Transoral Removal of Submandibular Stones

Johannes Zenk, MD; Jannis Constantinidis, MD; Basel Al-Kadah, MD; Heinrich Iro, MD

Objective: To assess transoral treatment of submandibular lithiasis.

Design: Study of a series of patients with submandibular stones undergoing transoral removal of the sialoliths. Duration of follow-up: 6 months to 7 years.

Setting: Department of Otorhinolaryngology, Head and Neck Surgery, University of Erlangen-Nuremberg, Erlangen, Germany, center for treatment of salivary stones.

Patients: Two hundred thirty-one patients (127 females, 104 males) suffering from submandibular lithiasis had a mean age of 41.7 years (age range, 12-86 years). Stone location was distal to the edge of the mylohyoid muscle in 115 patients and proximal to the gland in 102 patients (mean size of sialoliths, 6.3 mm [range, 2-30 mm]). Fourteen other patients had 2 separate stones, one within the hilum and a smaller more proximal one within the gland.

Interventions: Transoral removal of the stones under local anesthesia and preservation of the submandibular gland.

Main Outcome Measures: Complete removal of the stones, complications, and recurrence of the stones.

Results: All 115 patients with distal stone location, 93 (91%) of 102 patients with stones of the perihilar region, and 9 (64%) of the 14 patients with 2 separate stones in the hilum and parenchyma were free of stones. Submandibulectomy had to be carried out in 4 patients (1.7%). Recurrence of lithiasis and damage to the lingual nerve remained below 1%.

Conclusions: Transoral removal should be the treatment of choice in patients with submandibular stones that can be palpated bimanually and localized by ultrasound within the perihilar region of the gland.


Sialolithiasis accounts for more than 50% of the diseases of the large salivary glands in the head and neck. With a prevalence in central Europe of about 1.2%, sialolithiasis is thus the most common cause of acute and chronic infections. More than 80% of all sialoliths are localized within the duct system of the submandibular gland and only 20% within the parotid gland. Approximately 90% of submandibular stones are situated in the distal portion of the Wharton duct or at the hilum.

Over the last 10 years several new minimally invasive techniques were introduced in the treatment of sialolithiasis. Extracorporeal sonographically and intracorporeal endoscopically controlled lithotripsy seemed to change therapeutic methods completely. In the case of parotid duct stones, the long-term outcome for extracorporeal lithotripsy—with 50% of all patients being free of stones and 80% being free of symptoms—is very satisfying. In comparison, patients suffering from sialolithiasis of the submandibular gland receiving lithotripsy treatment are free of stones in less than 30% of all cases. The benefits of minimally invasive techniques and their comparison with other moderately invasive surgical and gland-preserving techniques must be considered for these patients.

Transoral removal of the stones within the distal part of the Wharton duct in the floor of the mouth is not a major surgical problem, whereas sialolithectomy within the duct posterior to the first molar or even more proximally in the so-called comma area (where the duct turns inferiorly at the posterior border of the mylohyoid muscle) is difficult and may be hazardous to the lingual nerve. Nevertheless, in the literature, expanded incision of the duct has been continually favored as a gland-preserving therapy.

From the Department of Otorhinolaryngology, Head and Neck Surgery, University of Erlangen-Nuremberg, Erlangen, Germany.
PATIENTS, MATERIALS, AND METHODS

DIAGNOSTIC MEASURES

Subsequent to taking the patient’s medical history and performing a clinical examination, an ultrasound of the affected gland was performed (Sonoline SI 450 and Sonoline Elegra; Siemens Co, Erlangen, Germany) to confirm the diagnosis. The presence of one or more concrements lodged within the duct system of the gland and their precise pretherapeutic localization (ie, intraparenchymal duct system, hilar region with its relation to the mylohyoid muscle, or distal duct system) could be reliably established using sonography (Figure 1). Additional diagnostic imaging techniques were not required in any of the patients.

PATIENTS

Between July 1, 1989, and December 31, 1998, two hundred thirty-one patients suffering from sialolithiasis of the submandibular ducts were treated by transoral incision and marsupialization of the duct and gland (ie, sialodochotomy and submandibulotomy).

The patient population comprised 127 (55%) females and 104 (45%) males with a mean age of 41.7 years (age range, 12-86 years). The duration of symptoms was 25 months on average (range, 1 month to 25 years). The mean maximum stone diameter (as determined by sonography) was 0.8 mm (stone diameter range, 2-30 mm). A total of 335 sialoliths were removed transorally from 231 patients.

STONE LOCATION

In 13.7% cases more than one concrement was identified in the course of the duct—generally in direct anatomical proximity to the largest concrement detected (Table). One hundred fifteen patients (50%) exhibited 1 or more sonographically imageable stones located above the mylohyoid muscle and more than 1.5 cm distant from its dorsal end in the distal portion of the Wharton duct (mean diameter, 6.3 mm). In 102 patients multiple concrements were detected sonographically adjacent to one another in more proximal areas extending as far as the hilar region or within the glandular parenchyma. Another 14 patients (6%) had one concrement in the intraparenchymatous part or in the hilum of the duct system and a second, smaller concrement at a distinctly proximal site (Figure 1).

INDICATIONS AND CONTRAINDICATIONS

Incision of the duct was performed in the event that stones were sonographically localized above the mylohyoid muscle in the anterior two thirds of the floor of the mouth, irrelevant of their palpability. Furthermore, the indication for incision of the duct was extended to transoral submandibulotomy when concrements were identified by palpation and sonography and localized in the posterior part of the floor of the mouth.

If 2 concrements were encountered—the first and larger of the detected stones located in the hilar region and the second and smaller stone more proximally in the obstructed duct system—incision of the duct was performed to remove the larger (preceeding) stone with the additional intention of achieving spontaneous discharge of the smaller concrement. Incision of the duct was contraindicated in the acute inflammatory stage.

SURGICAL PROCEDURE

Surgery was carried out under general anesthesia in only 5 patients (2%). All other interventions (98%) were performed with local anesthesia (4% lidocaine hydrochloride, 8-10 mL with epinephrine:1:200,000) (Figure 2). The duct, together with the oral mucosa, was incised from the ostium until the stone was visible. Following the incision of the oral mucosa, the course of the lingual nerve could be dissected from a lateral upper position below the duct to medially into the lateral lower portions of the tongue.

When sialoliths were located at very proximal sites or within parenchymatous regions, transoral dissection was enabled by cranial displacement of the uncinate process of the gland in the direction of the floor of the mouth. If the duct was incised up to the hilar region and the stone was palpable still further in the adjacent parenchyma, the glandular parenchyma was incised with a scalpel as far as the stone bed (submandibulotomy) under direct visual control. The duct or the incised parenchyma of the submandibular gland was subsequently sutured using 4-0 polyglactin (Vicryl) to the oral epithelium creating a neo-ostium.

FOLLOW-UP MEASURES

Postincisional therapy included regular oral rinses with a mixture of sage, eucalyptus, peppermint, cinnamon, cloves, fennel, and aniseol, levomenthol, and thymol (Salviathymol; Galenika Fr, Fuerth, Germany), detumescent medication, and gland massage to maintain a continuous salivary flow. In the event of conglutination and narrowing of the neo-ostium, repeated bougienage was performed. Antibiotic prophylaxis with roxithromycin was administered over a 3-day period in the event of a purulent salivary secretion and in cases of extensive expanded duct incision up to and beyond the hilar region.

Sonographic controls were conducted on the first day postoperatively and 4 weeks after incision of the duct. Regular clinical and sonographically controlled examinations followed.

RESULTS

All 115 patients with distal stones were stone free and symptom free following the duct-incision intervention (Table). Concrements in the region of the hilum of the gland or in the adjacent glandular parenchyma were treated 102 times (44%); stone clearance and freedom of symptoms was achieved in 93 patients (91%). In 6 patients intraoperative crushing of the concrement occurred, causing residual fragments to remain in the gland; residual concrements remained sonographically detectable despite freedom of symptoms. The concrement was inaccessible by the transoral approach in 3 patients, thus necessitating removal of the gland.
In 14 patients (6%) the indication for expanded incision of the duct was established when 1 stone was found in intraparenchymal parts in the hilum of the duct system and a second smaller stone was found at a more proximal site. The distally localized concrement could be removed in 13 patients. Complete stone clearance was achieved in 9 patients (64%) due to the additional secondary discharge of the smaller proximal concrement (Figure 3). Four patients (29%) were symptom free during follow-up despite the remaining smaller residual concrement. Stone removal was not possible in 1 case, requiring secondary submandibulectomy (Table).

Swelling of the floor of the mouth and the affected submandibular gland accompanied by disturbed swallowing was noted in all patients on the first postoperative day. At this time 95% of all patients were able to resume oral intake of food and to leave the clinic.

In 11 patients (5%), including 7 who had been subjected to expanded incision of the duct, pronounced swelling of the tongue and the pharynx occurred. In 1 patient the swelling spread as far as the larynx, causing moderate shortness of breath and hoarseness. All patients recovered from these effects following detumescent therapy (as described in the “Follow-up Measures” subsection of the “Patients, Materials, and Methods” section) and intravenous antibiosis (ampicillin sodium-sulbactam sodium, 2 g 3 times daily), albeit during a prolonged stay at the clinic.

Stenosis of the neo-ostium that developed in 5 patients (2%) was reopened by renewed incision. A lesion of the lingual nerve causing paresthesia and anesthesia in the area of the tongue and the inside of the lip was observed in 2 patients (1%). One patient recovered fully; in the other patient (0.4%) the lesion remained permanently. Follow-up in 2 patients demonstrated a ranula in the region of the sublingual gland that was treated by incision and marsupialization. A recurrent stone was detected 1 year later in 1 patient where stone clearance following incision of the duct had been sonographically demonstrated.

**Location and Results of Transoral Removal of Submandibular Stones in 231 Patients**

<table>
<thead>
<tr>
<th>Results of Removal of Stones</th>
<th>Distal Duct (n = 115)</th>
<th>Hilum/Parenchyma (n = 102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of stones</td>
<td>115 (100)</td>
<td>93 (91)</td>
</tr>
<tr>
<td>Free of complaints and small residual stones</td>
<td>...</td>
<td>6 (5.9) 4 (29)</td>
</tr>
<tr>
<td>No change and submandibulectomy</td>
<td>...</td>
<td>3 (2.9) 1 (7.1)</td>
</tr>
</tbody>
</table>

*Percentages do not total 100 because of rounding. Ellipsis indicates not applicable.

In 14 patients (6%) the indication for expanded incision of the duct was established when 1 stone was found in intraparenchymal parts in the hilum of the duct system and a second smaller stone was found at a more proximal site. The distally localized concrement could be removed in 13 patients. Complete stone clearance was achieved in 9 patients (64%) due to the additional secondary discharge of the smaller proximal concrement (Figure 3). Four patients (29%) were symptom free during follow-up despite the remaining smaller residual concrement. Stone removal was not possible in 1 case, requiring secondary submandibulectomy to be performed (Table).

Swelling of the floor of the mouth and the affected submandibular gland accompanied by disturbed swallowing was noted in all patients on the first postoperative day. At this time 95% of all patients were able to resume oral intake of food and to leave the clinic.

In 11 patients (5%), including 7 who had been subjected to expanded incision of the duct, pronounced swelling of the tongue and the pharynx occurred. In 1 patient the swelling spread as far as the larynx, causing moderate shortness of breath and hoarseness. All patients recovered from these effects following detumescent therapy (as described in the “Follow-up Measures” subsection of the “Patients, Materials, and Methods” section) and intravenous antibiosis (ampicillin sodium-sulbactam sodium, 2 g 3 times daily), albeit during a prolonged stay at the clinic.

Stenosis of the neo-ostium that developed in 5 patients (2%) was reopened by renewed incision. A lesion of the lingual nerve causing paresthesia and anesthesia in the area of the tongue and the inside of the lip was observed in 2 patients (1%). One patient recovered fully; in the other patient (0.4%) the lesion remained permanently. Follow-up in 2 patients demonstrated a ranula in the region of the sublingual gland that was treated by incision and marsupialization. A recurrent stone was detected 1 year later in 1 patient where stone clearance following incision of the duct had been sonographically demonstrated.

**COMMENT**

Preservation of gland function in conjunction with low-level risk and discomfort for the patient should be the primary objective in the treatment of sialolithiasis. Apart from problems such as scar formation, disturbances of skin sensation, and injury to the gustatory nerves, it is above all transient functional disturbances of the marginal branch of the facial nerve that are encountered in up to 12.5% of open gland excisions. Permanent lesions are reported in as many as 7% of the cases. Moreover, unilateral excision of the submandibular gland also leads to a substantial reduction in the nonstimulated flow of saliva, which may have an important influence on oral hygiene, risk of caries, and the development of xerostomia.

Preservation of the submandibular gland has always been attempted in the treatment of sialolithiasis by transoral resection of the salivary stone. The transoral approach for the removal of salivary concrements in the first 2 distal anatomical sections of the duct (in approximately 30%-50% of the patients)
is unproblematic. However, sialoliths lodged in the posterior third of the duct system, in the hilum, or still further within the glandular parenchyma present a problem.

Various techniques of sialodochotomy have been described in the literature whereby a major point of concern has always been the risk of injury to the lingual nerve which courses in close proximity to the Wharton duct.\textsuperscript{12,14,18,19} Surgical excision of the gland is recommended in cases of extreme proximal stone localization\textsuperscript{11,20} due to the anatomical circumstances and the assumption that the submandibular salivary gland has no tendency for recovery after years of obstruction and recurrent inflammation. Nevertheless, van den Akker et al\textsuperscript{21} were able to show by salivary gland scintigraphy that complete recovery of glandular function, in fact, can be achieved after stone removal.

While, in the literature, the indication for incising the duct has mostly been based on clinical examination in combination with plain radiography or sialography,\textsuperscript{14} diagnostic ultrasound (7.5 MHz) can furnish the surgeon with much more detailed information on the exact stone localization, the number of stones, and the functional status of the glandular parenchyma.\textsuperscript{22} However, the palpation of concrements localized within the parenchyma remains important in the preoperative assessment of the accessibility of the stone by expanded incision of the duct.

In contrast to the surgical techniques described in the literature, where the incision is performed directly over the palpated stone without dissecting the duct\textsuperscript{19} or where the Wharton duct is identified at a distant proximal point and opened above the stone,\textsuperscript{12} incision of the duct by proceeding from the ostium was used in this series. The duct thus provides the surgeon with an anatomical landmark as a guide. The lingual nerve that crosses below the duct from lateral to medial can be dissected without problem in a well-defined surgical field of view.

It is a problem when the stone location is directly below the course of the nerve and recurrent inflammation has led to scar formation in this area, a problem known also from the external approach. In 2 patients, nerve dissection in this situation led to lingual nerve injury and paresthesia. The risk of lingual nerve damage of 1% of the patients in this study is equal to that for the external approach. Ichimura et al\textsuperscript{23} reported a total incidence of 2.4% of paresthesia of the lingual nerve and of 1.6% in the case of inflammatory disorders following surgery in the submandibular angle.

The high rate of stone-free and symptom-free patients (91%), who had extremely proximal stones or multiple stones in the hilar and parenchymal regions (64%), and the low rate of lesions of the lingual nerve underscore the importance of transoral stone removal that can be performed under local anesthesia in as many as 98% of the patients. A submandibullectomy with the risk of injury to the marginal branch of the facial nerve thus can be avoided.

In the literature the rate of recurrent stones is reported as being low (<10%).\textsuperscript{3} In our series 1 recurrent stone has been observed to date. This low recurrence rate may be attributed to 2 factors.

First, the examination was not conducted with plain radiography or sialography to confirm the diagnosis as in earlier reports, but rather with high-resolution ultrasonography. It is likely that this led to the diagnosis and treatment of a greater number of secondary concrements that had previously escaped reliable detection. Second, the status of stone clearance following treatment can be better defined by ultrasonography.

Moreover, patients were advised to carry out gland massages regularly, even 4 weeks after surgery, and to take sialogogue. This represented a further prophylactic measure. The results of our series show that transoral incision of the duct should be the therapy of choice in most cases of sialolithiasis of the submandibular gland.

The indication for this therapy includes all sialoliths localized distally in the floor of the mouth and all more proximally localized concrements that can be demonstrated by sonography and palpation. According to investigations on stone localization, this encompasses almost 90% of all sialoliths of the submandibular glands.\textsuperscript{3}

The significance of extracorporeal and intracorporeal lithotripsy as an organ-preserving technique is reduced by the technique of expanded incision of the Wharton duct; nevertheless, extracorporeal lithotripsy, in particular, remains indicated for impalpable small stones located in the hilum and the parenchymal region. The use of intracorporeal lithotripsy\textsuperscript{24,25} and other techniques for stone removal\textsuperscript{20} will remain limited in the cases of submandibular duct stones.
REFERENCES