Sialoscopy—initial experiences with a new endoscope

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Introduction

Semirigid sialoendoscopes are widely used, because they are useful as diagnostic and therapeutic tools and cause few complications.

Diagnostic endoscopy of the ductal systems of the parotid and submandibular glands was first mentioned by Katz in 1991.[1] He described a flexible ''mini-endoscope'' (diameter: 0.7 mm). Königsberger et al.[2] and Gundlach et al.[3] used flexible endoscopes for laser lithotripsy (diameter: 2.0 mm including working channel). Nahlieli et al. used rigid endoscopes (diameters: 1.7—2.5 mm, together with cannulas of 2.0—2.7 mm).[4,5] Marchal et al. published a large series of patients to show the application of sialoscopy with semirigid instruments with outer diameters of 1.7 mm (a 1.1 mm endoscope together with a semirgid 0.8 mm working channel) for treatment and with a diameter of 1.3 mm for diagnosis.[6,7]

Ten years ago, after in vitro and in vivo experiments,[8] we did lithotripsies in patients with submandibular stones, using a 1.6 mm flexible instrument with a working channel of 0.6 mm in patients.[9] The introduction of instruments of this size into the ducts always required the slitting of the duct and dilatation of the ostium (papillotomy). In the submandibular gland this presented no technical problem, but stenoses developed in the first four patients who had had the duct of the parotid gland slit more than 5 mm. Because

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of this complication we no longer slit Stensen's duct.[10]

We did histological studies to find out the appropriate diameter of endoscopes and microinstruments (balloon dilators and catheters) for use in the salivary duct. We established that a maximum outer diameter of 1.2 mm is the ideal to minimise iatrogenic damage.[11]

We now report the first clinical trials of an endoscope that has been developed specifically for endoscopy of salivary ducts. It has an ideal outer diameter, rigidity, and good flexibility and quality of image.

Material and methods

The endoscope is known as the SalivaScope-FLEX, PD-ZS-2000^{TM} (Polydiagnost Company, D-78503 Pfaffenhofen, Germany). It is a highly flexible semirigid sialoscope with an Nitinol sheath. It is 75 mm long and has an outer diameter of 1.1 mm, a 0.4 mm working channel, and a separate channel for irrigation. The optical resolution is 6000 pixels and the view is 0° direct. It is accompanied by a 380—390 μm dormia basket, forceps, drill, and cleaning brush. Because of good quality of the images (both in resolution and size), durability, and considerations of hygiene, semi-rigid endoscopes have gained prominence in this field. A problem that still persists, however, is the crooked course of the excretory ducts of the salivary glands. In many cases this can be overcome because of the elasticity of the soft tissue of the cheeks and the floor of the mouth, but there is still the risk of damage as a result of forced introduction of the instrument. The size of the two integrated working channels allows the introduction of a basket for stone retrieval or a laser fibre up to 0.39 mm in the first channel under continuous irrigation through the second one. The special feature of the instrument is its extreme flexibility because of its Nitinol sheath (it can be bent to a 90° angle without breaking) combined with the rigidity that is needed to insert it into the ostium of the duct (Fig. 1a and b).

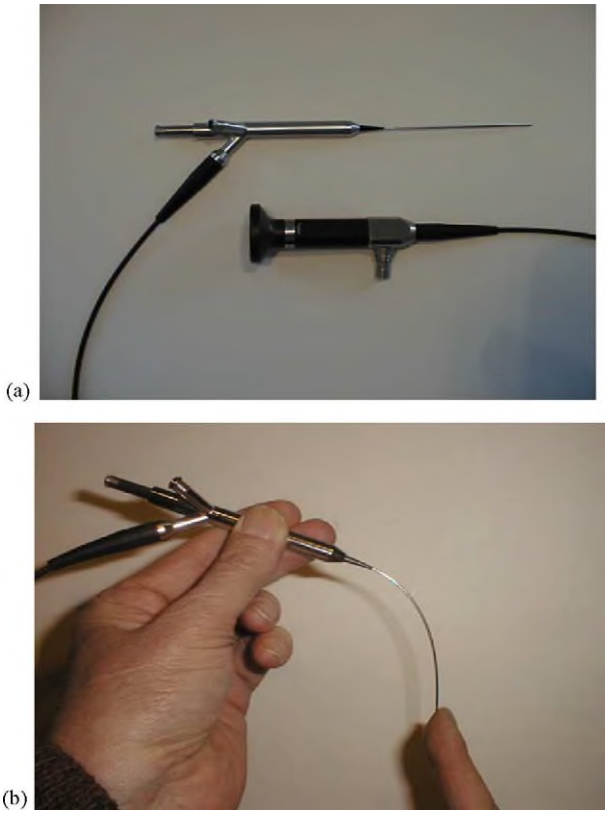


Figure 1 (a) Salivascope ''Salivaflex'' with two working channels for instruments and irrigation. (b) The rigid instrument allows flexibility up to an angle of 90°, and is therefore durable and easy to use.

The technique of endoscopy of salivary ducts

The excretory ducts of the submandibular and the parotid gland were investigated. To insert an endoscope with a calibre even as small as 1.1 mm into these ducts, the narrowest part—the ostium (the mean diameter of which is 0.5 mm)[11]—has to be dilated. Before dilatation the local area is treated with lidocaine 2% spray. After dilating the ostium with a commercially available conical dilator lidocaine solution (2%) is injected directly into the duct system through a 22G catheter and the endoscope is introduced carefully. Using gentle irrigation with 0.9% saline or Ringer's solution the instrument can be introduced up to the hilum of the duct system (Fig. 2a and b show normal hilar structures of submandibular and parotid glands).

The endoscope can easily be manoeuvred through kinks and bends of the duct system, particularly the curvatures of Stensen's duct (through buccinator muscle and in front of masseter muscle) or Wharton's duct ('comma area' at the dorsal end of the mylohyoid muscle). Continuous irrigation should be maintained during the course of the endoscopy to keep the duct lumen open. No additional local anaesthesia is required.

The attending physician will require assistance for irrigation and to operate the instruments. Antibiotics are not normally required. We prescribe roxythromycin for two days when treatment is extended for more than 15 min, because prolonged irrigation may cause extensive swelling of the gland.

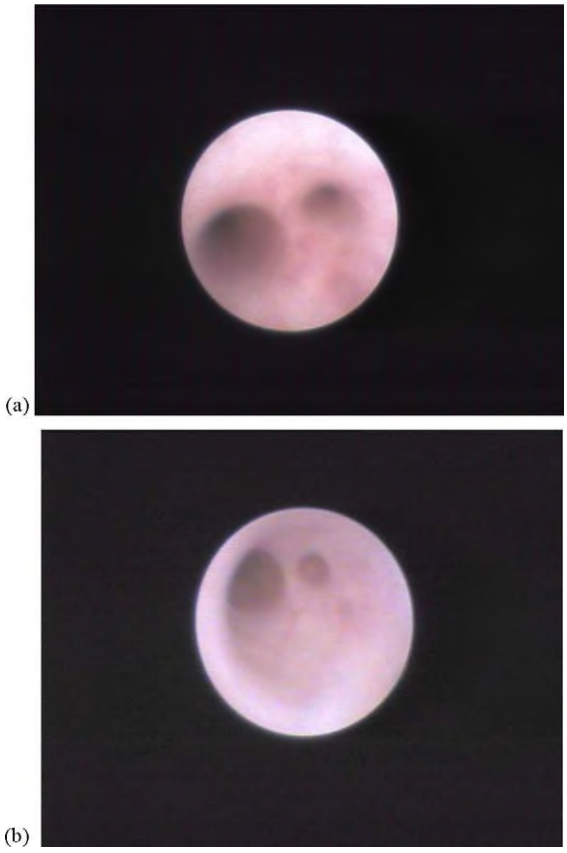


Figure 2 View of normal hilum of Stensen's (a) and Wharton's (b) ducts.

The gland should bemassaged regularlyand sialagogues are necessary after endoscopic treatment.

Patients

Twenty-two patients (10 women, 12 men, aged 23—65 years) who had symptoms of obstructive disease of the major salivary glands were treated with the new endoscopes (13 submandibular and 9 parotid glands).

Twelve patients had an ultrasonographically diagnosed sialolithiasis, 10 of whom had sialolithiasis of the submandibular gland or Wharton's duct. We did the endoscopy before incising the duct and, when the stones were distal, again after removal of stones to exclude further concretions and to assess the ductal epithelium. Two patients had sialolithiasis of the parotid gland.

Three patients were examined three months after extracorporeal lithotripsy (ESWL) because of a sonographically questionable residual concretion. ESWL was the first line of treatment of intraparenchymal sialolithiasis (Piezolith 2501, Richard-Wolf Company, Knittlingen, Germany).

Seven patients had vague symptoms and ultrasonographically unexplained swelling of the major salivary glands (four in the parotid gland and three in the submandibular gland).

Results

After dilatation of the ostium and local intraductal anaesthesia, it was possible to insert the sialoendoscope in all cases. This compares favourably with other endoscopes.[5—7,12]

Sialolithiasis (known or newly diagnosed) was the most common finding in 13 of the 22 patients. Examination of the duct up to the site of the stone in those 13 patients or up to the glandular hilum was easily achieved by adjusting the instrument manually while in the mid-section of the duct.

In 8 of the 12 patients with sialolithiasis (all in the submandibular gland) the stone had impacted into the surrounding tissue and endoscopic treatment was not tried. The remaining four had a mobile calculus (two, submandibular gland, two, parotid gland, diameter 3—4 mm) and it was possible to remove the stone using the basket (Fig. 3a and b). In one of the three patients after ESWL multiple small fragments were detected (Fig. 3c) and we could remove most of them endoscopically. Endoscopic treatment was possible in only 5 of the 13 patients with sialolithiasis, but it was successful in all those cases.

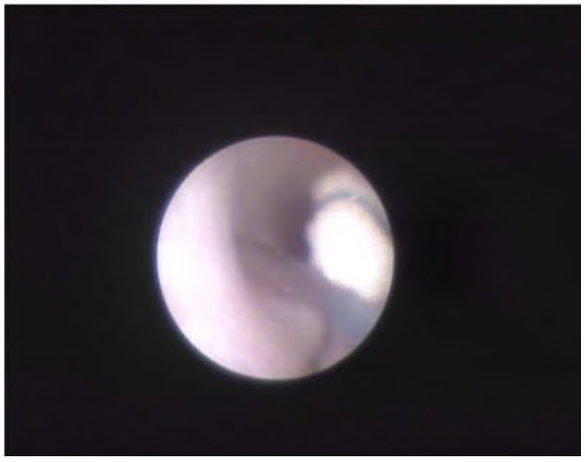
Of the seven patients with undiagnosed recurrent swelling of the salivary glands, stenosis was seen in three. In one patient the sialoscope could be passed up Wharton's duct for only 1.5 cm. This necessitated dissection of the duct in the floor of the mouth. There was a narrow diffuse stricture of the excretory duct from the ostium to the hilum of the gland. In two patients, a membrane-like stenosis of Stensen's duct was dilated with the endoscope (Fig. 4).

Sialodochitis was the pathological finding in three cases. These patients had an oedematous duct system with fibrin plaques in Stensen's duct. One of these had an undiagnosed swelling of the parotid gland, and the other two were after ESWL of a parotid duct stone when no residual fragments were found, but inflammatory changes in the duct system.

In one patient with recurrent swelling of the submandibular gland, a foreign body (a hair) was found in the hilum and was removed by a basket. Of the seven patients with undiagnosed recurrent swelling of the salivary glands two had no abnormal findings in the duct system (one submandibular and one parotid gland).

In all but one of these cases, it was possible to inspect the secondary ducts and, if the anatom-

(a)



(b)

(c)

Figure 3 (a) Stone within the hilum of a submandibular gland. (b) Extraction with the basket. (c) Multiple small fragments of a large parotid stone after lithotripsy.

ical conditions were favourable, also the tertiary branches. Endoscopic treatment was attempted in eight cases and was successful in all.

During endoscopy the patients had slight to moderate pain in the area of the gland that was being

Figure 4 Stenosis of Wharton's duct.

examined; this was caused by the irrigation and was well tolerated because of the local anaesthesia. The endoscope allowed the discharge of irrigating fluid alongside the instrument. This often disturbed patients, so that regular suctioning by an assistant was helpful. Nearly all glands swelled postoperatively, and this lasted from 1 to 3 h. In one instance, a false passage was made during the second attempt at endoscopy of Stensen's duct, resulting in swelling of the cheek, but this had completely subsided after three hours. There were no other complications. All patients, who had pathological findings, particularly when they were treated, were given roxithromycin postoperatively 300 mg a day. Postoperative sialadenitis was not seen in any case.

Discussion

Infections and obstructions of salivary glands are common. History and examination guide the investigator in the right direction, and modern imaging techniques such as ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) often show lesions precisely. Yet, particularly in the case of recurrent swelling of the large salivary glands, a diagnosis can often not be made by imaging. Ultrasound, for example, can recognise salivary stones lodged in the duct system with 99% reliability but only when they are bigger than 1.5 mm and are highly mineralised.[13]

Sialoscopy offers a new way to deal with these problems. Technical advances during the past 12 years have resulted in endoscopes with smaller and smaller diameters.[14,15] After Katz[1] described sialoscopy in 1991 other research groups have evaluated the method (Table 1).[2,4–8,12,16–20]

At first flexible endoscopes with a diameter of 0.8—2.0 mm were used.[1,8,17] Simple examinations

Table 1 Published experience with sialoscopes.

First author	Year (reference)	Diameter (mm) and type	Working channel (mm)
Katz	1991[1]	0.7, flexible	None
Gundlach	1991[3]	2.0, flexible	0.6
Nahlieli	1994[4]	2.7, rigid	None
Nahlieli	1997[5]	1.7, rigid 2.3, rigid	None
Iro	1995[9]	1.6, flexible	0.5
Ito	1996[17]	1.5, flexible	0.2
Arzoz	1996[16]	2.1	1.0
Yusua	1997[18]	0.8/1.8, rigid/flexible	None
Marchal	2001, 2002[6,7]	1.3, semirigid (with introducable 1.1 mm endoscope)	0.8
Chu	2003[19]	3.1, rigid	1.7
Nahlieli	2000, 2003[12,20]	1.3, 2.3 mm × 1.3 mm	1
Erlangen	2003	1.1, semirigid	0.4, irrigation channel

could be made, but they were not suitable for difficult examinations or for treatment as there was a risk of damage when they were bent. In the endoscopes with a small diameter the quality of light was not sufficient and in those with a larger diameter papillotomy was often necessary. Most endoscopes had no irrigation channel.

Later rigid endoscopes with diameters ranging from 1.0 to 2.7 mm were used.[4,5] These rigid endoscopes were far less fragile and various forceps and other miniature surgical tools could be introduced easily. Curves and bends of the ducts presented no difficulties when rigid endoscopes were used.[5] Manoeuvring was easier and the quality of light was better, but the risk of damage to the salivary duct was increased. This was particularly the case with endoscopes with larger diameters, which were used for treatment. Moreover, in most cases papillotomy was required to allow the insertion of the endoscope into the excretory duct system.[5,12] At the sublingual caruncle this poses no problem, but at the ostium of the excretory duct of the parotid gland introduction of the endoscope is technically more difficult and papillotomy may lead to stenosis of the duct.[10]

In recent years smaller semirigid endoscopes have been developed and papillotomy can be avoided in nearly all cases and the advantages of the flexible and rigid endoscopes were combined. Because of their smaller diameters the light yield and image quality were poorer.[6,7,12] The semirigid construction did not rule out the risk of damage from bending.

Appropriately sized endoscopes, which combine all advantages have now been developed and have been successful in the clinical trial presented in this paper. The aim was to develop instruments suited to a wide range of diagnostic and therapeutic purposes and, at the same time, take intensity of light, quality of image and ability to adapt to anatomical conditions into consideration.

The design of the new endoscope first took into account the optimal diameter. The mean diameter of the excretory ducts in major salivary glands was investigated in a previous histological study.[11] This showed that the diameter of endoscopes, given the presence of the normal physiological duct lumen, should not exceed 1.5 mm. The narrowest part of the ostium (0.1—0.5 mm) can be dilated by using a simple conical shaped dilator. These results were corroborated by Yuasa et al. who reported diagnostic endoscopies of the submandibular gland using endoscopes with diameters of 0.8 and 1.0 mm without the need for a papillotomy.[18] We found no need for papillotomy in our series but the endoscope could not be advanced further 1.5 cm in one patient as a result of a diffuse stricture of the submandibular duct.

Our sialoscope had 6000 pixels available, so we had an excellent view in all cases. As a result of the two working channels it was possible to make diagnoses and particularly to give treatment with high quality images. Instruments can be introduced easily in the working channel and manoeuvring is facilitated by dilatation of the duct, by using the irrigation channel and by intraductal anaesthesia.

Because of their construction with a Nitinol sheath our instruments are extremely flexible to nearly 90° (Fig. 1b), but retain their rigidity and optical function when required for manoeuvres.

We offer the following indications for endoscopy of the salivary ducts: diagnosis of swelling of major salivary glands of obscure origin, which have evaded the currently available imaging techniques;

endoscopic guided treatment; and monitoring the success of treatment (ESWL, intracorporeal lithotripsy, duct slitting, or other treatment).

Endoscopy closes a diagnostic gap and may be important in establishing the need for resection rather than preservation of major salivary glands.[21] There is so far hardly any detailed information about the excretory duct system in many salivary duct disorders (such as chronic recurrent sialadenitis, Sjogren's disease and sialadenosis). Interesting new insights could be gained by endoscopic studies. To what extent this may be viable in the future remains to be established by further investigation. One restriction is worth mentioning: the excretory duct system can be inspected only up to but not including tertiary ducts. Most of the smaller excretory ducts, which are part of the intraparenchymatous system, cannot be assessed.

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