



## The Qualitative and the Quantitative Assessment of the Deep Lobe of Parotid Gland After Superficial Parotidectomy

### KEYWORDS

Superficial parotidectomy, parotid scintigraphy, Modified saxon's test

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**ABSTRACT** *Introduction* - Superficial parotidectomy is the commonest procedure performed for benign lesion arising in the superficial lobe of the parotid gland. It is believed that after superficial parotidectomy the remaining gland eventually undergoes atrophy. There are not many studies to access the functioning of the remaining deep lobe. This study attempts to examine the quantitative and qualitative function of the remnant parotid gland after superficial

*Methods* - Twenty patients were prospectively analyzed who underwent superficial parotidectomy for the benign lesions. They underwent similar operation as for superficial parotidectomy; stention's duct was generally preserved after identification if technically it was feasible to be preserved. Postoperatively the remnant gland and the contra lateral gland were assessed using Technetium 99(Tc-99) and the modified Saxon's test (MST) on the tenth day and six weeks after surgery. The function and the percentage of the remnant gland were calculated.

*Results*-Functional assessment on the operated side by Tc99m scan in 20 patients showed reduction in 16 patient (mean 10.7%),increase uptake in 3 patients(mean 10%), no uptake in 1 patient. The decrease in uptake function when the duct was ligated as in 2 patients was 50% and 75%. Modified Saxon's test on the operated side showed that in 11 cases, there was actually increase in the saliva weight on the second measurement. In 6 cases, there was decrease in the saliva secreted. In one case there was no change in the weight. The percentage saliva secretion and the percentage function showed a similar trend (either increase or decrease) on the Saxon's test and the scan in 7 patients. The mean percentage function on the first and second Scintigraphy was 50.6% and 37% and this was statistically significant ( $p=0.017$ ). The mean percentage function of the 18 patients whose Stention's duct were preserved at first and second test was 49.3%and 35.9% respectively and mean secreted saliva weight of 99.5mg and102.4mg. in remaining 4 patient 2 had duct ligated and in two patient with duct unknown the difference was not significant .In the non operated side there was a significant compensatory increase in the uptake function from 69% to 75.36%( $p=0.01$ ) but no significant increase in the saliva secretion.

*Conclusion* - The hypothesis that the deep lobe atrophies lobe of parotid gland atrophies and stops functioning is false.

### Introduction

Superficial parotidectomy is the most common surgery performed for a benign pathology of parotid. What happens to the remaining deep lobe and duct? The understanding till now has been that the remaining part of the gland usually atrophies and undergoes fibrosis and is non functional. This is when a classical surgery as advocated by Blair is performed when the duct was also ligated along with the removal of the superficial lobe.

In our study we attempt to focus on the qualitative and the quantitative function of the deep part of the parotid gland following superficial parotidectomy. To see where the duct arises from superficial or deep lobe and what happens to the function of the deep lobe?

### Materials and methods

A prospective analytical study was designed to assess the

function of the remnant deep lobe of the parotid gland after superficial parotidectomy in the Department of General Surgery in a tertiary hospital in southern India. Lesions were confirmed to the superficial lobe clinically and all of them had Fine needle aspiration Cytology done prior to surgery.

The same surgical technique of superficial parotidectomy was adapted in all the cases. The functioning of the remnant deep lobe of the parotid gland on the operated side was compared to the contra-lateral non-operated side gland function by Technetium - 99 scan on the tenth day and sixth week after surgery and on the same days, salivary secretion from the remnant gland was quantified by modified Saxon's test. All patients were included in the trial after obtaining written informed consent. Details were documented

In the proforma made for the purpose.

**Exclusion criteria:**

Recurrent disease, Patients requiring post operative radiation, Patients who had previous radiation in the head and neck region, Deep lobe involvement, Malignancy: intermediate/high Grade, Pregnancy, Subtotal, superficial parotidectomy, Tuberculosis of the parotid gland. Twenty five patients were recruited for the study only 20 patients completed the study.

**Saxon's test:**

This test involves chewing on a folded sterile sponge for 2 minutes. Saliva production is measured by weighing the sponge before and after chewing.

Normal control subjects produce greater than or equal to 2.75 gm of saliva in 2 minutes. This test was modified and used in this trial.

**Clinical test (Modified Saxon's test):**

On the days of the first and second scans, the salivary secretions from the glands on both sides were quantified. A Vacutainer® was used with a small cut gauze piece instead of the sponge originally described. The weight of the container with the gauze was measured using a standard chemical balance. At a time two such containers were used, one for each side. The oral cavity was mopped dry with cotton and then the floor of the mouth was

Packed with gauze to absorb the salivary secretion. The Vacutainers were then opened and the gauze was packed in the upper gingivo-buccal sulcus in the region of the parotid duct opening on both sides for two minutes. Salivation was stimulated by placing 2-3 drops of concentrated lemon juice over the dorsum of the tongue. After 2 minutes, the gauze pieces from the two sites were placed back into the respective containers and now the post test weight was measured. The net saliva secretion was the difference between the pre and post test readings for each side.

**Technetium 99 m Pertechnetate scan:**

The function of the parotid glands were also measured by parotid

Scintigraphy on the tenth day and at six weeks later. Technetium 99m is trapped and excreted by the salivary glands through the Na-K-Cl transport system in the basement membrane of the parotid acinar cells.

**Parotid scintigraphy:**

Following intravenous administration of 370 MBq of Tc99 sodium Pertechnetate, a Scintigram (Fig.1) was taken with a digital large field gamma camera and data analysis system using a low energy, high sensitivity, parallel hole collimator. The images were digitally recorded in a 128 x 128 matrix. Duration of the scan was 30 to 45 minutes and the images of the salivary glands were acquired sequentially. Secretion from the salivary gland was stimulated with 2ml of concentrated lemon juice placed over the dorsum of the tongue for 2 minutes prior to the scan. Patients were also instructed not to swallow during imaging.

Semi-quantitative analysis was done by the same radiologist who was blinded to the patient's clinical information. Oval shaped regions of interest were drawn over the salivary glands (Fig.2). Time activity curves were generated by background subtraction. For each

salivary gland the maximum uptake was calculated.

The function of the gland was calculated using the following expression:

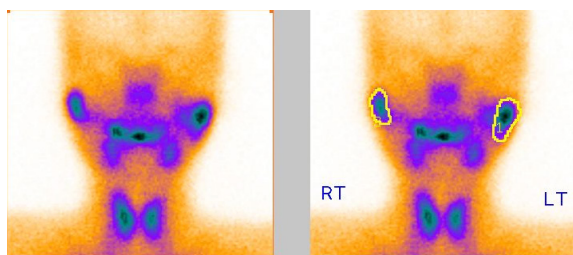


Fig. 1 Parotid scintigraphy

Function of the gland = (Maximum uptake - background)/background

Percentage function of the affected gland = (Function on the affected side/function on the normal side) x 100%

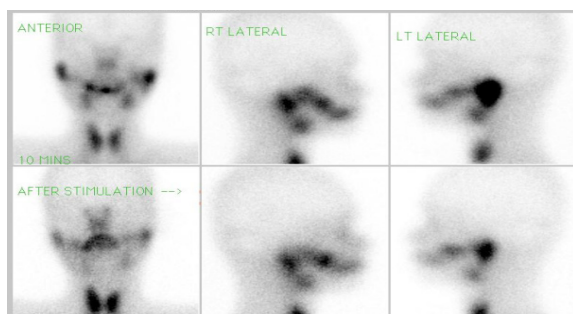


Fig.2. Measuring the uptake

**Surgical technique:**

Modified Blair's incision was made and superficial parotidectomy was done for all the patients, attempt was made to preserve the Stenson's duct and ligated only if the duct was arising from the superficial lobe and if could not be preserved.

Post operative studies patients were reviewed on the tenth day and six weeks later after surgery and each had modified Saxon's test and parotid Scintigraphy at these times.

**Statistical methods:**

The data was described using summary statistics such as mean, median, range and standard deviation. Univariate and bivariate graphs were plotted. Mann - Whitney test was used for analyzing unpaired groups and Wilcoxon signed rank test was used for paired data analysis. A 'p' value of less than 0.05 at 95% confidence intervals was considered significant. The data analysis was performed using SPSS 11.0 for windows

**Ethical issues:**

All the patients were explained about the safety of the radiation dose used for the Scintigraphy. The dose was 370 mBq which was a safety dose

## Results

Table 1 Partid uptake functions

Serial no.	Sex	Age	Operated side	Duct status	Technetium scan 1 – Right side uptake (%)	Technetium scan 1 – Left side uptake (%)	Technetium scan 2 – Right side uptake (%)	Technetium scan 2 – Left side uptake (%)
1	Male	22	R	Pre-served	35	65	34	66
2	Female	38	L	Pre-served	84	16	76	24
3	Female	84	L	Ligated	75	25	88	12
4	Male	49	L	Ligated	80	20	95	5
5	Male	15	L	Pre-served	72	28	63	37
6	Male	18	R	Pre-served	25	75	24	76
7	Male	36	R	Pre-served	51	49	26	74
8	Male	45	R	Pre-served	11	89	0	100
9	Female	40	L	Pre-served	63	37	90	10
10	Male	51	R	Pre-served	27	73	20	80
11	Male	39	R	Not Known	49	51	46	54
12	Female	38	L	Pre-served	75	25	75	25
13	Female	27	R	Not Known	42	58	39	61
14	Male	58	L	Pre-served	61	39	73	27
15	Female	43	L	Pre-served	91	9	98	2
16	Female	24	L	Pre-served	68	32	71	29
17	Male	60	L	Pre-served	79	21	89	11
18	Female	41	R	Pre-served	25	75	38	62
19	Male	35	R	Pre-served	52	48	42	58
20	Male	28	L	Pre-served	47	53	70	30

Table 2. Saliva secretion measurements:

Serial no.	Sex	Age	Side	Duct status	Saxon's 1 – Right side (mg)	Saxon's 1 – Left side (mg)	Saxon's 2 – Right side (mg)	Saxon's 2 – Left side (mg)
1	Male	22	R	Pre-served	15	110	5	41
2	Female	38	L	Pre-served	200	152	Not done	Not done
3	Female	84	L	Ligated	156	946	22	11
4	Male	49	L	Ligated	71	2	109	27
5	Male	15	L	Pre-served	132	85	194	157
6	Male	18	R	Pre-served	26	51	29	59
7	Male	36	R	Pre-served	19	255	28	61
8	Male	45	R	Pre-served	15	78	35	94
9	Female	40	L	Pre-served	155	32	184	114
10	Male	51	R	Pre-served	44	48	22	32
11	Male	39	R	Not Known	12	59	18	32
12	Female	38	L	Pre-served	67	28	52	16
13	Female	27	R	Not Known	210	114	90	102
14	Male	58	L	Pre-served	194	117	114	28
15	Female	43	L	Pre-served	28	18	48	33
16	Female	24	L	Pre-served	88	18	356	296
17	Male	60	L	Pre-served	14	16	36	21
18	Female	41	R	Pre-served	22	28	34	202
19	Male	35	R	Pre-served	12	20	12	22
20	Male	28	L	Pre-served	28	25	45	16

The Table 1 shows the uptake function of the glands of 20 cases. The operated side uptake is written in red. In 16 patients there was decrease in the function by 10.68% in the second scan compared to the first one. In one case (no. 12) there was no change in the function. In 3 cases (no. 2, 5, 18) there was increase by 10% in the uptake function.

In 2 cases (no. 19, 20) the uptake function in the operated gland was more than the normal gland in the first scan with subsequent reversal in the second scan. In one case (no. 8) the second scan function was 0%. In the cases (no 3, 4) where duct was ligated there was more decrease in the uptake function than the others.

**Saliva secretion measurements:**

In Table 2 modified Saxon's test was done on the first scan day in all the 20 patients. In one case the second modified Saxon's test was not done as the scan was done in the native place. In case (no.3), the saliva weight was erroneously high due to practical difficulty, as she had no tooth leading to saliva contamination from the floor of the mouth. In 11 cases, there was actually increase in the saliva weight on the second measurement. In 5 cases (10, 12, 13, 14, 20), there was decrease in the saliva secreted. In one case (no. 19) there was no change in the weight.

From the above data percentage function and percentage saliva secretion was calculated for the operated gland compared to the non-operated gland. Only in 7 cases (35%) both scan and Saxon's test correlated with the same finding (either increase or decrease).

From the Scintigraphy, the percentage function of the deep lobe on the affected side was calculated with respect to the gland on the opposite side assuming that it was normal, as it was normal clinically. Then the percentage functions were compared between the first and second scans. Analysis showed that the mean percentage function in the first scan was 50.62% (Median – 37.94, Range – 9.89 to 112.77) and in the second scan was 36.99% (Median – 34.23, Range – 0 to 85.19). This shows that there is a statistically significant reduction in the percentage function between the first and second scans, but still functioning. ( $p = 0.017$ ), calculated using Wilcoxon on Signed Ranks test.

Comparison between the saliva secretion on the days of first and Second scans were also made. The mean secreted saliva weight was 120.32 mg (Median – 62.29, Range – 2.82 to 733.33), on the day of first scan. The mean secreted saliva weight was 92.4 mg (Median – 54.84, Range – 16.83 to 88.24), on the day of second scan. This decrease in the saliva secretion between the first and second tests, was not statistically significant, ( $p = 0.717$ ).

Comparison was also made in the percentage uptake function and percentage saliva secretion between the groups with the ducts preserved, ligated and status not known.

**Duct preserved group:**

There were 18 glands with ducts preserved. The mean percentage function in the first test was 49.27% (Median – 37.93, Range – 102.88) and in the second test was 35.87% (Median – 34.23, Range – 78.57). The mean secreted saliva weight was 99.54 mg (Median – 62.29, Range – 725.88), on the day of first scan. The mean secreted saliva weight was 102.42 mg (Median – 54.54, Range – 803.17), on the day of second scan.

**Duct ligated group:**

There were 2 glands with ducts ligated. The mean percentage function in the first test was 29.16% (Range – 8.33) and in the second test was 9.44% (Range – 8.37). The mean secreted saliva weight was 304.61 mg (Range – 603.5), on the day of first scan. The mean secreted saliva weight was 37.38 mg (Range – 25.23), on the day of second scan. Here the difference in the decrease appeared more when compared to the previous group.

**Duct status unknown:**

There were 2 glands with ducts status unknown. The mean percentage function in the first test was 84.24% (Range – 23.66) and in the second test was 74.55% (Range – 21.25). The mean secreted saliva weight was 102.27 mg (Range –

163.87), on the day of first scan. The mean secreted saliva weight was 72.24 mg (Range – 31.99), on the day of second scan. Here also there was a decreasing trend.

The significance of the difference in the variables between the

above mentioned three groups was calculated by the Mann-Whitney Test which showed that there was no statistical significance among

The groups with the duct preserved, ligated and status not known in both uptake function as well as saliva secretion.

Comparison was done between the uptake function and the saliva secretion in the non-operated gland. There is increase in the uptake function from 69% to 75.36%. The significance of the increase in the uptake function was calculated by Wilcoxon on Signed Rank test, which showed a 'p' value of 0.01. Thus there is significant compensatory increase in the non – operated glands. The increase in the saliva secretion was from 90.05 mg to 93.1 mg.

Wilcoxon on Signed Rank test showed,  $p = 0.507$  which is not statistically significant.

**Discussion**

Parotid tumors' usually occur in adults with a slight female predominance. The benign tumors occur in fifth to seventh decades of life. In our study also the male: female ratio was 2:3 and the mean age was 40 Years 1. The incidence of pleomorphic adenoma is 50%, which in this study is 68%. The incidence of muco-epidermoid carcinoma is 15%, in our study is 9%. The incidence of basal cell adenoma is 5 – 10%; in our study is 4.5%

The embryology and anatomy describes the duct to be medial to the facial nerve in majority of the cases<sup>2-7, 15-24, 31</sup>. In the article by Zhao k et al, 91.6% of the ducts were medial to the facial nerve<sup>8</sup>. But the location of the remaining 8.6% of the ducts was not known. Similarly in this study also 90% of the ducts were identified medial to the facial nerve, but the duct status in 2 cases (10%) was not known. The duct might be lateral to the facial nerve or there may be multiple branching pattern of the duct which needs to be studied further

There has been variations in the parasympathetic innervations of the gland<sup>25-28</sup> and hence the physiology in humans as well as in animals<sup>29, 30, 32-34</sup>. The auriculo-temporal nerve also varies in its course<sup>12</sup>

In the study done in rats by Zheng G et al, there was initial decrease and then there was increase in the gland function after 6 weeks of superficial parotidectomy ( $p < 0.05$ )<sup>9</sup>. In this study also there was a decrease in the gland function after 6 weeks by 13.7% ( $p = 0.017$ ), this was statistically significant.

In the trial by Funds Masayuki et al, there was atrophy of the gland after duct ligation in 4 weeks time<sup>10</sup>. In the article by Burford Mason et al, there was initial decrease with ligation of the duct and then regeneration and regaining of function on removing the ligature<sup>11</sup>. The weight of the gland reduced by 50% at 7 days and the acinar cells decreased from 93.8% to 8.2%. Once the clamp was released there was 38.7 fold regeneration. In our study also there was profound decrease in function from 29% to 9% of the glands with their ducts ligated as compared to the others

with preserved ducts which showed decrease from 49% to 35% demonstrating the same. In our study the duct was permanently ligated, hence no further imaging could be done with removal of ligature to assess the regenerating potential. This shows that the gland continues to function if the duct is preserved. In one of our cases the duct was preserved and the function was still low. This could be that the main duct might be arising by more than one branch duct pattern (2 branch patterns) and therefore the duct from the deep lobe might have been ligated and the others preserved<sup>12</sup>.

The article by Gavrieta.al there was compensatory increase in the function of the non-operated glands observed in 6 patients, nearly half (34%) of the decline in the operated gland (75%)<sup>13</sup>. In 7 patients there was no affect. In our study the compensatory increase was seen in 16 non-operated glands by 7.05%. There was compensatory increase in 3 operated glands by 10%. There was no compensatory increase or decrease in both operated and non-operated glands in 1 patient.

the clinical trial by Judith et al, there was recovery of function of the glands in Scintigraphy after 1 year, which was a human trial<sup>14</sup>. In our study the second scans were done around 6 weeks post surgery. There may be increase suggestive of regeneration in our study also if another assessment is done at one year. One of the patients had the second scan after 269 days which still showed decrease in the function. The biopsy of that case was chronic parotitis.

The following limitations were encountered, while doing the clinical test. In the elderly the measurement was technically difficult as there was loss of tooth, there was saliva mixing from the floor of mouth. The composition of the saliva secreted was not studied which could also affect the flow rates.

While doing scan. Pre – operative function is not assessed, since tumors will interfere with the Tc99m radioisotope uptake Volume of the glands on the subsequent scans could not be assessed due to technical reasons. There was compensatory increase in the uptake function of the opposite gland which may indicate hyperfunctioning, thus taking up the radioisotope more than the affected side. The range of the uptake function was wide. A few scans were not done on the exact dates as the patients were from distant places. The duct pattern was not assessed.

### Conclusions

The deep lobe of the parotid gland has significant decrease in function at six weeks following superficial parotidectomy but there is no atrophy, disproving the hypothesis. There is significant decrease in the function if duct is ligated. Long term assessment may be required to show whether there is regeneration of the remnant gland or if it remains the same.

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