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Comparison of two transcutaneous approaches for the removal of impacted parotid stones

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Abstract. The aim of this study was to comparatively evaluate the indications and treatment outcomes of two transcutaneous approaches for the removal of impacted parotid stones. Sixty-eight consecutive patients with impacted parotid stones underwent endoscopy-assisted lithotomy via a direct mini-incision or a peri-auricular flap. Clinical safety and outcomes were evaluated. Complete stone extraction was achieved in all patients. In the mini-incision group (52 patients), the stones were in the middle third of the main duct in 31 patients, at the hilum in 16, and in the intraglandular duct in five. In the flap group (16 patients), they were in the middle third of the main duct in one patient, at the hilum in seven, and in the intraglandular duct in eight. Salivary fistula occurred in five mini-incision group patients (9.6%) and four flap group patients (25%). The clinical outcome in the mini-incision group (47 patients, median 25 months of follow-up) was good in 28 patients, fair in 13, and poor in six (12.8%). The clinical outcome in the flap group (16 patients, median 84 months of follow-up) was good in nine patients, fair in five, and poor in two (12.5%). The direct mini-incision approach was found to be safe and effective for impacted stones in the middle third, hilum, and proximal third of the main duct, while the peri-auricular approach would be best reserved for deeper intraglandular stones.

Keywords: Parotid gland; Salivary gland calculi; Endoscopy; Surgery; Treatment outcome.

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Parotid stones account for 5–20% of salivary calculi.[1–3] With the development of endoscopy-assisted surgery, the removal of mobile stones or distally located parotid stones is no longer a major surgical problem, however impacted stones located in the proximal and intraparenchymal ducts continue to pose a challenge.[4] Stones of a soft consistency and 5–8 mm in diameter may first be fragmented by extracorporeal shockwave lithotripsy (ESWL), intraductal shockwave lithotripsy (ISWL), laser lithotripsy, or pneumatic lithotripsy.[5] However, hard or larger stones are refractory to lithotripsy, and multiple lithotripsy procedures might lead to ductal trauma and secondary stenosis, as well as imposing a higher economic and psychological burden on the patient.[6]

In the absence of lithotripsy or in the case of failure of lithotripsy treatment, endoscopy-assisted transcutaneous surgery via a direct mini-incision or a

peri-auricular flap is often used.[7] In most previous reports, the indication for a direct mini-incision was confined to stones in the distal and middle thirds of the duct, while a peri-auricular flap was preferably used for stones at the hilum or intra-parenchymal ducts.[7–13]

In the absence of lithotripsy devices, the present authors' centre treated more than 350 patients with parotid calculi over the past 15 years, and the transcutaneous approach was used in approximately 20% of these cases. The aim of the present study was to evaluate these patients who underwent endoscopy-assisted lithotomy via a direct mini-incision or a peri-auricular flap, to compare the indications and outcomes of the two methods, and to suggest a positioning and treatment strategy for these intractable parotid stones.

Patients and methods

Patients with impacted and intractable parotid stones who underwent a combined endoscopic-transcutaneous surgery at Peking University School and Hospital of Stomatology between December 2006 and September 2021 were identified retrospectively. The diagnosis of impacted stones was made initially by ultrasonography, and was then confirmed by spiral computed tomography (CT). The inclusion criterion was the presence of impacted stones in the middle third, hilum, or proximal third of the main duct. Patients with impacted stones that could be removed via a transoral approach and patients with an acute infection of the parotid gland were excluded. The clinical data relative to the sites of the stones, operation records, and complications were reviewed retrospectively.

The study design was approved by the Institutional Review Board of Peking University School and Hospital of Stomatology (PKUSSIRB-201412005), and all participants signed an informed consent.

Measurements of stones on spiral CT

For each case, the location, size, depth, and horizontal distances of the main stone were calculated. On the axial image set parallel to the full course of the bilateral Stensen ducts, the junction of the main duct and the line running from the mesiobuccal root of the maxillary second molar through the anterior border of the masseter was defined as 'A′, while the intersection of the main duct and the line passing through the posterior margins of the mandibular ramus and the masseter muscle was defined as 'B′ (hilum). Consequently, the main duct was segmented into the distal third (from ostium to A), middle third (between A and B), hilum (B), and proximal third (proximal to B) (Figs. 1 and 2). Stone depth was defined as the minimum distance from the centre of the stone to the corresponding skin surface. Moreover, the distances from the centre of the stone to the ostium and earlobe were also measured.

Surgical procedures

Before endoscopy, the stone site was marked under ultrasonography. A 0.9/1.15 mm endoscope (PD-ZS-0084; PolyDiagnost, Hallbergmoos, Germany) was introduced to explore the stone. Two transcutaneous approaches were applied only if the stone was immobile and all intraductal methods failed. The first was the direct mini-incision approach (group 1): For stones close to site A, a 10–15 mm vertical incision (Fig. 3) was made along the skin fold to ensure a better cosmetic effect; however, for proximal stones with less skin tension, a 15–20 mm horizontal incision (Fig. 1C, 2C) was used to ensure better identification of the duct and possible facial nerve branches. With the aid of endoscopic transillumination and palpation, the accurate location of the duct was gradually exposed and the stone was removed by splitting the duct. The second approach was the peri-auricular flap approach (group 2): For stones close to or proximal to site B, a 50–60 mm modified Blair incision was made, and the flap was raised underneath the parotid fascia until the stone could be reached. Then, the main duct was prepared 2–3 cm and the stone was removed by splitting the duct. With both methods, great caution was taken to prevent injury to the duct and possible facial nerve. Following stone removal, the entire duct was explored again to remove possible residual stones or mucus plugs and to dilate the possible stenosis. Subsequently, a 3–4 F plastic stent was introduced from the natural orifice to the proximal duct under endoscopic guidance. The duct was closed with three to four 5–0 or 6–0 Vicryl sutures. After closure of the fascia and subcutaneous tissue, the skin was sutured using 5–0 Prolene or Vicryl.

A pressure dressing was applied and the patient was advised to avoid spicy food for 7–10 days. After complete cure, frequent gland self-massage and the use of a sialagogue were recommended. Saline irrigation and distal duct dilation were performed once or twice during the first postoperative month.

Outcome evaluation

Patients who could not return to the clinic were followed up through telephone calls or mailed questionnaires. Patients who returned to the clinic were invited to attend for the following clinical evaluations: the appearance of the scar, the size and tenderness of the affected gland, and the saliva flow upon massage. The clinical outcome was scored as good, fair, or poor according to previously suggested criteria.[14] Moreover, patients who gave informed consent underwent sialography of the affected gland. Two experienced oral radiologists analysed each case independently and reached a consensus by discussion. The sialograms were categorized into three types (I–III) according to previously suggested criteria.[1]

Statistical analysis

The statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). For continuous variables, the mean and standard deviation or median (range) values were calculated and compared using an independent *t*-test or Wilcoxon rank test. Categorical variables were expressed as percentages and were compared using the χ^2 test or Fisher's exact test. $P < 0.05$ was considered statistically significant.

Results

Overall, 68 consecutive patients were identified and evaluated; 52 patients were treated via a direct mini-incision and 16 patients via a peri-auricular flap. The patients ranged in age from 9 to 77 years (mean 49 years). The duration of symptoms ranged from 1 week to 20 years (median 15 months) (Table 1).

Radiographic features

Table 1 provides a summary of the data on stone site and size. There was no significant difference in stone size or stone depth between the two groups; however, significant differences were observed in the distance from the stone to the ostium and the distance from the

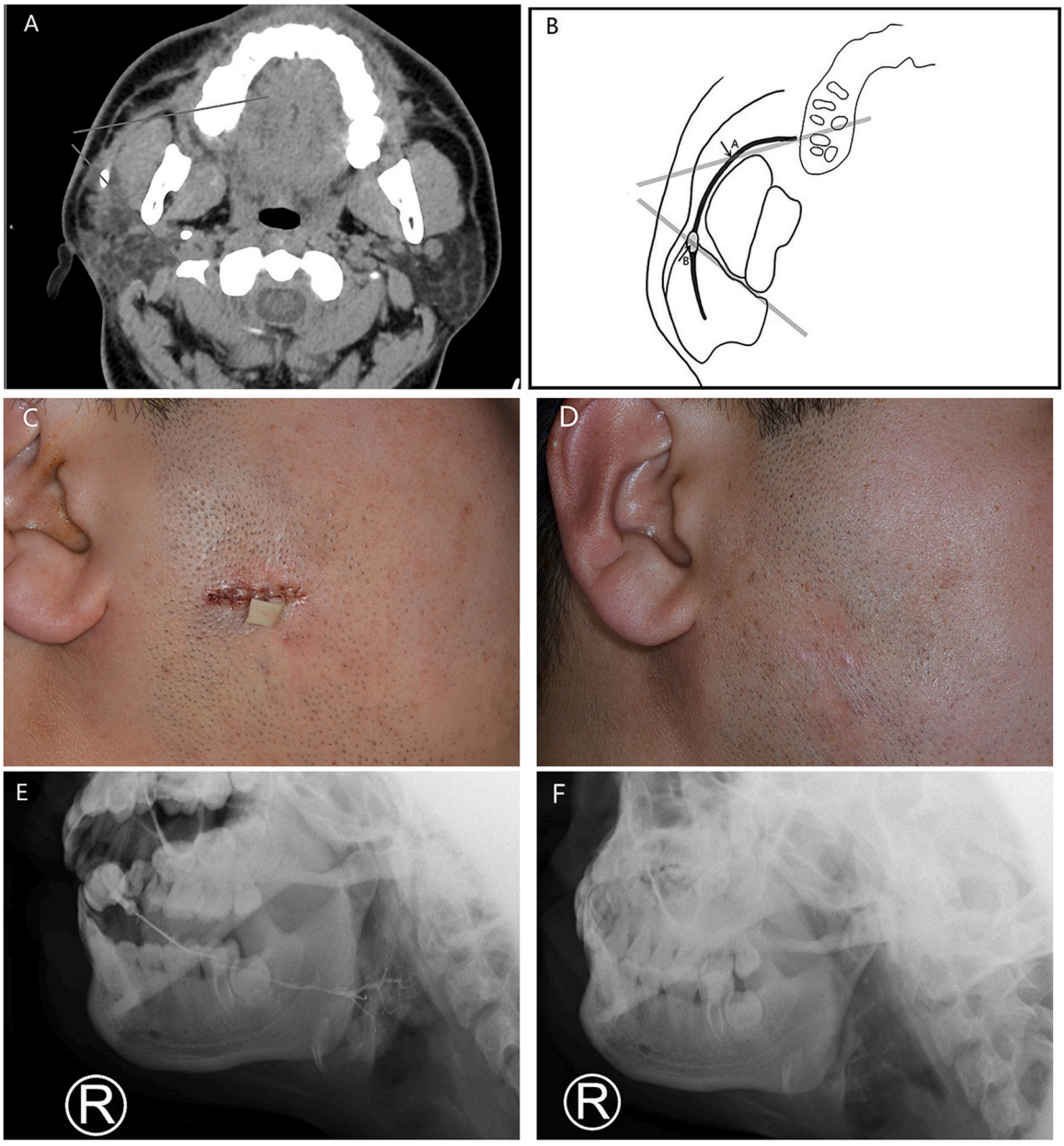

Fig. 1. The case of a 28-year-old man with a 10-year history of a right parotid gland stone. Axial computed tomography (A) and its schematic presentation (B) showed a 7-mm stone at the hilum, and the main duct was segmented into three parts. (C) The stone was removed via a 16-mm horizontal incision. (D) Fifteen months after surgery, the scar was nearly imperceptible. (E, F) Six months after surgery, follow-up sialography showed an approximately normal appearance of the ductal system on filling film (E) and no contrast retention on the functional film (F).

stone to the earlobe, indicating that the stones in the peri-auricular flap group were located more proximally than those in the mini-incision group.

Treatment results

In group 1 (mini-incision), 49 patients were operated on under local anaesthesia and three under general anaesthesia. The stones were observed to be in the main duct in 43 cases. In the remaining nine cases, the stones were not detected in the ductal lumen and were later localized by intraoperative spiral CT to be underneath the main duct in two cases, in the accessory parotid gland in one case, and superficially over the duct in six cases. Complete stone extraction was achieved in all patients (100%). The stones were removed via a vertical incision in eight patients and via a horizontal incision in the other 44 patients. In two patients, the wound was horizontally elongated by 5–10 mm due to the proximal movement of the stone. Facial nerve branches were encountered in 19 cases, but facial paralysis did not occur. The concomitant stones were removed via the buccal incision in three cases and via the ostium in the other three cases. The wound had healed well at 7–10 days after surgery in 47 patients (90.4%). However, five patients (9.6%) developed salivary fistula

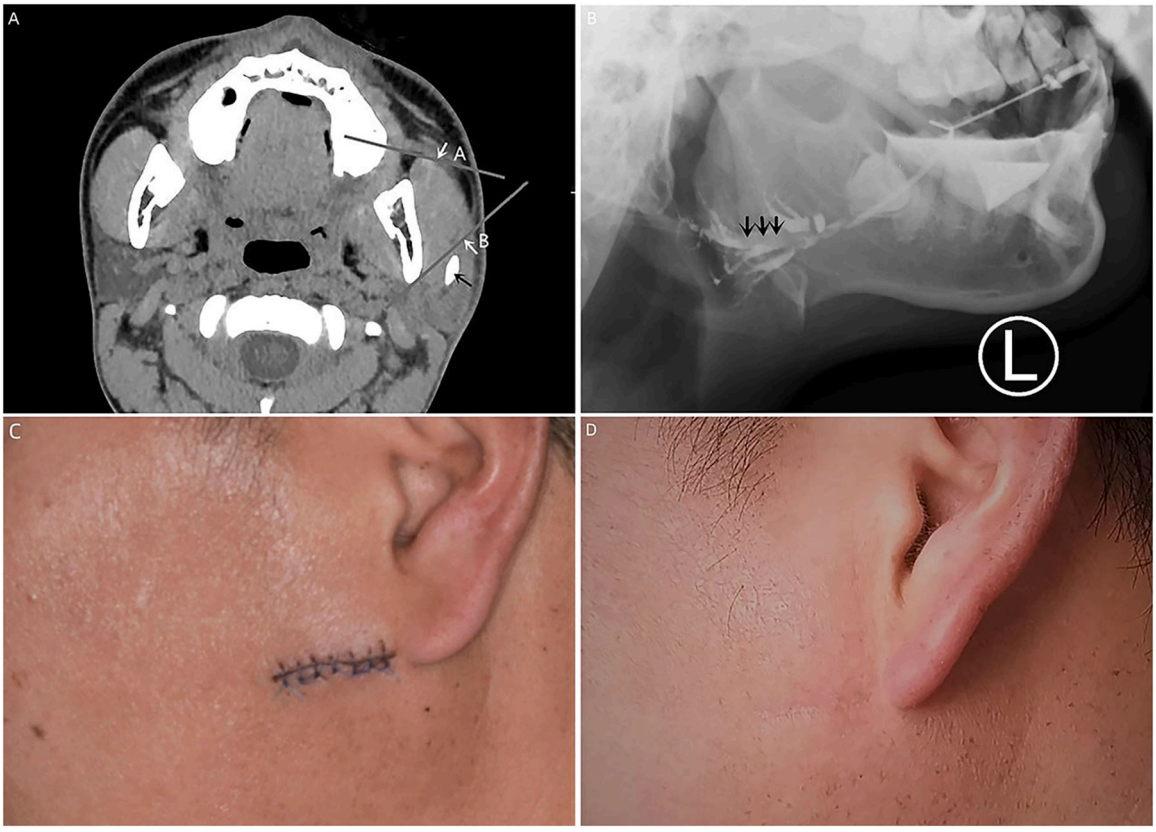

Fig. 2. The case of a 34-year-old man with a 2-year history of a left parotid gland stone. (A) Axial computed tomography showed a 15-mm stone (black arrow) in the intraglandular duct. Sites A and B (white arrow) were marked. (B) Preoperative sialography revealed a filling defect of the main duct at the stone site (black arrow) and ectasia of the branch ducts. (C) The stone was removed via a 20-mm horizontal incision near the earlobe. (D) Four years after surgery, the affected gland had good function, and the scar was nearly imperceptible.

or a wound infection, which were cured after additional antibiotic medication and a pressure dressing for 1–3 weeks.

In group 2 (peri-auricular flap), all 16 patients were operated on under general anaesthesia and had a 3-day hospital stay. In 12 cases, the stones were detected at the pre-estimated site. In the four remaining patients, however, the impacted stones moved intraoperatively into deeper ducts, necessitating further dissection of the gland parenchyma in three patients and resection of the postero-inferior lobe in one patient. Complete stone extraction was achieved in all patients (100%). Facial nerve branches were encountered in six patients, and one developed mild postoperative facial paralysis, which healed in 3 months. The wound had healed well at 7–10 days after surgery in 12 patients (75%). However, four patients (25%)

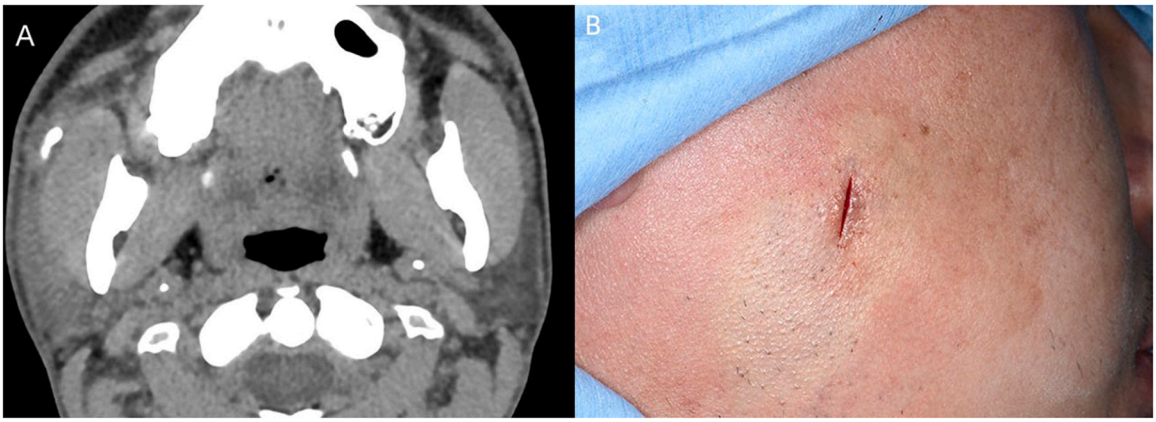

Fig. 3. The case of a 28-year-old man with an impacted stone of the right parotid gland. Axial computed tomography showed a 10-mm stone in the middle third of the duct. (B) The stone was removed via a 12-mm vertical incision.

Table 1. Clinical and imaging data of the 68 study patients with parotid stones.[a]

	Mini-incision (Group 1, $n = 52$)	Peri-auricular flap (Group 2, $n = 16$)	*P*-value
Clinical features			
Sex			0.618
Male	38 (73.1%)	10 (62.5%)	
Female	14 (26.9%)	6 (37.5%)	
Duration (months)	12.0 (0.2–240.0)	42.0 (0.3–120.0)	0.205
Stone location in the main duct			< 0.001
Middle third	31 (59.6%)	1 (6.3%)	
Hilum	16 (30.8%)	7 (43.7%)	
Proximal third	5 (9.6%)	8 (50%)	
Stone measurements			
Size (mm)	6.5 (3.6–16.1)	6.8 (5.0–15.0)	0.465
Depth (mm)	9.6 (5.0–17.9)	11.0 (6.0–17.3)	0.608
Distance from stone to ostium (mm)	50.5 ± 12.1	64.9 ± 8.2	< 0.001
Distance from stone to earlobe (mm)	34.5 ± 11.9	18.7 ± 10.4	< 0.001

[a]Data presented as the frequency (%), median (range), or mean ± standard deviation.

developed a wound infection and salivary fistula, which were cured in 2–3 weeks after additional antibiotic medication and a pressure dressing.

Clinical follow-up results

In group 1 (mini-incision), 47 patients were followed up for a median period of 25 months (range 3–63 months), while the remaining five patients with primary healing of the wound were lost to follow-up. The rate of follow-up was 90.4% (47/52). Of the 47 patients, 45 felt satisfied with the nearly imperceptible scar (Fig. 1D, Fig. 2D); a mild keloid or hyperplasia was noted in the wound region in the remaining two patients. During follow-up, 28 patients were asymptomatic and had clear saliva. Regarding the remaining 19 patients, one developed a recurrent calculus, which was removed by local curettage; 10 had occasional swelling or discomfort in the affected gland, which could be relieved by self-massage; two had frequent swelling and discomfort in the affected gland, which was alleviated after endoscopic ductal dilatation; three with recurrent symptoms needed an additional endoscopic procedure; and three patients developed duct obturation and gland atrophy. The parotid gland was preserved in all patients, and the gland status was evaluated to be good in 28% (59.6%), fair in 13 (27.6%), and poor in six patients (12.8%) (Table 2).

In group 2 (peri-auricular flap), all 16 patients were followed up, for a median period of 84.5 months (range 8–139 months). The rate of follow-up was 100%. Among the 16 patients, 13 felt satisfied with the imperceptible scar, while a keloid was noted in the cervical region in the remaining three. In 15 patients (93.8%) with preservation of the whole gland, nine were asymptomatic and had clear saliva flow. Of the other six patients, five had occasional swelling or discomfort in the affected gland, which could be relieved by self-massage, and one developed recurrent calculus necessitating further treatment. The remaining one patient was also asymptomatic despite partial resection of the parotid gland. Finally, the gland status was evaluated to be good in nine patients (56.3%), fair in five (31.2%), and poor in two (12.5%) (Table 2).

Sialography results

During a median follow-up of 5 months (range 3–36 months), 25 mini-incision group patients and eight peri-auricular flap group patients underwent follow-up sialography. The sialograms of the mini-incision group were scored as type I in 13 patients (Fig. 1E and F), type II in three patients, and type III in nine patients. The sialograms of the peri-auricular flap group patients were scored as type I in five patients, type II in two patients, and type III in one patient (Table 2).

Table 2. Outcome evaluation of the study patients with parotid stones.

	Mini-incision (Group 1)	Peri-auricular flap (Group 2)	*P*-value
Clinical outcomes[a], *n* (%)	($n = 47$)	($n = 16$)	0.962
Good	28 (59.6)	9 (56.3)	
Fair	13 (27.6)	5 (31.2)	
Poor	6 (12.8)	2 (12.5)	
Sialography[b], *n* (%)	($n = 25$)	($n = 8$)	0.386
Type I	13 (52)	5 (62.5)	
Type II	3 (12)	2 (25)	
Type III	9 (36)	1 (12.5)	

[a]Good: asymptomatic with clear saliva; fair: with occasionally mild symptoms that can be alleviated autonomously; poor: with persistent symptoms, severe side effects, or gland atrophy.

[b]Type I: approximately normal; type II: dilation or stricture of the main duct, but no persistent contrast seen on the functional film; type III: dilation or stricture of the main duct and persistent contrast evident on the functional film.

Discussion

Preoperative localization of the stone is of vital importance for determining the treatment options; nevertheless well-acknowledged segmentation criteria for the Stensen duct have rarely been reported in previous studies.[10,12] Koch and Iro[15] distinguished four locations or segments using the centimetre markings on the endoscope shaft, however the ductal length varied greatly according to sex, age, and among individuals.[16] Foletti et al.[17] used the masseter muscle and parotid body to localize stones into three sites and proposed the transcutaneous approach for stones > 3 mm in size located in the middle or posterior third of the Stensen duct. Hills et al.[12] stated that the anterior border of the masseter delineated the posterior limit for an intraoral approach, and an extraoral approach should be used for the proximal stones. In the present study, the main duct was segmented with the aid of two reference points on axial CT images. These two sites, which represent the distal and proximal bends of the main duct, were suggested from the endoscopy operational perspective. It was believed that stones distal to site A could be removed via a transoral approach, while stones close to site B should be removed by lithotripsy or a transcutaneous surgery.[12]

In 1991, Baurmarsh and Dechiara[18] first reported the transcutaneous removal of a large parotid stone via a horizontal skin incision. In 2002, Nahlieli et al.[4] used a vertical incision in 12 patients to remove impacted stones in the middle or proximal part of the Stensen duct, and recommended that this method be restricted to those stones with a depth not exceeding 6 mm. In 2010, Karavidas et al.[7] described a tertiary centre study of 27 patients with large parotid stones in the mid portion of the duct, which were removed via a vertical transcutaneous incision directly over the stone. Later, several other authors performed the direct mini-incision lithotomy surgery in a small number of parotid stone cases.[8–11,13,19,20] However, most authors believed that this technique should be confined to large palpable stones in the distal and middle parts of the duct, or superficial intra-parenchymal stones.[2]

In 2006, McGurk et al.[2] first described the pre-auricular flap incision approach, by which seven impacted parotid stones in the proximal or middle third of the duct were successfully removed. In 2007, Marchal[21] described the experiences of 37 patients with large intractable stones or tight stenoses who were treated via a classic 'lazy S' or facelift incision. Later, the peri-auricular flap approach was used in several studies, including an earlier study by the present authors' research group,[1] with or without severe complications.[7–13,22,23]

According to the previous reports and our experiences,[1,7–13] the peri-auricular flap approach commonly requires general anaesthesia, a hospital stay of 1–3 days, and a 5–6 cm incision, and entails a relatively larger operational injury to the facial tissue and parotid gland. Moreover, the reported incidence of side effects ranges from 10% to 30%. By contrast, the direct mini-incision approach can be performed under local anaesthesia as an ambulatory procedure.[20] With meticulous surgical skills, the risk of facial nerve injury may be avoided, and the local scar can be insignificant or even invisible.[2] In the present study, the stone size and depth were comparable in the two groups, however the group 2 (peri-auricular flap) stones were located more proximally than those in group 1 (mini-incision). Despite this, both groups achieved a 100% success rate. Further, the results showed a higher risk of salivary fistula in group 2 (25%) as compared to group 1 (10%). Eight of the early cases with impacted stones in the middle third or the hilum were treated via peri-auricular flap approach.[1] By contrast, 21 more recent patients with stones at the hilum or intraglandular duct had these stones removed successfully via the direct mini-incision approach. In recent years, the indications for the direct mini-incision approach have been extended to cover most impacted stones at the hilum and intraglandular ducts, while the peri-auricular flap approach has been reserved only for those deeper intraglandular stones. Also, it should be noted that several other factors, including the patient's ethnicity, sex, age, and cosmetic requirements, play a role in determining the treatment options.

Close postoperative follow-up was valuable for monitoring the recovery of the ductal shape and gland function, and this should not be ignored.[3,8,13,23] Among the 25 mini-incision group patients who underwent postoperative sialography, 36% exhibited a type III sialogram, indicating relatively poor gland status, which was higher than the frequency of type III in the peri-auricular flap group (12.5%). This could be explained by the different stone distribution in the middle third of the duct (59.6% in the mini-incision group versus 6.3% in the peri-auricular flap group). Distally located large stones might lead to more severe morphological abnormality of the whole ductal system and a poorer recovery of gland function. For these patients, additional ductal irrigation or endoscopy could be performed to improve gland function.[13]

ESWL and ISWL have been recommended by several authors. The success rate has been reported to reach 70–80% for stones < 8 mm in size that cannot be managed adequately using endoscopic methods.[5,24] Later, laser lithotripsy and pneumatic lithotripsy were introduced, with the reported success rate rising to 80–100%.[24,25] Several stone cases in the present study could have been treated by means of lithotripsy. Nevertheless, lithotripsy devices are expensive, and such equipment is not currently available at Peking University School and Hospital of Stomatology. A limitation of this study is that approximately 50% of the enrolled patients who were satisfied with the treatment outcome were reluctant to attend for follow-up sialography, which might have weakened the value of this objective test. Additionally, quantitative tests such as scintigraphy and sialometry were not used for postoperative evaluation. All of these should be improved in future studies.

In summary, preoperative localization and segmentation are valuable for determining the treatment options for impacted parotid stones. Endoscopy-assisted lithotomy via a transcutaneous mini-incision was found to be safe and effective for impacted stones located in the middle third, hilum, and proximal third of the Stensen duct. The peri-auricular approach is best reserved for deeper intraglandular stones. An extended postoperative follow-up and healthcare helps preserve the gland with good function.

Funding

None.

Competing interests

None.

Ethical approval

Ethical approval was obtained from the Biomedical Institutional Review Board, Peking University School and Hospital of Stomatology (PKUSSIRB-201412005).

Patient consent

All participants signed an informed consent.

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