Journal of Cranio-Maxillo-Facial Surgery 53 (2025) 1379–1384

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Influence of parotidectomy extent on complications after benign parotid surgery

Matteo Alicandri-Ciufelli [a], Carla Cantaffa [a,*], Francesco Maccarrone [a,b], Alfredo Lo Manto [a], Paolo Russo [a], Matteo Gibertini [a], Federico Salvatore Giordano [a], Nicola Amato [c,d], Mattia Di Bartolomeo [e,f], Alexandre Anesi [e], Francesco Mattioli [a], Daniele Marchioni [a], Livio Presutti [c,d], Giulia Molinari [c,d]

[a] *Department of Otolaryngology — Head and Neck Surgery, University Hospital of Modena, Modena, Italy*
[b] *Department of Otolaryngology — Head and Neck Surgery, 'B. Ramazzini' Hospital of Carpi, Carpi, Italy*
[c] *Otolaryngology and Audiology Unit, IRCCS Azienda Ospedaliero-Universitaria Policlinico di Sant'Orsola, Bologna, Italy*
[d] *Department of Experimental, Diagnostic and Specialty Medicine — DIMES, Alma Mater Studiorum University, Bologna, Italy*
[e] *Department of Maxillo-Facial Surgery, University Hospital of Modena, Modena, Italy*
[f] *Surgery, Dentistry, Maternity and Infant Department, Unit of Dentistry and Maxillo-Facial Surgery, University of Verona, Verona, Italy*

ARTICLE INFO

Keywords:
Parotid
Facial nerve
Head and neck surgery
Cancer
Outcomes

ABSTRACT

This study aimed to assess how the extent of parenchymal removal impacts on postoperative complications after benign parotid surgery.

A multicentric retrospective study on parotidectomies for benign lesions performed between 2014 and 2020 was carried out. Demographics, tumor characteristics, surgical details, and postoperative outcomes were analyzed.

In total, 591 patients were included. Multivariable logistic regression analysis revealed that partial superficial parotidectomy (PSP) was associated with a lower risk of postoperative facial nerve (FN) palsy, great auricular nerve (GAN) hypoanesthesia, and Frey syndrome (FS) than superficial parotidectomy (SP), irrespective of tumor size. Extracapsular dissection (ECD) was found to be protective for FS compared with SP, irrespective of tumor size. ECD was associated with a higher risk of FN palsy and GAN hypoanesthesia than PSP.

Minimally invasive parotidectomy procedures, such as ECD and PSP, are associated with similar or even decreased rates of postoperative complications when compared with more traditional procedures, such as SP.

1. Introduction

Surgery is the gold standard treatment for benign parotid lesions, with several options currently available to achieve complete mass removal, while preserving the facial nerve (FN) and preventing local complications. The surgical approach to these lesions has evolved from enucleation, with undesirable recurrence rates, to extended resections in which the FN is routinely dissected to remove at least the whole superficial lobe (Quer et al., 2016).

In recent decades, however, a progressive trend to limit the dissection to the involved parotid segment has been observed, with encouraging results regarding local disease control and complication rates (Mantsopoulos et al., 2015; Psychogios et al., 2021). The European Salivary Gland Society (ESGS) has supported such a tumor-tailored approach, proposing a comprehensive classification system for parotid surgery. This classification reports extracapsular dissection (ECD) as the minimal surgical treatment, and stratifies the extent of surgery according to the removal of well-defined parotid segments (Quer et al., 2016).

While complication rates after benign parotid surgery have been reported by several authors, predictive factors for FN palsy and other adverse outcomes remain controversial, as most results have been derived from small study populations (Ruohoalho et al., 2017; Henneman et al., 2020; Aydin et al., 2021). Furthermore, the impact of the stratified extent of surgery on complication rates has been rarely investigated (Wong and Shetty, 2018).

The aim of our study was to evaluate complication rates after benign parotid surgery in a large multicentric cohort, and to assess how the extent of parenchymal removal affects them. The prognostic roles of

* Corresponding author.
E-mail address: carla.cantaffa@outlook.com (C. Cantaffa).

https://doi.org/10.1016/j.jcms.2025.05.013
Received 10 April 2024; Received in revised form 17 April 2025; Accepted 17 May 2025
Available online 3 June 2025

demographic, clinical, and pathological parameters on postoperative outcomes were also investigated.

2. Materials and methods

This was a retrospective chart review of parotidectomy procedures for benign parotid neoplasms performed between January 2014 and December 2020 in the Otolaryngology Departments of Modena and Bologna University Hospitals, and the Maxillo-Facial Department of Modena University Hospital. Enrolled patients had a primary benign parotid tumor according to the WHO classification (El-Naggar et al., 2017). Patients having recurrent tumors, with a history of parotid surgery, and/or history of radiotherapy on the head and neck region were not eligible; nor were patients whose lesion was discovered to be malignant upon definitive histological analysis. Tumors with parapharyngeal extension were excluded as well.

In all cases, clinical diagnosis was supplemented with ultrasound and fine needle aspiration cytology (FNAC). Computed tomography scans or magnetic resonance imaging were performed in cases of larger neoplasms (>3 cm), suspicion of malignancy at FNAC, or suspicion of deep lobe involvement. The preoperative imaging protocol was the same in all centers. According to their larger diameter on imaging studies, tumors were classified as ≤ 2 cm, between 2 cm and 4 cm, or >4 cm, and as multifocal or single masses.

Based on the ESGS system (Quer et al., 2016), which divides the parotid gland into five levels (Fig. 1) — I (lateral superior), II (lateral inferior), III (deep inferior), IV (deep superior), V (accessory) — parotidectomy procedures were classified as follows.

- ECD;
- partial superficial parotidectomy (PSP), which includes parotidectomy I and parotidectomy II of the ESGS classification;
- superficial parotidectomy (SP), which corresponds to parotidectomy I–II of the ESGS classification;
- extended superficial parotidectomy (ESP), which corresponds to parotidectomy I–II–III of the ESGS classification;
- total parotidectomy (TP), corresponding to parotidectomy I–IV of the ESGS classification.

In addition to the surgical procedures coded by the ESGS, resection of levels I-II-IV and of levels II and III were included in the analysis as separate parotidectomy procedures, since they are sometimes performed at the institutions involved. All procedures were performed with the aid of a continuous nerve monitoring system and magnifying loupes. Where appropriate, the FN was accessed via an anterograde approach, with the cartilaginous pointer of the external auditory canal and the posterior belly of the digastric muscle used as landmarks.

The choice of surgical procedure was based mainly on lesion localization. Neoplasms involving either level I or II of the ESGS classification underwent PSP, while neoplasms involving more than one level were

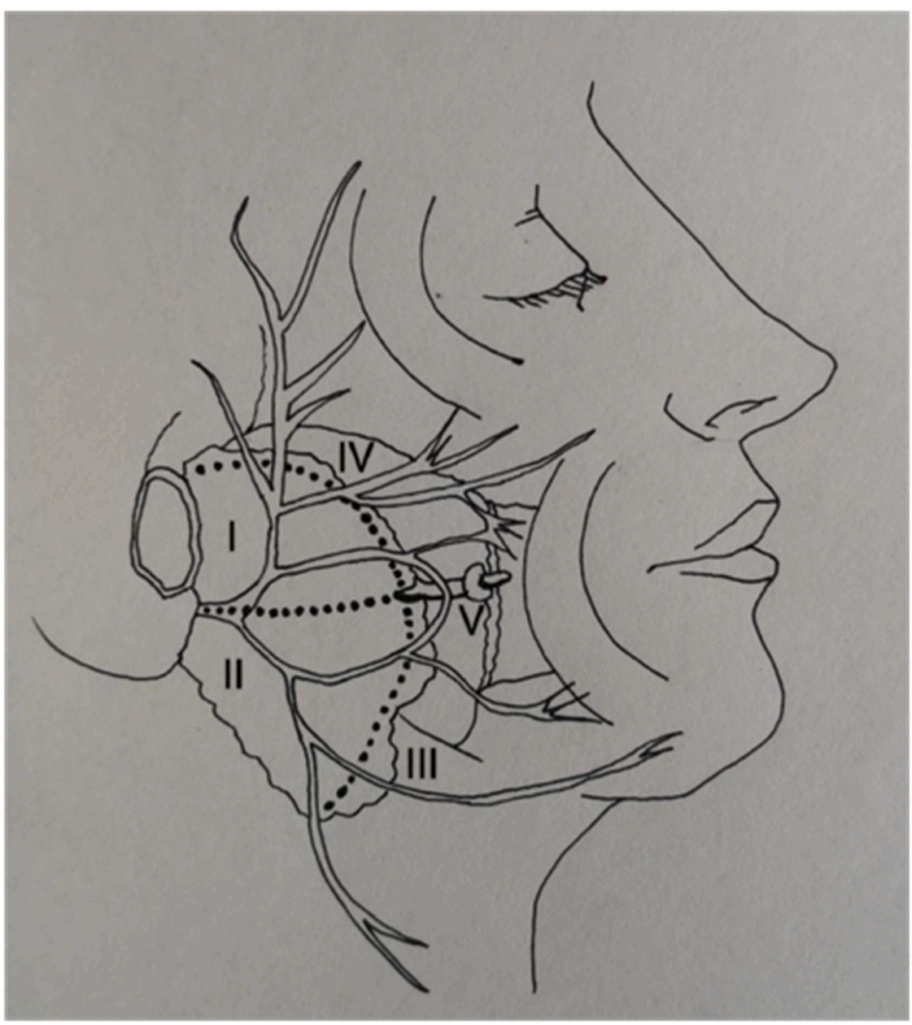

Fig. 1. Schematic drawing of parotid segments according to the classification of parotidectomies by the European Salivary Glands Society (ESGS): I — superficial superior lobe, II — superficial inferior lobe, III — deep inferior lobe, IV — deep superior lobe, V — accessory lobe.

subjected to either SP, ESP, TP, or resection of levels I–II–IV or of levels II and III. ECD was performed only in cases of well-capsulated neoplasms located in the most peripheral portion of the parotid gland.

Medical records were then reviewed to obtain the following information: patient demographics, pre-operative assessment, and surgical details, including extent of resection, histopathological diagnosis, and postoperative complications. Complications were classified as FN palsy at the time of discharge from the hospital (immediate FN palsy — IFNP), FN palsy at the last follow-up visit (persistent FN palsy — PFNP), great auricular nerve (GAN) hypoanesthesia, Frey syndrome (FS), and surgical site complications, including seroma, hematoma, sialocele, salivary fistula, and infection. Objective evaluation of postoperative FN function was performed using the House–Brackmann (HB) grading system (Fattah et al., 2015). Postoperative electromyography and electroneurography were not routinely performed. PFNP was assessed at least 6 months after surgery. GAN hypoanesthesia was subjectively reported by patients. FS was diagnosed according to the starch iodine test.

Postoperatively, patients with no complications at the time of hospital discharge were instructed to perform a yearly follow-up visit with at least a major salivary gland ultrasound (or parotid MRI, according to the histopathological features and type of surgery performed, in a patient-tailored approach). Patients with facial nerve palsy and/or Frey syndrome were referred to the respective institutional specific outpatient clinics for rehabilitation and followed every 6 months starting from the end of the rehabilitation process.

Data were entered into an electronic database (Microsoft Excel) and transferred to IBM SPSS Statistics version 28.0.0.1 (IBM Corp., Armonk, NY, USA) for data analysis. The statistical analysis was performed using a multivariate binomial logistic regression model. Odds ratios (ORs) with 95 % confidence intervals (CIs) for relevant risk factors were reported. The chi-square test was used to measure the association between size of lesion and type of surgery. A p-value ≤ 0.05 was considered statistically significant. For the multivariate analysis, patient's gender, side of the lesion, presence or absence of preoperative FNAC, and multifocality were assessed as dichotomous variables, and age as a continuous variable. Histological diagnoses were grouped into trichotomous variables (pleomorphic adenoma — PA, Warthin's tumor - WT, and others), as well as tumor size (≤ 2 cm, between 2 cm and 4 cm, or > 4 cm). Cases in which resection of distal FN branches was deemed necessary for the complete removal of the lesion were not included in the analysis of FN outcomes. Similarly, cases of accidental intraoperative section of the posterior branch or main trunk of the GAN were excluded from the analysis of postoperative GAN function. Analysis of FS was performed only on patients with a follow-up of at least 6 months.

For the chi-square test, tumor size was assessed as a dichotomous variable (≤ 2 cm vs > 2 cm).

This study was conducted in accordance with the Declaration of Helsinki and approved by the Research Committee of Emilia Romagna.

3. Results

3.1. General patients' features

In total, 591 patients were eventually included. Patients' ages at the time of surgery ranged between 14 and 85 years (mean 55.5). Mean follow-up was 34.5 months (range 1–153). Data regarding patient's demographics, tumor size, multifocality, type of surgery, and pathological diagnosis are reported in Table 1.

The most commonly performed surgery was conventional SP, followed by PSP. The most frequent histology was PA, followed by WT.

In two cases of SP, the gland was removed together with a segment of overlying skin. In three cases (one SP, one TP, and one SP extended to level III), distal FN branches were intentionally sacrificed for oncological purposes. The posterior branch or main trunk of the GAN was sacrificed in 27 cases.

Most patients who underwent ECD (60.5 %) had lesions of ≤ 2 cm, while SP patients had an even size distribution (44.9 % $\leq$ 2 cm, 54.8 % $>$ 2 cm). The odds of patients receiving ECD having a lesion of ≤ 2 cm were comparable to the odds of patients receiving SP. Similar results were obtained when comparing SP with PSP. Details on size distribution and results of chi-square tests are summarized in Table 2.

Table 1
Patient demographics, with tumor- and surgery-related data.

Patients (n)	591
Age in years (mean, SD, range)	55.5, 15.3, 14–85
	n (%)
Gender	
Male	289 (48.9)
Female	302 (51.1)
Tumor size	
≤2 cm	260 (44)
2–4 cm	290 (49.1)
>4 cm	40 (6.8)
NA	1 (0.1)
Tumor multifocality	
No	531 (89.8)
Yes	60 (10.2)
Type of parotidectomy (n, %)	
SP	403 (68.2)
PSP	75 (12.7)
ESP	20 (3.4)
ECD	38 (6.4)
TP	44 (7.4)
I–II–IV	7 (1.2)
II–III	4 (0.7)
Postoperative complications	
Overall	327 (55.3)
GAN hypoanesthesia	71 (30.3[a])
IFNP	49 (25.3[b])
FS	115 (25.6[c])
Surgical site complications	100 (16.9)
Histological diagnosis	
PA	315 (53.3)
WT	227 (38.4)
Other	49 (8.3)

SD: standard deviation, NA: not available, SP: superficial parotidectomy, PSP: partial superficial parotidectomy, ESP: extended superficial parotidectomy, ECD: extracapsular dissection, TP: total parotidectomy, GAN: great auricular nerve, IFNP: immediate postoperative facial nerve palsy, FS: Frey's syndrome, PA: pleomorphic adenoma, WT: Warthin's tumor.

[a] Total cases where there was no mention of accidental section of the GAN on the surgical report.

[b] Total cases where the FN or its branches were not removed for oncological purposes.

[c] Patients with a follow-up of at least 6 months.

3.2. Overall postoperative complications

GAN hypoanesthesia (71/564, 30.3 %), FS (115/449, 25.6 %), and IFNP (149/588, 25.3 %), accounted for the greatest percentages of complications. Less common complications are detailed in Table 1.

A higher overall complication rate was observed in patients treated

Table 2
Distribution of tumor dimensions according to type of parotidectomy procedure.

Surgical procedure	Tumor dimensions (cm)		OR	95 % CI	p-value
	≤2	>2			
SP (n = 403) — ref	n (%)	n (%)			
	181 (44.9)	221 (54.8)			
PSP (n = 75)	34 (45.3)	41 (54.7)	1.01	0.62–1.66	0.96
ECD (n = 38)	23 (60.5)	15 (39.5)	1.87	0.95–3.69	0.07

OR (odds ratio) refers to the result of a chi-square test between either PSP or ECD and SP (i.e. the odds of patients receiving PSP or ECD having a lesion ≤2 cm versus patients receiving SP). CI: confidence interval, SP: superficial parotidectomy, PSP: partial superficial parotidectomy, ECD: extracapsular dissection.

with SP, SP extended to level III, TP, and ECD with respect to the PSP group. There was no significant difference between ECD and SP. No other demographic or clinical variables were found to be associated with overall complication rates (Table 3).

3.3. Facial palsy

A significant association was observed between patient age and the risk of IFNP. ECD, SP, SP extended to level IV, and TP were associated with an increased risk of IFNP when compared with PSP. There was no statistically relevant difference between ECD and SP.

Tumor histology compatible with WT was associated with a reduced risk of IFNP with respect to PA and other less common histologies (Table 4). Of the 149 patients with IFNP, 27 were lost during follow-up, while the remaining 122 were followed for at least 6 months after surgery. A recovery rate of 86.9 % (106/122) was observed. All 16 patients with PFNP had grade II FN palsy according to the HB classification. Of these, 12 underwent SP, two TP, and two ECD. None of the patients treated with PSP developed PFNP. However, there was no statistically significant association between the risk of PFNP and the type of procedure ($p = 0.82$). Moreover, there was no association between any of the other analyzed variables and PFNP.

3.4. GAN hypoanesthesia

SP, SP extended to level III, TP, and ECD were associated with an increased risk of GAN hypoanesthesia in comparison with PSP. ECD and SP did not show any statistically relevant difference in this regard. No association was observed between any of the other analyzed variables and GAN hypoanesthesia (Table 5).

3.5. Frey syndrome

Analyses of FS were performed only on patients with a follow-up of at least 6 months ($n = 449$). Increasing age was a protective factor for the occurrence of FS postoperatively. SP was associated with worse

Table 3
Results of multivariate binomial logistic regression analysis for overall complication rate.

	OR	95 % CI		*p*-value
		Lower	Upper	
Gender (F vs M)	0.73	0.54	1.13	0.19
FNAC preop	1.20	0.69	2.08	0.51
Age	0.99	0.98	1.01	0.21
Parotidectomy type according to ESGS (ref: PSP)				
Levels I–II	3.26	1.91	5.56	<0.001[a]
Levels I–II–III	4.42	1.52	12.8	0.01[a]
Levels II–III	2.21	0.28	17.3	0.45
Levels I–II–III–IV	3.00	1.34	6.71	0.01[a]
Levels I–II–IV	4.68	0.75	29.1	0.10
ECD	2.65	1.17	6.00	0.02[a]
Parotidectomy type according to ESGS (ref: ECD)				
PSP	0.38	0.17	0.86	0.02[a]
Levels I–II	1.23	0.62	2.44	0.55
Levels I–II–III	1.67	0.52	5.35	0.39
Levels II–III	0.84	0.10	6.88	0.87
Levels I–II–III–IV	1.14	0.46	2.82	0.79
Levels I–II–IV	1.77	0.27	11.7	0.55
Side (left vs right)	0.81	0.58	1.15	0.24
Histology (ref: pleomorphic adenoma)				
Warthin tumor	1.05	0.67	1.63	0.84
Other	1.07	0.55	2.08	0.84
Multifocality	0.93	0.51	1.72	0.83
Size (ref: <2 cm)				
2–4 cm	0.70	0.49	1.00	0.05
>4 cm	0.79	0.39	1.60	0.51

OR: odds ratio, 95 % CI: confidence interval, ref: reference variable, PSP: partial superficial parotidectomy, ECD: extracapsular dissection.
[a] Statistically significant ($p < 0.05$).

Table 4
Results of multivariate binomial logistic regression analysis for immediate postoperative facial nerve palsy.

	OR	95 % CI		*p*-value
		Lower	Upper	
Gender (F vs M)	1.19	0.78	1.83	0.41
FNAC preop	0.84	0.45	1.58	0.59
Age	1.02	1.01	1.04	0.002[a]
Parotidectomy type according to ESGS (ref: PSP)				
Levels I–II	10.8	3.31	35.4	<0.001[a]
Levels I–II–III	2.41	0.37	16.0	0.36
Levels II–III	0	0	0	0.999
Levels I–II–III–IV	16.7	4.33	64.5	<0.001[a]
Levels I–II–IV	17.8	2.43	131	0.005[a]
ECD	6.83	1.62	28.8	0.009[a]
Parotidectomy type according to ESGS (ref: ECD)				
PSP	0.15	0.04	0.62	0.009[a]
Levels I–II	1.59	0.66	3.79	0.3
Levels I–II–III	0.35	0.06	1.99	0.24
Levels II–III	0	0	0	0.999
Levels I–II–III–IV	2.45	0.82	7.28	0.12
Levels I–II–IV	2.61	0.41	16.6	0.31
Side (left vs right)	0.96	0.64	1.43	0.83
Histology (ref: pleomorphic adenoma)				
Warthin tumor	0.42	0.25	0.71	0.001[a]
Other	1.14	0.56	2.33	0.72
Histology (ref: other)				
Pleomorphic adenoma	0.88	0.43	1.8	0.72
Warthin tumor	0.37	0.18	0.77	0.008[a]
Multifocality	1.29	0.63	2.65	0.49
Size (ref: <2 cm)				
2–4 cm	1.19	0.79	1.8	0.41
>4 cm	0.55	0.21	1.45	0.23

OR: odds ratio, 95 % CI: confidence interval, ref: reference variable, PSP: partial superficial parotidectomy, ECD: extracapsular dissection.
[a] Statistically significant ($p < 0.05$).

Table 5
Results of multivariate binomial logistic regression analysis for great auricular nerve hypoanesthesia.

	OR	95 % CI		*p*-value
		Lower	Upper	
Gender (F vs M)	0.94	0.63	1.41	0.76
FNAC preop	0.87	0.47	1.59	0.65
Age	0.99	0.98	1.01	0.24
Parotidectomy type according to ESGS (ref: PSP)				
Levels I–II	6.04	2.55	14.3	<0.001[a]
Levels I–II–III	7.17	2.01	25.6	0.002[a]
Levels II–III	3.87	0.33	44.9	0.28
Levels I–II–III–IV	5.1	1.7	15.2	0.004[a]
Levels I–II–IV	5.2	0.74	36.4	0.097
ECD	6.15	2.08	18.2	0.001[a]
Parotidectomy type according to ESGS (ref: ECD)				
PSP	0.16	0.06	0.48	0.001[a]
Levels I–II	0.98	0.48	2.03	0.96
Levels I–II–III	1.17	0.35	3.88	0.8
Levels II–III	0.63	0.06	7.04	0.71
Levels I–II–III–IV	0.83	0.31	2.23	0.71
Levels I–II–IV	0.85	0.13	5.66	0.86
Side (left vs right)	0.99	0.68	1.44	0.94
Histology (ref: pleomorphic adenoma)				
Warthin tumor	0.9	0.55	1.48	0.69
Other	1.03	0.5	2.12	0.94
Multifocality	1.19	0.61	2.33	0.61
Size (ref: <2 cm)				
2–4 cm	0.78	0.52	1.15	0.21
>4 cm	0.51	0.22	1.2	0.12

OR: odds ratio, 95 % CI: confidence interval, ref: reference variable, PSP: partial superficial parotidectomy, ECD: extracapsular dissection.
[a] Statistically significant ($p < 0.05$).

outcomes in terms of FS with respect to PSP. The same was found for SP extended to level III and TP. No difference was observed between ECD and PSP in this regard. Moreover, SP, SP extended to level III, and TP were associated with increased risk of FS when compared with ECD.

Size was found to be inversely correlated with FS: in comparison with patients with lesions >4 cm, patients with lesions smaller than 2 cm and those with lesions between 2 cm and 4 cm were found to have a higher risk of developing FS postoperatively (Table 6). No difference was found between patients with lesions smaller than 2 cm and those with lesions between 2 cm and 4 cm (OR 0.95, CI 0.61–1.49; $p = 0.83$).

3.6. Surgical site complications

Female gender (OR 0.468, CI 0.284–0.769; $p = 0.003$) and left-side parotidectomy (OR 0.517, CI 0.327–0.818; $p = 0.005$) were found to be protective for the outcome. The extent of surgery did not have any statistical correlation with the risk of postoperative surgical site complications ($p = 0.56$).

4. Discussion

SP used to be the gold standard surgical treatment for benign parotid tumors of the superficial lobe, where the vast majority of these lesions are actually located. There is convincing evidence in the literature regarding the efficacy of this procedure in terms of risk of recurrence (Ayoub et al., 2002). In our series, SP was the most commonly performed type of surgery (68.3 %). However, SP is invariably associated with a certain risk of postoperative sequelae. This has prompted the search for less radical procedures, such as PSP, in which less parotid tissue is removed and fewer FN branches are dissected, thus theoretically reducing the risk of postoperative complications, while still guaranteeing a negligible recurrence rate. Moreover, the risk of transient FN palsy seems to be significantly reduced in patients treated with PSP rather than SP (Papadogeorgakis, 2011; El Fol et al., 2015; Ogreden et al., 2016).

In line with the literature, our results show a protective role of PSP versus SP for IFNP. On the other hand, according to most authors, the incidence of PFNP does not seem to differ between the two groups (Mlees and Elbarbary, 2020; Li et al., 2020; Al-Aroomi et al., 2021). Furthermore, our results showed advancing age to be a risk factor for IFNP, independently from the parotidectomy type, as previously reported by other authors; this is most likely due to the poorer nerve recovery that is typical of older patients. Finally, in our cohort, patients with a histological diagnosis of WT were less likely to develop IFNP when compared with other histologies, despite the type of procedure performed. To our knowledge, tumor histology is seldom evaluated as a potential risk factor for postoperative complications, but we feel that this topic deserves further investigation.

Less is known from the literature regarding the impact of less invasive dissection on complications other than FN palsy, and the results are conflicting. Several recently published studies comparing different parotidectomy types for benign tumors show no statistically significant differences in the incidences of sialocele, hemorrhage/hematoma, FS, and GAN hypoanesthesia (Ogreden et al., 2016; Li et al., 2020; Thölken et al., 2021). However, a protective role of PSP versus SP for auricular numbness and FS has been reported in some cohorts, similarly to ours. Regarding GAN dysfunction, it has been suggested that a more conservative approach may explain the lower injury rates associated with this procedure. However, several other factors could influence GAN function, including the location of the tumor with respect to the nerve, the expertise of the surgeon, and the scarring process. Thus, conclusions on the role of parotidectomy extent on GAN function are difficult reach.

The higher risk of FS in SP with respect to PSP is likely due to SP being associated with more extensive parotid tissue removal, leading to more extensive damage to parasympathetic fibers crossing the gland, and consecutive aberrant reinnervation. Of note, strategies to reduce the risk of FS, such as superficial musculoaponeurotic system dissection, or sternocleidomastoid muscle or free fat graft transfer, are not routinely performed at our institutions, explaining the relatively high incidence of FS observed (19.5 % in the total cohort, 25.6 % in patients with a follow-up of at least 6 months). Counterintuitively, our results show that smaller lesions (<4 cm) are associated with an increased risk of FS development. Finally, the incidence of FS was found to be inversely associated with age. Age is not among the classical clinical predictors of FS. However, based on the pathogenic mechanism behind its occurrence, we hypothesize that the lower incidence of FS in older patients could be attributed to nerve regeneration being less efficient in this group.

ECD is another minimally invasive option for selected benign parotid tumors, characterized by the removal of a 2–3 mm margin of healthy tissue without FN dissection (Emodi et al., 2010). This technique has its disadvantages, since the FN is not controlled from the outset and there is a risk of rupture of the tumor capsule (Witt and Iacocca, 2012). In a meta-analysis of 14 studies with 3194 patients, Xie et al. underlined that, as has been observed for PSP, there seemed to be no significant difference in recurrence rates between ECD and SP. They also reported significantly lower incidences of transient and permanent FN dysfunction and FS in the ECD group (Xie et al., 2015). Similarly, a recent review by Martin et al. showed that ECD was associated with reduced rates of FN palsy and FS (Martin et al., 2020). These and similar studies have prompted surgeons increasingly to indicate ECD as an alternative to more conventional approaches (Albergotti et al., 2012; Lin et al., 2019; Mashrah et al., 2021). In our cohort, ECD was associated with a lower risk of FS with respect to SP, but has the same rates of IFNP, PFNP, GAN hypoanesthesia, and surgical site complications.

The main point of uncertainty limiting widespread usage of ECD seems to be the dimensional cut-off above which ECD is no longer an option. Dell'Aversana Orabona et al., who reported a dramatic improvement in postoperative complications for ECD, referred patients with lesions <3 cm for ECD, while larger lesions were treated with SP (Dell'Aversana Orabona et al., 2013). The 3 cm cut-off can be found in other studies too. In two recent comparative studies, lesions were simply

Table 6
Results of multivariate binomial logistic regression analysis for Frey syndrome.

	OR	95 % CI		*p*-value
		Lower	Upper	
Gender (F vs M)	1.28	0.81	2.04	0.29
FNAC preop	0.8	0.31	2.32	0.75
Age	0.98	0.99	0.96	0.005[a]
Parotidectomy type according to ESGS (ref: PSP)				
Levels I–II	3.52	1.00	12.4	0.049[a]
Levels I–II–III	6.01	1.19	30.4	0.03[a]
Levels II–III	1.82	0.15	22.6	0.64
Levels I–II–III–IV	7.29	1.66	31.9	0.008[a]
Levels I–II–IV	1.60	0.12	20.7	0.72
ECD	1.10	0.21	5.78	0.91
Parotidectomy type according to ESGS (ref: ECD)				
PSP	0.91	0.17	4.77	0.91
Levels I–II	3.19	1.03	9.94	0.045[a]
Levels I–II–III	5.46	1.12	26.3	0.04[a]
Levels II–III	1.65	0.14	19.7	0.69
Levels I–II–III–IV	6.61	1.63	26.9	0.008[a]
Levels I–II–IV	1.46	0.12	18.0	0.77
Side (left vs right)	1.10	0.71	1.69	0.68
Histology (ref: other)				
Pleomorphic adenoma	0.62	0.30	1.32	0.22
Warthin tumor	0.46	0.20	1.03	0.06
Multifocality	1.15	0.54	2.43	0.72
Size (ref: >4 cm)				
<2 cm	3.62	1.16	11.3	0.03
2–4 cm	3.81	1.23	11.8	0.02

OR: odds ratio, 95 % CI: confidence interval, ref: reference variable, PSP: partial superficial parotidectomy, ECD: extracapsular dissection.
[a] Statistically significant ($p < 0.05$).

described as < 4 cm, therefore there are no data regarding the size distribution between the two approaches (McGurk et al., 2003; Ozturk et al., 2019).

In light of this, results of studies comparing ECD with SP may suffer from selection bias, because patients may be assigned to different procedures depending on tumor size. In our study, although there seemed to be a trend in reserving ECD for smaller lesions, there was no statistically significant difference in size distribution when comparing the two procedures.

With regard to differences in postoperative complications between ECD and PSP, a recent meta-analysis of 1641 patients showed that transient FN injury and FS were less prevalent in the ECD group. Rates of PFNP, recurrence, infection, and salivary fistula/sialocele were similar (Lin et al., 2019). In our cohort, ECD was associated with a higher overall complication rate and a higher risk of IFNP and GAN hypoanesthesia with respect to PSP, while there were no differences in FS, surgical site complications, or PFNP between the two procedures. We believe that the advantage of PSP over ECD with regard to FN outcomes stems from the dissection of the FN that this procedure encompasses, since it allows the surgeon to visualize and control the nerve during surgery.

Our study had a number of limitations, with the main one being its retrospective nature. In addition, data regarding long-term recurrence were not collected, and some patients were lost during follow-up. The standard SP approach is the preferred one by our surgeons, accounting for the small number of patients in the ECD and PSP groups; this made our analysis weaker in terms of statistical power. In addition, given that this was a multicentric study, procedures were performed by different surgeons, and their variable expertise could have affected the internal validity of our results. However, this may also be viewed as an advantage of the study, since our results may be more representative of real-life conditions, and therefore have higher external validity, because in most centers procedures are performed by a number of surgeons with varying degrees of expertise. Finally, due to the short follow-up time, the rate of long-term complications, especially FS, may have been underestimated. However, data supporting the safety of PSP and ECD in terms of low complication rates when compared with more traditional approaches for benign parotid lesions of similar size could not be overlooked.

Financial support

This research received no specific grant from any funding agency, or from any commercial or not-for-profit sectors.

Competing interests

None.

References

Al-Aroomi, M.A., Mashrah, M.A., Abotaleb, B.M., Sun, J., Al-Worafi, N.A., Huang, Y., et al., 2021. Comparison of postoperative complications and facial nerve recovery rates after conventional and partial superficial parotidectomy of benign parotid tumours: a prospective study. Int. J. Oral Maxillofac. Surg. 50, 335–340.

Albergotti, W.G., Nguyen, S.A., Zenk, J., Gillespie, M.B., 2012. Extracapsular dissection for benign parotid tumors: a meta-analysis. Laryngoscope 122, 1954–1960.

Ayoub, O.M., Bhatia, K., Mal, R.K., 2002. Pleomorphic adenoma of the parotid gland: is long-term follow-up needed? Auris Nasus Larynx 29, 283–285.

Aydin, S., Erbay, M.F., Kizilay, A., 2021. The effects of residual parotid volume on symptom-specific quality of life and complications in patients undergoing parotid surgery. Eur. Arch. Otorhinolaryngol. 278, 5003–5011.

Dell'Aversana, Orabona G., Bonavolontà, P., Iaconetta, G., Forte, R., Califano, L., 2013. Surgical management of benign tumors of the parotid gland: extracapsular dissection versus superficial parotidectomy — our experience in 232 cases. J. Oral Maxillofac. Surg. 71, 410–413.

El Fol, H.A., Beheiri, M.J., Zaqri, W.A., 2015. Comparison of the effect of total conservative parotidectomy versus superficial parotidectomy in management of benign parotid gland tumor: a systematic review. J. Craniomaxillofac. Surg. 43, 131–136.

El-Naggar, A.K., Chan, J.K.C., Grandis, J.R., Takata, T., Slootweg, P.J., 2017. WHO classification of head and neck tumours. 4th edition. Int Agency Res Cancer 1, 1–310.

Emodi, O., El-Naaj, I.A., Gordin, A., Akrish, S., Peled, M., 2010. Superficial parotidectomy versus retrograde partial superficial parotidectomy in treating benign salivary gland tumor (pleomorphic adenoma). J. Oral Maxillofac. Surg. 68, 2092–2098.

Fattah, A.Y., Gurusinghe, A.D.R., Gavilan, J., Hadlock, T.A., Marcus, J.R., Marres, H., et al., 2015. Facial nerve grading instruments: systematic review of the literature and suggestion for uniformity. Plast. Reconstr. Surg. 135, 569–579.

Henneman, R., Berger, D.M.S., Karakullukcu, M.B., Smeele, L.E., Lohuis, P.F.J.M., Jóźwiak, K., et al., 2020. Surgical site complications after parotid gland surgery for benign tumors in a centralized setting: a Clavien-Dindo class cohort analysis. Eur. J. Surg. Oncol. 46, 258–262.

Lin, Y.Q., Wang, Y., Ou, Y.M., Dong, S.Y., Wang, Y.D., 2019. Extracapsular dissection versus partial superficial parotidectomy for the treatment of benign parotid tumours. Int. J. Oral Maxillofac. Surg. 48, 895–901.

Li, C., Matthies, L., Hou, X., Knipfer, C., Gosau, M., Friedrich, R.E., 2020. A meta-analysis of the pros and cons of partial superficial parotidectomy versus superficial parotidectomy for the treatment of benign parotid neoplasms. J. Craniomaxillofac. Surg. 48, 590–598.

Mashrah, M.A., Al-Sharani, H.M., Al-Aroomi, M.A., Abdelrehem, A., Aldhohrah, T., Wang, L., 2021. Surgical interventions for management of benign parotid tumors: systematic review and network meta-analysis. Head Neck 43, 3631–3645.

Martin, H., Jayasinghe, J., Lowe, T., 2020. Superficial parotidectomy versus extracapsular dissection: literature review and search for a gold standard technique. Int. J. Oral Maxillofac. Surg. 49, 192–199.

McGurk, M., Thomas, B.L., Renehan, A.G., 2003. Extracapsular dissection for clinically benign parotid lumps: reduced morbidity without oncological compromise. Br. J. Cancer 89, 1610–1613.

Mantsopoulos, K., Koch, M., Klintworth, N., Zenk, J., Iro, H., 2015. Evolution and changing trends in surgery for benign parotid tumors. Laryngoscope 125, 122–127.

Mlees, M.A., Elbarbary, A.H., 2020. Superficial or partial superficial parotidectomy for the treatment of primary benign parotid tumors. J. Surg. Oncol. 122, 1315–1322.

Ogreden, S., Ruzgar, S., Alimoglu, Y., Eroglu, S., Taskin, U., Oktay, M.F., 2016. Comparison of Frey syndrome rates following superficial parotidectomy and partial superficial parotidectomy for pleomorphic adenoma. J. Craniofac. Surg. 27, e469–e471.

Ozturk, K., Ozturk, A., Turhal, G., Kaya, I., Akyildiz, S., Uluoz, U., 2019. Comparative outcomes of extracapsular dissection and superficial parotidectomy. Acta Otolaryngol. 139, 1128–1132.

Papadogeorgakis, N., 2011. Partial superficial parotidectomy as the method of choice for treating pleomorphic adenomas of the parotid gland. Br. J. Oral Maxillofac. Surg. 49, 447–450.

Psychogios, G., Bohr, C., Constantinidis, J., Canis, M., Vander Poorten, V., Plzak, J., Knopf, A., et al., 2021. Review of surgical techniques and guide for decision making in the treatment of benign parotid tumors. Eur. Arch. Otorhinolaryngol. 278, 15–29.

Quer, M., Guntinas-Lichius, O., Marchal, F., Vander Poorten, V., Chevalier, D., León, X., et al., 2016. Classification of parotidectomies: a proposal of the European salivary gland society. Eur. Arch. Otorhinolaryngol. 273, 3307–3312.

Ruohoalho, J., Mäkitie, A.A., Aro, K., Atula, T., Haapaniemi, A., Keski-Säntti, H., et al., 2017. Complications after surgery for benign parotid gland neoplasms: a prospective cohort study. Head Neck 39, 170–176.

Thölken, R., Jering, M., Mayer, M., Schiele, S., Müller, G., Zenk, J., 2021. Prospective study on complications using different techniques for parotidectomy for benign tumors. Laryngoscope Investig Otolaryngol 6, 1367–1375.

Witt, R.L., Iacocca, M., 2012. Comparing capsule exposure using extracapsular dissection with partial superficial parotidectomy for pleomorphic adenoma. Am. J. Otolaryngol. 33, 581–584.

Wong, W.K., Shetty, S., 2018. The extent of surgery for benign parotid pathology and its influence on complications: a prospective cohort analysis. Am. J. Otolaryngol. 39, 162–166.

Xie, S., Wang, K., Xu, H., Hua, R.X., Li, T.Z., Shan, X.F., et al., 2015. PRISMA — extracapsular dissection versus superficial parotidectomy in treatment of benign parotid tumors: evidence from 3194 patients. Medicine (Baltim.) 94, e1237.