

Partial-thickness sternomastoid rotational flap in parotid surgery: the functional and esthetic outcomes

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SUMMARY

Introduction: Majority of parotid tumor requires parotid surgery and complications following parotidectomy are multiple namely facial nerve paresis, Frey's syndrome, retromandibular depression and hypoesthesia of ear lobule. Parotidectomy with sternomastoid (SCM) flap may play significant roles in preventing these complications.

Objectives: The objectives of this study were to compare the occurrence of Frey's syndrome, esthetic outcome, facial nerve paresis and ear lobe paresthesia between the two groups, parotidectomy with sternomastoid flap and parotidectomy without sternomastoid flap.

Methodology: This was a comparative cross-sectional study performed at Hospital Universiti Sains Malaysia and Hospital Sultanah Bahiyah from June 2016 until October 2018, after ethical committee approval (USM/JEPeM/17020092). The patient was recruited prospectively for the SCM flap group and retrospectively for non-flap group. Frey's syndrome was evaluated both subjectively and objectively by patient's complaint assessment and Minor Starch Iodine test. Evaluation of esthetic outcome was conducted using Visual Analog Score (VAS). In addition, assessment of facial nerve was performed by using the House-Brackmann grading system, whereas hypoesthesia of ear lobe numbness was evaluated by patient complaints documentation. All data were entered and analyzed using the software IBM SPSS version 24. Descriptive analysis and Pearson's Chi-square test were used in analyzing the obtained data.

Results: Occurrence of Frey's syndrome in parotidectomy without SCM flap was higher compared to parotidectomy with SCM flap group. Results showed that 13 patients (72.2%) in the non-SCM flap group had Frey's syndrome whereas only 2 patients (11.8%) in SCM flap group had the syndrome. The aesthetic result showed that patients with parotidectomy with SCM flap had lower mean score of 1.21 (SD=0.36) at day 14, 0.06 (SD=0.24) at day 30 and 0.03 (SD=0.12) at day 60 respectively. Both outcomes were statistically significant ($p < 0.05$). While incidence of facial nerve palsy and cervical/ear lobe numbness were the same in the two studied groups.

Conclusion: There was a significant difference in Frey's syndrome and aesthetic outcomes of the parotidectomy with SCM flap compared to those without SCM flap. Partial-thickness sternomastoid flap should be routinely practiced especially in young patients with benign big tumor going for parotidectomy.

Key words: sternomastoid flap, frey's syndrome, retromandibular depression, parotidectomy, parotid tumors, minor starch iodine test, facial nerve paralysis

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INTRODUCTION

Generally, 80% of salivary gland tumor occur in the parotid gland and 80% of these are benign in nature [1]. Pleomorphic adenoma is the commonest type of benign tumor and mostly affecting the parotid and submandibular glands, whereas the commonest malignancy is mucoepidermoid carcinoma. In majority of tumors, parotid surgery i.e. superficial or total parotidectomy is necessary in order to relieve the patient's symptoms or as part of oncological surgical clearance. As parotid gland is located within the facial region, meticulous surgical dissection and significant patient's esthetic outcomes need to be carefully considered.

Noteworthy, parotid surgery is challenging because of the facial nerve branching within the gland, between the superficial and deep lobe parotid gland. The facial nerve mostly provides the motor supply of the muscles of facial expression. This nerve must always be identified and preserved when performing parotidectomy. Otherwise, it can cause significant facial asymmetry, if the nerve is traumatized or sacrificed during the surgery. Superficial parotidectomy is a resection of the entire superficial lobe of the parotid gland. Total parotidectomy involves resection of the entire parotid gland, usually with preservation of the facial nerve [2]. Parotid surgery may cause several complications namely Frey's syndrome, facial nerve palsy, hypoesthesia of greater auricular nerve, amputation neuroma, cosmetic deficit with retromandibular depression, hemorrhage, infection, wound seroma as well as parotid fistula [3].

Many surgical flaps have been introduced to decrease these complications, such as fascia lata grafts [4], dermal-fat-fascia free grafts [5], dermal-fat grafts [6], platysma muscle flaps [7], temporoparietal fascia flaps [8], Superficial Musculoaponeurotic System (SMAS) flaps [9-11], vascularized fat grafts [12] and vascularized dermis-fat grafts [13]. These mentioned flaps are mainly used to overcome the surgical defects post parotidectomy. The sternomastoid (SCM) flap is easy to raise and within the surgical access. It can provide a larger width and length of muscle tissue that can be interposed, and ease with flap design and axis of rotation after parotidectomy [14-16]. To date, there are only few available kinds of literature that highlight the usage of superiorly base sternomastoid flap in parotid surgery in order to improve both, the functional and aesthetic outcomes. However, none of the literature has compared the results between two groups of patients who undergo parotidectomy without SCM

flap and non-SCM flap. This study conducted to investigate the effectiveness of using SCM flap in parotid surgery in order to improve post-operative outcomes.

METHODOLOGY

This was a comparative cross-sectional, exploratory study performed at Hospital Universiti Sains Malaysia and Hospital Sultanah Bahiyah from June 2016 until October 2018, after ethical approval obtained (USM/JEPeM/17020092). A total of 35 patients that underwent superficial or total parotidectomy who met the inclusion and exclusion criteria were included. The comparator arm (parotidectomy without SCM flap) is from retrospective group while the active arm (parotidectomy with SCM flap) is from prospective group. Inclusion criteria were all patients underwent a superficial or total parotidectomy for a benign or malignant parotid tumor or chronic sialadenitis. Exclusion criteria were patient with recurrent tumors of parotid, history of previous surgery involving the face and neck region, history of chemoradiation, patients with severe comorbidity (blood dyscrasia) and patient with history of allergic reaction towards iodine. Intraoperatively, after tumor removal, depending on the size of the defect, the sternomastoid muscle was harvested and rotated superiorly to cover the post parotidectomy defect as well as to create the interposed barrier between parotid bed and overlying skin (Figure 1A & 1B).

Post-operative assessment of Frey's syndrome, cosmetic outcomes, facial palsy, and cervical or ear lobes paresthesia

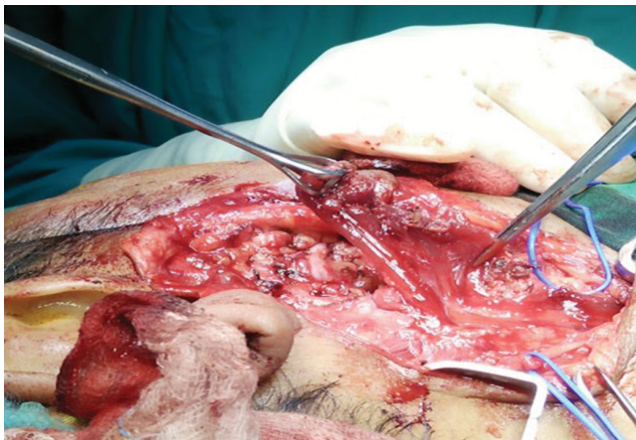


Fig. 1A. A partial thickness sternomastoid muscle harvested at superior one third of its length and rotated anteriorly to cover the parotid surgical defect



Fig. 1B. Sternomastoid flap sutured to the subcutaneous tissue anterior to the surgical defect before skin closure

were carried out. Evaluation of Frey's syndrome was performed subjectively by inquiry from patients about the presence of facial sweating, flushing or pain while eating and objectively by Minor Starch Iodine test. Iodine 1% tincture was applied to pre-auricular and infra-auricular area at surgical site. When the area is dried the starch is applied over the area and the patient is asked to chew lemon for 10 minutes. The test is positive if the area > 1 cm² appeared as punctate discoloration. The test will be carried out on day 30 and day 60 post-operatively.

Assessment for esthetic outcomes, facial nerve palsy, and ear lobule paresthesia was done on days 14, 30 and 60 postoperatively. The esthetic outcome was evaluated by using a designed visual analog score (VAS) as below. The 2 blinded medical officers were recruited to fill the VAS for each patient. Evaluation of facial nerve palsy performed by using House-Brackmann classification [17]. Assessment of ear lobule paresthesia was done by enquiring on presence of any numbness over cervical or ear lobe. All data was entered, cleaned and analyzed using the software IBM SPSS version 24.

RESULTS

Descriptive analysis and Pearson's Chi-square test were used in analyzing the data. There were 35 patients who participated in this study where 18 patients underwent parotidectomy without SCM flap and 17 patients underwent parotidectomy with SCM flap. The patients aged from 19 to 77 years old with mean age was 50.31 (SD=16.32). There were 20 Malay patients (82.9%), followed by Chinese 5 (14.3%) and 1 Siamese (2.9%). Most of the patients underwent superficial parotidectomy (n=34, 97.1%) and only 1 patient had total parotidectomy (2.9%). The majority of patients were diagnosed to have parotid pleomorphic adenoma which accounts for 60%. Descriptive parametric data were presented as percentage using descriptive analysis (Table 1).

Result of Frey's syndrome

At day 30 post parotidectomy, there were 7 patients in the non-SCM flap group had gustatory sweating and pre-auricular flushing which also positive objective test of Minor Starch Iodine. While in parotidectomy with SCM flap, there were only 2 patients had flushing which positive for Minor Starch

Iodine Test and none of them complain of gustatory sweating. At day 60 post parotidectomy, there was an increased number of patients in non-SCM flap group developed gustatory sweating and pre-auricular flushing, which accounts for 11 patients. As compared to SCM flap group, there were only 2 patients experienced it. This association result is well illustrated in (Table 2a).

Overall, in comparison between these two groups of patients, the occurrence of Frey's Syndrome in parotidectomy without the SCM flap group was higher than parotidectomy with SCM flap group [18]. It showed that 13 patients (72.2%) in non-SCM flap group had Frey's Syndrome whereas only 2 patients (11.8%) in SCM flap group.

From statistical analysis, it revealed significant difference in occurrence of Frey's Syndrome between two groups at day 30 and day 60 post-operatively ($p < 0.05$) by Pearson Chi-square test (Table 2b).

Tab. 1. Socio-demographic and characteristics of patients who underwent parotidectomy

| Variables | Mean (SD) | N (%) |
|---------------------------------|---------------|-----------|
| Age | 50.31 (16.32) | |
| Gender | | |
| Female | | 17 (48.6) |
| Male | | 18 (51.4) |
| Race | | |
| Chinese | | 5 (14.3) |
| Malay | | 29 (82.9) |
| Siamese | | 1 (2.9) |
| Diagnosis | | |
| Adenocarcinoma | | 1 (2.9) |
| Fibrous histiocytoma | | 1 (2.9) |
| Mucoepidermoid carcinoma | | 2 (5.7) |
| Oncocytoma | | 1 (2.9) |
| Pilomatrixoma | | 1 (2.9) |
| Pleomorphic adenoma | | 21 (60.0) |
| Warthin's tumor | | 8 (22.9) |
| Surgery | | |
| Left superficial parotidectomy | | 7 (20.0) |
| Right superficial parotidectomy | | 27 (77.1) |
| Right total parotidectomy | | 1 (2.9) |

Tab. 2a. Association of gustatory sweating and pre-auricular flushing with relation to Minor Starch Iodine Test at day 30 and day 60 respectively

| | | Day 30 post-operative | | |
|-------------|-------------------------------|--------------------------|-----------------|---------|
| Group | | Minor Starch Iodine Test | | p-value |
| | | Negative, n (%) | Positive, n (%) | |
| No SCM flap | Gustatory sweating | | | 0.038 |
| | Absent | 6 (54.5) | 5 (45.5) | |
| | Present | 0 (0.0) | 7 (100.0) | |
| | Pre-auricular flushing | | | 0.038 |
| Absent | 6 (54.5) | 5 (45.5) | | |
| Present | 0 (0.0) | 7 (100.0) | | |
| SCM flap | Gustatory sweating | | | - |
| | Absent | 15 (88.2) | 2 (11.8) | |
| | Present | 0 (0.0) | 0 (0.0) | |
| | Pre-auricular flushing | | | 0.044 |
| Absent | 13 (100.0) | 0 (0.0) | | |
| Present | 2 (50.0) | 2 (50.0) | | |
| | | Day 60 post-operative | | |
| Group | | Minor starch Iodine Test | | p-value |
| | | Negative, n (%) | Positive, n (%) | |
| No SCM flap | Gustatory sweating | | | <0.001 |
| | Absent | 6 (85.7) | 1 (14.3) | |
| | Present | 0 (0.0) | 11 (100.0) | |
| | Pre-auricular flushing | | | 0.002 |
| Absent | 5 (71.4) | 2 (28.6) | | |
| Present | 0 (0.0) | 11 (100.0) | | |
| SCM flap | Gustatory sweating | | | - |
| | Absent | 15 (88.2) | 2 (11.8) | |
| | Present | 0 (0.0) | 0 (0.0) | |
| | Pre-auricular flushing | | | 0.044 |
| Absent | 13 (100.0) | 0 (0.0) | | |
| Present | 2 (50.0) | 2 (50.0) | | |

Result of the esthetic outcome

In this objective, the visual analog score (VAS) was used to evaluate the aesthetic outcomes post parotidectomy whereby the higher the score means the poor aesthetic result. The comparison of aesthetic outcomes was done on day 14, day 30, day 40 post-operatively between these two groups (non-SCM flap versus SCM flap group). The result showed patients

underwent parotidectomy with SCM flap had lower mean score 1.21 (SD=0.36) at day 14, 0.06 (SD=0.24) at day 30 and 0.03 (SD=0.12) at day 60 respectively. In comparison with patients who underwent parotidectomy without SCM flap, they had higher mean score. Based on statistical analysis using independent t-test, there was significant difference in mean score of aesthetic outcomes between these groups for day 14 (p<0.001), day 30 (p<0.001) and day 60 (p<0.001) (Table 3a).

Tab. 2b. Comparison of occurrence of Frey's syndrome between SCM flap and non-SCM flap group

| Time | Group | Minor Starch Iodine Test | | p-value |
|------|-------------|--------------------------|----------------|---------|
| | | Negative,n (%) | Positive,n (%) | |
| D30 | No SCM flap | 6 (33.3) | 12 (66.7) | 0.001 |
| | SCM flap | 15 (88.2) | 2 (11.8) | |
| D60 | No SCM flap | 5 (27.8) | 13 (72.2) | <0.001 |
| | SCM flap | 15 (88.2) | 2 (11.8) | |

Tab. 3a. Comparison of mean score of aesthetic outcomes on day 14, day 30 and day 60 post-operative between two groups

| Time | Comparison group | Mean (SD) | Mean difference (95% CI) | p-value |
|------|------------------|-------------|--------------------------|---------|
| D14 | No flap | 3.94 (0.29) | 2.73 (2.52,2.96) | <0.001 |
| | SCM flap | 1.21 (0.36) | | |
| D30 | No flap | 3.39 (0.61) | 3.33 (3.01,3.65) | <0.001 |
| | SCM flap | 0.06 (0.24) | | |
| D60 | No flap | 3.35 (0.61) | 3.33 (3.02,3.63) | <0.001 |
| | SCM flap | 0.03 (0.12) | | |

Tab. 3b. The occurrence of the facial nerve palsy in post parotidectomy with SCM flap and without SCM flap

| Facial nerve palsy | No SCM flap mean (SD) | SCM flap mean (SD) | Mean difference (95% CI) | t-statistics (df) | p-value |
|--------------------|-----------------------|--------------------|--------------------------|-------------------|---------|
| D1 | 1.44 (0.51) | 1.12 (0.33) | 0.33 (0.03,0.63) | 2.23 (33) | 0.033 |
| D14 | 1.06 (0.24) | 1.00 (0.00) | 0.06 (-0.06,0.17) | 0.97 (33) | 0.339 |
| D30 | 1.06 (0.24) | 1.00 (0.00) | 0.06 (-0.06,0.17) | 0.97 (33) | 0.339 |
| D60 | 1.00 (0.00) | 1.00 (0.00) | A | - | - |

*t' cannot be computed because the standard deviations of both groups are 0

Tab. 3c. The occurrence of the cervical/ear lobe paraesthesia in parotidectomy with SCM flap and without SCM flap

| Cervical or ear lobe numbness | D14 | D30 | D60 |
|-------------------------------|-----------|-----------|-----------|
| Non-flap Group | | | |
| No | 11 (61.1) | 11 (61.1) | 13 (72.2) |
| Yes | 7 (38.9) | 7 (38.9) | 5 (27.8) |
| SCM Flap Group | | | |
| No | 15 (88.2) | 15 (88.2) | 15 (88.2) |
| Yes | 2 (11.8) | 2 (11.8) | 2 (11.8) |

Tab. 3d. Comparison of cervical/ear lobe numbness between flap and non-flap group at day 14, day 30, day 60

| Cervical/ear lobe numbness | D14 | | D30 | | D60 | |
|----------------------------|-----------|-----------|-----------|------------|-----------|------------|
| | No, n (%) | Yes,n (%) | No, n (%) | Yes, n (%) | No, n (%) | Yes, n (%) |
| Group | | | | | | |
| No flap | 11 (61.1) | 7 (38.9) | 11 (61.1) | 7 (38.9) | 13 (72.2) | 5 (27.8) |
| SCM flap | 15 (88.2) | 2 (11.8) | 15 (88.2) | 2 (11.8) | 15 (88.2) | 2 (11.8) |
| p-value | 0.121 | | 0.121 | | 0.402 | |

Result of facial nerve paresis

All patients were assessed post-operatively for any facial nerve palsy encountered by using House-Brackmann score at day 1, day 14, day 30 and day 60. The comparison was made between these two groups for any occurrence of facial nerve palsy. We did not analyze result on day 1 because the effects of edematous changes post-operative. The analysis showed the mean score for no SCM flap groups was higher at all days measured but not enough to be statistically significant. For day 60, the mean is equal to mean score of SCM flap group (Table 3b).

Result of paresthesia of ear lobe

All patients were enquired any present of numbness over cervical or ear lobe post-operatively at day14, day 30 and day 60. The result showed no changes in frequency of cervical/ear lobe paresthesia in post parotidectomy with SCM flap on three intervals. It demonstrated 2 patients (11.8%) had paresthesia during final assessment on day 60. While, in non-SCM flap group, the result showed 5 patients (27.8%) had paresthesia on day 60 (Table 3c).

From statistical analysis, there was no significant difference in cervical/ear lobe numbness between the non-SCM flap group and SCM flap group ($p>0.05$) (Table 3d).

DISCUSSION

Frey's syndrome is a significant complication following parotidectomy. It is characterized by flushing and gustatory sweating on the skin overlying parotidectomy site when eating. It is due to aberrant regeneration of the injured postganglionic parasympathetic fibers of auriculotemporal nerve that normally supplying the parotid gland which innervates the sweat glands of the skin postoperatively. The incidence of Frey's syndrome varies according to series of literature as it depends on methods of measurement. It's reported incidence was 94% when a minor starch iodine test is performed [3], but only 12% to 54% if assessed by patient's symptoms [5, 6]. Frey's syndrome causes social embarrassment and unpleasant conditions to patients which subsequently may lead to public avoidance.

Several types of the flap have been advocated to prevent Frey's syndrome by creating an interposing barrier between the

overlying skin and the parotidectomy bed. Thus, it prevents re-growth of the postganglionic parasympathetic fibers from growing into the sweat gland of skin during post-operative period. Sternomastoid rotational flap in parotidectomy is a versatile choice of flap in order to prevent Frey's syndrome. Wail et al. had conducted a comparison study assessing Frey's syndrome in parotidectomy patients with SCM flap and without SCM flap. The result showed Frey's syndrome was diagnosed objectively in 36.8% of patients with non-flap group and 0% in the SCM flap group [19]. Our study also revealed that occurrence of Frey's syndrome was less among parotidectomy with SCM flap group (11.8%) in comparison with non-SCM flap group (72.2%). The majority of patients in non-flap group gave history of flushing or gustatory sweating which is characteristic of Frey's syndrome, and it is evident by positive Minor Starch Iodine test.

The sternomastoid muscle receives segmental blood supply from three main arteries, occipital artery (superior segment), superior thyroid artery (middle segment) and transverse cervical artery (inferior segment). These segmental blood supplies ensure SCM can be harvested based on the defect created, to be transposed either superiorly or inferiorly. In addition, the risk of flap atrophy is low due to this multiple blood supply. In this study, superiorly based flap was used where the anterior and partial thickness of SCM was harvested and rotated antero-superiorly to cover the parotid bed defect. Thus, it creates an adequate barrier between parotid bed and skin in order to avoid Frey's syndrome. The SCM flap can be harvested at ease because it was within the surgical field. There was no extra skin incision needed since it used the same modified-Blair skin incision.

Following parotidectomy, parotid bed defect can be significant where it forms a hollow and upon skin closure, it will create a depression at retromandibular region or in severe cases, it extends to pre-auricular region as well. These circumstances can be prevented by applying the SCM flap that ensures excellent cosmetic outcomes. According to prospective study done by Deepak et al., using anteriorly based partial-thickness sternomastoid muscle flap, the cosmetic result showed overall good satisfaction is 90% [19]. From our study, it was showed that most of the patients who underwent parotidectomy with SCM flap had good aesthetic outcome. The aesthetic outcome was measured using Visual Analog Score (VAS) which ranges from score 0 to score 5. The mean score value was lower in this group which indicates good cosmetic results while comparing with non-SCM flap group that carried higher mean score. In our study, partial-thickness superiorly-based SCM flap was harvested and rotated to cover the defect. It provided satisfactory results in terms of symmetrical and contour deformity over parotidectomy site.

Facial nerve palsy and/or paresis is a common complication of parotidectomy. The incidence of facial nerve paresis after parotidectomy was around 46.1% for temporary deficit and permanent damage ranging from 1.9 to 3.9% [20, 21]. It is commonly affected marginal mandibular branch (64.1%), subsequently buccal branch (20.5%) and zygomatic branch (7.7%) [21]. If facial nerve palsy occurs, it causes facial asymmetry with significant

cosmesis embarrassment as well as the affecting function of speech, drinking and eating as well as eye closure. These circumstances if left neglected had detrimental effect on quality of life as patients may suffer from eye pain due to exposure keratopathy, trouble with drinking and communicating. Thus, facial nerve must be identified and preserved at all times, intraoperatively to avoid these dreadful complications. Facial nerve monitor can be used intra-operatively to assist the surgeon in locating the nerve.

Nofal et al., conducted a prospective cohort study, assessing post parotidectomy complications in SCM flap where the result showed 5 patients developed temporary facial palsy which was recovered completely [22]. From this study, it was documented that 8 patients from non-SCM flap group and 2 patients from the SCM flap group had mild transient facial nerve paresis (House-Brackmann grade 2) on assessment at two weeks post-operation. This usually due to inflammatory effect from nerve manipulation intra-operatively and most recover completely 8-12 weeks post-surgery. Therefore, all the patients had intact facial nerves during final assessment at day 60 for both groups. There was no statistical difference in terms of facial nerve palsy between parotidectomy with SCM flap or without flap.

The risk of injury to greater auricular nerve in parotid surgery also warrants discussion. The nerve innervates skin overlying parotid gland, skin over mastoid process and ear lobules. This nerve encountered during parotidectomy as it emerges onto anterior surface of sternomastoid muscle and resides in a superficial plane. The nerve should be identified and preserved while raising the skin flap but in certain circumstances, it has to be sacrificed due to tumor adhesion or difficult surgical access. In our study, there were 5 patients (27.8%) from non-SCM flap group and 2 patients (11.8%) from SCM flap group developed ear lobes numbness. It was documented that the greater auricular nerve was being sacrificed intra-operatively.

CONCLUSION

Partial-thickness superiorly based sternomastoid rotational flap in parotidectomy provides excellent functional and aesthetic outcomes by significantly improves contour deformity and reduced incidence of Frey's syndrome. Hence, it should be routinely practiced especially in young patients underwent parotidectomy with greater surgical defect. It is a versatile flap as it can be harvested at ease, is located within the surgical access, with no additional skin incision required and it did not add extra time to total operation time.

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CONFLICT OF INTEREST

All authors declared that they don't have any conflict of interest.

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