Incidence and risk factors of facial nerve palsy after parotidectomy for benign parotid diseases

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Background
The mechanism of postparotidectomy facial palsy is not only clear but also there is a great heterogenecity in the reported risk factors for that complication. The authors conducted this study to report the incidence of facial nerve dysfunction after parotidectomy for benign lesions and to identify the risk factors for this complication.
Patients and methods
This prospective cross-sectional study included 73 cases that were allocated into two groups according to the incidence of facial palsy: group A included 54 cases that did not develop facial palsy, and group B included 19 cases diagnosed with it. The incidence of postoperative facial palsy was our primary outcome, whereas risk factors for that complication were the secondary outcomes. The following factors were collected and statistically tested as risk factors: age, sex, BMI, preexisting comorbidities, tumor site, tumor side, operative time, and postoperative pathology.
Results
Although basic patient demographics were comparable between the two groups, the prevalence of diabetes was higher in group B. Moreover, deep-located tumors, large-sized tumors, and prolonged operative time were also observed in cases that developed facial palsy. Tumor pathology showed no significant difference between the two groups.
Conclusion
Facial nerve palsy is a common complication that could be encountered after parotidectomy even for benign lesions. In our study, deep tumor location, tumor diameter greater than 3 cm, and diabetes mellitus are independent risk factors for this complication.

Keywords:
benign lesions, facial nerve palsy, parotidectomy, risk factors

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Introduction

Approximately 3–10% of head and neck tumors occur in the salivary glands [1]. The parotid gland is the most affected one (36.6–83%) [2,3], and most of these lesions are benign in nature [4]. Surgical intervention is the mainstay modality of managing such lesions [5].

Parotidectomy procedure has well-documented complications including facial nerve palsy, Frey syndrome, salivary fistula, tumor recurrence, and surgical site infections [6]. Previous authors reported that transient facial nerve palsy could be detected in ~30–65% of cases following parotidectomy, whereas the incidence of permanent facial dysfunction ranges between 3 and 6% [7].

The exact mechanism behind postparotidectomy facial palsy in the presence of anatomically intact nerve remains unclear. However, neural elongation was the most accepted theory. Other mechanisms include nerve compression, crushing, and electrocoagulation heat damage [8]. Owing to nerve stretch during dissection, neurapraxia, or axonotmesis occurs, leading to its dysfunction. This is supported by the fact that most of these lesions have a transient and reversible nature [5].

Peripheral facial palsy is clinically characterized by ipsilateral acute loss of facial muscular power, leading to inability to wink, raise the eye brow, close the eye, or smile. Moreover, speech abnormalities along with drooping of the angle of the mouth could be detected [9]. The severity of these manifestations is often assessed via House and Brackmann grading system [6,10].

This complication has a significant negative effect on patient's quality of life; thus, it is of crucial importance to know risk factors before operation [4]. This would have multiple advantages, as better surgical planning

could be prepared, by recruiting high-experience surgeons and intraoperative nerve monitoring. Moreover, an informed consent would cover this possibility for medicolegal purposes [5].

Multiple risk factors have been identified for such complication including old age, malignancy, large size lesions, deeply located lesions, and revisional surgery [11,12]. However, there is a great heterogenicity between different studies regarding these predictors [5,11].

We conducted this study to report the incidence of facial nerve dysfunction after parotidectomy for benign lesions and to identify the risk factors for this complication.

Patients and methods

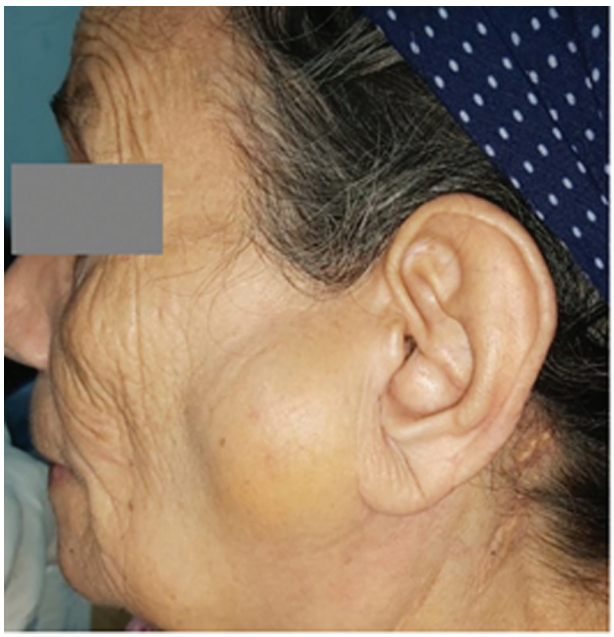
This study is a prospective cross-sectional one that included patients who underwent parotidectomy for benign lesions at the General Surgery Department, Tanta University, during the period between January 2018 and December 2020. The study was conducted after gaining approval from the Local Ethical Committee of the same University.

The required sample size was calculated using the IBM SPSS SamplePower version 3.0.1 (IBM Corp., Armonk, New York, USA). The primary outcome measure was the incidence of facial paralysis. A previous study conducted by Bittar *et al.* [4] reported that the incidence of facial paralysis after superficial parotidectomy was 16.7%. Thus, it was estimated that a minimal sample size of 73 patients is required to achieve a power of 80% to detect expected difference in incidence of facial paralysis of 5% at a significance level of 0.05.

We included cases from either sex, aged between 20 and 70 years, and classified as I or II according to the American Society of Anesthesiologists [13]. On the contrary, cases aged beyond the previous limits, having American Society of Anesthesiologists class greater than 2, uncontrolled systemic comorbidities, diabetic neuropathy, recurrent disease, or malignant lesions were excluded. We also excluded patients who needed nerve sacrifice or had iatrogenic gross nerve or nerve branch injury during the operation.

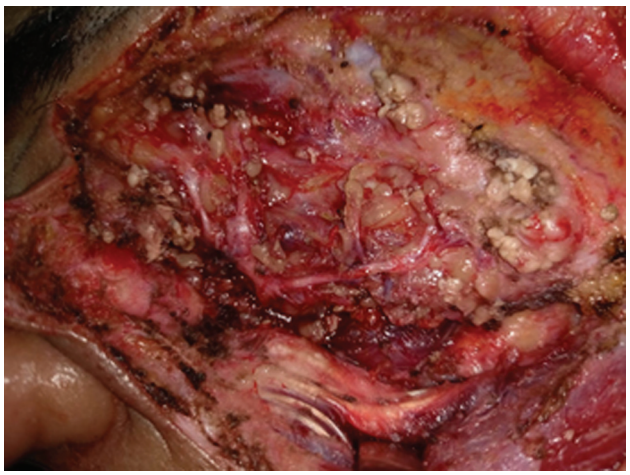
The included cases were subjected to history taking, clinical assessment (Fig. 1), as well as routine laboratory investigations. Radiological assessment included neck ultrasonography, computed tomography, and/or MRI.

Figure 1



Preoperative photo of left parotid swelling.

Figure 2

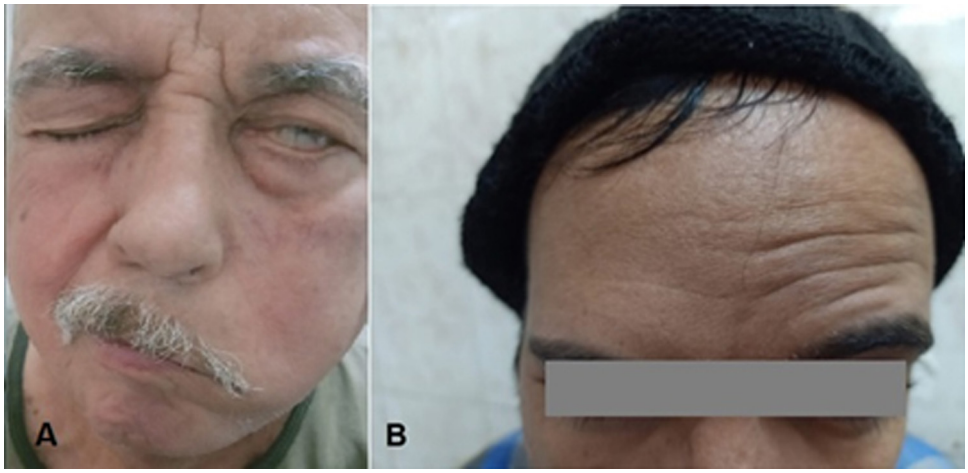


Intraoperative photo showing main facial nerve trunk and peripheral branches after superficial parotidectomy.

Ultrasound-guided fine-needle aspiration cytology was ordered for all cases.

Regarding operative data, all cases were performed under general anesthesia using a modified Blair incision. We performed lateral or superficial parotidectomy for superficial lobe lesions, whereas the total procedure was kept for deep lobe lesions. In superficial parotidectomy, the facial nerve trunk was identified at first. Then, the parotid tissue was gently elevated from the nerve and its consequential branches (Fig. 2). This process was continued till delivery of all

Figure 3



(a) Postoperative photo showing inability to close the left eye with dropping of angle of mouth. (b) Loss of right forehead wrinkling.

parotid tissue lateral to the facial nerve. For the total procedure, we continued dissection to separate the underlying parotid tissue from the facial nerve. In our practice, intraoperative neural monitoring was not routinely used during parotidectomy operation owing to limited resources. Therefore, it was kept for recurrent cases, which were excluded from our study.

We classified the cases into two groups according to the incidence of postoperative facial palsy: group A included 54 cases that did not develop facial palsy, and group B included the remaining 19 cases that experienced this complication (Fig. 3). Postoperative facial palsy was defined as the presence of any weakness in the facial areas supplied by the facial nerve (frontal, zygomatic, buccal, marginal, or cervical), and such condition was considered to be persistent if it lasted for more than 6 months [5]. It was classified according to House-Brackmann scale [14]. Follow-up visits were scheduled for all cases at 1 week and then 1, 2, 6, and 12 months after surgery.

The incidence of postoperative facial palsy was our primary outcome, whereas risk factors for that complication were the secondary outcomes. The following factors were collected and statistically tested as risk factors: age, sex, BMI, preexisting comorbidities, tumor site, tumor side, operative time, and postoperative pathology.

We used SPSS software for Mac for data collection and analysis. Data were either expressed in the form of number and percentage (for categorical data), whereas the quantitative data were expressed as mean±SD for parametric data or median and range for nonparametric data. We used χ^2 or Fischer's exact tests to compare two independent groups of categorical data. While comparing the quantitative data within two independent groups, independent samples *t*-test was used for parametric data and Mann–Whitney *U*-test for nonparametric data. Univariate and multivariate regression analyses were used to assess the dependent and independent predictors of binary outcome. For all used statistical tests, the cut-off point less than 0.05 for probability (*P* value) was considered to be statistically significant.

Results

Postoperative facial palsy was detected in 19 of 73 cases (incidence rate=26.02%). All of these cases were transient in nature, apart from one case that had persistent symptoms (1.36%).

On comparison of the two groups and starting with patient age, it ranged between 22 and 70 years in group A, whereas it ranged between 23 and 69 years in group B. Females represented 55.56 and 57.89% of cases in groups A and B, respectively. In addition, BMI had mean values of 29.64 and 28.97 kg/m^2 in groups A and B, respectively. All of the previous parameters were statistically comparable between the two groups ($P>0.05$).

Diabetes mellitus was more prevalent in group B (42.11 vs. 16.67% of cases in group A; $P=0.001$). On the contrary, other comorbidities including hypertension, smoking, and dyslipidemia did not show any significant difference on comparing the two groups ($P>0.05$).

When it comes to tumor characteristics, the left side was more affected in group A (51.85%), whereas the

Table 1 Patient, lesion, and operative characteristics between the study groups

Items	Group A (*n*=54 cases) [*n* (%)]	Group B (19 cases) [*n* (%)]	*P* value
Age (years)	48 (22–70)	51 (23–69)	0.236
Sex			
Male	24 (44.44)	8 (42.11)	0.578
Female	30 (55.56)	11 (57.89)	
BMI (kg/m^2)	29.64±3.12	28.97±3.14	0.218
Comorbidities			
Diabetes	9 (16.67)	8 (42.11)	0.001
Hypertension	9 (16.67)	4 (21.05)	0.184
Smoking	8 (14.81)	4 (21.05)	0.120
Dyslipidemia	2 (3.7)	0	0.304
Side			
Right	26 (48.15)	10 (52.63)	0.264
Left	28 (51.85)	9 (47.37)	
Tumor location			
Superficial loop	44 (81.48)	5 (26.32)	< 0.001*
Deep loop	10 (18.52)	14 (73.68)	
Tumor size			
≤3 cm	28 (51.85)	4 (21.05)	< 0.001*
>3 cm	26 (48.15)	15 (78.94)	
Operative time (min)	89.5±17.45	102.6±14.85	0.009
Tumor pathology			
Pleomorphic adenoma	39 (72.22)	13 (68.42)	0.294
Warthin tumor	6 (11.11)	2 (10.52)	0.872
Lymphoepithelial cyst	5 (9.25)	2 (10.52)	0.730
Chronic lymphadenitis	2 (3.7)	1 (5.26)	0.602
Chronic abscess	2 (3.7)	1 (5.26)	0.602

*$P<0.05$, significant.

right side was more affected in the other group (52.63%). However, there was no significant difference between the two groups (P=0.264). Deep tumors were significantly more prevalent in group B (73.68 vs. 18.52% in group A; $P<0.001$). Moreover, cases in the same group tended to have larger tumors compared with the other group. The operative time was more significantly prolonged in group B, as it had a mean value of 102.6 compared with 89.5 min in group A.

There was no significant difference between the two groups regarding surgical specimen histopathology. Pleomorphic adenoma was the commonest pathology in both groups (72.22 and 68.42% of cases in groups A and B, respectively). Other lesions included Warthin tumor, lymphoepithelial cysts, chronic lymphadenitis, and chronic abscess. The previous data are summarized in Table 1.

On classification of group B cases according to the House–Brackmann classification, 10 cases had grade II, six cases had grade III, whereas the remaining three cases had grade IV. Table 2 illustrates these data.

On performing regression for analysis to detect risk factors for facial palsy, diabetes, deep tumor location, and tumor size (>3 cm) were significant predictors for that complication on both univariate and multivariate analyses. Nevertheless, operative time was only significant on univariate analysis. These data are shown in Table 3.

Table 2 Classification of the study cases according to the House–Brackmann grading system

Grade	*n*=73 [*n* (%)]
I	54 (73.97)
II	10 (13.69)
III	6 (8.21)
IV	3 (4.11)

Discussion

Transient facial nerve palsy is the most common encountered complication after parotidectomy. It constitutes a major source of distress for both the patient and the surgeon [7]. This study was conducted to report the incidence of facial nerve dysfunction after parotidectomy for benign lesions and to identify the risk factors for this complication. It was previously supposed that dissection of the facial nerve in benign lesions would be also challenging owing to long disease duration along with the surrounding inflammatory process [15,16].

Table 3 Regression analysis to detect factors for facial nerve palsy

Variables	Univariate analysis	Multivariate analysis		
		OR	95% CI for OR	*P* value
Age	0.215			
Sex	0.112			
BMI	0.236			
Diabetes	0.009*	1.845	1.243–2.315	0.021*
Hypertension	0.346			
Smoking	0.620			
Dyslipidemia	0.241			
Deep tumor location	0.005*	2.116	1.857–2.784	0.011*
Tumor size >3 cm	<0.001*	2.775	2.426–3.665	0.001*
Operative time	0.036*	1.154	0.872–1.397	0.266
Pleomorphic adenoma	0.385			
Warthin tumor	0.639			
Lymphoepithelial cyst	0.971			
Chronic lymphadenitis	0.229			
Chronic abscess	0.385			

CI, confidence interval; OR, odds ratio. *$P<0.05$, significant.

In our study, facial nerve palsy occurred in 19 of 73 cases (incidence rate=26.02%). The incidence of postparotidectomy facial nerve palsy ranges between 10 and 68% in the current literature [17], and our incidence (26.02%) lies between the previously reported range. The wide range reported in this literature could be explained by different sample population, sample size, surgeon experience, operative facilities, postoperative care, and statistical analysis between different studies.

In our study, all of these cases were transient in nature, apart from one case that had persistent symptoms (1.36%). The incidence of permanent nerve dysfunction ranged between 0 and 19% in previous different studies [15,18–20]. The previous range also confirmed our findings.

A recent study reported results near to ours, as the incidence of temporary and permanent facial nerve palsy occurred in 26.6 and 7.6% of included cases, respectively [5]. The previous study reported an incidence rate of transient lesions near to ours, though permanent lesions occurred more frequently. This could be attributed to the previously mentioned reasons.

In the current study, age was not identified as a significant risk factor for facial nerve palsy on either univariate or multivariate analysis. Another study supported our findings regarding age, which was not a significant risk factor for facial paralysis after operation (P=0.907) [5]. Tung *et al.* [8] also confirmed these findings regarding permanent palsy (P=0.76).

Our results revealed no significant difference between the two groups regarding sex or BMI. Besides, both of the two parameters did not constitute a significant predictor for nerve palsy in the studies. In agreement with our findings, other previous studies have negated any significant effect of sex or BMI on the development of facial nerve palsy after parotidectomy (P=0.499 and 0.767, respectively) [5].

Diabetes mellitus was more prevalent in group B (42.11 vs. 16.67% of cases in group A; P=0.001) in our study, which made it a significant predictor for facial palsy on multivariate analysis. On the contrary, other comorbidities showed no significant association with the occurrence of that complication.

People with diabetes mellitus are more prone to nerve degeneration compared with nondiabetic personnel [21,22]. Moreover, both Schwann cells and myelin sheath are at higher risk for damage [23]. This could explain our findings. In addition, Yuan *et al.* [12] reported that diabetes was a significant risk factor for transient facial palsy (P=0.022).

Conversely, Lameiras and his associates reported that diabetes was not a significant risk factor for that complication (P=0.768) [5]. Nevertheless, the same study also negated any significant effect of other systemic comorbidities (hypertension, vascular arterial disease, and dyslipidemia) on the development of such complication, and that is in accordance with our findings. In addition, the previous study of Yuan *et al.* [12] also showed that smoking and hypertension were not significant

predictors of that complication (P=0.098 and 0.674, respectively).

Our findings revealed that tumor size larger than 3 cm was an independent predictor of facial palsy. In line with our findings, Bittar and colleagues reported that increased tumor dimensions are significantly associated with an increased risk of postoperative facial palsy. Authors demonstrated that tumors with a length greater than 3 cm or depth greater than 2 cm are risk factors for developing facial palsy [4]. Another study also reported that increased tumor length was a significant risk factor for the same complication (P=0.045) [5]. Fareed and his associates noticed that the incidence of facial palsy was more common in cases with lesions greater than 3 cm (40 vs. 30% in cases with lesions <3 cm) [16].

On the contrary, tumor size was not a significant risk factor for facial palsy in another study [12]. This was an interesting finding, but the authors explained that finding by the presence of larger lesions in sites away from the facial nerve. Gillard *et al.* [15] reported that cases with tumors located near the facial nerve were at higher risk for facial dysfunction after surgery.

In this study, deep tumor location (requiring total parotidectomy) was a significant risk factor for postoperative facial palsy. Other Egyptian authors confirmed the previous findings, as facial palsy was encountered in 75% of cases that underwent total parotidectomy [16]. Tung *et al.* [8] also reported that total parotidectomy was a significant predictor for facial nerve dysfunction on both univariate and multivariate analyses.

Of course, deep tumor location will need total parotidectomy which involves more dissection around the facial nerve. This will increase the risk of neural elongation. Moreover, extensive dissection of facial nerve may cause injury of the vase nervosum, which have a negative effect on nerve integrity [24].

In our study, operative time was more significantly prolonged in group B, as it had a mean value of 102.6 compared with 89.5 min in group A. Operative time was a significant risk factor for facial palsy only on univariate analysis. However, multivariate analysis showed its insignificance.

Another Egyptian study confirmed our findings regarding operative time. It showed a significant prolongation in the facial palsy group compared with other cases that did not develop facial palsy (>140 vs. 132.5 min for other cases) [16]. Generally speaking, prolonged operative time will be needed for large-sized tumors as well as deep lobe lesions. Both of these parameters were associated with facial palsy.

Our study negated any significant effect of tumor pathology on the development of facial palsy. A previous study also showed that tumor pathology was not a significant risk factor for postparotidectomy facial palsy (P=0.136) [12].

This study has some limitations, apart from being a single-center study, which included a relatively small sample size, and the effect of intraoperative nerve monitoring on that complication should have been assessed. These cons need to be well covered in the upcoming surgical research.

Conclusion

All in all, facial nerve palsy is a common complication that could be encountered after parotidectomy even for benign lesions (incidence rate=26.02%). In our study, deep tumor location, tumor diameter greater than 3 cm, and diabetes mellitus are independent risk factors for this stressful complication.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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