

ROLE OF INTRAVITAL STAINING OF PAROTID GLAND AS AN AID TO PAROTID SURGERY IN COMPARISON WITH NERVE INTEGRITY MONITOR

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ABSTRACT

BACKGROUND

Incidence of salivary gland tumours is increasing recently. They are slow growing and well-circumscribed. 70% of these occur in parotid gland, which has close relation with facial nerve.

The aim of the study is to identify facial nerve, delineate tumour extent during parotidectomy and to assess incidence of risk factors in parotid tumours.

MATERIALS AND METHODS

Study was conducted in 45 patients undergoing elective parotidectomy for parotid tumour in General Surgery, Government Medical College, Kozhikode, over a period of 18 months. These patients are divided into 3 groups of 15 each for which intravital staining and nerve monitor used and one group used as control.

RESULTS

86% had benign tumours with a female preponderance. Warthin's tumour dominates among male smokers. There is a definite increase in operation time when nerve identification techniques are not used. 30% had permanent facial nerve palsy and 93% had transient facial palsy.

CONCLUSION

Facial nerve palsy after parotidectomy is usually transient. Intravital staining and nerve monitor has got definite role in preventing facial nerve injury. Pleomorphic adenoma is the most common benign and mucoepidermoid carcinoma is most common malignant tumour.

KEYWORDS

Parotidectomy, Facial Nerve, Intravital Staining, Nerve Integrity Monitor.

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BACKGROUND

Tumours of the major salivary glands account for about 3 to 4% of all head and neck neoplasms.¹ They are usually slow growing and well circumscribed. The average age of patients with malignant neoplasms is approximately 55 years and for benign tumours about 40 years. The findings of rapid growth, pain, paraesthesia and facial weakness are signs of malignancy.² Approximately, one fourth of parotid gland tumours and one half of submandibular gland tumours are malignant. Most of these tumours arise from superficial lobe of parotid gland. Parotid gland tumours usually present as slow growing painless swellings either below the ear or on the upper part of the neck. Rarely, those arising from deep lobe present as parapharyngeal mass.

Most common parotid tumour is pleomorphic adenoma followed by Warthin's tumour. Most common primary malignant tumour is mucoepidermoid carcinoma. Treatment of parotid tumour is either by surgery alone or surgery followed by radiotherapy as in certain malignant cases.

The major complications of parotid gland surgery reported in the literature are facial nerve damage, salivary fistula and Frey's syndrome.³ In spite of recent advances in operative techniques, a significant population of patients undergoing parotidectomy develop postoperative facial palsy. The incidence of facial nerve paralysis is about 30-65% for transient weakness and 3-6% for permanent dysfunction.⁴ Permanent facial palsy means facial palsy persisting even after six months.

The thought that they might wake up with the paralysed face is probably the chief anxiety of most patients who have been advised to undergo surgeries on parotid. Such paralysis may occur in three ways.

Although, the surgeon preserves the nerve anatomically, patient may develop a functional facial paralysis after surgery, which is transient.

The surgeon may deliberately sacrifice the nerve as a necessary step in removing the pathological process.

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The surgeon may inadvertently cut or grossly interrupt the anatomical continuity of facial nerve.^{5,6,7,8}

Injury to facial nerve can be prevented by identification of facial nerve by one of the four methods.

Supravital staining of parotid gland, contrast the blue normal gland from the unstained tumour. Facial nerve fibres appear gleaming white.

Facial nerve monitoring using nerve integrity monitor.

Direct identification of main trunk as it exits through the stylomastoid foramen.

Retrograde approach to the trunk from either mandibular branch where it passes over the retromandibular vein or the peripheral branches alongside the parotid duct.⁹

The operations of parotid gland tumours are a challenge to the surgeon. The main aim of these operations is removal of the tumour with facial nerve preservation. Despite imaging investigations showing the location of the tumour, it's important for the surgeon to have an opportunity to discriminate between tumour, normal parotid tissue and also facial nerve during operation.

Success of parotid surgery depends on the careful identification and dissection of facial nerve. To prevent recurrence, all tumours should be excised with a wide margin of normal tissue. These two requirements are facilitated by the supravital staining of the parotid gland with 2.5% methylene blue.

Opening of Stensen's duct and adjacent tissues are first anaesthetised with lignocaine spray half an hour before the surgery. Stensen's duct is a small duct of caliber 1-2 mm and length 6-7 cm. Stensen's duct is then cannulated with a 30-gauge needle and 0.5 to 1.5 mL of dye is injected into it. Sometimes, flush catheter can be retained in the duct for a continuous intraoperative staining of the gland. Normal gland contrast blue colour and can be differentiated from unstained tumour and gleaming white facial nerve fibres.^{10,11,12}

Alternatively, intraoperative use of Nerve Integrity Monitor has been advocated in identifying facial nerve. Two channel nerve monitor is the one available in our department. Using this, we are monitoring the function of two muscles- Orbicularis, Oculi and Mentalis.^{13,14}

Each channel has got 3 leads- red, green and black. Red is the active lead, black the reference lead and green the ground lead. Red lead of the 1st channel is placed just above the lateral end of upper eyelid, black lead placed just below the lateral end of the upper eyelid and green lead placed on the upper part of the maxillary area. Red lead of the 2nd channel is placed just above the angle of mouth, black lead placed just below the angle of mouth and green lead placed on the lower part of maxillary area. All these leads are kept on the side of surgery.

A special probe is kept intermittently at various stages of dissection over the surgical field to locate the facial nerve. The instrument makes an alarm tone as the probe gets near the facial nerve trunk or its branches. The alarm increases in intensity as the probe gets more and more close to the facial nerve and heard maximum when kept directly over the

nerve. Thus, it helps in delineating the facial nerve trunk and its branches and helps in preventing injury to facial nerve.

MATERIALS AND METHODS

This is an observational and interventional study for checking the risk of facial nerve palsy following parotidectomy and to assess the outcome of facial nerve identification. Study population is classified into three groups randomly; for first group, intravital staining technique was employed to identify the facial nerve during parotidectomy; in second group, nerve integrity monitor was used; and the third group was control group where no technique is employed. Facial nerve damage was assessed by using House-Brackmann score on first operative day, after a week, after a month and if still persisting after two months, again reassessed after six months.

HOUSE-BRACKMANN SCORE

Calculated by measuring upward movement of mid portion of top of eyebrow and outward movement of angle of mouth. One point was given for each 0.25 cm movement up to a maximum of 1 cm. Scores are added to give a number out of 8.

Grade	Facial Palsy	Score
I	Normal	8
II	Slight	7
III	Moderate	5-6
IV	Moderately severe	3-4
V	Severe facial palsy	1-2
VI	Total	0

Study Material

Longitudinal study - prospective.

Study Period

One and half years.

Size Sample

Group 1 (Intravital stain)	15 cases
Group 2 (Nerve monitor)	15 cases
Group 3 (Control)	15 cases

Inclusion Criteria

Cases of parotid swelling underwent parotid surgery from Medical College, Kozhikode.

Exclusion Criteria

1. Cases with preoperative facial palsy.
2. Cases with inflammatory parotid swellings.
3. Cases with posttraumatic parotid swellings.
4. Cases with recurrent parotid swellings previously operated.
5. Cases with preoperative facial palsy.

OBSERVATION AND RESULTS

Incidence of Malignancy in Parotid Tumours

39 (86.7%) patients had benign and 6 (13.3%) patients had malignant tumours.

Age Distribution	Male	Female	Total
13-20	0	1	1
21-30	1	4	5
31-40	1	11	12
41-50	5	4	9
51-60	8	4	12
61-70	3	2	5
71-80	1	0	1
Total	19	26	45

Table 1. Age Distribution in Parotid Tumours

Parotid tumours are commonly seen in third, fourth and fifth decade of life. Malignant tumours are seen in older population compared with benign tumours.

Sex Distribution in Parotid Tumours

Parotid tumours are common in females.

	Pleomorphic Adenoma	Warthin's Tumour	Basal cell Adenoma	Mucoepidermoid Carcinoma	Adenoid Cystic Carcinoma
Male	8	7	1	2	1
Female	21	1	1	2	1

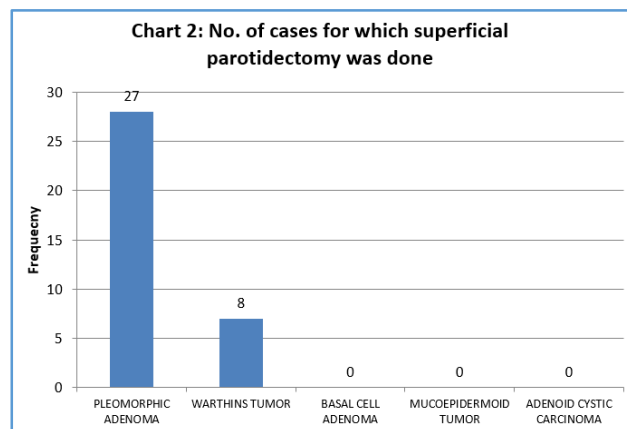
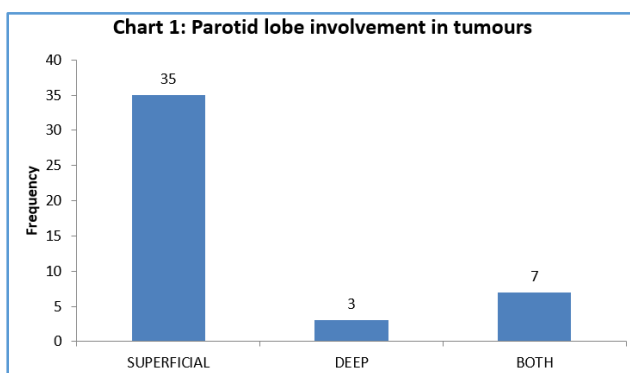
Table 2. Sex Distribution in Parotid Tumours

Pleomorphic adenoma is the most common parotid tumour.

	Pleomorphic Adenoma	Warthin's Tumour	Basal Cell Adenoma	Mucoepidermoid Carcinoma	Adenoid Cystic Carcinoma
Smoker	8	7	1	2	1
Nonsmoker	21	1	1	2	1

Table 3. Smoking and Parotid Tumours

Warthin's tumour is commonly seen in males with smoking habits.



Superficial parotidectomy is commonly done for pleomorphic adenoma.

Superficial lobe is commonly involved in parotid tumours. Malignant parotid tumour usually involves both lobe of parotid.

Pleomorphic Adenoma	Warthin's Tumour	Basal Cell Adenoma	Mucoepidermoid Tumour	Adenoid Cystic Carcinoma
2	0	2	4	2

Table 4. Number of Cases of Total Parotidectomy was Done

Mucoepidermoid tumour is the most common malignant tumour.

	Pleomorphic Adenoma	Warthin's Tumour	Basal Cell Adenoma	Mucoepidermoid Tumour	Adenoid Cystic Carcinoma
Positive	10	0	0	0	0
Negative	17	8	0	0	0

Table 5. Margin Clearance in Superficial Parotidectomy

Margin positivity is the most common cause of recurrence in parotid tumours.

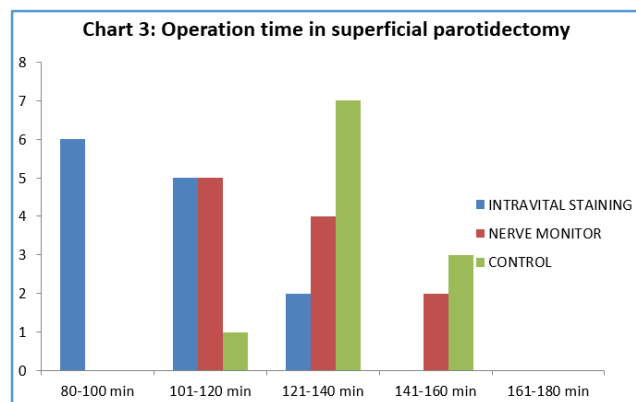
	Pleomorphic Adenoma	Warthin's Tumour	Basal Cell Adenoma	Mucoepidermoid Tumour	Adenoid Cystic Carcinoma
Positive	1	0	1	2	1
Negative	1	0	1	2	1

Table 6. Margin Clearance in Total Parotidectomy

Warthin's tumour are usually confined to superficial lobe of parotid.

Operation Time in Superficial Parotidectomy with Facial Nerve Identification Techniques

Operation time is decreased if facial nerve identification techniques are employed.



Superficial Parotidectomy	Intravital Staining	Control	Percentage
Positive	5	9	40%
Negative	8	13	60%
Percentage	38.4%	40.9%	

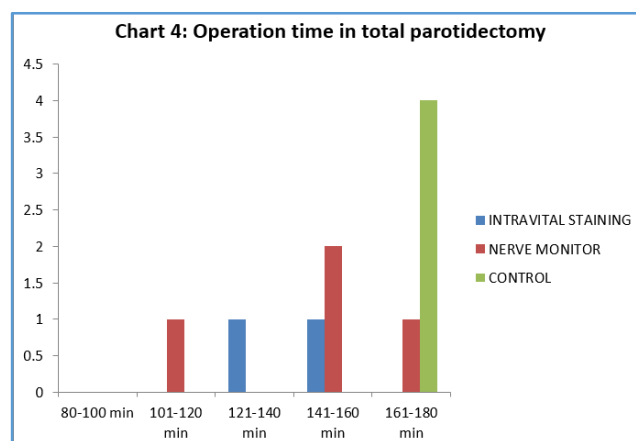
Table 7. Intravital Stain to Assess Margin Clearance in Superficial Parotidectomy

Margin Positivity is Less Frequent in Benign Neoplasms

Total Parotidectomy	Intravital Staining	Control	Percentage
Positive	1	4	50%
Negative	1	4	50%

Table 8. Intravital Stain to Assess Margin Clearance in Total Parotidectomy

Operation Time in Total Parotidectomy



Operation time is increased if facial nerve identification techniques are not employed.

Margin positivity is commoner in malignant neoplasms.

	Intravital Stain	Nerve Monitor	Control
No	2	0	1
Mild	7	9	5
Mod	4	2	5
Severe	0	0	0

Table 9. Superficial Parotidectomy - Facial Nerve Palsy on Postop Day 1

Transient nerve palsy is common in superficial parotidectomy.

	Intravital Stain	Nerve Monitor	Control	Percentage
No	12	10	8	85.7%
Mild	1	1	3	14.3%
Mod	0	0	0	0%
Severe	0	0	0	0%
Nerve Palsy	7.69%	9.09%	27.27%	

Table 10. Superficial Parotidectomy - Facial Nerve Palsy After Six Months

Facial nerve palsy is around 15% in superficial parotidectomy.

	Intravital Stain	Nerve Monitor	Control
No	0	0	0
Mild	0	0	1
Mod	1	2	1
Severe	1	1	1
Total	0	1	1

Table 11. Total Parotidectomy - Facial Nerve Palsy on Postop Day 1

All patients for whom total parotidectomy was done developed transient facial nerve palsy on postop day 1.

	Intravital Stain	Nerve Monitor	Control	Percentage
No	1	3	3	70%
Mild	0	0	0	0%
Mod	1	0	0	10%
Severe	0	0	0	0%
Total	0	1	1	20%
Nerve Palsy	50%	25%	25%	

Table 12. Total Parotidectomy - Facial Nerve Palsy After Six Months

Permanent facial palsy in total parotidectomy is around 30%.

	Superficial Parotidectomy	Total Parotidectomy	Percentage
Present	32	10	93.3%
Absent	3	0	6.7%

Table 13. Transient Facial Nerve Palsy After Parotidectomy

Transient facial nerve palsy is 100% in total parotidectomy.

Transient facial palsy is seen in 91% of superficial parotidectomy.

	Superficial Parotidectomy	%	Total Parotidectomy	%
Absent	30	85.7%	7	70%
Mild	5	14.3%	1	10%
Moderate	0	0%	0	0%
Severe	0	0%	0	0%
Total	0	0%	2	20%

Table 14. Permanent Facial Nerve Palsy After Parotidectomy

Incidence of facial nerve palsy is 14.3% in superficial parotidectomy and 30% in total parotidectomy.

DISCUSSION

Parotid neoplasm accounts for 2-3% of head and neck neoplasm. 65-75% of these tumours are benign.

	Benign	Malignant	Percentage
Edward J Dunn et al ¹⁵	177	73	59%
Qubilat AR et al ¹⁶	116	93	80%
This study	39	6	87%

Table 15. Benign Incidence

Parotid neoplasm have equal incidence in male and female population.

	Male	Female	Ratio
Edward J Dunn et al	107	143	1:1.3
Qubilat AR et al	32	30	1.06:1
This study	19	26	1:1.4

Table 16. Sex Distribution

Parotid neoplasm are seen in all ages (9½ months to 91 yrs., Edward J Dunn et al) 17 yrs. to 72 yrs. in this study with peak incidence in third, fourth, fifth decade of life. Mean age of benign tumours was 44 years and of malignant tumours was 52 years.

	Benign	Malignant
Edward J Dunn et al	48	57
This study	44	52

Table 17. Histology Comparison

Pleomorphic adenoma is found commonly in females compared to Warthin’s tumour, which is common in males. Most of the patients with Warthin’s tumour are smokers.

Warthin’s tumour is commonly seen in smokers (86%) compared to nonsmokers (14%). Similar results are seen John A Pinkistion et al¹⁷ in which Warthin’s tumour were common in smoker (84%). Smoking does not increase the risk in other parotid tumour. They are seen (33%) in smokers and (67%) in nonsmokers. Similar results were seen in John A Pinkistion et al where incidence was (45%) in smokers and (55%) in nonsmokers.

Superficial lobe is frequently involved by the parotid tumours. In this study, 28% tumours were involving deep lobe. Similar results were found in Hussain and Murry et al¹⁸ in which 15% tumours were involving deep lobe. In case of malignant parotid tumours, both lobes are equally involved. Hence, superficial parotidectomy is commonly done for benign tumours and total for malignant tumours.

Incidence of resected margin becoming positive for tumour cells have decreased as enucleation of parotid tumours is not commonly done nowadays. Positive resected margin have higher incidence in malignant parotid tumours compared with benign ones.

Role of intravital staining of parotid gland in delineating tumour form normal tissue was attempted in this study. Positive resected margin after intravital staining and without any staining technique was compared.

	Intravital Stain	Control
Positive Margin	6	13
Negative Margin	9	17

Table 18. Tumour Margins by Intravital Staining

It was found that intravital staining with methylene blue does not have any role in preventing positive resected margin in parotidectomy (P value 0.65) contradictory with Cheesman et al¹¹ in which it was found that this staining has got a definitive role in delineating tumour from normal tissue.

Role of nerve integrity monitor and intravital staining was compared in preventing facial nerve palsy after parotidectomy.

	Intravital Stain	Nerve Monitor	Control	Percentage
No	12	10	8	85.7%
Mild	1	1	3	14.3%
Mod	0	0	0	0%
Severe	0	0	0	0%
Nerve Palsy	7.69 %	9.09%	27.27%	

Table 19. Superficial Parotidectomy - Facial Nerve Palsy After Six Months

	Intravital Stain	Nerve Monitor	Control	Percentage
No	1	3	3	70%
Mild	0	0	0	0%
Mod	1	0	0	10%
Severe	0	0	0	0%
Total	0	1	1	20%
Nerve Palsy	50%	25%	25%	

Table 20. Total Parotidectomy - Facial Nerve Palsy after Six Months

Facial Nerve Palsy Following Parotidectomy

It was observed that 90% of superficial parotidectomy patients and 100% of total parotidectomy patients developed postop facial nerve palsy. Most of them were transient due to neurapraxia involving buccal and marginal mandibular branch. Permanent facial palsy after parotidectomy was found in 14.28% of superficial parotidectomy and 30% in total parotidectomy. Most of these nerve palsy falls into mild category according to House Brackmann score.

The temporalis and ramus marginalis branches are freely dissected from the parotid. These peripheral branches of the facial nerve are least probable to maintain function should injury occur. Neurologic injury to CN VII can result from desiccation as well as from mechanical trauma. The former is easily avoided if moist sponges are applied during the dissection.

“Even in the absence of a histological diagnosis, surgeons should not be influenced by the current zeal for nerve preservation. Piecemeal tumour excision to preserve a nerve branch that should be sacrificed must be condemned as a violation of one of the basic tenets of oncologic practice.

Moreover, postoperative radiotherapy does not produce the disease-free outcomes of an adequate en bloc resection.”¹⁹

It was found that either nerve integrity monitor or intravital staining have a role in preventing facial nerve palsy in superficial parotidectomy compared with control group. Incidence of permanent facial palsy was 7.69% and 9.09% respectively, if either of above technique was employed and 27.27%, if not employed.

	Transient Nerve Palsy	Permanent Nerve Palsy
Lowry TR et al ²⁰	50-70%	0-7%
Al Salamah et al ²¹	19%	0%
This study	90%	14.2%

Table 21. Comparison of Severity of Nerve Palsy

Meier JD et al,²² Grimminger C et al²³ similar results were found. Nerve integrity monitor helps in early identification of facial nerve, but incidences of facial palsy after surgery are within comparable limits with the control group.

Incidences of both transient and permanent facial palsy are slightly higher in this institute. This is because parotidectomies are performed by many surgeons and each surgeon will be performing only 3-5 parotidectomies an year. A surgeon is more likely to produce facial nerve injury if he is performing less than 25 parotidectomy a year. Moreover, the nerve palsy occurred here is due to the transaction of small terminal branches of facial nerve arising from its buccal and mandibular division, which are hard to demonstrate with above techniques of nerve integrity monitor or intravital staining.

Incidence of permanent facial nerve palsy after total parotidectomy (30%) is also high at this institute. This maybe because of the reason that only 10 total parotidectomies were done in this period and 80% of them were malignancy in which tumours were in close proximity with the facial nerve.

Intravital staining and nerve integrity monitor has got definite role in delineating facial nerve trunk. Hence, total duration of surgery was 10 to 30 minutes less if either of the techniques is employed.

Superficial Parotidectomy			Total Parotidectomy		
Intravital Stain	Nerve Monitor	Control	Intravital Stain	Nerve Monitor	Control
105 mins.	125 mins.	145 mins.	145 mins.	155 mins.	180 mins.

Table 22. Mean Operation Time

Similar results were found in Meier JD et al in which this technique helps in early identification of facial nerve, thus decreasing operative time.

CONCLUSIONS

1. Facial nerve palsy after parotidectomy are usually transient.
2. Intravital staining or nerve integrity monitor has got a definite role in preventing facial nerve palsy in superficial parotidectomy.

3. Positive resected margins are common in malignant tumours.
4. Intravital staining has got no role in preventing positive resected margin for tumour.
5. Pleomorphic adenoma is the most common parotid tumour (64.4%) and mucoepidermoid carcinoma is the most common malignant tumour (8.8%).
6. Warthin's tumour is commonly seen in males (87.5%) with smoking habits.

LIMITATIONS

1. Number of patients available for this study in this study period was only 45, which are too low to make a statistically significant analysis.
2. Intravital stain failed to stain gland completely in patients with sialolithiasis.
3. Identification of Stensen's duct opening was not possible in some patients.
4. It was not possible to use nerve integrity monitor in patients for whom muscle relaxant used.

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