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Comparison of Facial Nerve Injury and Recovery Rates after Antegrade and Retrograde Nerve Dissection in Superficial Parotidectomy Surgery for Benign Parotid Disease

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Abstract

Aim: This study was undertaken to compare the proximal and distal facial nerve exploration approach during superficial parotidectomy. *Materials and Methods:* A retrospective analysis of patients who underwent superficial parotidectomy at our tertiery referal center was conducted. Cases were divided into those who underwent superficial parotidectomy using distal facial nerve exploration and those who underwent standard proximal facial nerve exploration. Statistical comparisons of intraoperative blood loss and margin status (negative, focally, positive) were conducted between these two approaches. *Results:* A total of 42 patients underwent superficial parotidectomy at our Tertiary referal center between May 2015 and April 2019. The technique used in most of the cases was conventional proximal nerve exploration technique (30 cases). Distal exploration of the buccal branch was undertaken only in 12 cases, on account of difficulty in locating the main trunk intraoperatively due to the presence of postinflammatory fibrosis. The average patient age was 38 years with a female preponderance (64%). Distal nerve exploration technique consumed almost average operative time less than 2 hours (1.6 hrs) and average intraoperative blood loss 25 ml but in proximal nerve exploration technique have average operative time more than 2 hours (2.2 hrs) intra operative average blood loss 70 ml was recorded. No significant difference in surgical margin status was noticed between the two techniques ($p > 0.05$). *Conclusion:* Both the techniques are efficient without compromising the surgical margins, but the average intraoperative blood loss and surgical operative time are less in distal facial nerve exploration technique.

Keywords: Distal; Facial nerve; Proximal; Superficial parotidectomy

Introduction

The facial nerve can be dissected using an antegrade or retrograde approach. Antegrade dissection is the established technique and retrograde dissection is used less often. Recent publications have drawn attention to the potential value of the retrograde technique particularly if direct identification of the nerve trunk is difficult, and in revision procedures.Parotid gland surgery is technique sensitive because of the close relationship of the gland with the extracranial facial nerve which is the

motor supply to the muscles of facial expression. If the facial nerve is not involved preoperatively, its preservation is important for both aesthetic and functional outcome of the surgery. The most frequent morphology of the facial nerve is reported, in the literature[1–3] to be dichotomous, with cervicofacial and temporofacial divisions further dividing into temporal, zygomatic, buccal, marginal mandibular, and cervical branches. The superior temporofacial branch runs upward and medially and is generally larger. The anatomical evaluations reveal that all the five branches run in the substance of parotid isthmus, dividing the gland into superficial and deep lobes. They are covered by glandular acini and rests on the aponeurosis of the masseter muscle, with its temporal and zygomatic component running to a thin adipose layer upon its emergence from the cranial pole of the gland. Facial nerve is identified by means of proximal surgical technique aimed at isolating proximally the main nerve trunk anywhere between stylomastoid foramen and parotid gland entry. Distal nerve identification techniques are rarely described in the literature, these being adapted, as necessary, by the surgeon, depending on the localization of the neoplasm, and approach the isolation of the nerve beginning from any of its peripheral branches. Rarely, after recurrent infection and fibrosis or previous radiotherapy, the trunk of facial nerve is difficult to be identified using conventional technique.[4] In this situation, nerve is identified at the anterior border of the parotid and traced centrally toward the stylomastoid foramen. This study was undertaken to compare the proximal and distal facial nerve exploration approach during superficial parotidectomy.

It was advocated by Janes[19] and Bailey[20] to identify the main trunk of the facial nerve first, followed by removal of the superficial and/or deep lobe of the parotid gland. Using this technique, the reported recurrence rate and permanent facial nerve paralysis rate become very rare, decreasing to (0.2%) and (2.2%) respectively.[21]

Materials and Methods

This is a retrospective analysis of patients who underwent superficial parotidectomy at our tertiary referal center was conducted. Cases were divided into those who underwent superficial parotidectomy using distal facial nerve exploration (n = 12) and those who underwent standard proximal facial nerve exploration (n = 30). Exclusion criteria included planned total parotidectomy for known high-grade malignancy, parotid biopsy of salivary tissue for diagnostic purposes (i.e., rule out Sjogren's syndrome), and revision parotidectomy. The study population comprised 27 females and 15 males, from 19 to 56 years of age. In none of the cases, a loupe/operative microscope was used or electrophysiological monitoring of facial nerve was undertaken. The average patient age was 38 years with a female preponderance (64%). Distal nerve exploration technique consumed almost average operative time less than 2 hours (1.6 hrs) and average intraoperative blood loss 25 ml but in proximal nerve exploration technique have average operative time more than 2 hours (2.2 hrs) intera operative average blood loss 70 ml was recorded. Statistical comparisons of average intraoperative blood loss and margin status (negative, focally, positive) were conducted between these two approaches. Postoperative complications, such as facial nerve weakness, and wound complications, such as sialocele formation, hematoma, and wound infection, were also recorded. Statistical comparisons were conducted for the significance with the standard error of difference between two means and Pearson's Chi-square, where appropriate, with significance set at $p < 0.05$.

Surgical Technique

Whenever the medical condition allowed and the patient was fit, hypotensive anesthesia was used, as this considerably reduced oozing and thus made it easier to trace the facial nerve fibres. The modified Blair's incision line (Fig. 2) was marked and infiltrated with lignocaine hydrochloride with 1:80,000 adrenaline. The incision was made with a Colorado microdissection needle. The skin flap was raised in the plane of the preparotid fascia. Blood-free plane, anterior to the external auditory meatus which leads the surgeon down to the base of skull, just superficial to the styloid process and the stylomastoid foramen, was then gently opened up in an inferior direction by blunt dissection until the trunk of the facial nerve is seen, but was generally misleading and hence was not our choice of entry in the region. We identified the posterior belly of the digastric muscle in the cervical extension of the incision. The anterior border of the sternocleidomastoid muscle was mobilized and retracted inferiorly to display the posterior belly of digastric muscle beneath it. This maneuver necessitated the sectioning of great auricular nerve. The posterior belly of the digastric was traced upward and backward to its insertion onto the mastoid which lay immediately below the stylomastoid foramen, thus leading the operator

to the facial nerve from below. Once the facial nerve trunk was identified, the superficial lobe of the parotid was "exteriorized" by opening along a plane in which the branches of the facial nerve run between the two lobes, by blunt dissection. Usually, as it leaves the stylomastoid foramen, the trunk of the facial nerve turns abruptly to become more superficial (Fig. 3) and also divides into the larger zygomaticofacial trunk and smaller cervicofacial trunk (Fig. 4). The five main branches of the nerve (Fig. 5) were then followed peripherally through the parotid until the superficial lobe was completely freed. This part of the operation was performed using fine scissors, opened up in the plane of the facial

(A.) (B.) (C.)

Fig. 1: Pre operative view showing different size of parotid tumour

Fig. 2: Marking of modified Blair's incision

Fig. 3: Exploration of proximal facial nerve main trunk

Fig. 4: Dissection of upper and lower division of facial nerve

nerve branches, with care always taken to identify the nerve fiber before dividing parotid tissue. During dissection of the lower part, branches of the posterior facial vein were encountered immediately deep to the marginal mandibular branch. Great care was taken when vascular clamps are applied to these branches to avoid damaging the facial nerve. If the superficial parotidectomy was being performed for chronic infection, the duct was tied off as far forward as possible to prevent recurrent ascending infection from the oral cavity. Rarely, after recurrent infection and fibrosis or previous radiotherapy, the identification of the trunk of facial nerve was difficult using conventional technique. In this situation, nerve was identified at the anterior border of the parotid and traced centrally towards the stylomastoid foramen. In the distal nerve exploration method, we first identified the buccal branch of the facial nerve (Fig. 6) about 4 cm anterior to the tragus along the alatragal line. This branch was dissected in a retrograde fashion as far as the main trunk of the facial nerve. The decision to resort to the identification of the buccal nerve was supported by the regular course and adequate size of this branch of facial nerve in its peripheral area colocated with Stenson's duct, which enables it to be easily identified during surgery. The remaining branches of the facial nerve were dissected in an anterograde fashion, displacing the parotid gland superiorly and inferiorly. Following removal of the parotid gland, the blood pressure was returned to normal, all bleeding points were controlled, a vacuum drain placed, and the wound closed in layers. There is minimal post-operative scar in all patients (Fig. 7).

All patients had peroperative nerve monitoring and were followed up at 1 week, 1 month, 3 months, or to full recovery of the nerve. The House-Brackmann (HB) grading system was used to assess the degree of injury to the nerve. A high rate of serious nerve injury (HBIII or above) was associated with retrograde dissection at 1 week. Serious nerve injuries (HBIII or above) were slow to recover after the antegrade technique at 3 months. There was no difference between groups in the rates of full nerve recovery at 6 months. The exclusion criteria included our studies that reported one of the following: 1) Malignant Tumors, 2) Pediatric patients 3) Revision Parotid surgery. 4) Sjogren's syndrome.

Fig. 5: Branching of facial nerve exposed following superficial parotidectomy

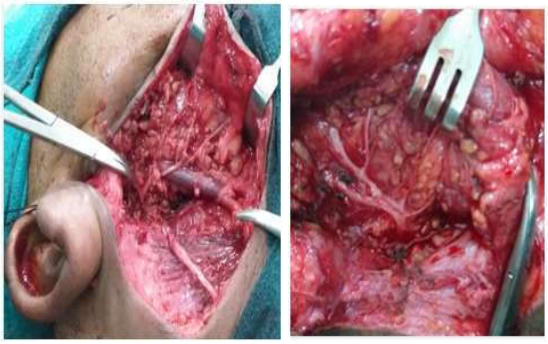

Fig. 6: Distal facial nerve exposure (buccal branch)

Fig. 7: Post Operative Wound

Statistics

Standard error of difference between two means of intraoperative blood loss

Average intraoperative blood loss in distal nerve identification technique = 25.00 cc

Standard deviation = 1.44

Average intraoperative blood loss in proximal nerve identification technique = 70 cc

Standard deviation = 4.14

Standard error of difference between two means

$= \sqrt{(4.14)^2/29 + (1.44)^2/10}$

$= \sqrt{0.598 + 0.207}$

$= \sqrt{0.805}$

$= 0.89$

The actual difference between the two means = 70-25 = 45

Chi-square test for testing significance of difference of surgical margins status

Surgical Margins Status	Proximal Nerve Identification	Distal Nerve Identification
Negative Margins	25	09
Close Margins	05	03
Positive Margins	00	00

Surgical margin in proximal nerve identification technique

Observed negative margins = 25

Expected = 21.56

Observed close margins = 05

Expected = 5.94

Observed positive margins = no

Expected = 0.48

Applying the Chi-square test,

$x^2 = \sum(O-E)^2/E$

$= 1.44^2/21.56 + 0.94^2/5.94 + 0.48^2/1.48 + 1.43^2/7.43 + 0.95^2/2.05 + 0.74^2/0.26$

$= 0.096 + 0.149 + 0.156 + 0.275 + 0.440 + 2.106$

$= 3.222$

Degrees of freedom = (column-1) (row-1)

$= (3-1)(2-1) = 2$

Using published probability tables, for degree of freedom 2, the value of Chi-square for a probability of 0.05 is 5.99. Therefore, at the value of Chi-square 3.222, $p > 0.05$.

Results

A total of 42 patients underwent superficial parotidectomy at our tertiary referral center between May 2015 and April 2019. The technique used in most of the cases was conventional proximal nerve exploration technique (30 cases). Distal exploration of the buccal branch was undertaken only in 12 cases, on account of difficulty in locating the main trunk intraoperatively due to the presence of postinflammatory fibrosis. The average patient age was 38 years with a female preponderance (64%). Distal nerve exploration technique consumed almost average operative time less than 2 hours (1.6 hrs) and average intraoperative blood loss 40 ml but in proximal nerve exploration technique have average operative time more than 2 hours (2.2 hrs) intera operative average blood loss 70 ml was recorded. The actual difference between the two means is 42.6, which is more than twice the standard error of difference between the two means, and therefore "significant." This signifies that the average intraoperative blood loss is less in distal facial nerve exploration technique. Among the standard parotidectomy using proximal facial nerve identification group, there were 25 negative margins, 05 focally close margins, and 0 no positive margin, whereas among the distal facial nerve identification group, there were 09 negative margins, 03 focally close margins, and no positive margins. No significant difference in surgical margin status was noticed between the two techniques ($p > 0.05$).

Table 1: Distribution of patients demographic

		Proximal Nerve Exploration	Distal Nerve Exploration	Total Patients
Age(Avg.)		38	38	
Sex	Male	10	05	15
	Female	20	07	27

Though there was no motor deficit in the case where distal nerve exploration was done, functional outcome of the surgery cannot be compared. Temporary facial nerve dysfunction of 01 (Marginal Mandibular) branch was found only in one case (Table 2).

Table 2: Complication of superficial parotidectomy

Complication of superficial parotidectomy	Total patients
Permanent facial nerve dysfunction	00
Temporary facial nerve dysfunction	01
Wound Infection	00
Hematoma	00
Sialocele	00
Others	00

Table 3: Histopathological tumours type

Benign Tumours of Parotid	Total patients
Pleomorphic Adenoma	33
Warthin tumour	06
Parotid cyst	02
Parotid fistula	01

The most common tumours are pleomorphic adenoma was operated in our study.

Discussion

Whatever the type of parotidectomy surgical technique performed, dissection and preservation of the facial nerve can only be achieved using two approaches; antegrade or retrograde. To the best of our knowledge, this is the our retrospective study compared the AFND and RFND approaches used in parotidectomy regarding the incidence of facial nerve paralysis and other complications in benign parotid surgery. The classic approach to facial nerve requires four anatomical landmarks leading to the identification of the trunk of the facial nerve,[4] as it leaves the stylomastoid foramen which are as follows: (a) The cartilaginous external auditory meatus forms a "pointer" at its anterior inferior border indicating the direction of the nerve trunk; (b) Just deep to the cartilaginous pointer is a reliable bony landmark formed by the curve of the bony external meatus and its abutment with the mastoid process. This forms a palpable groove leading directly to the stylomastoid foramen. Unfortunately, this groove is filled with fibrofatty lobules that often mimic the trunk of the facial nerve which can lie as much as 1 cm deep to this landmark; (c) The anterior, superior aspect of the posterior belly of the digastric muscle is inserted just behind the stylomastoid foramen; (d) The styloid process itself can be palpated superficial to the stylomastoid foramen and just superior to it. The nerve is always lateral to this plane and passes obliquely across the styloid process. A branch of the postauricular artery is usually encountered just lateral to the nerve. This technique is most frequently used and generally held to be the safest for anatomical and functional nerve preservation. Satisfactory results are obtained after partial or total conservative parotidectomy procedures with proximal nerve identification technique, in which the percentage of permanent nerve paralysis is less than 1 to 2% in cases of benign pathologies,[5–8] while the rate of temporary deficits ranges from 20 to 55%.[9-11] In very few cases, the proximal approach to facial nerve is extremely difficult, even with the use of an operative microscope and with intraoperative monitoring of the facial nerve, and it is, therefore, necessary to use the distal nerve localization technique. The technique of identifying the facial nerve by means of the isolation of its peripheral branches has been codified for years: in the 80s, even Work and Bailey presented several examples of the retrograde approach from the buccal, mandibular, and temporal rami in those cases in which they reach the surface of the parotid gland. These authors recommend following the deep parotid vein as reference for the mandibular rami, which crosses it laterally.[4] In our opinion, both proximal and distal nerve exploration can be used to identify the facial nerve without compromising the outcome of the surgery, though at our center, distal nerve exploration is only used when proximal nerve isolation is found to be extremely difficult intraoperatively. In our case, after the preparation of the skin flap, dissection in the parotid region was found difficult due to fibrosis, because of recurrent parotid and periparotid inflammation preoperatively. In our opinion, identification of the buccal nerve is supported by the regular course and adequate size of this facial branch in its peripheral area co-located with Stenson's duct which enables it to be easily identified. Intraoperative monitoring of facial nerve function, using electromyographic techniques, is proposed in parotid surgery to identify the principal nerve trunk and its peripheral branches in complex cases or during retrograde approaches.[12–14] Following parotidectomy using facial nerve monitoring, Terrell et al.[15] achieved a low percentage of early postoperative facial nerve paralysis in the group monitored, albeit there was no significant statistical difference in long-term nerve function; Witt,[11] on the other hand, demonstrated a high rate of facial paralysis in a group monitored during superficial parotidectomy, concluding that electrophysiological monitoring is optional and must not be considered a standard technique in such surgery. The validity of facial nerve monitoring can play an important and advantageous part in the surgical treatment of recurrent parotid neoplasms.[12,15] Facial nerve monitoring along with distal nerve exposure is well supported in literature and found to be efficacious in cases of partial parotidectomy. The distal facial nerve identification technique causes less intraoperative bleed.[16] The main point of reference in the isolation of the facial nerve is the posterior belly of the digastric muscle; when, however, if proximal nerve exploration is difficult, isolation of the nerve through the distal nerve exploration from the buccal branch can be carried out.[17,18]

Conclusion

Both proximal and distal facial nerve exploration techniques for superficial parotidectomy are efficient without compromising the surgical margins status. From the results we have achieved, we can conclude that the both the techniques are equally effective for preventive facial nerve paralysis but the average intraoperative blood loss and surgical operative time are less in distal facial nerve exploration technique.

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