

## Research Article

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# Sialoendoscopy, sialography, and ultrasound: a comparison of diagnostic methods

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**Keywords:** Sialoendoscopy; Ultrasound; Sialography; Benign salivary gland obstruction; Sialolithiasis

**Abstract:** Objective. To compare the accuracy of ultrasound, sialography, and sialendoscopy for examining benign salivary gland obstructions.

**Methods.** In this prospective study, patients with symptoms of obstruction of the major salivary gland duct system presenting at the ENT Clinic University Hospital, Ostrava, from June 2010 to December 2013 were included. All patients (n=76) underwent ultrasound, sialography, and sialoendoscopy. The signs of sialolithiasis, ductal stenosis, or normal findings were recorded after the examinations. Statistical analysis of the sensitivity and specificity of all the methods was performed, as well as a comparison of the accuracy of each method for different kinds of pathology (sialolithiasis or stenosis).

**Results.** The sensitivity of ultrasound, sialography, and sialoendoscopy for sialolithiasis findings were 71.9%, 86.7%, and 100%, respectively. The sensitivity of sialography and sialoendoscopy for stenosis of the duct was 69.0%, and 100%, respectively. The study showed impossibility of ultrasonic diagnostics of ductal stenosis. The sensitivity of sialoendoscopy for both pathologies was significantly higher than that from ultrasound or sialography ( $p < 0.05$ ). The specificity of sialoendoscopy was significantly higher than that from by ultrasound or sialography ( $p < 0.05$ ).

**Conclusion.** Sialoendoscopy was the most accurate method for examination ductal pathology, with significantly higher sensitivity and specificity than by ultrasound or sialography.

## 1 Introduction

The most frequently occurring salivary gland disease (excluding tumors) is benign salivary gland obstruction (BSGO)[1]. BSGO includes all of the symptoms caused by obstruction of the salivary duct system [1]. A majority of BSGO cases are caused by sialolithiasis (60% to 70%) or stenosis of the salivary duct (15% to 25%) [2,3]. BSGO most often occurs in persons between 25 and 50 years of age.

A history of BSGO includes painful swelling of the salivary glands (especially after a meal) [4]. Clinical findings include swelling of the salivary gland and a muddy discharge from the salivary duct. The most common imaging method used for salivary diseases is ultrasound; however, the accuracy of ultrasound for establishing the etiology of ductal stenosis seems to be limited [2]. Sialography, which is characterized by examination of the duct with contrast medium, is nowadays considered obsolete in many cases [5, 6]. However, it remains highly effective for imaging the ductal system in chronic inflammation of the salivary gland ducts and sialolithiasis. According to some studies, sialography can identify sialolithiasis with high sensitivity and specificity [2-6].

After its implementation in the early 1990s, sialoendoscopy rapidly developed into an important diagnostic and therapeutic technique for salivary gland disorders, especially in sialolithiasis [2]. Advances in endoscopic equipment, mainly miniaturization, permitted progress in endoscopic examinations of the salivary gland duct. This method, characterized by high accuracy in examining the ductal system, is currently used in our department.

The goal of our current study was to compare ultrasound, sialography, and sialoendoscopy in terms of their sensitivity and specificity for establishing the etiology of BSGO (ductal stenosis or sialolithiasis).

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## 2 Material and methods

### 2.1 Study design

Patients with symptoms of obstruction of the major salivary gland duct system (swelling, pain, and incrustation of the gland), or with a proven pathology (chronic, recurrent sialadenitis, sialolithiasis) at the ENT Clinic University Hospital Ostrava, from June 2010 to December 2013 were included. The aim of the study was to compare the sensitivity and specificity of ultrasound, sialography, and sialendoscopy for their accuracy in diagnosing sialolithiasis and duct stenosis. Patients with a history of previous surgical interventions in the affected area and patients with acute sialadenitis were excluded from the study, as well as patients allergic to articaine.

Patients were asked to complete a questionnaire about the frequency and intensity of the swelling in the area of the salivary gland and their past history of diseases of the salivary glands. Patients underwent a clinical examination (by sight, palpation, and quality of secretion).

The study was performed in accordance with the Declaration of Helsinki, Good Clinical Practice guidelines, and applicable regulatory requirements. Written informed consent was obtained from all patients before the initiation of all procedures.

### 2.2 Ultrasound

All patients underwent ultrasound examinations using high-resolution sonography (GE Logiq 7, 7.5 MHz). Assessment of the salivary gland parenchyma and the gland orifice was performed. For a sialolithiasis, the presence of heterogeneous lesions with an acoustic shadow was con-



**Figure 1:** Procedure of sialoendoscopy. The sialoendoscope was inserted in the right Wharton's duct.

sidered. In our study, indirect signs of prestenotic dilatation of the diameter of Stensen's and Wharton's ducts of more than 2 mm were the parameter for stenosis (without signs of sialolithiasis).

### 2.3 Sialography

Sialography (contrast media, Omnipaque 300 mg I/ml, GE Healthcare, Kodak DR 7500 Direct View) was performed in all patients. A complete deficit of signal from the sialogram was taken as a sign of sialolithiasis. Narrowing of the signal of the diameters of Stensen's and Wharton's ducts < 1.5 mm was taken as a sign of stenosis (based on anatomical data) [7].

### 2.4 Sialendoscopy

For the sialendoscopy, the patient was placed in a sitting position. Sialendoscopy was conducted under local intra-ductal anesthesia (articaine 4%) using a semi-rigid flexible endoscope with working and flushing channels 1.1 mm and 1.6 mm in diameter (Karl Storz GmbH & Co KG, Tuttlingen, Germany, a compact modular semi-rigid interventional endoscope with three channels). The endoscope was inserted into the gland duct following dilation of the orifice (in case of an obstruction at the level of the papilla, a so-called papillotomy was performed) (Fig. 1). The presence of sialolithiasis or stenosis in the ductal system of the gland was examined. As a reference, the mean diameters of Stensen's and Wharton's ducts were estimated to be 1.5 mm (based on anatomical data) [7]. For a stenosis, at least 25% narrowing of the diameter of the duct was specified.

### 2.5 Statistical Analysis

To describe our cohort, charts with the number of findings in each group and the arithmetic mean and standard deviation were used.

For each examination group (ultrasound, sialography, and sialoendoscopy), the sensitivity and specificity for each pathology (sialolithiasis or stenosis) was established. For specificity and sensitivity, 95% confidence intervals (CI) were calculated according to a binomial distribution of the data. The  $\chi^2$  test for 5% significance was used to analyze differences between groups, with  $p < 0.05$  considered statistically significant. Stata software (version 13) was used for all statistical calculations.

### 3 Results

Between June 2010 and December 2013, 76 patients [57 (75%) males, 19 (25%) females] were subjected to 79 examinations; in 3 patients, two glands were involved. The male to female ratio was 1/0.75. The study included 19 (24%) parotid and 60 (76%) submandibular glands. The parotid gland to submandibular gland ratio was 1/3.1.

In the ultrasound group, the sensitivity for sialolithiasis findings was 71.9% (95% CI 53.3–85.3%). The study confirmed, that ultrasound is unusable method in ductal stenosis diagnostics. In the sialography group, the sensitivity for sialolith findings was 86.7% (95% CI 69.3–96.2%), and the sensitivity for stenosis of the duct was 69.0% (95% CI 49.3–84.7%). The specificity of sialography was 71.4% (95% CI 41.9–91.6%). Both the sensitivity and specificity of sialoendoscopy for sialolithiasis and stenosis findings were 100% (Table 1).

There was no significant difference in the sensitivities for sialoliths between ultrasound and sialography ( $p=0.235$  vs  $p=0.500$ ). However, the sensitivity of sialoendoscopy was significantly higher than that for ultrasound or sialography ( $p<0.05$ ). The sensitivity of sialoendoscopy for ductal stenosis was significantly higher compared with sialography ( $p<0.05$ ).

The specificity of sialoendoscopy was significantly higher than that for ultrasound and sialography ( $p<0.05$ ). The specificity of sialography was not significantly higher than that for ultrasound ( $p=0.563$ ).

### 4 Discussion

The typical symptomatology of BSGO includes painful recurrent swelling of the salivary gland, whereas clinical findings include swelling of the salivary gland and muddy discharge from the salivary duct [4]. Usually, anamnesis and clinical findings are not sufficient to determine

the etiology of BSGO. The most widely used diagnostic tools are ultrasound, x-ray examination, and sialography [8-10]. Between 15% and 30% of all submandibular concretions and up to 40% to 60% of all parotid stones are not detectable on plain x-rays or other conventional radiological images [8, 9]. Sialography is the gold-standard of examinations at many centers and can identify sialoliths with high sensitivity and specificity; however, it cannot be used when acute infection is present or when the patient is sensitive to the contrast medium [8, 11, 12]. According to Bohndorf et al, 91% of chronic obstructive or non-obstructive sialadenitis cases could be correctly diagnosed with sialography [16]. Other authors such as Kress found that sialography frequently produced a false diagnosis of “glandular tumor”, which resulted in a comparatively lower sensitivity of 54% for sialography in detecting sialoadenitis [5]. In our study, the sensitivity of sialography for detecting sialolithiasis was comparable to ultrasound (86.7% vs 71.9%), and the sensitivity of sialography for identifying stenosis was 69.0%. According to these findings, sialography seems to be a very useful imaging method for examining the ductal system.

Ultrasound revealed calculi sized greater than 1.5 mm in nearly all cases in an experimental study, but calculi with a low mineral composition or early-stage stones may not be detected [8, 13]. Often, only indirect signs of obstruction, appearing as duct dilation or changes in the echogenicity of the glandular parenchyma can be identified [14]. In his study of 93 patients and 111 Stensen’s ducts, Koch et al found ultrasound to have very limited ability for evaluating ductal stenosis, which is in agreement with our findings. Koch et al considered duct dilatation and the presence of hypoechogenic changes in the glandular parenchyma to be an indirect sign of duct stenosis.

In the past 20 years, the use of sialendoscopy, a novel diagnostic and treatment method for the major salivary gland ductal system has grown in the world [2]. Accord-

**Table 1:** Sensitivity and specificity of ultrasound, sialography, and sialoendoscopy (N=79).

	Sialolithiasis		Stenosis		
	TPR (%)	CI (%)	TPR(%)	CI	SPC (%)
Ultrasound	71.9	53.3–85.3	–	–	66.7
Sialography	86.7	69.3– 96.2	69.0	49.3–84.7	71.4
Sialoendoscopy	100	–	100	–	100

TPR: Total Positive Rate (Sensitivity); CI: Confidence Interval; SPC: Specificity

ing to Koch et al., ultrasound and sialoendoscopy are currently the most important methods of examination for salivary glands, with complementary diagnostic potential [3]. Sialoendoscopy enables a direct examination of the salivary duct and can be used for the classification of stenoses. Koch et al recognized that inflammation-dominated areas had various narrowing of the lumen (type I) in 16.1% of patients; fibrous and web-associated, predominant incomplete (luminal narrowing <50%, type II) in 18.3%; and fibrous, predominant high-grade (luminal narrowing >50%, type III) in 66.6% [15]. The proposed classification may influence further therapy. Type I stenoses may be treated successfully in the majority of cases by conservative means (e.g., applying cortisone into the duct system) [15].

Sialoendoscopy is a minimally invasive method with high sensitivity and specificity for ductal pathology and, according to our findings, is superior to ultrasound or sialography. In many cases of ductal pathology, sialoendoscopy has high treatment potential (Table 2). This decreases the cost/benefit ratio for the patient with the possibility of avoiding open surgery of the major salivary glands, and may justify use of a sialoendoscopy in ENT departments.

## 5 Conclusion

Sialoendoscopy is the most accurate method for examining ductal pathology. Its sensitivity and specificity is significantly higher than both ultrasound and sialography. However, both sialography and ultrasound are useful basal diagnostic methods when examining the pathology of the major salivary glands. Sialography remains an important diagnostic tool for ductal pathology. Ultrasound provides great results in diagnostics of sialoliths.

**Table 2:** Comparison of ultrasound, sialography, and sialoendoscopy in ductal pathology examinations

	Advantages	Disadvantages
Ultrasound	Non-invasive High sensitivity for sialolithiasis Low cost	Low sensitivity for stenosis
Sialography	High sensitivity for ductal lesions	Radiation Invasive
Sialoendoscopy	High sensitivity and specificity for ductal lesions Therapeutical possibilities	Invasive High cost

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