Temporary facial nerve paralysis after parotidectomy: the mansoura experience, a prospective study

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Background
Parotidectomy was first introduced into the world literature by Berard in 1823 who removed a parotid tumor of 8 years' duration. Since then the procedure has been modified and applied to a variety of benign and malignant conditions affecting the gland; superficial parotidectomy, subtotal parotidectomy, and total parotidectomy are now the options available to the head and neck surgeon. The primary goal of parotid surgery is the complete removal of tumors while preserving facial nerve function. Despite efforts to preserve the anatomic and functional integrity of the facial nerve, facial nerve paralysis continues to be a daunting complication of parotidectomy.

Purpose
The aim of the study was to evaluate our experience in parotid surgery, aiming to lower the incidence of facial nerve palsy and study postoperative complications.

Patients and methods
This prospective study was conducted on 30 patients from July 2012 to June 2013 with parotid swelling persistent over 1 year; patients were submitted to careful history taking, complete clinical examination, and examination of facial nerve integrity before surgery. Over a period of 1 year these 30 patients with parotid swelling underwent parotidectomy by means of an antegrade technique of whom 26 underwent superficial conservative parotidectomy (nine men and 17 women) and four underwent total conservative parotidectomy (two men and two women).

Results
Most patients (26) underwent superficial conservative parotidectomy. Four patients underwent total conservative parotidectomy with excision of the superficial lobe, dissection of facial nerve branches, and excision of the deep lobe of the gland from between the branches of the facial nerve. In our study population (30) 10 patients had temporary facial nerve paralysis (33.3%) of whom five were HB II (16.7%), three were House-brackmann Scale HB III (10%), and two were HB IV (6.6%).

Conclusion
In our study, we adopted certain precautions to lower the incidence of temporary facial nerve paresis. One of these precautions is vertical retraction to reduce the risk of traction injury. Once the nerve trunk was identified we did not use diathermy at all; hemostasis was performed with surgical ligatures (5/0 polygalactin).

Keywords:
facial nerve palsy, House–Brackmann, parotidectomy

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Introduction

Parotidectomy was first introduced into the world literature by Berard in 1823 who removed a parotid tumor of 8 years' duration. Since then the procedure has been modified and applied to a variety of benign and malignant conditions affecting the gland; superficial parotidectomy, subtotal parotidectomy, and total parotidectomy are now the options available to the head and neck surgeon [1].

The most common indications for this operative procedure are a neoplasm of the parotid gland or metastases to parotid lymph nodes [2]. In addition, parotidectomy may be a component of first branchial cleft cyst resection or may be included in the management of chronic parotid sialadenitis. In rare cases parotidectomy is performed for cosmetic purposes, as in cases of sialadenosis [3].

The primary goal of parotid surgery is the complete removal of tumors while preserving facial nerve function. Despite efforts to preserve the anatomic and functional integrity of the facial nerve, facial nerve paralysis is a daunting complication of parotidectomy [4].

Postoperative complications following parotidectomy are well documented and include complications such as facial nerve paresis or paralysis, salivary fistula, Frey's syndrome, infection, and recurrence of the tumor. Parotid gland surgery complications can affect the quality of life and are potentially disfiguring [5].

Facial nerve injury mechanisms during parotidectomy include nerve division, stretch, compression, ligature entrapment, thermal and electrical injuries, and ischemia [6].

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The incidence of temporary facial nerve dysfunction may be quite high, with some authors reporting incidences in up to 76% of patients. Permanent facial nerve paralysis occurs much less frequently; in 'experienced hands' the incidence would be expected to be around 3% or less. It is reasonable to assume, therefore, that long-term disfigurement from facial nerve injury will not affect the overwhelming majority of patients; most cases of postoperative facial nerve paralysis resolve within 6 months if the facial nerve remains intact during parotid surgery [1,4].

More conservative parotid surgery has resulted in reduced facial nerve morbidity without oncologic compromise [7].

In comparing the different types of incisions in patients who underwent superficial parotidectomy, it was found that a greater rate of temporary facial nerve dysfunction was seen with the modified Blair incision (64%) compared with the facelift incision (28%), and hence the modified Blair incision is used only in cases thought to be inappropriate for facelift incision; large tumors that extended beyond the anterior border of the parotid gland were the main indication for the modified Blair incision [8].

Two techniques are used for dissection of the facial nerve in parotid surgery: the antegrade technique and the retrograde technique. In the antegrade technique the nerve trunk is identified as it leaves the stylomastoid foramen and dissection then proceeds peripherally; in the retrograde technique the peripheral nerve branches are identified initially and dissection takes place toward the nerve trunk [9].

Nerve monitoring is an adjunctive method that a surgeon can choose to use during parotid surgery to assist with the functional preservation of the facial nerve [6].

Antegrade dissection is used most commonly. In a national survey conducted in 2007 using a specially prepared questionnaire, 87% of responding surgeons reported using it routinely. Almost half of the surgeons combined both techniques in revision parotid surgery, indicating their familiarity with both approaches. In some clinical situations, such as in obese patients with large tumors, it may be difficult to identify the nerve trunk directly [10].

Many factors affect the rate at which the facial nerve recovers after parotid gland surgery. They include age, sex, disease, location (superficial or deep lobe involvement), tumor size, recurrent disease, type and duration of operation, and the total length of nerve dissected [11].

Patients and methods

This prospective study was conducted over 1 year from July 2012 to June 2013 on 30 patients with parotid swelling; patients were subjected to careful history taking, including age, sex, occupation, duration of the swelling (whether short or long, or accidentally discovered), development of pain (either local or referred), subsequent development of lymph node enlargement in the neck, and history of diabetes mellitus or neurological disorders.

The patients were submitted to complete clinical examination, examination of facial nerve integrity before surgery, and the following laboratory and radiological investigations:

(1) Neck Ultra sound (US): to detect whether the enlargement is superficial or deep lobe swelling, solid or cystic, and well defined or ill defined, and to detect enlarged Lymphnode (LNs).
(2) Computerized tomography (CT) (19 cases) or MRI (11 cases): to obtain clear details about the extent of swelling (whether it extends to the deep lobe) and metastasis to LN.
(3) Pathological diagnosis (FNAC): to diagnose whether the lesion is malignant or benign.

Patients fulfilling one or more of the following criteria were excluded from the study: those with collagen diseases, previous facial nerve palsy, neuromuscular diseases affecting the face, diabetic neuropathy, psychiatric disease, or any other condition that could influence the study or that might affect the completion of the study.

Over the period of 1 year these 30 patients with parotid swelling underwent parotidectomy following an antegrade technique: 26 patients underwent superficial conservative parotidectomy (nine men and 17 women) and four underwent total conservative parotidectomy (two men and two women). The male to female ratio overall was 1 : 1.72.

Procedure

A modified Blair incision is used for access to the parotid gland (Fig. 1). Antegrade dissection is performed by identifying the facial nerve trunk using the tragal pointer method (Fig. 2). After initial identification of the nerve trunk, dissection proceeds toward the peripheral branches with simultaneous mobilization of parotid tissue anteriorly and laterally. The length and number of branches dissected depend on the disease that necessitated removal of the parotid gland.

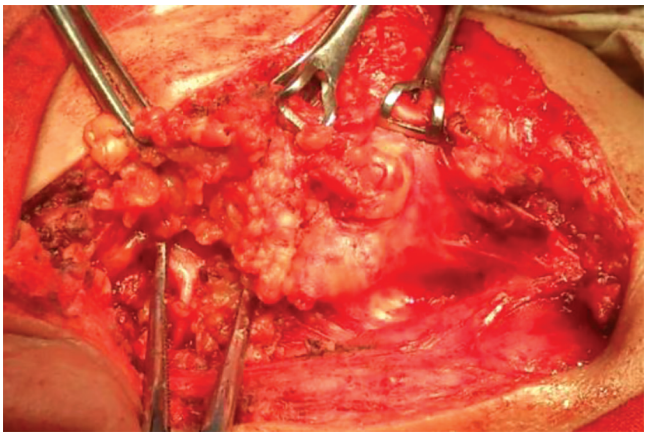
Technique of nerve preservation

(1) The flap dissection was kept in the proper subcutaneous plane outside the parotid capsule, with careful dissection when the terminal branches were reached.
(2) Skin hooks were used to apply vertical traction. To reduce the risk of traction injury, tissue was spread perpendicular to the incision and thus parallel to the direction of the main trunk of the nerve.
(3) Vertically oriented blunt dissection minimizes the risk of injury to the distal branches of the facial nerve.
(4) Once the nerve trunk was identified we did not use diathermy at all; hemostasis was performed with surgical ligatures (5/0 polygalactin).
(5) For parenchymal division, we divided the substance of the parotid gland sharply and used ligatures as appropriate when bleeding was encountered (Figs 3 and 4).
(6) Gentle retraction and fine curved artery forceps were applied. The artery forceps were placed immediately above the nerve and then opened to carefully divide the bridging tissue over the nerve.
(7) Heavy pressure should not be applied on the dissected facial nerve by way of a dry swab or an excessively hot pack in the interest of hemostasis.
(8) Saline irrigation of the dissection field was carried out as the nerve dissection advanced.
(9) For total conservative parotidectomy, once mobilization was completed we placed fine vascular slings beneath the nerve and very gently lifted it away from the tumor and continued dissection.
(10) One suction drain was left and the wound was closed in two layers subcutaneously with vicryl 3/0 and proline 5/0 for skin.

Figure 1

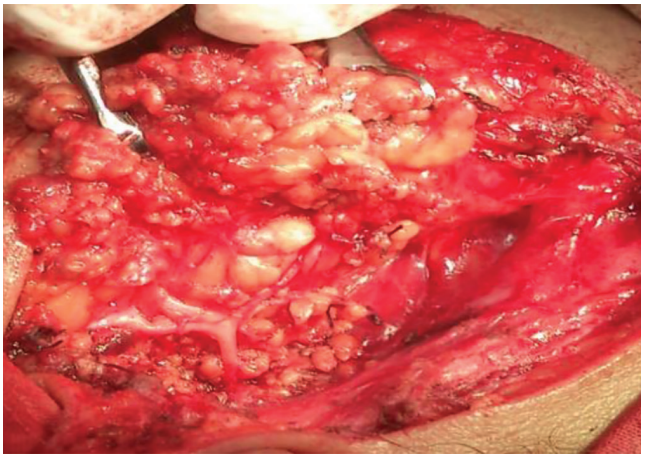
Modified Blair incision for parotidectomy [3].

Figure 2



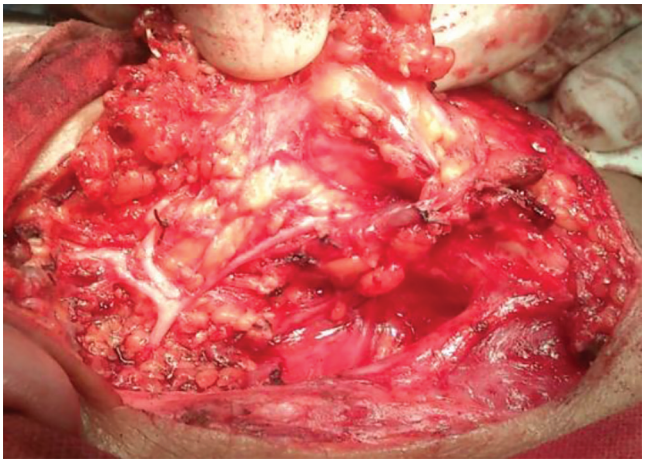
Identification of the main trunk of the facial nerve at the tragal pointer.

Figure 3



Parenchymal dissection toward peripheral branches of the facial nerve; no diathermy was used; hemostasis was carried out with surgical ligatures.

Figure 4



Removal of the superficial lobe including the tumor after dissecting it from the facial nerve branches.

(11) The suction drains should be placed in such way that they do not overlie the trunk or any branch of the facial nerve as misplacement of the suction drains may also lead to neuropraxia.
(12) The drain was usually left for 24–48 h and the sutures were removed on the fifth postoperative day.

Follow-up

Postoperative follow-up of facial nerve function was carried out using the House–Brackmann grading system. This scoring system includes six grades based on the degree of FN function: grade I is normal nerve function; grade II indicates mild nerve dysfunction not detectable at rest; and grades III–VI indicate progressively severe paresis of the nerve in function and at rest. All patients were followed up weekly for 1 month, then monthly for 6 months, or to full recovery.

Statistical analysis

Statistical analysis was performed using the statistical package of services solutions (SPSS Inc., Chicago, Illinois, USA), version 18.0. Exploratory analysis and testing of continuous data for normality of distribution was carried out using the Kolmogorov–Smirnov statistics and the Shapiro–Wilk statistics. Continuous data with normal distribution are expressed in terms of mean ± SD, whereas nonparametric data are expressed as median and range and categorical data are presented in the form of proportion and number. Plots and figures were designed using Microsoft Office Excel 2007 chart editor.

Results

During the study period, 30 parotid procedures were carried out to treat parotid swellings. There were 11 men (36.6%) and 19 women in the series. The average age at presentation was 46 (range 20–68), and in 16 cases the lesion affected the right parotid gland (53.3%).

All these cases were new except one case that recurred 6 years after parotidectomy.

A painless parotid mass was the most common presenting complaint (75%) with pain and oral purulence being less common presenting features, occurring in 14 and 2% of patients, respectively. The disease followed a progressive course in the form of a gradually enlarging mass in most patients. The average duration of symptoms before presentation was 10 months, and clinically none of the patients had preoperative facial nerve paresis.

Preoperative pathology

Preoperative FNAC was carried out for 21 of 30 cases in our study, of which 19 cases were suggestive of benign disease and two were suggestive of malignant disease.

Preoperative radiology

Neck US

The 30 patients included in our study underwent neck US, of whom 17 had well-defined swelling and 13 had ill-defined swelling; 12 cases were cystic and four cases were solid; as regards LN status, nine cases showed no enlarged cervical LN, whereas 21 cases showed enlarged cervical LN, of which eight cases showed suspicious LNs and the other 13 cases showed inflammatory LNs.

Computerized tomography or magnetic resonance imaging

Of the 30 patients, 19 underwent CT of the head and neck, whereas 11 underwent MRI of the head and neck; 26 patients had swelling limited to the superficial lobe and only four patients had swelling with deep lobe extension (Table 1).

Postoperative pathology

There were 18 (60%) cases of pleomorphic salivary adenoma, four (13.3%) cases of Warthin's tumors, and four (13.3%) cases of benign lymphoepithelial lesions. Details about pathological types are provided in Table 2.

Surgical management

Most patients (26) underwent superficial conservative parotidectomy. Four patients underwent total

Table 1 Demographic data of 30 patients

Parameters	Is number (*n*)
Age	Median = 46, range: 20–68
Sex (*n*)	Males = 11, females = 19
Side (*n*)	Right = 16, left = 14
Comorbidities and past history (*n*)	
Diabetes	1
HTN	3
CLD	1
Smoking	2
Previous parotid operation	1

Table 2 Postoperative pathology

Pathology	*n* (%)
Pleomorphic adenoma	18 (60)
Warthin's tumor	4 (13.3)
Benign lymphoepithelial lesion	4 (13.3)
Adenoid cystic carcinoma	1 (3.3)
Non-Hodgkin's lymphoma	1 (3.3)
Noncaseating epithelioid granuloma	1 (3.3)
Low-grade mucoepidermoid carcinoma	1 (3.3)

conservative parotidectomy with excision of the superficial lobe, dissection of facial nerve branches, and excision of the deep lobe of the gland from between the branches of the facial nerve (Table 3).

Postoperative facial nerve function

In our study population (30) 10 patients had temporary facial nerve paralysis (33.3%), of whom five were HB II (16.7%), three were HB III (10%), and two were HB IV (6.6%) (Table 4).

In relation to type of operation, 26 patients underwent superficial conservative parotidectomy; seven of them (26.9%) had postoperative temporary facial nerve dysfunction of whom four patients were HB II, two were HB III, and one was HB IV. Four patients underwent total conservative parotidectomy of whom three had postoperative temporary facial nerve paresis: one patient was HB II, one was HB III, and one was HB IV.

In relation to pathology; the most common was pleomorphic adenoma, as seen in 18 cases, of which 11 cases were with normal postoperative facial nerve function (HB I) and seven cases had temporary facial nerve palsy [four cases with mild dysfunction (HB II) and three cases with moderate nerve dysfunction]. As regards Warthin's tumor (four cases), three cases were HB I and one case was HB IV. For benign lymphoepithelial lesions (four cases) all were HB I. One case was adenoid cystic carcinoma with postoperative moderately severe facial nerve dysfunction (HB IV).

Table 3 Grade of nerve affection by number of cases

Grade of nerve affection	*n* (%)
HB I (no nerve affection)	20 (66.7)
HB II (mild nerve affection)	5 (16.7)
HB III (moderate nerve affection)	3 (10)
HB IV (moderately sever affection)	2 (6.6)

Table 4 Branches of facial nerve affected postsurgery

Type	Branch affected	Number of patients (%)
Single branch	Temporal	0
	Zygomatic	0
	Buccal	0 (20)
	Marginal mandibular	2
	Cervical	0
Multiple branches	Buccal, marginal mandibular	1
	Buccal, marginal mandibular, cervical	1
	Buccal, marginal mandibular, zygomaticotemporal	1 (40)
	Marginal mandibular and zygomaticotemporal	1
All branches	All branches	4 (40)

In relation to operative time, most cases of postoperative temporary facial nerve paresis (9/10) occurred when operative time prolonged for more than 140 min.

Follow-up of patients with temporary facial nerve dysfunction was performed weekly for 1 month, and then monthly until recovery of patients. The time-course to recovery of facial nerve function is shown in Fig. 5, with median time for recovery from postoperative facial dysfunction of 5 months.

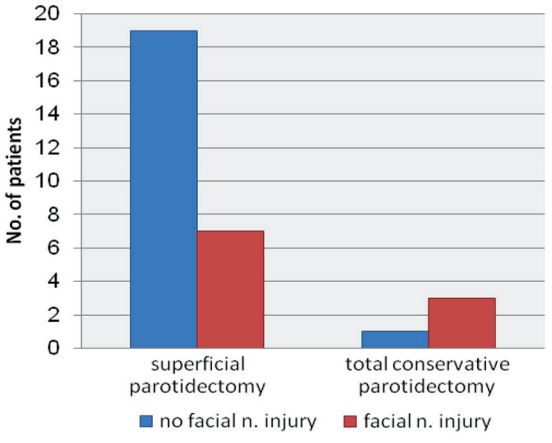
On follow-up, all (100%) patients were seen to have normal facial nerve function by approximately 9 months after the operation.

Discussion

The surgical treatment of parotid diseases is a challenge because of the intraparenchymal course of the facial nerve, especially when treating benign parotid disease. Dissection of the facial nerve in close proximity to a benign tumor can be technically challenging, especially because intraoperative tumor spillage should also be avoided to prevent local recurrence. Moreover, inflammatory lesions frequently lead to parenchymal fibrosis, which can make nerve dissection difficult [12,13].

In this study, we carried out a prospective review of 30 patients undergoing parotidectomy for parotid swelling in Mansoura University Hospitals between July 2012 and June 2013, to investigate the incidence of, risk factors associated with, and modalities to lower the development of postoperative temporary facial nerve dysfunction. This was undertaken to improve preoperative planning and to identify potentially modifiable risk factors for better surgical practice.

Figure 5



Comparing facial nerve injury after superficial and total conservative parotidectomy.

In our study, out of the 30 patients 10 developed facial nerve palsy immediately after operation. Those patients were followed up for 1 year after surgery and we re-evaluated the status of nerve palsy to detect whether it was temporary or permanent.

As regards parotid tumors, in one study the superficial lobe was involved in the case of 90% of patients, whereas the deep lobe was involved only in 10% of patients [14].

In our study, 86.67% of the patients had a tumor in the superficial lobe of the parotid, whereas only 13.33% of the patients had tumor extending into the deep lobe.

In another study 85% of parotid tumors were benign and only 12% were malignant [15]. Mucoepidermoid carcinoma was the most common type (80%), followed by adenocarcinoma (20%) [16].

In our study we found that 90% were benign and only 10% were malignant. Hence, the frequency of benign tumors was significantly higher than that of malignant tumors; in the study by Rahman *et al*. [17] the most common benign parotid tumor was pleomorphic adenoma (84%) followed by Warthin's tumor (10%).

In our study also the most common benign parotid tumor was pleomorphic adenoma (60%), followed by Warthin's tumor (13.3%). Statistical analysis of these observations showed that pleomorphic adenoma was the most common benign tumor.

In our series, superficial parotidectomy was performed in 26 patients (86.7%) and total conservative parotidectomy was performed in four patients (13.3%). Out of these four patients, three (10%) had a benign tumor that involved the deep lobe of the parotid and the remaining one (3.33%) patient had a malignant tumor but without involvement of the facial nerve. Superficial parotidectomy was the adopted technique in our study.

Postoperative facial nerve dysfunction occurred in 33.3% of the patients in our series, which compares well with the 30–60% reported incidence in the published work of Bron and O'Brien. [18].

Upton *et al*. [19] stated that temporary postoperative facial nerve weakness ranges between 18 and 65%. Similar results are reported by Nouraei *et al*. [20] in whose study 40% of patients had some degree of postoperative facial nerve dysfunction.

Although the patient may have normal facial nerve function on recovery from anesthesia, facial nerve function subsequently deteriorates, before eventual full recovery. The endoneural capillary endothelium is impaired by anoxia and trauma of surgery. Following surgery, the endoneural capillaries become permeable, allowing edema to accumulate within the nerve. This may take some hours to develop and often days to resolve and results in transient disturbance of the condition. More extensive compression or traction, as can occur during parotidectomy, will result in demyelination. This takes a few days to develop fully and it may be several days or weeks before the nerve remyelinates. Thus, this phenomenon of delayed-onset facial nerve weakness can be classified as grade 2 neuropraxia, and recovery from it is expected to occur within 4–6 weeks [21].

In our study, in relation to tumor size, the incidence of temporary facial nerve affection in tumors measuring 3 cm or smaller (6/20 cases) (30%) is less than that of tumors measuring more than 3 cm (4/10 cases) (40%). As regards operative time, in nine of 10 cases postoperative temporary facial nerve paresis occurred when operative time prolonged for more than 140 min (mean operative time = 132.5 min); thus, statistical analysis shows that the incidence of temporary paralysis increases with increase in operative time.

Total conservative parotidectomy was performed in four (13.33%) patients, among whom facial nerve paresis was noted in three (75%) patients. All of these three patients with facial nerve paresis had temporary palsy. The difference between facial nerve injury following superficial parotidectomy and total conservative parotidectomy is statistically significant.

The incidence of facial nerve paralysis is higher with total than with superficial parotidectomy, which may be related to stretch injury or as a result of surgical interference with the vasa nervosum [22].

In our study, of the 10 cases having temporary facial nerve paralysis, five cases were HB II (16.7%), three cases were HB III (10%), and two cases were HB IV (6.6%). Statistical analysis shows that most cases (50%) with temporary facial nerve palsy in our series are in the HB II (mild nerve affection) group.

In another study it is mentioned that temporary facial nerve palsy occurred in all facial nerve branches in 26.67% of patients and in one or two branches of the facial nerve in 18.88% of patients and the branch of the facial nerve most at risk for injury during parotidectomy is the marginal mandibular branch [23].

In our study, we found that temporary facial nerve paresis involving all branches of the facial nerve occurred in 40% of cases with temporary nerve

dysfunction, single branch involvement occurred in 20% of cases, and multiple branch affection occurred in 40% of cases.

In our study, we found that six (60%) patients had marginal mandibular branch palsy (two as single branch affection and four as a part of multiple branch affection). This may be because it is the longest of all facial nerve branches, and hence dissection along its course takes longer.

The higher incidence of affection of the marginal mandibular branch compared with other branches may reflect a comparatively more vigorous dissection of this branch in the tumors of the parotid tail, the paucity of anastomotic connections of this branch as compared with others, or an increased sensitivity to minimal trauma secondary to a smaller diameter or longer course [21]. It is known that even small amounts of nerve stretch can lead to postoperative temporary dysfunction [24].

In a comparative study it was mentioned that most of the patients with postoperative facial nerve paresis regained their normal function within 12–14 months after surgery, regardless of the pathology, and that a slower recovery over 2 years was seen after surgery [25].

In our study, the majority of patients (8/10 patients) showed significant functional recovery within 3–6 months after surgery (median time for recovery = 5 months) and all affected patients recovered within 9 months after surgery.

Different recommendations have been reported in the literature to lower the incidence of temporary facial nerve paresis following parotidectomy.

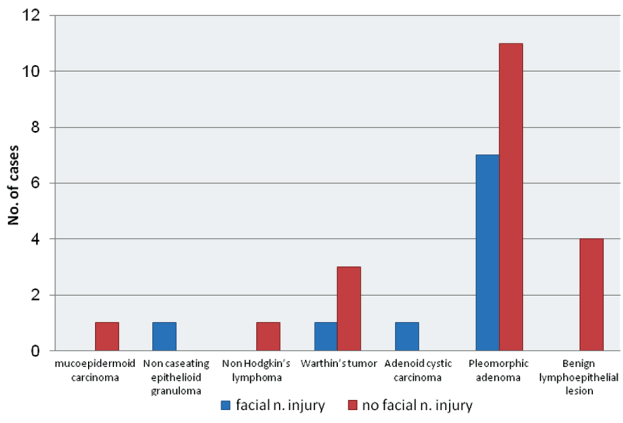
The best means of reducing iatrogenic facial nerve injury in parotid gland surgery still remains a clear understanding of the anatomy, good surgical technique with the use of multiple anatomic land marks, and the use of modern instruments like harmonic scalpel and nerve monitor [17].

With regard to purely surgical factors, ischemia was thought to be the most important, with edema and stretching, particularly of the finer branches of the nerve, as possible subsidiary factors. Although some surgeons advocate the use of hemostatic devices for parenchymal division, it is more preferred to divide the substance of the parotid gland sharply and use ligatures as appropriate when bleeding is encountered [26].

It's reported that the main blood supply of the trunk of the facial nerve in its extracranial course comes from two small branches of the stylomastoid artery, which enters the nerve close to the stylomastoid foramen. In an attempt to preserve this blood supply it is better to identify the trunk of the facial nerve nearer to its main division rather than near the stylomastoid foramen. Never use unipolar diathermy because this will lead to nerve damage. The nerve stimulator and bipolar diathermy are good servants and bad masters [27].

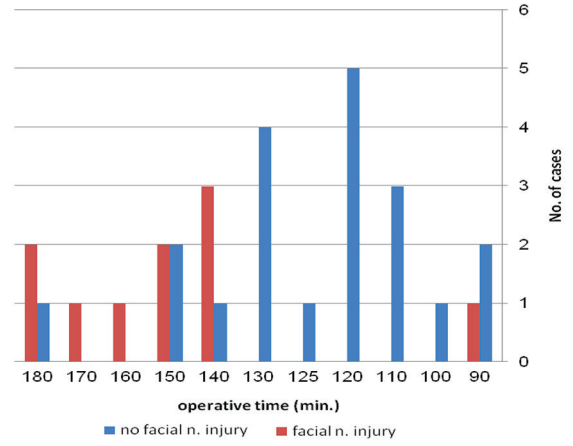
The flap dissection was kept in the proper subcutaneous plane outside the parotid capsule, with a careful dissection when the terminal branches were reached. The dissection proceeds forward and with minimal flanking movements, using gentle retraction and fine curved artery forceps. The technique involves laying the artery forceps immediately above the nerve and then opening it and carefully dividing the bridging tissue over the nerve. Avoid repeated heavy pressure on the dissected

Figure 6



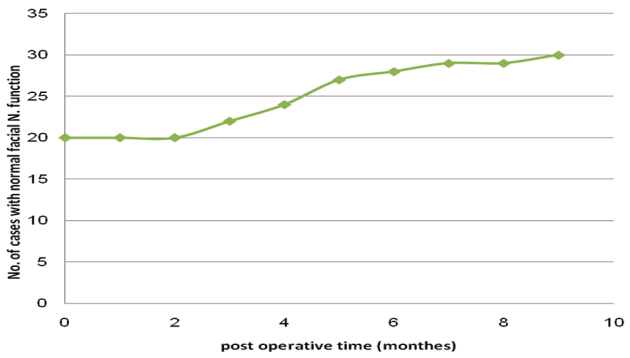
Function of the facial nerve postoperatively in relation to pathology.

Figure 7



Postoperative facial nerve injury in relation to operative time.

Figure 8



Number of cases with normal facial nerve functions on postoperative follow-up and rate of recovery.

facial nerve by way of a dry swab or an excessively hot pack used in the interest of hemostasis [28].

Misplacement of the suction drains may also lead to neuropraxia. The suction drains should be placed in such way that they do not overlie the trunk or any branch of the facial nerve and should be secured to the bed of the wound with 4 : 0 catgut sutures [29].

The avoidance of washing out of the wound with powerful antiseptics combined with the limitations in the indications for total parotidectomies provides an obvious explanation for the reduced incidence of major functional paralysis [27].

In our study, we adopted certain precautions to lower the incidence of temporary facial nerve paresis. One of these precautions is vertical retraction to reduce the risk of traction injury.

Once the nerve trunk was identified we did not use diathermy at all; hemostasis was carried out with surgical ligatures (5/0 polygalactin).

Saline irrigation of the dissection field was carried out as the nerve dissection advanced. We did not use finger palpation, neither to the stem nor to the branches of the facial nerve.

One suction drain was left and the wound was closed in two layers subcutaneously with vicryl 3/0 and proline 5/0 for skin. The drain was usually left for 24–48 h and the sutures were removed on the fifth postoperative day (Figs. 6–8).

Acknowledgements

Conflicts of interest

None declared.

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