethical standards

Conflicts of interest All authors declare that they have no conflict of interest.

Ethics Approval All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. This article does not contain any study with animals performed by any of the author. The study was approved by Ethics Committee of University College of Medical Sciences, Delhi University.

Consent to Participate Informed consent was obtained from all the individual participants included in the study.

Consent for Publication All authors consent for publication of this article.

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