Evaluation of Speech Intelligibility And Factors Influencing Its Outcome in Patients with Tongue Reconstruction Using Radial Forearm Free Flap

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ABSTRACT

Objective: To study the speech outcomes in patients undergoing tongue reconstruction after tumour resection in terms of intelligibility and to examine the factors influencing the outcome.

Study Design: Prospective observational study.

Place and Duration of Study: Department of Plastic Surgery, Shifa International Hospital, Islamabad, Jan 2015 to Jan 2020.

Methodology: A total of 109 patients diagnosed with tongue cancer meeting the inclusion criteria were included in the study. All the participants underwent tumor resection followed by adjuvant radiotherapy (unless refused by the patients). Patients were followed for six months and then underwent speech evaluation via the Functional Intra-oral Glasgow Scale score and Likert scale.

Results: Thirty (27.5%) patients could be clearly understood at all the times, while 27 (24.8%) and 42 (38.5%) required some and frequent repetition, respectively. Nine (8.3%) patients could only be understood by close relations and one patient was completely unintelligible. Advancing age (p=0.01), male gender (p=0.01), tumour stage (p=0.004), presence of comorbidities (p=0.004) and degree of resection (p=0.004) had a significant statistical relationship with speech outcome. Addiction (p=0.32), adjuvant radiotherapy (p=0.97) and the development of complications (p=0.59) had no effect on speech.

Conclusion: The provision of a mobile reconstructed tongue gives speech intelligibility in a majority of the patients however, the degree of speech recovery is directly dependent on advanced age, disease stage, the presence of comorbidities and degree of resection.

Keywords: Functional intraoral glasgow scale (FIGS), Speech intelligibility, Tongue reconstruction.

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INTRODUCTION

Malignancies of the oral cavity account for 12.5% of all the cancers of the human body. Disease of the anterior and base of the tongue accounting for 22.5% and 10.9% of these cases, respectively.[1] The primary aim of treatment is to reduce mortality and the treatment of choice is resection of the lesion with a wide margin to remove the entire tumour and achieve microscopic clearance as well.[2] The tongue has an important role in gustation, deglutition, mastication and phonation. Its resection can result in the partial or total loss of important functions.[3]

Although, no method of repair can possibly mimic the exact range and complexity of motion of the native tongue due to its muscular anatomy and innervation, microsurgery has provided the necessary knowledge to effect the free tissue transfer which results in improved results in terms of appropriate tissue bulk, flap inset versatility without tissue tethers and composite tissue replacement.[4,5] Tongue reconstruction is one of the many surgical procedures that benefits from microsurgery and the radial forearm flap is a useful option for free tissue transfer for this procedure.[5] However, it is not without complications; difficulty in speech, chewing, swallowing and pain are just some of the possible complications and effect quality of life adversely.[6] A tongue which can maintain its shape and position while retaining the maximum possible flexibility and motion is paramount to produce clear speech.[7]

Unfortunately, the various methods used to assess the functional outcome for speech post-surgery, are either difficult to implement e.g. transcript scoring or largely subjective e.g. Likert scales.[8] Furthermore, some studies have demonstrated a poor outcome for speech with free flap repair as compared to other modalities, while still others have demonstrated potentially controllable factors that have a great impact on speech outcomes such as gender, the presence of comorbidities and substance abuse.[9,10]

Speech is the primary mode of communication, particularly in the societies with high levels of illiteracy where alternate modes of communication such as writing are not well adapted. For such patients,

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objective assessment of speech post reconstruction is of paramount importance. As in such patients, speech becomes the only mode to socialize and integrate back in the society without having to feel the loss of an important body organ. Moreover understanding the effects of various pre-surgical reconstruction modifiers requires a standardized measure by which to evaluate their outcome. This study was conducted to contribute to the existing knowledge regarding the validity and objectivity of Functional Intraoral Glasgow Scale (FIGS), as well as to identify factors effecting speech negatively, so that these factors, if possible, should be mitigated in future, for better speech outcome.

METHODOLOGY

We conducted a prospective observational study from January 2015 to January 2020 in the Department of Plastic Surgery, Shifa International Hospital, Islamabad on 109 patients diagnosed with a biopsy-proven malignancy of the tongue, chosen via non-probability consecutive sampling. The sample size was calculated using the WHO sample size calculator keeping a confidence level of 95%, an absolute precision of 0.09 and an anticipated population proportion of 0.318.[11]

Inclusion Criteria: Patients between the age of 20-85 years, with ASA class I to III, who had tumor stage T2 disease or higher (T3 or T4 disease, or their variants) were included.

Exclusion Criteria: Patients with previous speech or mental disabilities, recurrent tumours, metastatic disease or with primary closure were excluded.

A questionnaire was filled out by each patient on the first clinical visit to collect demographic data, presence of co-morbid conditions and history of addiction. The clinical stage of disease just before surgery was also documented. This was followed by excision of tumor and margin as required (Figure-1A-1D). The degree of surgery was categorized as partial, hemi, or sub-total glossectomy, which was followed by radial forearm free flap reconstruction during the same procedure. All the patients received radiotherapy unless it was contraindicated, refused by the patient or death before initiation occurred. All the patients were followed up for 6 months, at that point they underwent evaluation of speech.

Patients evaluated their own speech using the Functional Intraoral Glasgow Scale (FIGS) for speech self-questionnaire, which has 5-points with higher values indicating good speech at 6 months (Table-I). A 5-point Likert scale (1=poor, 2=bad, 3=satisfactory, 4= good, 5=excellent) was applied to each patient by a team composed of one plastic surgeon, one speech therapist and one relative of the patient for intelligibility with each score being either unanimous or rounded to the lowest score suggested by all the scorers if there was disagreement. All the patients were asked to read a phonetically balanced text paragraph and they were scored according to their performance.

Data was analyzed using Statistical Package for

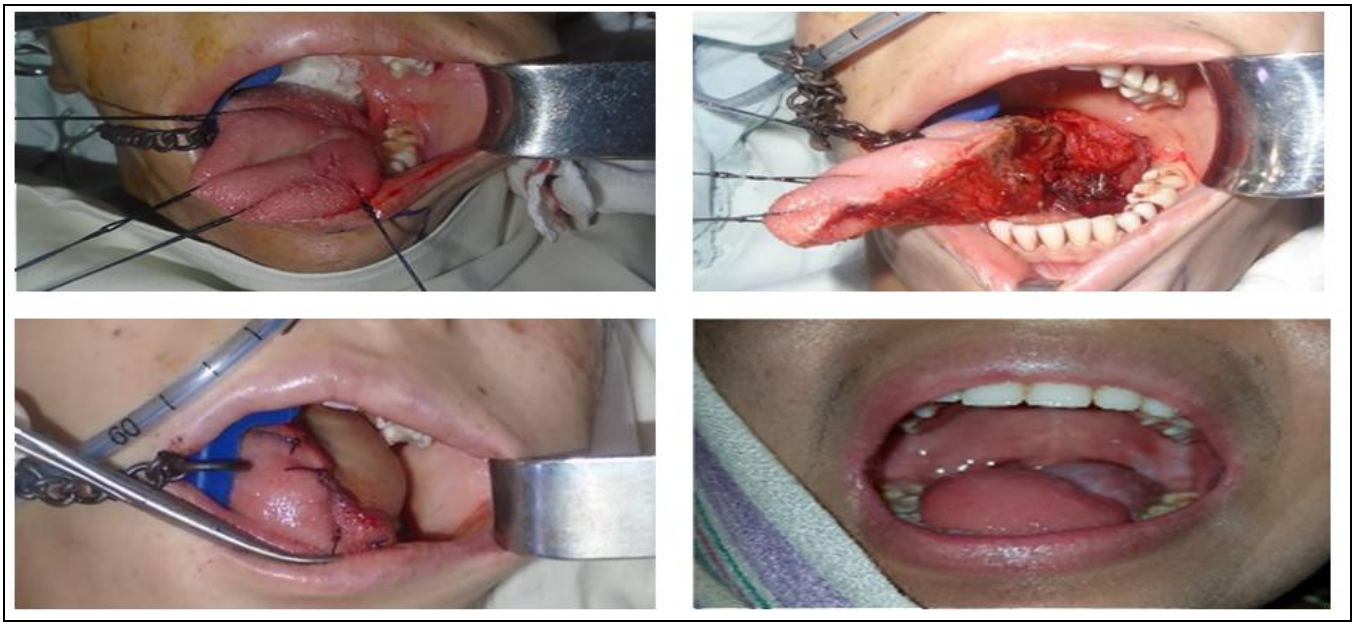

Figure-1A-1D: SCC left lateral border of tongue (Intra-operative view), Defect size after resection, Reconstructed tongue with radial forearm free flap, Follow-up of reconstructed tongue.

Social Sciences (SPSS) version 26. Mean and SD were calculated for quantitative variables like age, FIGS score and Likert score. Qualitative variables like gender, comorbidities, addiction, tumor staging, degree of resection, radiation treatment and complications of surgery were summarized in terms of frequency and percentage. Chi square test was applied for comparison. The *p*-value of ≤0.05 was considered significant.

RESULTS

A total of 109 patients were studied. The mean age of the sample was 56.53 ± 13.79 years. Results for pre-surgery evaluation and comparison with FIGS for statistical significance were shown in Table-II. A higher tumor stage had a statistical association with a poor speech outcome (p=0.004). Additionally, speech in patients with one or more comorbidities was also associated with a poor outcome (p=0.004). Conversely, substance addiction/abuse was not associated with any effect on the speech outcome.

Table-I: Functional intraoral glasgow scale for speech.

Characteristic	Score
Unintelligible	1
Speech only understood by relative	2
Requires multiple repetitions to be understood	3
Requires only minimal repetitions to be understood	4
Clear speech	5

Table-II: Pre-Surgery patient characteristics; comparison with functional intraoral glasgow scale for speech.

Variables	Male	Female	*p*-value
Age (years)	57.80 ± 14.47	54.73 ± 12.72	0.01
Tumor Stage			
T2M0N0	28 (25.7%)	25 (22.9%)	0.004
T3N0M0/T1-T3M1N0	26 (23.9)%	12 (11.0%)	
T4aN0-1M0/T1-4aN2M0	10 (9.2%)	8 (7.3%)	
Comorbidities			
Diabetes Mellitus	7 (6.5%)	8 (7.3%)	0.004
Hypertension	12 (10.9%)	7 (6.5%)	
Diabetes/Hypertension	23 (21.0%)	7 (6.5%)	
Other	6 (5.4%)	7 (6.5%)	
None	16 (14.7%)	16 (14.7%)	
Substance Addiction			
Smoking	30 (27.5%)	11 (10.1%)	0.32
Betel Chewing	2 (1.8%)	12 (11.0%)	
Tobacco Snuff	8 (7.3%)	5 (5.5%)	
Alcohol	7 (6.5%)	2 (1.8%)	
Multiple Addictions	11 (10.1%)	2 (1.8%)	
None	6 (5.4%)	13 (12.0)	

The degree of resection was inversely proportional to good speech outcomes (p=0.004). No significant relationship was seen between use of adjuvant radiotherapy, the development of complications and speech outcome. Results for post-surgery evaluation and comparison with FIGS were shown in Table-III.

Table-III: Post-Surgery patient characteristics; comparison with functional intraoral glasgow scale for speech.

Variables	Male	Female	*p*-value
Degree of Resection			
Partial Glossectomy	18 (16.6%)	14 (12.8%)	0.004
Hemi- Glossectomy	31 (28.4%)	20 (18.4%)	
Sub-Total Glossectomy	15 (13.8%)	11 (10.1%)	
Adjuvant Radiotherapy			
Yes	61 (55.9%)	44 (40.4)	0.97
No	3 (2.8%)	1 (0.9%)	
Complications			
None	53 (48.7%)	43 (39.4%)	0.29
Haematomas	7 (6.5%)	1 (0.9%)	
Partial Flap Failure	1 (0.9%)	0 (0%)	
Flap Exploration	2 (1.8%)	0 (0%)	
Wound Dehiscence	2 (1.8%)	0 (0%)	

Patients were scored according the FIGS score in which one patient was unintelligible, 9 (8.3%) patients could only be understood by relatives, 42 (38.5%) required repetition many times to be understood, 27 (24.8%) required repetition sometimes, while 30 (27.5%) patients could be clearly understood at all the time. In addition, patients' speech was scored according to a Likert scale which showed 8 (7.3%) patients were scored as poor, 20 (18.3%) were scored bad, 40 (36.7%) had satisfactory speech, 41 (37.6%) were scored good, and 41 (37.6%) patients received an excellent score. The Likert scale was compared to FIGS and it showed statistical significance (p<0.001).

DISCUSSION

The majority of the patients in our study were male (64, 58.7%). This result was consistent with Nguyen *et al*, Windrich *et al*, and Molina *et al*. Their studies showed a male preponderance of 25 (83.33%), 33 (71.74%) and 17 (85%), respectively.[12-14] These results are due to the fact that tongue malignancies are more common in males than in females. The mean age of the patients in our study was 56.53 ± 13.79 years. Longo *et al*, showed a similarly aged population of 55.39 ± 6.27 years and Sun *et al*, who studied a population of 55.29 ± 15.01 years.[15,16] Conversely, Engel *et al*, studied a population that was slightly younger (49 ± 11 years).[17] The earlier presentation in the latter study

might be due to the increased volume of alcohol consumption prevalent in Western and Far-Eastern populations as opposed to Middle-Eastern and Sub-continental population.

In our study, 30 (27.5%) patients had excellent speech, 27 (24.8%) and 42 (38.5%) required minimal or persistent repetition to be understood, respectively, 9 (8.3%) were only understood by relatives and one patient was unintelligible. Nicoletti *et al*, reported on a study sample of 196 cases, 101 (51.53%) were always understandable, 75 (38.26%) needed occasional repetition to be understood, 18 (9.18%) needed multiple repetitions to be understood, 2 (1.02%) patients could only be understood by relatives, while none were incomprehensible.[11] While we only used the radial forearm free flap in all our patients, Nicoletti *et al*, used a wider variety of sources for their flaps which might account for the difference between the two studies. Engel *et al*, reported results similar to ours; 13 (39.4%) patients achieved normal speech, 9 (27.3%) required some degree of repetition while 11 (33.3%) required frequent repetition.[17]

We found that advanced stage of the disease resulted in poor speech outcome scores, with 53 (48.6%) showing low-grade disease, 38 (34.9%) with intermediate disease, and 18 (16.5%) with advanced disease. Ellaban *et al*, reported 28 (45.2 %) patients with T1 disease, 15 (24.2 %) with T2 disease, and 9 (30.6 %) patients with T4 disease, with higher grades showing the worst FIGS scores, and statistically significant relationship (p<0.001).[18] Advanced stages resulted in requirement for larger resections, which in turn led to poorer speech outcomes.[18] Nicoletti *et al*, also reported a statistically significant relationship between the size of resection and FIGS (p< 0.001).[11] Longo *et al*, showed the relationship between speech intelligibility and degree tongue resection was not significant, (p=0.286), with 6 (46.2%) patients only needing occasional repetitions and 7 (53.8%) patients having normal speech.[15] This difference might be due to the two reasons, the sample size in the study by Longo *et al*, was small and the patients in that study underwent either sub-total or total glossectomy, resulting in a non-significant relation.

Our study showed no statistical difference in speech outcomes between patients who received radiotherapy versus those who did not (p=0.97). However, Nicoletti *et al*, reported a statistically significant difference between FIGS and patients receiving radiotherapy i.e. those who received radiotherapy had poorer speech outcomes (p= 0.013).[11] This difference might be due to the fact that the vast majority (96.3%) of our sample received radiotherapy post-surgery, while it was given in only a minority of cases in a study by Nicoletti *et al*.

Our study showed that alcohol and tobacco consumption did not have a statistically significant relationship with worse speech outcomes (p=0.32), possibly due to the lower levels of substance use in our study sample with only 55 (50.4%) and 9 (8.3%) patients consuming tobacco and alcohol, respectively. While Ellaban *et al*, showed significant alcohol consumption in 56 (90.3 %) patients and tobacco use in 56 (90.3 %) patients.[18]

Due to its thin and pliable nature radial forearm free flap works well in obliteration of dead space, reconstruction of a mobile tongue that helps in achieving intelligible speech and is largely free of complications. It is pertinent to know the detailed medical history especially of substance abuse and associated co-morbid as both can compromise functional outcomes. Because of the intricate anatomy and 3D structure of the tongue, its reconstruction poses a challenge to the reconstructive surgeon. Radial free flap repair is quickly gaining popularity in recent times but in developing countries like Pakistan, the requisite skill is not readily available everywhere.

LIMITATIONS OF STUDY

Our study had a follow-up period of six months, which only looked at short-term functional outcomes and complications. Further research is required to rule out outcome instability, long-term complications and psychological effects related to this surgery.

CONCLUSION

The provision of a mobile reconstructed tongue gives speech intelligibility in a majority of the patients however; the degree of speech recovery is directly dependent on advanced age, disease stage, the presence of comorbidities and degree of resection.

Conflict of Interest: None.

Authors' Contribution

SM: Conception & Design ot the study, data collection analysis & interpretation writing the article, SURS: Critical revision of the article, MR: Final approval of the article to be published, MIK: Critical revision of the article, MMQ: Data analysis and Interpretation, HK: Data collection.

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