Original Article - Prospective Study

Assessment of Speech in Patients Undergoing Hemiglossectomy with Primary Closure and Radiotherapy - A Prospective Study

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Abstract

Introduction: The oral cavity plays a pivotal role in the generation of speech. The treatment of oral squamous cell carcinoma of the tongue requires an aggressive approach, combining resective surgery along with radiation therapy, with long-lasting effects on the patient's ability to speak. This study was designed to assess speech in subjects with carcinoma of the tongue following hemiglossectomy with primary closure and radiotherapy. **Methods:** A prospective study was carried out in 20 subjects who underwent hemiglossectomy with primary closure for carcinoma of the tongue followed by radiotherapy. All subjects were evaluated for speech using 'Kannada Diagnostic Photo Articulation Test' before surgery, after surgery (on the 10th and 30th day), during radiation therapy after 15 fractions of radiation and after 1, 2 and 3 months following completion of radiotherapy. Statistical analysis was performed using SPSS software (v. 17.0). Significance levels were determined using ANOVA followed by Bonferroni correction. **Results:** Intelligibility of speech was noted to be affected most at the one month follow-up visit after completion of radiotherapy ($P < 0.001$). The Kannada Diagnostic Photo Articulation Test proves to be a useful tool in assessing changes in speech, with results that can be replicated in further studies. **Discussion:** The incidence of articulatory errors is increased following surgery and radiotherapy. Over time, the number of errors reduce and approach the baseline, indicating that although speech is indeed hampered by the treatment, with adequate speech therapy one can regain their preoperative articulation.

Keywords: Glossectomy, mouth neoplasms, radiotherapy, speech

Introduction

Neoplastic transformation and subsequent invasion of healthy tissue seen in the structures that form and surround the human mouth have disastrous consequences on the lives of patients. The treatment, by its aggressive nature and inability to guarantee a cure, has long-lasting implications for those who suffer from oral squamous cell carcinoma (OSCC).[1]

The human tongue is considered the prime target in about 35% of the population, and the management of lesions at this site is almost entirely carried out by surgical intervention and/or radiotherapy. Resective surgery is mostly performed for cancerous lesions of the tongue, followed by either primary closure or reconstructive techniques. However, such procedures lend themselves to unavoidable and profound effects on how the patients perceive their lives.

The tongue in particular influences this particular function by redirection of the stream of breath when aiming to produce consonants, or by being raised/lowered for the purposes of vowel resonance.[2] The usually effortless and simple process of

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verbal communication is noticeably and distressingly hampered after such surgical intervention. The extent to which a disability is encountered rests in no small part on how much tissue was removed, and how the defects were closed or reconstructed.[2-4]

In light of this predictable and problematic outcome, this study was designed with the primary purpose of assessing the speech of patients who underwent surgical excision of the lesion and primary closure after being diagnosed with carcinoma of the human tongue.

Materials and Methods

Twenty patients who reported with carcinoma of the tongue to the Leela Narayan Shetty Memorial Cancer Institute, Justice K. S. Hegde Charitable Hospital, Mangaluru, and A. B. Shetty Memorial Institute of Dental Sciences, Mangaluru, between October 2019 and May 2021, who fulfilled the inclusion and exclusion criteria and who gave consent, were included in this prospective study. The study abides by the principles outlined in the Declaration of Helsinki and was carried out after obtaining clearance from the Institutional Ethical Committee (certificate number ABSM/EC 50/2019, dated 11 October 2019). The main objectives of the study were to assess and compare speech in these patients before and after the surgical intervention and to determine the changes in speech once the patients were subjected to radiotherapy. Patients with tongue carcinoma who required surgical excision not greater than hemiglossectomy with primary closure were included in the study. Patients having lesions with TNM grading of T1, T2 and any N were included and any lesion more than T3 was excluded from the study. Patients having neoplasms in other areas of the body, any lesion other than tongue lesion, any lesion which requires more than hemiglossectomy and edentulous patients were also excluded. After patient selection as per the criteria mentioned earlier, the demographic details of these patients were collected and required case history recorded. To determine the extent of tongue lesion, computed tomography was done to aid in treatment planning. For the speech sampling, each subject was made to sit comfortably on a chair inside a sound proof room. A microphone was kept at a distance of around 15 cm from the mouth of the subject so that the speech sample could be audio recorded. Once the patient was ready, the set of words in the Kannada Diagnostic Photo Articulation Test (KDPAT) were read out to them one by one and they were asked to repeat the same while being recorded. The speech was first assessed before surgery and then postoperatively on day 10 and day 30. After hemiglossectomy with primary closure, all patients were subjected to a course of radiotherapy as per our hospital protocol. The same dosage of radiation was used for all 20 patients, which was 60 Gy divided into 30 fractions over six weeks. Patients underwent assessment of speech during radiotherapy, after 15 fractions and after the 1st, 2nd and 3rd month following completion of radiotherapy. All subjects included in this study were Kannada speaking. The recorded data were evaluated using the "KDPAT" and assessed by a speech-language pathologist. This assessment was done based on the scoring system for KDPAT. The recorded samples were analysed for substitutions (S), omissions (O), distortions (D) and additional errors, and then scored.[5] The sample size was calculated using the formula, n ={ (Zα + Zβ) 2/C2 }+3 where C = 0.5 × ln (1 + r/1-r), r = correlation coefficient – 0.616. With 95% confidence level and 90% power sample size comes to be a minimum of 20.[6] Counts/percentages were used to present the qualitative data. Speech assessment scores were documented using mean and standard deviation. Multiple comparisons using ANOVA with Bonferroni correction were used to test the changes in scores before and after the surgery, and following radiotherapy.

Results

All 20 subjects who were included in this study were present at each stage. No patient withdrew from the study at any point and none of the patients were lost to follow-up. Six of the patients were below 50 years of age (30%) and 7 (35%) were above 60 years. It was found that 14 (70%) were male and the remaining 6 (30%) were female. The gender ratio of M:F was 7:3. Following the inclusion and exclusion criteria of the study, 20 subjects were clinically and radiologically assessed and selected for this study who underwent partial resection of the tongue with primary closure and then underwent radiotherapy. The subjects were assessed before surgery and at six follow-up intervals, one on post-operative day (POD) 10, one on POD 30, then during radiotherapy after 15 fractions of radiation and finally one, two and three months after the completion of radiotherapy. Speech assessment was done using standard articulation tests. Since all patients included were Kannada-speaking, the KDPAT was used to analyse speech recorded on all visits. The correct, distorted, substituted and omitted sounds were noted and scored individually based on KDPAT scores and then the total score was calculated. Mean of total score, D, S, O and correct responses of all the follow-up groups were compared by applying ANOVA (Fisher's *F* test) [Figures 1-5], and the Bonferroni *t*-test was applied for repeated measures for inter-comparison of mean total, mean D and mean correct responses recorded in every visit. Since there were no differences in different follow-up groups for S and O groups,

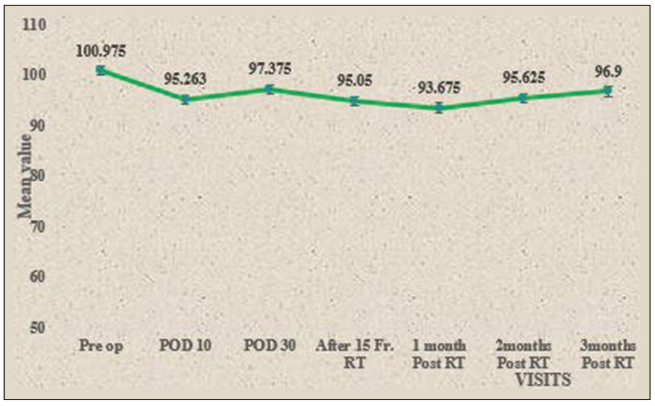

Figure 1: Comparison of total scores before & after surgery and after radiotherapy. Total scores were calculated for the patients before operation, after operation and after radiotherapy as mentioned in the study

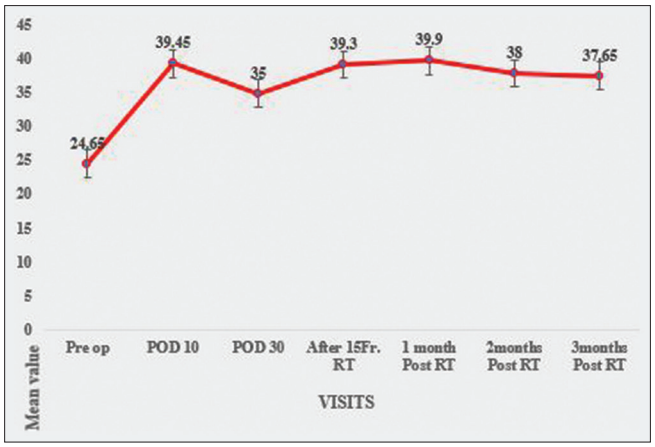

Figure 2: Comparison of scores of distortion before & after surgery and after radiotherapy

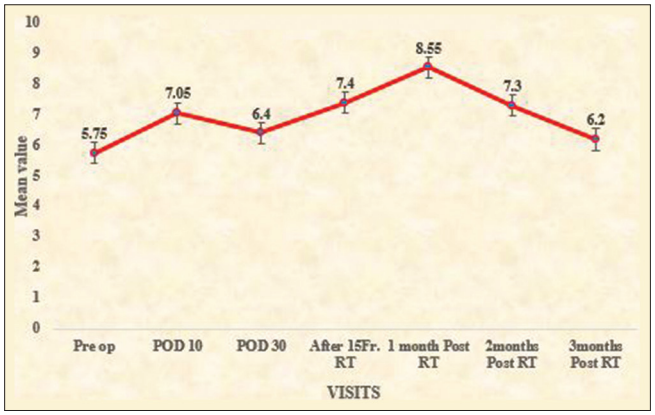

Figure 4: Comparison of scores for omission before & after surgery and after radiotherapy

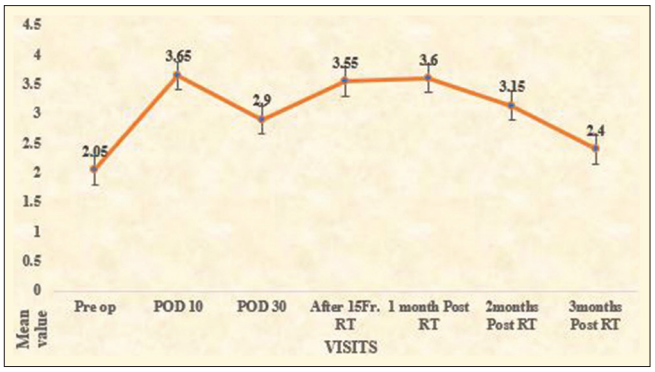

Figure 3: Comparison of scores of substitution before & after surgery and after radiotherapy

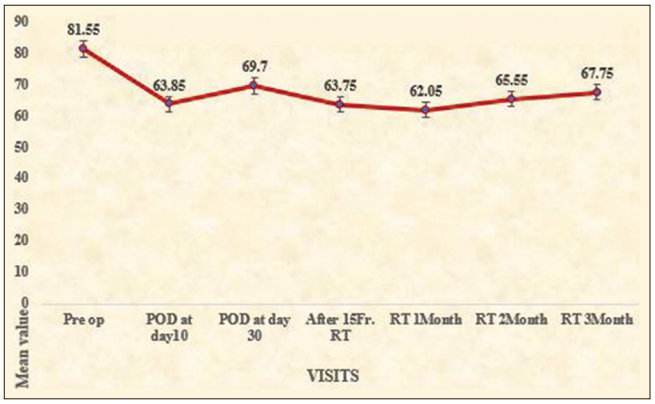

Figure 5: Comparison of scores for correct responses before & after surgery and after radiotherapy

inter-comparison was not done. The comparison of total scores, D and correct responses was found to be very highly significant with $P < 0.001$, whereas the comparison of S ($P = 0.202$) and O ($P = 0.079$) was considered insignificant. Intelligibility of speech was noted to be affected most at the one month follow-up visit after completion of radiotherapy ($P < 0.001$). When the recorded data were analysed, speech sounds that were affected most were the palatal, retroflex and high vowel sounds. In the manner of articulation, fricatives were affected more than the stops. Finally, on analysis of the scores based on the key provided in the test, results showed that distortions in speech sounds were the most in number, followed by the omission of sounds and finally substitutions. The distortions (D) increased significantly on POD 10, with a slight reduction during POD 30. Substitutions (S) and omissions (O) did not show significant changes, indicating that although the speech was most affected in the 10 days following the procedure, the errors were mostly limited to distortions. Distortions recorded in KDPAT increased during radiation and one month after radiation and remained the same or showed a slight reduction during 2nd and 3rd month after radiation. This difference was highly significant, while substitutions and omissions were rare, indicating that distortion was the most prevalent error amongst patients and that radiotherapy (RT) had the greatest influence on speech in the 1st month following completion of radiation.

Discussion

OSCC is one of the most common diseases seen affecting the human population with more predilection for men than women, and the highest incidence occurring in the sixth to the eight decades.[1] In about 25-50% of the population affected by OSCC,[7] the primary site affected has been revealed to be the tongue which in turn has shown to have considerable effects on speech functions.[8-11] In this study, 20 patients with carcinoma of the tongue were included. The mean age of patients was 58.4 ± 12.701 and male patients were more in number than females.

In a case report by Irfana *et al*., a 40-year-old male with abusive oral habits requiring hemiglossectomy was evaluated for speech and swallowing pre-surgery and post-surgery. The study showed pre-operative speech and swallowing changes but general health concerns were more significant in the pre-operative period. After surgery, the speech and swallowing were significantly affected. Active articulators of speech were affected, which in turn resulted in poor post-operative speech. However, the speech was seen to improve after regular therapy.[12]

Another study showed that type of surgery and radiotherapy were significantly affecting swallowing while speech was affected mostly by the type of surgery alone. They suggested that surgery of oral or oropharyngeal malignancies with reconstruction had poorer outcomes in terms of function than when surgery is done with primary closure. Their study also confirmed that radiation used as an adjuvant therapy resulted in worsening of swallowing functions.[13]

In this study, the first objective was to assess the speech and compare the speech before and after surgical intervention. The data showed that tongue lesions adversely affected speech in the pre-operative period. The total score became worse immediately after the surgery when evaluated on POD 10 and then showed a slight improvement on POD 30 evaluation. Similarly, a study done by Takatsu *et al*. assessed changes in characteristics of acoustics in a prospective study conducted involving 62 Japanese-speaking patients with carcinoma of the tongue. The results revealed that deviations of acoustic characteristics are connected to the site and size of the tissue removed, which lends itself to the idea that different sounds are related to different parts of the tongue, and suggested that rehabilitation significantly improves articulation to the pre-operative state.[4]

The second objective of this study was to assess the effects of radiation therapy on speech. When patients were subjected to radiotherapy, speech started worsening and the worst affected speech was seen in the one month post-RT period, with a slight improvement in speech two and three months after RT. The difference was found to be very highly significant ($P < 0.001$).

Literature shows that when hemiglossectomy is performed with primary closure for malignancies of SCC of the tongue, the mobility of the remaining tongue is maintained, thereby optimising speech.[14] The results of our study are comparable to previously published literature. To conclude, definitive repercussions were noted that inevitably follow extensive resective surgery used to treat cancers of the human tongue, and our study finds that the outcome of speech intelligibility is moderately hampered after hemiglossectomy and primary closure. Intelligibility was already noticeably lower than normal in patients who presented with cancerous lesions on the tongue, which subsequently worsened in the immediate postoperative period. However, consistent speech therapy helped overcome some of these shortcomings, which also helped indicate the benefit of healing by primary intention, and we hope that this helps guide practitioners when planning reconstructive techniques following surgical interventions of this kind. The first limitation of this study is the smaller duration of follow-up. Another limitation is that this study does not compare the results of speech after hemiglossectomy and primary closure with any postsurgical tongue reconstructive parameters. A study with a larger sample size and follow-up period and comparison with reconstruction parameters will be considered as a part of future research.

Acknowledgement

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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