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**ORIGINAL ARTICLE**

# Facial Nerve Morbidity after Superficial Parotidectomy in the Absence of Nerve Conductor: A Cross-Sectional Study from a Tertiary Centre in Pakistan

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## ABSTRACT

**Objective:** After superficial parotidectomy, the incidence of facial nerve injury for pleomorphic adenoma of the parotid gland remains the topic of interest despite different techniques to identify the nerve during surgery. We aim to evaluate the incidence of facial nerve injury in patients undergoing superficial parotidectomy without a nerve conductor.

**Material and Methods:** After calculating the sample size, 101 patients, irrespective of age and gender, were included in this cross-sectional study at the Department of Surgery, for nine years, from 1st January 2012. The primary outcome was the incidence of temporary or permanent facial nerve injury with a follow-up period of 12 months. The data was calculated using SPSS version 23, where mean and standard deviation were calculated for continuous variables, and frequencies were calculated for categorical data.

**Results:** Facial nerve injury was evident in 16/101 (15.8%) patients. Among these, the main truck of facial nerve was involved in 6(5.9%), temporary loss of function in 4(4.0%) and permanent injury in 2(2.0%). The most common branch of facial nerve affected was the marginal mandibular nerve (6, 5.9%), of which 4(4.0%) had a permanent loss. Additionally, four (4.0%) patients developed salivary fistula, whereas 2% developed Frey's syndrome.

**Conclusion:** Facial nerve injury should be clearly explained, in the consent, to the patient for a medicolegal purpose. Where the nerve stimulator is not available, identification of the proposed anatomical landmarks allows a safe recognition of the facial nerve

**Keywords:** Pleomorphic adenoma, facial nerve, facial nerve injury, superficial parotidectomy

## INTRODUCTION

The parotid gland is the largest paired exocrine salivary gland, located in the pre-auricular region, which like other salivary glands, secrete saliva. A unique extratemporal course of the facial nerve, after it comes out of the stylomastoid foramen through the parotid gland, gives it both clinical and surgical importance when it anatomically divides the gland into superficial and deep lobes. Within the gland, the main trunk of the facial nerve divides into two main divisions before further forming terminal branches[1,2]. Parotid gland tumours are the most common salivary gland tumour presentation worldwide, accounting for about 80% of cases with female gender preference. The literature describes that most of these parotid tumours are benign, pleomorphic adenomas most typical histopathological diagnosis [2-5]. The classical procedure, widely used for these pleomorphic adenomas, is superficial parotidectomy due to tumour location in the superficial lobe of the parotid gland [3,6,7]. The facial nerve is one of the critical landmarks of greater importance and concern during superficial parotidectomy. Identification of its trunk through its anatomical course remains an important step during superficial parotidectomy with a better outcome. Injury to this nerve can be either temporary or permanent, resulting from either direct or indirect trauma. Temporary injury is more common than permanent nerve damage, with its marginal mandibular nerve being the most commonly affected branch. It is expected that temporary facial nerve injury recovers entirely within six months. Any further dysfunction of the nerve beyond this period is to be considered a permanent injury [3,5,8]. Different grading scales have been proposed to assess the regional facial nerve function, like House-Brackmann facial nerve grading system. Despite criticism, this system has the benefit of reliably monitoring the facial nerve function over time to assess recovery after its injury. As per this system, there are six different grades identified. Table 1 further describes the grades of the system[9]. We conducted this study to evaluate the incidence of facial nerve injury in patients undergoing superficial parotidectomy for previously untreated pleomorphic adenoma in the absence of a nerve conductor. We also assessed the facial nerve's function during follow-up using House-Brackmann facial nerve grading system.

## MATERIALS AND METHODS

This single-centre cross-sectional study reviewed the retrospective data of a prospectively maintained database of consecutive patients. The study was carried out at the Department of Surgery. The clinic assessment of the regional facial nerve function was performed using House-Brackmann facial nerve grading system (Table 1) at 6- and 12-month follow-ups. The institutional Research Ethics Committee (#LUMHS/REC/-12) approved this study. All individuals diagnosed with pleomorphic adenoma were included in the study, regardless of their age or gender. However, those who had previously experienced a recurrence of the disease were not considered for the study. The study's sample size was determined using the World Health Organization's sample size calculator, with a disease prevalence of 7.1 and a 95% confidence interval. The calculated sample size turned out to be 101 participants. This sample size was achieved over nine years, from 1st January 2012 till August 2020. In order to minimize the possibility of bias, one of the researchers involved in the study was a member of the surgical team who performed the procedures on the patients. All of the eligible and chosen patients provided consent for surgery after being informed about the potential complications associated with the procedure. For these selected patients, a superficial parotidectomy was the customary surgical approach. The intraoperative facial nerve identification technique was an ante-grade method after identifying the posterior belly of the digastric and tragal pointer. Intraoperative facial nerve monitoring or frozen section technique was not used. The main focus of the study was on the occurrence of facial nerve injury, whether temporary or permanent, while the secondary outcomes were wound infections, seromas, hematomas, Frey's syndrome, salivary fistulas, and scar

disfigurement. The study classified facial nerve injury as temporary if it resulted in facial nerve palsy but fully resolved within six months of the operation. Permanent facial nerve injury was defined as any facial nerve dysfunction that persisted beyond six months after the procedure. The information was documented on a predesigned Performa, and the authors kept the patients' confidentially by allocating codes to every case that were only known to those conducting the research. The calculations were done in SPSS version 23, which was used. For continuous variables, values of mean and standard deviation were calculated, while for categorical data, frequencies were determined. This study was registered on ClinicalTrials.gov (NCT04706052)[10], and was reported in line with the Strengthening The Reporting Of Cohort Studies in Surgery (STROCSS) statement[11]

Table 1: House-Brackmann regional facial nerve grading system

| Location | Grade | Description |
|---|---|---|
| Forehead | 1 | Normal forehead movement |
| | 2 | Slight weakness in forehead movement |
| | 3 | Obvious weakness but not disfiguring |
| | 4 | Obvious weakness of disfiguring |
| | 5 | Barely perceptible motion |
| | 6 | No movement |
| Eye | 1 | Normal eye closure |
| | 2 | Mild weakness in eye closure |
| | 3 | Obvious weakness but able to close eye |
| | 4 | Unable to close eye with maximum effort |
| | 5 | Barely perceptible eyelid movement |
| | 6 | No movement |
| Midface | 1 | Normal midface movement |
| | 2 | Slight weakness in midface movement |
| | 3 | Obvious but not disfiguring weakness |
| | 4 | Obvious weakness and disfiguring |
| | 5 | Barely perceptible motion |
| | 6 | No movement |
| Mouth/ Jaw | 1 | Normal corner of mouth movement |
| | 2 | Slight weakness in corner of mouth movement |
| | 3 | Obvious but no disfiguring weakness |
| | 4 | Obvious weaknesses and disfiguring |
| | 5 | Barely perceptible corner of mouth movement |
| | 6 | No movement |

## RESULTS

One hundred and one patients with fine-needle aspiration cytology (FNAC) proven and previously untreated pleomorphic adenoma underwent superficial parotidectomy after preoperative assessment and informed consent.

In our study, there were 58(57.4%) male and 43(42.6%) female patients, with mean age of 43.43 ± 8.175 years. All the postoperative histopathological reports confirmed preoperative FNAC results without any synchronous variety. All the patients were successfully followed up for one year. The tumour site was left in 55 (54.5%) while right in 46 (45.5%), with the tumour involving only the superficial lobe of the parotid in all cases. The mean operative time was 78.12 with Std. Deviation 14.575. Hospital stay ranged from 1 to 7 days (3.27 ± 1.165).

Out of these 16 facial nerve injuries, global/ main truck facial nerve was involved in 6(5.9%); temporary loss of function in 4(4.0%) and permanent injury in 2(2.0%). The most common branch of the facial nerve affected was the marginal mandibular nerve (6, 5.9%) followed by the buccal branch of the facial nerve (2, 2.0%). We also found permanent injury of temporal and zygomatic branches (1, 1.0%), and buccal, marginal mandibular and cervical branches (1, 1.0%) as a group (Table 2).

Tables 3 and 4 further describe the detailed individual outcomes of the regional facial nerve function assessments at 6- and 12-month follow-ups, respectively.

Secondary results

Among other complications, seroma was the most frequent postoperative finding (14, 13.0%). Incidence of postoperative hematoma, surgical site infection and disfigured scar was 3 (3%) in each case. Two patients (2%) in our study complained about gustatory sweating at the operative area, and Frey's syndrome was diagnosed during follow-up in the clinic. The incidence of the salivary fistula was 4/101, 4% (Fig 1).

Table 2: Branches of Facial Nerve injured

| Nerve Injured | Frequency | (%) |
|---|---|---|
| Global/ Main trunk facial nerve | | |
| Temporary | 4 | 4.0 |
| Permanent | 2 | 2.0 |
| Buccal branch | | |
| Temporary | 1 | 1.0 |
| Permanent | 1 | 1.0 |
| Marginal mandibular branch | | |
| Temporary | 2 | 2.0 |
| Permanent | 4 | 4.0 |
| Temporal & Zygomatic branches (together) | | |
| Temporary | 0 | 0.0 |
| Permanent | 1 | 1.0 |
| Buccal, Marginal & Mandibular branches (together) | 0 | 0.0 |
| Temporary | 1 | 1.0 |
| Permanent | | |

Table 3: House-Brackmann Facial Nerve Grading assessment at 6 months FU

| | Patient | Affected side | Forehead | Eye | Midface |
|---|---|---|---|---|---|
| GTT | 1 | left | 5 | 4 | 2 |
| GTT | 2 | right | 2 | 2 | 2 |
| GTT | 3 | right | 2 | 3 | 2 |
| GTT | 4 | left | 3 | 2 | 2 |
| GTP | 5 | left | 6 | 6 | 6 |
| GTP | 6 | right | 5 | 6 | 6 |
| BT | 7 | left | 1 | 1 | 4 |
| BP | 8 | right | 1 | 1 | 5 |
| MMT | 9 | left | 1 | 1 | 1 |
| MMT | 10 | left | 1 | 1 | 1 |
| MMP | 11 | right | 1 | 1 | 1 |
| MMP | 12 | left | 1 | 1 | 1 |
| MMP | 13 | left | 1 | 1 | 1 |
| MMP | 14 | right | 1 | 1 | 1 |
| TZP | 15 | left | 5 | 4 | 1 |
| BMMP | 16 | left | 1 | 1 | 3 |

Table 4: House-Brackmann Facial Nerve Grading assessment at 12 months FU

| | Patient | Affected side | Forehead | Eye | Midface |
|---|---|---|---|---|---|
| GTP | 5 | left | 6 | 5 | 6 |
| GTP | 6 | right | 5 | 6 | 6 |
| BP | 8 | right | 1 | 1 | 5 |
| MMP | 11 | right | 1 | 1 | 1 |
| MMP | 12 | left | 1 | 1 | 1 |
| MMP | 13 | left | 1 | 1 | 1 |
| MMP | 14 | right | 1 | 1 | 1 |
| TZP | 15 | left | 4 | 4 | 1 |
| BMMP | 16 | left | 1 | 1 | 3 |
| GTP | 5 | left | 6 | 5 | 6 |
| GTP | 6 | right | 5 | 6 | 6 |
| BP | 8 | right | 1 | 1 | 5 |
| MMP | 11 | right | 1 | 1 | 1 |
| MMP | 12 | left | 1 | 1 | 1 |
| MMP | 13 | left | 1 | 1 | 1 |
| MMP | 14 | right | 1 | 1 | 1 |

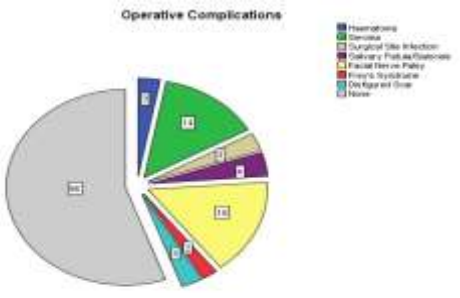


Figure 1: Operative Complications

GTT: Global Trunk Temporary injury. GTP: Global Trunk Permanent injury. BT: Buccal Temporary injury. BP: Buccal Permanent injury. MMT: Marginal Mandibular Temporary injury. MMP: Marginal Mandibular Permanent. TZP: Temporal & Zygomatic Permanent

GTP: Global Trunk Permanent injury. BP: Buccal Permanent injury. MMP: Marginal Mandibular Permanent. TZP: Temporal & Zygomatic Permanent injury. BMMP: Buccal & Marginal Mandibular Permanent injury

## DISCUSSION

Our hospital is a 1450-bed tertiary hospital where general surgeons perform superficial parotidectomy for untreated pleomorphic adenoma, with facial nerve exposure and dissection as the standard approach.

Various cadaveric and surgical pieces of literature have clearly stated the preservation of facial nerve during parotid surgery as the most crucial and strenuous step due to the incidence of related injury [3,8,12]. Several methods have been described in the past, including anatomical identification, nerve monitoring, and microsurgery. Though there is an emphasis on having a facial nerve stimulator during parotidectomy, a systematic review on facial nerve monitoring by Amit J Sood et al. has not reported any advantage over permanent facial nerve damage [13]. When a nerve stimulator is unavailable, numerous anatomical techniques have been described as a safe and popular approach for identifying constant landmarks. These include the identification of stylomastoid foramen, posterior belly of the digastric muscle, tragal pointer, mastoid process, tympano-mastoid suture and identification of peripheral branches of the facial nerve. Al-Qahtani et al., after cadaveric dissection, have recently confirmed the consistent location of the facial nerve truck at the midpoint between the mastoid tip inferiorly and the osteocartilaginous junction of the external auditory canal superiorly [12,14]. As the evidence does not superior antegrade to retrograde dissection and where anatomical identification is the primary approach, it is also advised to limit the exploration of the facial nerve to the branches in close relation with the adenoma [15,16]. In our setup, the first primary step remains the identification of the posterior belly of the digastric muscle and tragal pointer, followed by antegrade identification and dissection of the facial nerve and its branches.

Facial nerve injury is the most common complication associated with superficial parotidectomy. The incidence is reported up to 50%, primarily as temporary dysfunction, with the marginal mandibular nerve as the most commonly affected [3,8,17]. Certain risk factors like old age as compared to young and type of parotid tumour are considered independent risk factors for nerve injury. On the other hand, parotid tumour size is not considered a significant risk factor [8]. Neuropraxia, which leads to temporary weakness of facial nerve function, results from direct trauma or contusion injury during dissection. It has been reported that mechanical trauma during dissection on the nerve, stretch or traction-related injury, prolonged operative time and ischemic cautery injury are the possible causes of temporary facial nerve neuropraxia [14,18]. In a case series published by Gaillard C et all. the incidence of temporary facial nerve injury was highest on the first operative day, with full recovery to normal function in all cases by six months. This series, like others, also confirmed the mandibular marginal nerve as the most commonly affected branch of the facial nerve [2,17]. Our study observed temporary loss of facial nerve function as a primary outcome. The marginal mandibular nerve was the most commonly affected branch, followed by global facial nerve dysfunction.

Permanent facial nerve injury is a worrisome complication and a nightmare for a surgeon operating on the parotid gland, resulting from complete transection of the nerve or direct cautery injury. In our study, House-Brackmann facial nerve grading system was found easy to use in a busy clinic setting to assess the facial nerve's postoperative function[9]. Using this grading system, the incidence of permanent facial nerve dysfunction beyond six months was found with a particular reference to its marginal mandibular branch, which is about 4%. However, this is still comparable with the published literature with reference to intraoperative anatomical nerve identification where there is non-availability of nerve conduction device where variable [2,3,8,13,14]. However, a few studies did not observe the permanent loss of facial nerve function [15,18].

Although our study mainly focused on identifying facial nerve injury, other secondary complications are also encountered in a patient, like a seroma in most cases with a rare incidence of Frey's syndrome and salivary fistula. Frey's syndrome occurs when regenerating sympathetic nerves mistakenly connect with parasympathetic fibers, resulting in facial sweating and flushing while eating. This syndrome has been frequently reported in the literature, with incidence up to 23%, with less than half being symptomatic. In the present study, only two patients reported symptomatic presentation of this syndrome, whereas incidence has been reported to a much higher rate [19]. It must be remembered that the symptomatic presentation may appear after a few weeks of surgery. However, delayed presentations have also been reported, demanding longer follow-up of the patient after superficial parotidectomy [20].

Although our study demonstrates 4% incidence of salivary fistula, the largest retrospective study on salivary fistula following parotidectomy by Christopher J et al. had an incidence of 9.1%, with more incidence when associated with an anterior location of the tumour and use of energy devices like a harmonic scalpel [21,22].

We recognized that the lack of an intra-operative nerve conduction device was a limitation to our study. However, this limitation was overcome by the fact that careful dissection and identification of anatomical landmarks remains crucial in protecting facial nerve during parotid surgery. We used only one grading system to assess the regional facial nerve function during follow-up, which may inadequately describe the facial function and limit the scope of our study. Another limitation of our study was a follow-up of 12 months which may be the reason for a higher incidence of marginal mandibular nerve injury and Frey's syndrome. As we know that the dynamic neural network can recover mandibular nerve injury, a longer than 12-month follow-up study is recommended to address this.

## CONCLUSION

In conclusion, the incidence of temporary and permanent facial nerve loss was 6.9% and 8.9% respectively, with marginal mandibular nerve as the most commonly affected branch. Facial nerve injury should be clearly explained to the patient while mentioning in the consent pre-operatively as a medicolegal purpose. The proposed anatomical landmarks identification during superficial parotidectomy allows a safe recognition of the facial nerve where the nerve stimulator is not available.

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