Extracapsular dissection via sternocleidomastoid muscle−parotid space approach—a new operative technique for treating clinically benign tumor in the parotid tail

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Objective. The aim of this study was to introduce extracapsular dissection via the sternocleidomastoid muscle−parotid space approach (ECD-SMPSA) as a modified operative technique for removal of clinically benign tumors from the parotid tail.
Study Design. The study included 52 patients with clinically benign tumors in the parotid tail, and the patients were divided into 2 groups: one group was treated with ECD-SMPSA and the other with extracapsular dissection (ECD). All of the patients were followed up for at least 2 years.
Results. The ECD-SMPSA group had lower incidence of subjective Frey syndrome ($P = .03$) and higher satisfaction with the cosmetic result after the surgery ($P = .023$) compared with the ECD group. All of the patients were free of salivary fistulae. Facial palsy ($P = .234$) and earlobe numbness ($P = .291$) were not significantly different between the groups ($P < .05$).
Conclusions. With careful preoperative assessment, ECD-SMPSA may be a more suitable approach for the treatment of clinically benign tumors in the parotid tail. (Oral Surg Oral Med Oral Pathol Oral Radiol 2020;129:109−114)

As a result of efforts to reduce the incidence of surgical complications, such as facial palsy, Frey syndrome (FS), salivary fistula, earlobe numbness, depressed facial deformity, keloid formation, and so on, the range of parotid tumor operations became more limited. Currently, superficial and partial parotidectomy and extracapsular dissection (ECD)[1,2] are the most commonly used surgical modalities, whereas total parotidectomy has been almost abandoned. ECD has been evaluated as a minimally invasive operation and is widely considered a viable alternative surgical method to partial parotidectomy because of fewer complications, higher efficiency, and better preservation of salivary function, without oncologic compromise, while treating benign parotid tumors[3-5] as well as localized malignant tumors.[3] ECD has been proposed as an effective treatment not only for superficial and relatively small tumors[6] but also for pleomorphic adenoma in the parapharyngeal space and does not increase the risk of tumor recurrence.[7]

The surgical process of a standard ECD[8] can be roughly divided into 2 steps: (1) windowing the neoplasm and (2) dissection outside the tumor capsule. Obviously, the second step is the same for all tumors, with careful dissection outside the tumor capsule till the tumor is removed. But the first step, windowing the tumor, which consists of skin−fascia incision and flap raising, can be modified to adapt to the individual requirements of each case, especially with regard to variations in the different parts of the parotid, such as the parotid tail.

Statement of Clinical Relevance

Extracapsular dissection via the sternocleidomastoid muscle−parotid space approach which was introduced to remove clinically benign tumors in the parotid tail, is an easier, safer, and less invasive operative technique that would result in better clinical outcomes compared with standard extracapsular dissection.

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Received for publication Nov 28, 2018; returned for revision Feb 4, 2019; accepted for publication Mar 9, 2019.

2212-4403/$-see front matter
https://doi.org/10.1016/j.oooo.2019.03.006

The parotid tail, which can be defined as being located 2 cm inferior to the superficial lobe of the gland,[9] is quite different from other parts of the gland. It lies anteromedial to the sternocleidomastoid muscle, thus forming a potential facial space, which may be named the *sternocleidomastoid muscle−parotid space (SMPS)*. The SMPS is quite large and does not contain any important anatomic structures. Because the sternocleidomastoid muscle is one of the most identifiable operational landmarks, dissection along anteromedial surface of sternocleidomastoid muscle is a very easy and safe surgical technique.

Most tumors in the parotid tail are exposed or even plunge into the SMPS. When the SMPS is exposed, the tumor is also exposed and can be easily dissected. Therefore, when ECD is applied to the parotid tail, the first step of ECD may be modified to expose the SMPS. Thus, instead of windowing the tumor directly above the mass, as in the standard ECD (see Supplemental Figure S1), the modified ECD—ECD via the sternocleidomastoid muscle−parotid space approach (ECD-SMPSA)—provides a window in the SMPS through dissection along the anteromedial surface of the sternocleidomastoid muscle. It simplifies the first step of ECD—that is, windowing the tumor—because of avoidance of skin flap elevation and the least disturbance to the gland tissue.

In this study, we introduced ECD-SMPSA to remove clinically benign tumors in the parotid tail. We hypothesize that this easier, safer, and less invasive operative technique will result in better clinical outcomes compared with ECD.

MATERIALS AND METHODS

Patients

This study included 52 patients who were recruited at the Department of Oral and Maxillofacial Surgery, School and Hospital of Stomatology, Peking University (Peking, China), between July 2013 and May 2016. Of these 52 patients, 26 were assigned to the ECD-SMPSA group, and the other 26 patients who underwent synchronous ECD were assigned to the control group. Informed consent was obtained from all patients, and approval for the study was obtained from the institutional review board of the hospital.

Preoperative *computed tomography* (*CT*) images were routinely taken to establish the precise site, extent, relevant anatomy, and pathologic nature of the tumor. The location of the tumor and its relationship to the SMPS were critically analyzed. SMPS plunge tumors are usually attached to the sternocleidomastoid muscle, which can be easily distinguished on CT or magnetic resonance imaging (MRI) images showing the "shot-put" sign in the axial plane and the "dolphin lift ball" sign in the coronal plane (Figure 1). Cases with signs of malignancy, such as undefined borders of the tumor, those with manifestation of multicentric foci, and those with mental disability were excluded.

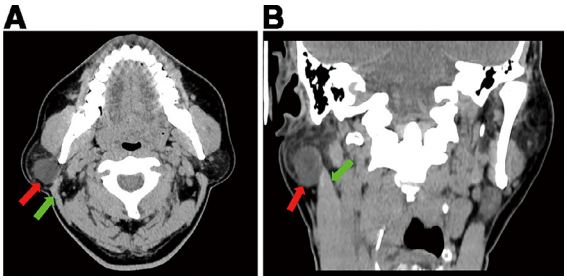

Fig. 1. Typical computed tomography (CT) image features. **(A)** Axial CT scan. **(B)** Coronal CT scan. Typical CT image of clinically benign tumor *(red arrow)* in the parotid tail and its relationship with sternocleidomastoid muscle−parotid space *(green arrow)*, with typical image of "shot put" sign in the axial plane and "dolphin lift ball" sign in coronial plane.

Surgical procedures

All the operations were performed by experienced surgeons with more than 10 years of relevant experience. In the ECD group, a preauricular incision with cervical extension was performed with the patients under general anesthesia. After the skin flap was raised from the parotid capsule, an incision was made with at least 1 cm of margin from the edges of the tumor to improve access. The uninvolved parotid tissue was then retracted, revealing loose tissue planes and 2 or 3 mm of the tumor capsule.[10]

The skin flap dissection is more limited in ECD-SMPSA than in ECD. A curved skin incision was made above the sternocleidomastoid muscle posterior to the mass, followed by identification of sternocleidomastoid muscle and dissection along the anteromedial side of the muscle until the SMPS was exposed. Thus, partial tumor capsule exposure was also achieved simultaneously (see Supplemental Video S1). The great auricular nerve and its posterior branch were identified, dissected, and preserved or were sectioned and sutured after the excision of tumor, if possible.

In all patients from the control group and the ECD-SMPSA group, when the tumor capsule was exposed, dissection was done along the capsule (see Supplemental Figure S2). The plane of dissection was within a compartment of loose tissue approximately 2 to 3 mm from the tumor. The main trunk or/and branches of the facial nerve were carefully preserved and retracted from the capsule once they were identified. The incision was extended forward and/or downward for better access to larger neoplasms. After removal of the tumor,

the wound was sutured, with a rubber drainage, which was removed on postoperative day 1. Patients were discharged 1 to 3 days after the operation. The sutures were removed 5 to 7 days after the operation. Postoperative pressure dressing was applied for 14 days, which was also the routine practice at our institution. The surgical steps are shown in the Figure 2.

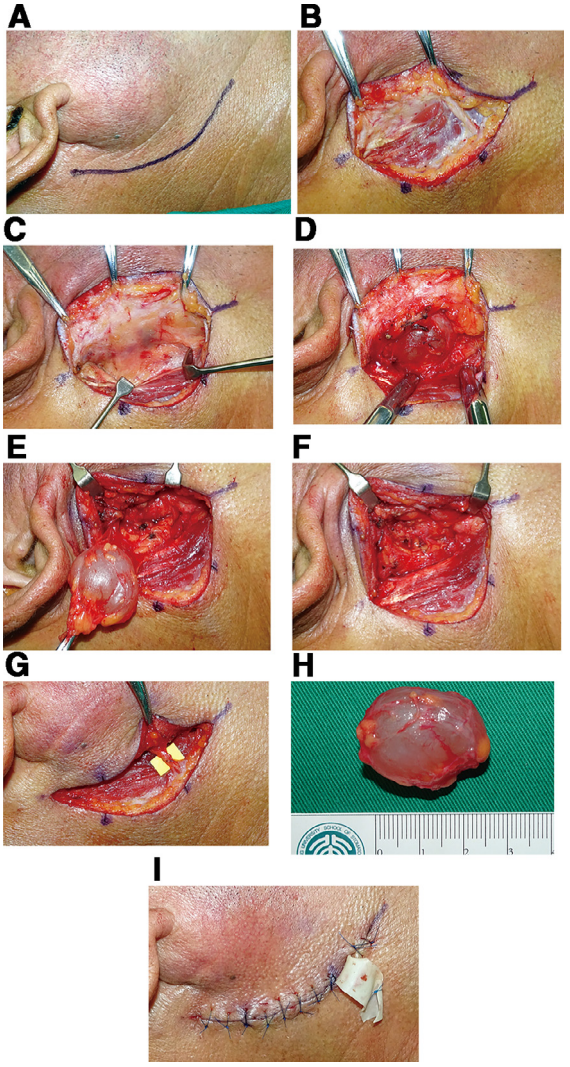

Fig. 2. Operation steps of the extracapsular dissection via the sternocleidomastoid muscle−parotid space approach (ECD-SMPSA). **(A)** The curved skin incision. **(B)** Identification of the sternocleidomastoid muscle, dissection along the muscle without raising skin flap. **(C)** Space between the sternocleidomastoid muscle and the parotid gland. **(D)** Windowing the tumor capsule. **(E)** Dissection along the tumor capsule and dissection plane within loose tissue plane approximately 2 to 3 mm from the tumor. **(F)** Tumor completely removed. **(G)** Neuroanastomosis of the great auricular nerve. **(H)** The specimen. **(I)** The sutured wound.

Assessment of complications

Facial weakness was evaluated within 1 week postoperatively. Other complications were assessed through outpatient reviews and/or telephone interviews. All of the patients were followed up for 27 to 61 months postoperatively. Median follow-up time was 40 months.

The survey included questions related to the following: (1) patients' subjective experience of sweating, flushing, or pain in the affected area while eating after the surgery; (2) salivary fistula, described as a clear fluid that was no longer contained and drained onto an epithelial surface; (3) facial palsy, which was assessed by asking patients whether they experienced unilateral facial weakness or not; and (4) presence or absence of earlobe numbness. All the above listed questions were presented in a closed question form (yes/no).[11] (5) Subjective perceptions of cosmetic results in each patient were recorded by using a 3-point scale. Satisfaction was graded as follows: 1 = "Not satisfied with the esthetics of my parotid surgery"; 2 = "I am satisfied with the cosmetic result of my parotid surgery"; and 3 = "I am highly satisfied with the cosmetic result of my parotid surgery."[11]

Statistical analysis

The Mann-Whitney U test was performed to compare nonparametric data, including age, tumor size, and operation duration. Mean volumes and standard deviation were also compared between the 2 groups. χ^2 tests were used to evaluate enumeration data: gender by continuity correction, tumor side, and earlobe numbness were evaluated by using Pearson's χ^2 test; and clinical FS, facial palsy, and subjective cosmetic results were evaluated by using Fisher's exact test. All statistical analyses were performed with SPSS software, version 20.0 (SPSS Inc., Chicago, IL). P value of $< .05$ was considered statistically significant.

RESULTS

The basic characteristics of patients from both study groups are shown in Table I. Age, gender, and tumor side were not significantly different between the groups. The average operation duration in the control group was 70 minutes, which was not significantly different from that in ECD-SMPSA group (63 minutes; $P = .417$). Therefore, the groups were homogeneous in terms of baseline characteristics, except for tumor size, and according to mean and standard deviation, these characteristics were not lower in the ECD-SMPSA group compared with those in the control group. Consequently, the degree of surgical difficulty in the ECD-SMPSA group was not lower compared with that in the control group. Moreover, all the neoplasms were completely removed.

Table I. Patients' basic characteristics

Variables	*Control (n = 26)*	*ECD-SMPSA (n = 26)*	*Significance P*
Age (mean/SD)	54/16.6	49/11.3	.128
Gender (no./%)			.337
Male	21/81%	18/69%	
Female	5/19%	8/31%	
Tumor side (%)			.266
Left	10/38%	14/54%	
Right	16/62%	12/46%	
Tumor size (cm) (mean/SD)	2.3/0.5	3.0/1.1	.016
Operation duration (min) (mean/SD)	70/24.8	63/18.4	.417

ECD-SMPSA, extracapsular dissection via the sternocleidomastoid muscle−parotid space approach; *SD,* standard deviation.

Postoperative pathologic diagnoses comprised mostly benign tumors, including Warthin tumor and pleomorphic adenoma. In addition, a few cases were histologically characterized as basal cell adenoma, lymphoepithelial cyst, vascular malformation, and eosinophilic lymphoid granuloma (Table II).

Postoperative complications are shown in Table III. After 24 months' follow-up, subjective FS was observed in 2 patients from the control group and in none of the patients in the ECD-SMPSA group. The observed difference was statistically significant ($P = .03$). In addition, patients in the ECD-SMPSA group had significantly higher cosmetic satisfaction compared with patients in the control group ($P = .023$). Fortunately, all patients were free of salivary fistulae. The other postoperative complications, including facial palsy and earlobe numbness, were not significantly different between the groups ($P = .234$; $P = 0.291$). After 2 years of review and follow-up, no tumor recurrence was observed.

DISCUSSION

The parotid tail is one of the most common tumor-bearing areas. The majority of tumors in this area are benign lumps, with Warthin tumor and pleomorphic adenoma being the most frequently reported. The

Table II. Postoperative pathologic diagnoses of cases

Pathologic diagnosis	*Control n = 26*	*ECD-SMPSA n = 26*
Warthin tumor	13 (50.0%)	12 (46.2%)
Pleomorphic adenoma	8 (30.8%)	10 (38.5%)
Basal cell adenoma	3 (11.5%)	2 (7.7%)
Lymphoepithelial cyst	1 (3.9%)	1 (3.9%)
Vascular malformation	0	1 (3.9%)
Eosinophilic lymphoid granuloma	1 (3.9%)	0

ECD-SMPSA, extracapsular dissection via the sternocleidomastoid muscle−parotid space approach.

Table III. The outcomes of the operation

Evaluation Indicators	*ECD n = 26*	*ECD-SMPSA n = 26*	*Significance P*
Subjective Frey syndrome			.03
Yes	6 (23.1%)	0	
No	20 (76.9%)	26 (100%)	
Facial palsy			.234
Yes	3 (11.5%)	0	
No	2 3(88.5%)	26 (100%)	
Salivary fistulae			–
Yes	0	0	
No	26 (100%)	26 (100%)	
Earlobe numbness			.291
Yes	7 (26.9%)	3 (11.5%)	
No	19 (73.1%)	23 (88.5%)	
Subjective cosmetic result			.023
1	0	0	
2	6 (23.1%)	0	
3	20 (76.9%)	26 (100%)	

ECD, extracapsular dissection; *ECD-SMPSA,* extracapsular dissection via the sternocleidomastoid muscle−parotid space approach.

parotid tail is the most common site for Warthin tumor.[12] The surgical techniques used to treat neoplasms in the parotid tail may be different from those for tumors in other parotid areas. Although partial parotidectomy may include dissection of the lower division of the facial nerve, resection of the tumor as well as the whole parotid tail,[13-15] ECD is often applied to excise tumors confined to the parotid tail[16] and may also be further modified, as demonstrated in our ECD-SMPSA cases.

In the present study, 26 cases with clinically benign lumps in the parotid tail were treated with ECD-SMPSA, resulting in fewer surgical complications and better subjective cosmetic satisfaction compared with ECD, confirming our hypotheses that ECD-SMPSA not only is easier, safer, and less invasive but also has better clinical outcomes. None of 26 patients treated with ECD-SMPSA reported experiencing FS, whereas 6 (23.1%) of the 26 patients treated with ECD reported subjective FS, a well-known postparotidectomy complication. Previous studies have reported that the incidence may be as high as 96% in postparotidectomy patients[17] and that only those with subjective FS should be selected for the intervention.[18] Nonsubjective FS is completely asymptomatic, rarely progresses, and does not affect patients' quality of life. Diagnosis of completely asymptomatic FS may provoke needless anxiety and unnecessary intervention. Therefore, we focused on subjective clinical FS and did not use the Minor starch iodine test, which is currently recognized as the most objective evaluation method.[19]

Interpositioning of various flaps, such as the sternocleidomastoid muscle flap,[20] tissue autograft,[21] and alloplast, have been suggested for the prevention of FS.[22] Botulinum toxin injection has also been shown to be effective in the treatment of FS.[23] Nonetheless, techniques that would totally prevent or alleviate FS have not yet been identified. Because FS is the result of aberrant regeneration and misdirection of injured postganglionic secretomotor parasympathetic nerve fibers, eventually causing improper innervation to the sweat glands of the skin,[24] ECD-SMPSA without superficial musculoaponeurotic system (SMAS) flap lifting obviously prevents FS. Further long-term prospective observations are warranted to strengthen this hypothesis.

Sacrifice of the great auricular nerve is a minor complication of parotid gland operation, but it does not affect the overall quality of life.[25] The great auricular nerve ascends to the parotid gland on the sternocleidomastoid muscle beneath the platysma, where it divides into an anterior branch and a posterior branch. With lifting of the SMAS flap and superficial fenestration to the tumor, the routine ECD procedure may preserve the great auricular nerve through dissection. However, with ECD-SMPSA, the negative outcomes of sensory nerve injury can be minimized with intentional dissection and sectioning of the main trunk of the great auricular nerve, followed by neurorrhaphy. Consequently, the risk of injury to the great auricular nerve branch can be minimized or overcome through neurorrhaphy.

Unilateral multifocal primary tumors should be the contraindication for ECD and for this new approach. Yet, in a series of 877 cases with major salivary gland tumors reported by Foote and Frazell, synchronous multifocal tumors accounted for less than 1%.[26] At our department, during a 40-year period (1962−2002), only 38 (1.8%) unilateral multiple primary parotid tumors were found in 2055 cases, among which Warthin tumor was the most common one.[27] Unilateral multiple primary pleomorphic adenomas of the parotid gland are extremely rare, with less than 20 cases being reported in the literature.[28] As revealed through routine preoperative CT or MRI screening for multifocal primary tumors, it is clear that the significantly low rates do not warrant the more radical prophylactic excision of clinically normal gland tissue. As long-term low recurrence rates are now the norm in the management of parotid tumors, there is an emerging trend toward low-morbidity surgery. However, how to achieve a balance is still being debated. A recent historical review demonstrated a significantly higher rate of recurrent pleomorphic adenoma with ECD compared with partial parotidectomy.[29]

This study has some limitations that must be pointed out. The observation samples were not very large. Most of the cases only had postoperative pathologic reports of Warthin tumor and pleomorphic adenoma. To verify the long-term benefits of this modified technique, further prospective studies with larger sample sizes and longer follow-up durations are necessary.

CONCLUSIONS

Overall, ECD-SMPSA may be a more suitable approach for the treatment of clinically benign tumors in the parotid tail because it has fewer complications. It is safer and enables a closer approach to the lesion, thus lowering the risk of parotid tissue damage. Moreover, ECD-SMPSA may reduce the incidence of subjective FS, increase patient satisfaction, and result in a lower level of defects compared with the traditional surgical approach.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.oooo.2019.03.006.

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