



## SPEECH QUALITY AFTER GLOSSECTOMY

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### Summary

This study is an attempt to assess speech disability following glossectomy and primary reconstruction in patients with locally advanced carcinoma tongue. Twenty nine patients who underwent glossectomy involving removal of 50% or more of the tongue followed by reconstruction were assessed using screening articulation tests, standardized passages, word lists and conversation samples in Kannada and Malayalam languages. Objective quantification of speech was carried out by assessing the two psychoacoustic parameters, intelligibility and acceptability of speech. Intelligibility was calculated in percentage as the number of words intelligible to the listener from a prepared word list. Acceptability was rated on a one to five scale by the speech pathologists. This study revealed that intelligibility and acceptability were not always directly proportional to the amount of tongue removed. The other factors found to influence the intelligibility were preservation of the mandible and timing of radiotherapy in relation to surgery. This score gives us an objective index to assess the functional outcome of surgery.

*Key Words: Intelligibility, Acceptability, Speech Assessment, Glossectomy*

### Introduction

Any form of glossectomy involves disturbances in speech. Glossectomy disrupts muscular support for the tongue, brings out major changes in articulatory aerodynamics and produces alterations in vocal tract morphology. For proper rehabilitation of patients undergoing glossectomy for carcinoma of the tongue, it is essential that we try and objectively quantify the speech disability following surgery. This will help us in evaluating both our surgical results and post surgical rehabilitation programmes. In this study we have made an attempt to quantify this disability in our patient population using the speech assessment procedures in the local languages here and tried to find the factors affecting speech following reconstruction for carcinoma tongue.

### Methods

Twenty nine patients who underwent glossectomy involving 50% or more of tongue removal were assessed postoperatively (Table 1-5). The amount of tongue resected was quantified in each case. The anterior two thirds of the tongue was taken as 70 percentage and the posterior one thirds as 30 percentage. Of the 29 patients, 25 patients had radiotherapy. (pre-operative 20, postoperative 5). The dosage of radiotherapy is shown in tables 1,2,3&5. The most commonly used dose schedule was 60 gray in 30 fractions. Four patients were not irradiated following surgery. A hemi mandibulectomy along with the existing primary lesion was done in 25 patients. In the remaining four patients the mandible was preserved (Table 5). All patients had a primary recon-

Table 1. RT followed by Surgery (Group-I patients)

Case No.	Age	Sex	RT Dose	Surgery	Duration after RT (months)	Tracheostomy	Time of evaluation (weeks)	Intelligibility Score (%)	Acceptability Score
1	35	F	60Gr/30Fr	S1a	4	No	4	17	1
2	55	F	60Gr/28Fr	S1a	6	No	4	20	1
3	38	F	60Gr/30Fr	S1a	24	Yes	4	25	3
4	60	M	70Gr/35Fr	S1a	5	Yes	20	32	1
5	49	M	60Gr/30Fr	S1a	9	Yes	28	65	3

S1a = Total glossectomy with excision of floor of mouth, partial pharyngectomy, hemi mandibulectomy and PMMC Flap reconstruction

Table 2. RT followed by Surgery (Group-II patients)

Case No.	Age	Sex	RT Dose	Surgery	Duration after RT (months)	Time of evaluation (week)	Intelligibility Score (%)	Acceptability Score
6	50	F	50Gr/25Fr	S2b	3	8	62	3
7	29	M	60Gr/30Fr	S2a	9	2	44	2
8	6	M	55Gr/28Fr	S3a	4	4	33	2
9	43	M	40Gr/20Fr	S3a	10	4	35	2
10	56	F	60Gr/30Fr	S3a	3	4	24	2
11	46	M	65Gr/28Fr	S3a	5	8	91	4
12	47	M	60Gr/30Fr	S3b	11	48	50	2
13	56	F	60Gr/30Fr	S3a	3	8	82	3
14	58	M	60Gr/30Fr	S4a	12	24	85	4
15	47	F	60Gr/30Fr	S4b	9	8	98	4
16	50	M	60Gr/30Fr	S4a	13	16	85	3
17	42	M	50Gr/16Fr	S4a	5	4	94	3

S2a = Near total glossectomy (71-90%) with resection of floor of mouth, hemi mandibulectomy and PMMC Flap reconstruction

S2b = Near total glossectomy (71-90%) with resection of floor of mouth, hemi mandibulectomy and LDMC Flap reconstruction

S3a = Sub total glossectomy (61-70%) with resection of floor of mouth, hemi mandibulectomy and PMMC Flap reconstruction

S3b = Sub total glossectomy (61-70%) with resection of floor of mouth, hemi mandibulectomy and LDMC Flap reconstruction

S4a = Hemi glossectomy (approximately 50-60%) with hemi mandibulectomy and PMMC Flap reconstruction

S4b = Hemi glossectomy (approximately 50-60%) with hemi mandibulectomy and LDMC Flap reconstruction

Table 3. Surgery followed by RT (Group-IIIa patients)

Case No.	Age	Sex	Surgery	RT Dose	Time of evaluation (week)	Intelligibility Score (%)	Acceptability Score
18	45	M	S2a	60Gr/30Fr	2	54	3
19	38	M	S2a	60Gr/30Fr	2	20	2
20	42	M	S3a	60Gr/30Fr	14	11	1
21	55	F	S4a	60Gr/30Fr	28	49	2

S2a = Near total glossectomy (71-90%) with resection of floor of mouth, hemi mandibulectomy and PMMC Flap reconstruction

S3a = Sub total glossectomy (61%-70%) with resection of floor of mouth, hemi mandibulectomy and PMMC Flap reconstruction

S4a = Hemi glossectomy (50-60%) with hemi mandibulectomy and PMMC Flap reconstruction

Table 4. Surgery Only (Group-IIIb patients)

Case No.	Age	Sex	Surgery	Time of evaluation (week)	Intelligibility Score (%)	Acceptability Score
22	64	M	S3a	10	80	2
23	42	M	S3a	2	22	2
24	55	M	S3a	3	80	3
25	44	M	S3a	4	38	2

S3a = Sub total glossectomy (61-70%) with resection of floor of mouth, hemi mandibulectomy and PMMC Flap reconstruction

Table 5. Mandible Preserving Surgery (Group-IV patients)

Case No.	Age	Sex	Extent of tongue removed(%)	RT Dose	Flap used	Time of evaluation (week)	Intelligibility Score (%)	Acceptability Score
26	42	M	90	60Gy/30Fr	PMMC	2	72	2
27	36	F	60	50Gr/25Fr	Trapezius	12	95	4
28	62	F	50	-	Platysma	4	90	4
29	61	F	50	60Gy/30Fr	Naso Labial	12	100	4

struction of the tongue using a myocutaneous flaps. Pectoralis major myocutaneous (PMMC) flap was used for reconstruction in 23 patients, latissimus dorsi myocutaneous (LDMC) flap in 3, and platysma myocutaneous flap, trapezius myocutaneous flap and bilateral nasolabial skin flap in one patient each.

Speech was assessed in the post-operative period after complete wound healing. The time of evaluation ranged from 2 weeks to 48 weeks with 19 patients having their evaluation within 8 weeks of surgery. The delay in assessment in remaining 10 patients was either due to presence of tracheostomy ( 2 patients ) or post operative complications like stroke (1 patient) or presence of delayed wound healing with or without oro-cutaneous fistula (7 patients ).The first group of patients (Table 1) had a total glossectomy with hemi mandibulectomy, excision of the floor of the mouth and part of the pharyngeal wall followed by reconstruction. Three patients in this group had a temporary tracheostomy. The second group patients (Table 2) had a near total glossectomy (more than 71% tongue removed), subtotal glossectomy (61-70% tongue removed) or hemi glossectomy (50-60% tongue removed) along with hemi mandibulectomy and reconstruction. The group-IIIa patients (Table 3) had surgery followed by radiotherapy. The group-IIIb patients (Table 4) had surgery alone. The group-IV patients had also surgery alone but mandible was preserved in all the patients of this group.

There was no anatomical or functional disintegrity in any of the other speech producing organs in the cases under study. Speech assessment was carried out in 29 patients. The phonation and resonance were assessed subjectively by listening to the voice / speech sample. They had no other speech problems.

Objective quantification of speech was carried out by assessing the intelligibility and acceptability. Intelligibility (%) is defined as the number of words intelligible to the listener;

The patients were instructed to read the word

$$\text{Intelligibility (\%)} = \frac{\text{Number of words identified} \times 100}{\text{Total number of words}}$$

list (Kannada/ Malayalam) comprising of fifty words at their comfortable loudness and rate. The word list is chosen in such a way that they include all types of sound in their own languages. Two experienced speech pathologists analysed the speech. They were instructed to "write down the words as they hear them". The intelligibility score was computed as percentage using the formula mentioned above. Average of intelligibility scores provided by the two speech pathologists was considered as the intelligibility score for each subject.

Two speech pathologists were asked to rate the acceptability using a one to five point scale where one represents the least acceptable and five the most acceptable. Acceptability was assessed using standardized passages (in Kannada & Malayalam ) and conversational speech sample. The standardized passages in Kannada and Malayalam were developed and is routinely used in the Speech Sciences Department of All India Institute of Speech and Hearing, Mysore, India for speech evaluation.

## Results

The phonation and resonance of all 29 patients were found to be normal. Articulation of speech sounds consequent to glossectomy was found to be severely impaired in all the 29 patients. Distortion was the prominent articulatory error noticed. In group-I patients with a total glossectomy with hemi mandibulectomy and partial pharyngectomy (Table 1) the intelligibility score ranged from a lowest of 17 to a highest of 65. Four of these 5 patients had an intelligibility score below 40 (the minimum score required for speech to be legible).The acceptability score was not always directly proportional to the intelligibility.

In the second group of twelve patients (Table 2) who had initial radiotherapy followed by surgery involving removal of tongue ranging from 50% to 90% with hemi mandibulectomy, the intelligibility ranged from 24 to 98 with only 3 out of the 12 patients having a score below 40. The acceptability scores in this group were fairly proportional to the intelligibility score though not directly proportional to the amount of tongue removed.

The scores in the third group comprising of four patients (Table 3) who had surgery followed by RT (group-IIIa) were much lower.

Out of four patients in the surgery alone group (group-IIIb) two had intelligibility scores of 80 but the remaining two had low scores (Table 4). Of the four patients in the mandible preservation group (group-IV) three had intelligibility score more than 90 and acceptability score more than 4 (Table 5).

## Discussion

Intelligibility reflects the overall ability of the individual to produce and use articulatory patterns effectively in such a way that they are understood as speech<sup>1</sup>. In order for speech to be understood, a listener must be able to understand atleast 40% of the words spoken<sup>2</sup>. Sixty-two percent of the patients in this group had an intelligibility above 40%. This includes one patient with 100% and four with 90% tongue removed. Many authors have shown a direct relation between amount of tissue of the tongue removed and its effect on speech articulation and intelligibility<sup>3-6</sup>. However, in this study intelligibility was not directly proportional to the amount of tongue removed and also the acceptability was not always directly proportional to the intelligibility. The use of a myocutaneous flap seems to have contributed to the reasonably good intelligibility scores even in patients who had near total glossectomy with hemimandibulectomy. This observation is consistent with other studies<sup>7</sup>. Two other factors which affected speech intelligibility in this study was the timing of radiation in relation to surgery and preservation of the mandible. This may be due to the increased fibrosis caused by post-operative radiotherapy in the remaining muscles and soft tissues of the tongue and floor of mouth. Similarly preservation of the mandible improved the intelligibility scores greatly.

## Conclusion

A number of factors affect speech following glossectomy. These include amount of resection, concomitant removal of the mandible, associated tracheostomy, pre- or post-operative radiotherapy, wound healing, time and type of reconstruction, motivation and age of the patient, and anatomical and functional integrity of the remaining speech mechanisms. Assessment of the role of these factors individually was not possible during the present study, but by using the intelligibility and acceptability scores, we have a score against which the

patient can be assessed as regards functional outcome of the surgery. The scores can also be used as a motivating factor to help the patient participate more actively in the rehabilitation programme.

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