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Combined endoscopic and transcutaneous approach for parotid gland sialolithiasis: Indications, technique, and results

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ABSTRACT

OBJECTIVE: Despite all the advances of minimally invasive surgery, refractory stones remain in 10 to 20 percent of all cases of parotid gland sialolithiasis, and persistence of the symptoms makes removal of the gland inevitable. In some of these cases, however, it may be possible to conserve the gland using a combination of endoscopic and transcutaneous procedures.

STUDY DESIGN: Case series with chart review.

SETTING: Tertiary referral center.

SUBJECTS AND METHODS: Nine patients treated with a combined endoscopic transcutaneous operation were evaluated. During this procedure, the stone is removed through a skin incision under endoscopic guidance. Indications were sialolithiasis refractory to treatment (n = 5), sialolithiasis with complications (n = 2), contraindications to primary minimally invasive surgery (n = 1), and primary treatment (n = 1). In seven cases, the stones were extracted. Simultaneous resection of a sialocele was carried out in one case, and simultaneous resection of a saliva-cutaneous fistula was carried out in another. A stent was inserted in 66.7 percent of the cases.

RESULTS: Treatment was successful in 88.9 percent of the patients. All of these patients were free of stones and symptoms, and glandular function was maintained both clinically and on ultrasound assessment. Complete parotidectomy had to be carried out in one case because it was not possible to reconstruct the duct system.

CONCLUSION: The combined operation offers a further option for gland-conserving treatment in cases with obstructive salivary gland disease, especially sialolithiasis. At present, it is indicated for cases that are resistant to treatment after sialendoscopy or extracorporeal shock wave lithotripsy. The gland resection rate can thus be further reduced.

Sialolithiasis is the most common cause of obstructive disease in the parotid gland, being responsible for about 70 percent of cases.[1,2] The introduction of various minimally invasive surgical procedures has significantly reduced the rate of gland removal.[2-7]

Endoscopy of the salivary ducts allows stones, especially small and mobile ones, to be extracted and/or fragmented in the duct under direct vision, with success rates of more than 80 percent.[2-4,7-9] Very often, however, it is not possible to successfully treat impacted calculi and stones measuring more than about 5 to 6 mm with the endoscope.

Extracorporeal shock wave lithotripsy (ESWL) can be used for stones of any size and localization, but requires up to three therapy sessions. Seventy-five percent of all patients treated with ESWL are free of stones and/or symptoms, and in up to 50 percent of cases, all the stones are completely removed with ESWL alone. The success rate decreases with increasing size of the stone.[7,10-14]

Currently, ESWL and sialendoscopy are the standard combination for complete stone removal.[2-7] In our department, endoscopic controlled stone extraction is the treatment of first choice, with primary ESWL as an alternative. After fragmentation by ESWL, repeat sialendoscopy is indicated for removal of residual fragments.

Despite all advances, five to 10 percent of all patients with parotid stones cannot be treated successfully with these minimally invasive methods. The main reasons seem to be the size and material quality of the stones in these patients. In rare cases, there is also a contraindication to the major therapeutic modalities (e.g., ESWL in patients with a cardiac pacemaker).

Several reports deal with stone extraction through a skin incision after its position in the duct system has been located and marked. Baurmash reported a case in which transcutaneous stone extraction was carried out after ultrasound and sialographic marking.[15] Three publications describe the technique of transcutaneous stone extraction with simultaneous sialendoscopic guidance. The main indications were refractory or large stones.[16-18]

In the Department of Otorhinolaryngology, Head and Neck Surgery at our institution, nine patients were treated

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with the combined endoscopic and transcutaneous approach. We report our clinical experience with this surgical technique in these patients.

Patients and Methods

Patients and Indications to the Combined Endoscopic and Transcutaneous Approach

Since 2006, nine patients (5 men and 4 women, aged 47-68 yrs) have had stones removed from the parotid gland by the combined endoscopic transcutaneous operation. In five cases, large stones in the parotid gland were resistant to treatment. In these cases, repeated ESWL (range 3-6, average 4.5) and sialendoscopies had been performed previously.

In four cases, however, there was a primary indication for the procedure. Two of these patients presented to our department with complications: in one, an abscess with a subsequent skin fistula occurred; in the second case, a large stone perforated the duct wall and a sialocele developed. One patient with a large stone (10 mm) had a contraindication to ESWL because she had an implanted pacemaker. After in-depth explanation of the therapeutic options, one patient (stone measuring 11 mm) elected to have the combined endoscopic transcutaneous operation because he wanted to avoid multiple treatments (Table 1).

Diagnosis, Findings, and Treatment Planning

The diagnosis is made on ultrasound scanning (Sonoline Elegra and Acuson Antares; Siemens Medical Solution, Issaquah, WA) and by using semi-rigid sialendoscopes and instruments from our routine set (Karl Storz, Tuttlingen, Germany).[2] This set includes three endoscopes with external diameters between 0.8 mm and 1.6 mm. The 1.1 mm and 1.6 mm endoscopes have two channels (irrigation channel and instrumentation channel of 0.4 or 0.8 mm).

Accurate ultrasound diagnosis with respect to the size and location of (residual) stones was made in all cases. Immediately before the transcutaneous operation, the average size of the stones in the nine patients was 8.2 mm (range 5.5-11 mm).

Diagnostic sialendoscopy was carried out preoperatively to make sure that the stone could be marked with the endoscope. The endoscope was selected according to the width of the duct system.

Before the treatment was performed, informed consent was received from all patients and approved by the review board of the Friedrich-Alexander University of Erlangen-Nuremberg.

Surgical Technique

As we always monitored the facial nerve (two-channel EMG, Neurosign 100, Inomed, Tenningen, Germany), surgery was performed with the patient under a general anesthetic. After the stone had been located in the duct system by sialendoscopy, its position was marked transcutaneously by transillumination. The incision was made along a skin fold if the stone lay distally (1 patient) (Fig 1), whereas a pre-auricular flap similar to that for a parotidectomy was prepared for a stone in a proximal position (8 patients) (Fig 2). Guided by the transillumination, the parotid capsule was dissected out to the position of the sialendoscope in the duct system, which was marking the stone (Figs 1 and 2). The main duct was then dissected under continuous endoscopic guidance and transillumination; buccal branches of the facial nerve were regularly identified at this time. Sialodochotomy and stone extraction were performed under endoscopic guidance. Sialendoscopy confirmed that there were no residual stones in the rest of the duct system; any stones found were removed (Fig 3). To splint the duct system, we used a special polyurethane stent (Sialotech, Ashkelon, Israel) with an external diameter of 4.5 F and a maximum length of 120 mm. The stent, which has to extend from the

Table 1
Indications, operative technique, and results in nine patients treated by the combined endoscopic and transcutaneous approach

Age (yrs), sex	Indication	Operative therapy	Stent	Success of surgery	Current symptoms	Follow-up (mo)
57, m	Therapy-resistance	Combined approach	Yes	Yes	None	30
51, m	Therapy-resistance	Combined approach + parotidectomy	No	No	None	27
56, f	Sialocele	Combined approach + resection of a sialocele	No	Yes	None	27
47, m	Therapy-resistance	Combined approach	Yes	Yes	None	26
55, f	Fistula	Combined approach + resection of a fistula	Yes	Yes	None	19
57, f	Primary	Combined approach	Yes	Yes	None	17
48, f	Therapy-resistance	Combined approach	Yes	Yes	None	15
55, m	Therapy-resistance	Combined approach	Yes	Yes	None	13
68, f	Contraindication for ESWL	Combined approach	Yes	Yes	None	4

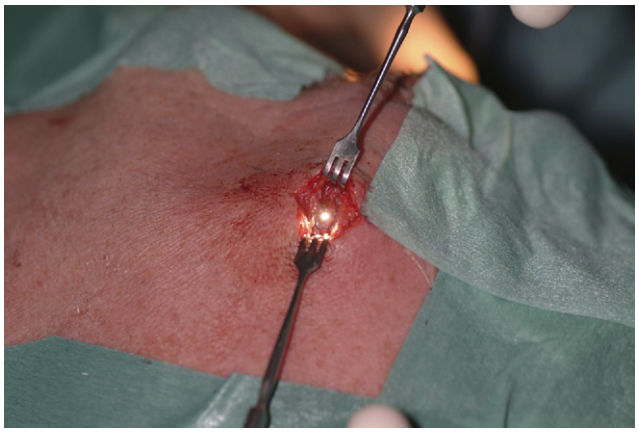

Figure 1 Transcutaneous approach: access via skin incision in a skin fold, for a stone in the distal duct system. The exact position of the stone is marked by transillumination using the distal part of the endoscope.

papilla across the opening in the duct, was inserted either from distal to proximal or vice versa through the sialodochotomy. Using the former technique, the stent was pulled over the shaft of the endoscope, and the endoscope with the stent was advanced into the duct system until it reached across the sialodochotomy (Fig 4). In two cases the duct system was too narrow for this method to be used, so the stent was fixed to an instrument that was introduced through the opening in the duct via the instrumentation channel of the sialendoscope and inserted from proximal to distal (Fig 5). Correct positioning of the stent was checked both through the sialendoscope and transcutaneously (Fig 6). The stent was fixed to the buccal mucosa with nonabsorbable sutures (5-0 Ethilon, Johnson & Johnson Intl, St-Stevens-Woluwe, Belgium). Absorbable sutures (5-0 and 6-0 Vicryl, Johnson & Johnson Intl) were used to close the parotid duct, parenchyma, and capsule. Criteria for a successful operation were complete removal of all stones, reconstruction of the

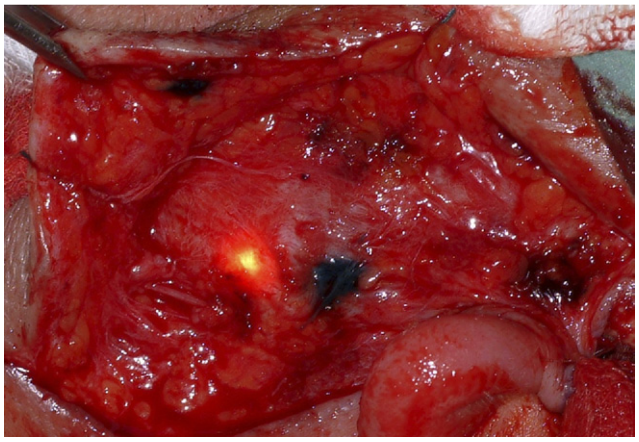

Figure 2 Transcutaneous approach: access after preparation of a pre-auricular flap with the stone lying in the proximal duct system. The exact position of the stone is marked by transillumination using the distal part of the endoscope.

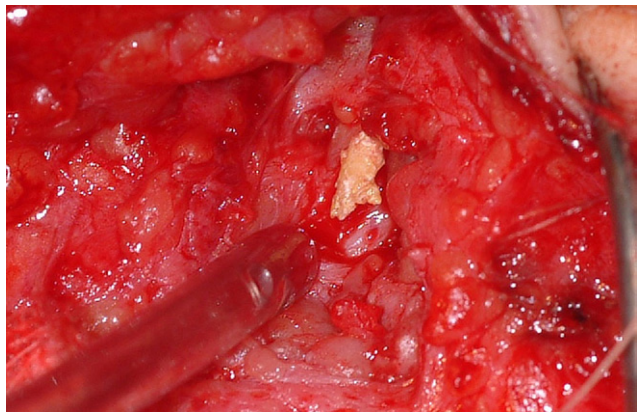

Figure 3 Stone is extracted after performing the sialodochotomy under direct sialendoscopic control.

duct (with or without stent implantation), prevention of resection of the gland, and absence of complications (e.g., facial nerve paresis, development of a salivary gland fistula).

Figure 4 Distal insertion of the stent through the papilla: the stent is pulled over the shaft of the endoscope and advanced in a proximal direction through the papilla.

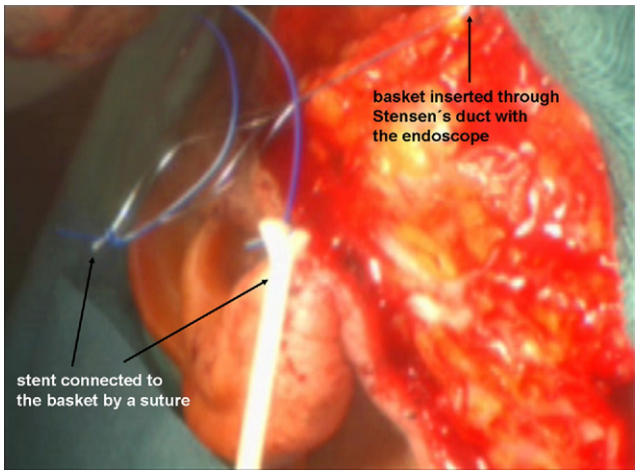

Figure 5 Proximal insertion of stent through the sialodochotomy: the stent is inserted after being fixed to an instrument (basket, *arrows*) that is pushed from the papilla through the sialodochotomy (*arrow*).

Postoperative Follow-up and Measurement of Outcome

To prevent fistula formation, a wick was inserted for drainage, prophylactic antibiotics were given (e.g., amoxicillin and sulbactam), and a compression dressing applied for one week. Wound healing, the correct position of the stent, and gland function were assessed clinically and by ultrasound. The outcome was classified as successful when the patient reported no complaints, no residual stones were detectable, and the preserved salivary gland showed recovery of its physiological function. Complete stone extraction was controlled by intraoperative sialendoscopy and intraoperative and postoperative ultrasound. Recovery of physiological function was demonstrated by normalization of the glandular parenchyma echogenicity on ultrasound scanning (diminished echopoor changes)[2,19] and by the appearance of abundant clear secretions from the papilla after massaging the gland and/or stimulating the excretory function of the gland (e.g., with vitamin C).[20]

Results

Stone Extraction

Stone extraction out of the duct system through the sialodochotomy was achieved in all nine patients. In three cases, residual stones were extracted endoscopically from the adjacent ducts using a basket or forceps.

In one case, a stone was removed from a sialocele that had developed very close to the main duct, and the sialocele was resected. Transillumination of the endoscope made it much easier to distinguish the boundaries of these two structures. In the case of the fistula between the duct system and the skin, stone extraction and then excision of the fistula were carried out after the connection with the duct system had been demonstrated by transillumination.

Duct Reconstruction and Gland Preservation

Duct reconstruction to prevent gland resection was necessary in seven cases and was achieved in six cases. In each of these, stent insertion was performed to splint the wall. The stents were well tolerated by all patients and either removed without any problems after six weeks or dislocated spontaneously after three to four weeks. In one case (salivocutaneous fistula), after closure of the parotid duct, a collagen sponge (Tachosil, Nycomed GmbH, Constance, Germany) was placed on the suture bed for fistula prophylaxis. The gland was preserved in 88.9 percent of the patients (8/9). However, in one case, considerable damage to the anatomical structures meant that reconstruction of the parotid duct was no longer possible. After opening it at operation, the duct wall was found to be so macerated that reconstruction could not be attempted and a complete parotidectomy was carried out.

Success Rates and Gland Function

No patient had any postoperative complication; in particular, there were no cases of facial paresis or fistula. Overall, 88.9 percent (8/9) of the patients were treated successfully; the mean follow-up period for these eight patients was 18.9 months (Table 1). None of these eight patients developed recurrent obstructive sialopathy. Gland function was conserved in all of them. Postoperative ultrasound examinations showed a marked reduction (follow-up time of >3 mo) or almost complete resolution (follow-up time of >6 mo) of the hypoechogenic changes of the parenchyma in all preserved glands. After gland stimulation with vitamin C, a slight increase of duct diameters up to 2 to 3 mm for two to three minutes due to the increased salivary flow was observed. Abundant salivary flow after vitamin C without any complaints indicated an undisturbed function of the gland in eight patients.

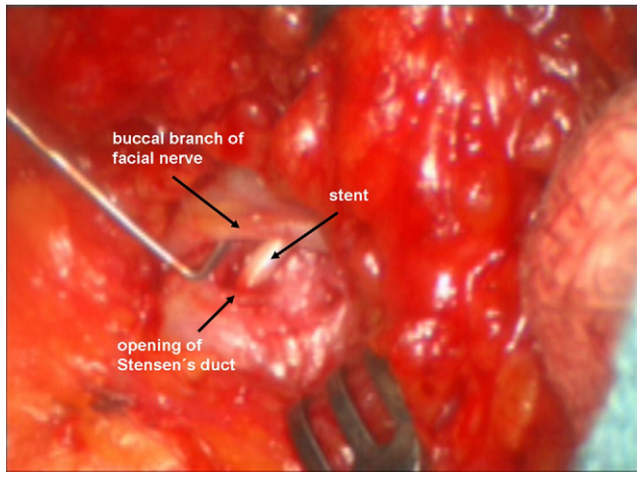

Figure 6 Checking the correct position of the stent: transcutaneously through the sialodochotomy (*arrow*); the buccal branch of the facial nerve (*arrow*) can be seen directly adjacent—this is routinely dissected out.

Discussion

Eighty to ninety percent of all patients with stones in the parotid gland can be treated by minimally invasive methods such as sialendoscopy and ESWL, which conserve the glands.[2-7,9]

Impacted stones and stones with a diameter of more than 6 mm limit the possibilities of sialendoscopy.[2-4,8,9] After ESWL, large stones with a diameter of more than 8 to 10 mm in particular are often refractory. Some of these cases can be treated successfully with a repeat sialendoscopic extraction after fragmentation.[2,4,6,7] Even so, about 10 percent of the stones remain resistant to treatment and continue to cause symptoms. The transcutaneous surgical procedure presented here completes the concept of minimally invasive surgery. Transcutaneous stone extraction alone, under ultrasound guidance, as described by Baurmash et al,[15] does not allow protection of the tissues in the way that the additional use of sialendoscopy does. In our cases, transillumination of the tip of the endoscope introduced into the duct system turned out to be an important prerequisite for a technique with minimum tissue damage, as it marked the surgical approach precisely (Figs 1 and 2). To date, three surgical teams have published reports of their experience with this surgical procedure.[16-18] Nahlieli et al treated 12 patients in this way: eight cases as primary treatment because of large stones (>5 mm) in the main duct, and four cases after unsuccessful sialendoscopic interventions. Seventy-five percent of the patients became free of stones; stone extraction was not possible in two cases, and there was a residual stone in the duct system in one case. Atrophy of the gland developed in three cases. One superficial parotidectomy had to be carried out. Gland function was conserved in 58 percent of the patients (7/12).[16] McGurk et al published a report of eight cases: seven had stones and one had stenosis. All the stones were successfully removed from all seven patients. In one case, severe maceration of the duct meant that reconstruction was not possible, and the duct had to be ligated. The average size of the stones was 11 mm. In the one case of stenosis, the duct system could not be adequately reconstructed after the excision of the fibrotic tissue, so this duct also had to be ligated. All patients were symptom free; gland function was conserved in 75 percent of the patients.[18] Marchal reported his experience with large stones (>6 mm) and severe refractory duct stenosis in a total of 37 patients. Symptoms were improved in 92 percent; the duct was ligated in three of the four unsuccessful cases. However, he gave no precise information on the number of stones or stenoses, previous treatment, or how many of the patients became completely symptom free.[17]

The indications for combined endoscopic transcutaneous operation are large stones,[16,17] poor chance of success for other minimally invasive procedures or contraindications to them (2 cases in our patient population), refractory stones,[16-18] and complications (2 of our cases). Intraparenchymal stones of any size, particularly if it is not certain they can be reached with the endoscope, are not an indication and are treated with ESWL. The main indication in the patients presented here was refractory stones with a mean diameter of 8.2 mm (5 cases), followed by complications of sialolithiasis (2 cases). In one case, there was a contraindication to ESWL, which would otherwise have been the treatment of choice. Less frequent indications are severe and refractory stenoses.[17,18] Marchal et al reported reconstruction of the duct system with a venous patch after resection of fibrotic tissue, but there are no precise data on this modification and its success rate.[17]

The transcutaneous incision depends on the position of the stone. Pre-auricular access (Fig 1) or an approach similar to that for rhytidectomy is recommended for stones lying very proximally.[16-18] A local incision (Fig 2) can be made in a skin fold if the stone is in a distal position, as was done in one of our cases. The risk of facial nerve damage is not increased if the nerve is monitored.[16,17]

All the authors agree that follow-up endoscopy is necessary after sialodochotomy and extraction of the principal stone.[16-18] This need was confirmed in our patients, as residual stones were removed from the rest of the proximal duct system in 30 percent of cases.

All surgeons recommended inserting a stent to stabilize the opened duct system and prevent obliteration by scars.[16-18] The stents used in our institution and by Nahlieli et al[16] have small hook-like appendages that should prevent their dislocation. A conical expansion of the proximal end of the stent allows it to be fixed to the buccal mucosa by means of sutures placed through preformed holes. We inserted stents in 75 percent of our successful interventions, and they seem to be beneficial for complication-free healing, as they stabilize the duct system and prevent stenosis due to scarring. The stents are not associated with additional symptoms and can be removed without any problems. Their correct positioning in the duct system can also be checked with ultrasound both during and after surgery.

Our success rate was 88.9 percent, which was higher than in the previous publications. Therapy was classified as successful when patients were free from both stones and symptoms and when the gland and its function were preserved as well. This was not always clearly defined in the other publications.[16-18]

In general, there are no long-term results that allow us to draw any conclusions on the recurrence of stones or the development of duct stenosis. The average follow-up period of 18.9 months for our patients was comparable with the other publications (10 months,[18] 19 months[17]). Marchal's evidence that, thanks to the minimal dissection of the parotid tissue, this procedure can also be used without any increased risk for a recurrent stone, may represent a possible widening of the range of indications.[17]

The operation cannot be successfully completed in up to 25 percent of cases.[16-18] The reasons mentioned most often were that the stones could not be removed[16] and that reconstruction of the duct after stone extraction was not possible.[18] The latter was the case in one of our patients. With

severe stenosis and associated changes in the duct, many failures have been described, so there is no consensus of opinion on the indication with duct changes of this nature.[17,18] Two procedures are possible in these cases. Marchal et al and McGurk et al ligated the duct with the aim of inducing atrophy of the gland. The procedure was described as being without complication.[17,18] The advantage of the procedure is that the patients do not have to undergo gland resection with its associated morbidity risks. However, duct ligation has not yet been established as a standard procedure because there are no long-term observations with respect to disease activity and risk of recurrence in the retained gland. Our experience shows that permanent symptoms can also arise with nearly complete or complete occlusion of the duct.[21] Because the success rates amount to maximally 50 percent, duct ligation is viewed with varying degrees of acceptance concerning its perceived value and long-term effect.[22] The alternative is gland resection,[16] which was performed in one of our cases. It minimizes the risk of recurrence even though it carries the risks of operation and associated morbidity.

Conclusion

It can be said that the combined endoscopic transcutaneous operation is indicated for large refractory stones, complications, and when there is a contraindication to established minimally invasive procedures. A meticulous surgical technique, the endoscopic accessibility of the stone, and the integrity of the anatomical structures—especially those of the duct system—are prerequisites for the success of this operation. Short- and medium-term follow-up show that surgery can be performed with a high rate of success. The aim is to ensure that the patient is free of stones and symptoms while maintaining the function of the gland. Long-term data and experience of use in larger numbers of patients are not yet available. Depending on these results, it is possible that the range of indications could be extended in the future to include a primary treatment option for larger stones, calculi that cannot be removed by sialendoscopy, and for refractory stenosis.

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Author Contributions

Michael Koch, operative procedures, writing, contribution to design, acquisition, analysis, interpretation, critical review, final approval; **Alessandro Bozzato,** contributions to concept, critical review of article, final approval; **Heinrich Iro,** contributions to concept, critical review of article, final approval; **Johannes Zenk,** operative procedures, contributions to concept, critical review of article, final approval.

Disclosures

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